IMPERIAL COLLEGE

OF SCIENCE & TECHNOLOGY

KARAKORAM

1957

THE EXPLORATION BOARD

KARAKORAM EXPEDITION 1957.

Imperial College Exploration Board.

As the members of the Expedition have produced no final report in the five years since their return from the Karakoram there is a danger that the expedition may go completely unrecorded. The Exploration Board has decided therefore to place on record the Interim Report issued in September, 1958.

A. Stephenson (Chairman)
P.F. Taylor (Secretary)

Imperial College February, 1963.

Members of the Expedition

E. Shipton,	Leader
G. Budd,	Doctor
G. Bratt	
B. Amos	
C. Cratchley	
C. Gravina	
P. Grimley	
K. Miller	

THE IMPERIAL COLLEGE

KARAKORAM EXPEDITION 1957.

INTERIM REPORT

September, 1958.

Note

This interim report is a collection of individual reports and does not in any way conclude the work of this expedition. All but two of the sections are complete, but as yet not edited. The slowness in the final completion of the survey and geological work can be chiefly attributed to the fact that four of the six students on the expedition had the final year of their course to do, so that a large amount of immediately available spare time was difficult to find.

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GENERAL TRAVEL DETAILS

G.C. Bratt.

On 25th June information was received via the High Commissioner's Office that the ship carrying the expedition baggage was held up in Bombay for an unknown period. This necessitated a change of plane and the departure of half the party was delayed by a week. The first group flew out from London on Thursday, 25th June. The party was Shipton, Miller, Gravina and Grimley.

This party stayed only one day in Karachi and then travelled by rail to Rawalpindi, where they were accommodated and entertained by the Attock Oil Co.

The second party - Bratt, Amos, Budd and Cratchley - left London by air on 3rd July. Amos and Cratchley remained in Karachi until the 8th, then went to Hindi. Bratt and Budd remained in Karachi until the baggage arrived. The "Coromandel", although originally scheduled to arrive in Karachi in early June, docked on 16th July. The last packages of equipment were unloaded about 1.30 p.m. 18th July and were leaving Karachi in a scaled goods waggon at 4.00 accompanied by Bratt and Budd.

Meanwhile, Shipton had sent all other members of the expedition including Qureschi, the Pakistan surveyor, on to

Skardu; Grimley and Cratchley remaining to collect porters and supplies; Amos, Miller, Gravina and Qureshi moving up to Goma to initiate the survey work. This party reached Goma on 26th July but by 1st August, when the main party arrived, the survey work had not been started. Due to bad weather and engine troubles, Shipton, Bratt and Budd had to wait four days in Findi before the plane flew to Skardu.

After one day in Skardu all the loads had been sorted, porters hired and the party began to move along the Indus valley. The journey up the valley can be summarised as follows:-

			Distance from previous stopping place (approx.)
24th July	Left Skardu		
25th "	Gol.	Rest House.	21 miles
26th "	Kiris.	Rest House. (River Crossing delays)	7
27th "	Kuru.	Rest House.	10
28th "	Doghani.	Rest House. (Forded)	14
29th "	Saling.	Camped. (Some of party went to Khapalu.)	16
30th "	Huldi.	Rest House. (New bridge on Hushi)	10
31st "	Paroa.	Rest House.	15

1st August	Gagolu.	Camped. (Party united)	16
2nd "	Gagolu.	Resorting and reducing Loads. Porters payed off and permanent porters signed on.	
3rd "	Ghyari.	Camped one mile below snout of Bilafond.	
4th "	Naram.	Camped. Still not clear of moraine covered glacier.	
5th "	Ali Bransa.	All porters except 12 paid off.	

At Ali Bransa the party split into three sections.

(a) Gravina, Cratchley and Amos with two porters to move on to the Teram Shehr glacier to make a geological and topographical survey. For details of this work see separate section on Teram Shehr survey.

(b) Shipton, Qureshi and 10 porters. This group initiated the plane table survey work from the Bilafond La, then Qureshi with four porters broke off to carry the survey down the Bilafond La. Shipton then supervised the transfer of supplies to the camp at the Lolofond-Siachen base.

(c) Bratt, Grimley, Miller and Budd set up camps at the Bilafond La and near Island Peak to carry out survey and geological work in the head of the Lolofond glacier and to investigate the climbing route on K.36 from the

Bilafond wall. During the stay in this area, two different cols on the Bilafond wall were visited, Tawis peak climbed (previously climbed by Fanny Bullock Workman), Island Peak climbed and both of the northern arms of the Lolofond glacier visited. About five of the sixteen days of this period were snowy.

On Saturday, 24th August, the whole party re-united at the junction of the Siachen and Lolofond glaciers. Previous to this, food and equipment ready for the survey of the K.36 had been moved to a convenient site by Shipton, Miller, Grimley, Bratt and Budd.

On the 25th, 26th and 27th August, bad snow falls occurred and a major change of plans became necessary. It was decided that to go to the higher country of the K.36 basin, the attempt on K.36 and the crossing of the Sia Lan would have to be abandoned. The alternative was to move to the lower reaches of the Siachen glacier and, if snow conditions eased, to explore the snow basin at the foot of K.12 and attempt to cross a col back to the Bilafond glacier. Accordingly, on the 27th, Cratchley, Budd and Gravina with three porters moved off down the Siachen glacier to locate the entrance to the basin, investigate snow conditions in the basin and attempt to reach the col leading to the Bilafond. (Both the basin and the col had been sighted from Island Peak -

there existence not being indicated on the Survey of India maps.)

Shipton and Bratt remained at the base camp to organise the movement of stress down the Siachen, to recover the stores in the K.36 basin and to carry out survey work.

Amos, Grimley and Miller began to move down the Siachen, carrying out survey and geological work en route.

On 2nd September, the various parties united at the junction of the Siachen and K.12 glaciers. Bad weather delayed the departure from here until 5th September. The whole party was then employed carrying supplies through the first ice fall in support of two small parties who were to work in the K.12 basin.

The first party, Bratt and Gravina with two porters, moved up into the basin itself but because of poor visibility could not carry out any survey work and were prevented from crossing the col by snow waist deep.

The second party, Cratchley and Miller, carried out some survey work in the lower reaches of the K.12 glacier before rejoining the main party, who were working near the Siachen-K.12 junction.

Three members of the party had to be back in London early in October so they began to retreat back to Goma via the Bilafond La supported by the main party.

Bratt and Gravina joined the main party just before the crossing of the Bilafond La and moved with them to the Naram on 14th September. Shipton and Bratt remained in this area until 18th September, while the remainder of the party returned to Goma.

Grimley made a short geological investigation of the Chulung area from Goma while Budd and Gravina made a visit to the Gyong Nala.

Four days were spent in the area around Gagolu investigating side valleys, then the party began the return march to Skardu. Skardy was reached on 29th September, but no plane arrived until late on 4th October. The train was taken from Lindi to Karachi, where the plane was taken to London, the last section of the party arriving on 9th October.

Further details are available in the Alpine Club Journal article by Mr. E Shipton.

TRAVEL DETAILS OF THE TERAM SHEHR SURVEY

C.M. Gravina.

When Base Camp had been established on the bank of the Siachen glacier, a party was formed of Cratchley, Amos and Gravina to explore the country surrounding the "Col Italia", which separates the Teram Shehr glacier rising from the Siachen, from the Remu icefields which drain into the valley far to the east. The Col had been visited only once before, when Professor Danielli had crossed it in 1936 from a camp on the Siachen, having successfully crossed the maze of crevasses which had barred progress up the Teram Shehr glacier to the Bullock Workmans in 1910. Danielli had had to make his crossing in poor weather with rapidly diminishing food supplied and consequently the vast icefields surrounding the 20,000 ft. Col remained unexplored. Not far north of the Col lay the frontier of Chinese Turkestan and the Shaksgam region visited by Shipton shortly before the war.

The Teram Shehr glacier joined the Siachen opposite Base Camp. The junction of these two vast ice streams, one two miles wide, the other three, flowing nearly parallel to each other but in opposite direction, must be unique. The narrow promontory between the two glaciers had been

visited by both Mrs. Bullock Workman and Professor Danielli, who were amased to find it covered with lush grass and alpine flowers and inhabited by a herd of ibex - all this at 16,000 ft. and completely surrounded by ice.

The first camp was set up near the remains of Danielli's old Base Camp, which was ransacked, without success, for the chianti bottles Italians never travel without. Two of the porters dumped their loads and returned to Base Camp. Below the tents was a sizeable glacial lake with icebergs floating. A couple of sheltered pools on the Peninsula itself were warm enough to bathe in, and a glimpse was caught of some ibex on one of the grassy slopes.

The next camp was on the moraine far enough up the glacier to obtain a view of what lay beyond. The glacier rose fairly slowly towards a line of crevasses which seemed to stretch right across the ice; above them the glacier widened and levelled out into the great snowfields of the Col Italia, hemmed in on all sides by 22,000 ft. peaks. On the left of the glacier a steep icefall led to a col which was a possible short cut to the Chinese Frontier. It did not appear feasible, however, to reach it with laden porters.

The easiest route through the crevassed region of the Teram Shehr glacier appeared to be on the right (the true

left bank) of the glacier. The porters were sent back in the morning to bring up the remaining loads from below, and the "Sahibs" set off with 50 lb. loads to attempt to set up a dump above the crevasses. The going was easy at first and rapid progress was made up the dry surface of the ice. In among the crevasses, however, a thick layer of snow required careful prodding to avoid treading on air. Cratchley was leading the rope of three at one point, and put a foot through into a small crevasse; Amos followed across, put both feet through and disappeared rather rapidly from sight to find himself dangling upside down between two overhanging walls with nothing very much below him. He managed to remove his heavy load and drop it on a ledge fifty feet below; after a rather tiring half-hour he was back on the surface. The party was now at over 18,000 ft. and Amos was completely exhausted by his struggles; ahead, the crevasses seemed to be getting worse and it was concluded that the route lay on the opposite side of the glacier. Gravina and Cratchley dumped their loads and returned to camp where the porters told them that the lake by the Teram Shehr peninsula had completely disappeared overnight. This was later found to be true.

It snowed that night and all the following day, giving an excuse for a rest badly needed after the crevasse episode.

The following day was better and the party went over to the true right bank of the glacier. Here, surprisingly, there were few crevasses and camp was pitched well past all the difficulties. Steps were then retraced to where the loads had previously been dumped. A crude form of rope ladder was constructed and Cratchley was able to climb back into the crevasse to retrieve the pack, which was borne triumphantly to the new camp.

At this point the party split up for a few days, Amos carrying out his geological work from this camp with one porter to assist him, while Cratchley and Gravina with Hassen established a survey camp at 20,000 ft. on the Col Italia itself. Despite the height, a pool of water was found under some rocks, which saved the bother of melting snow. Above camp a cairn was found, which, if not put there by Danielli, must have marked the fantastuc route taken, according to legend, many hundreds of years ago, by tribes of Tibetan origin who crossed the Col Italia and the Bilafond La in order to maraud the Baltistani villages and kidnap their wives.

The Col Italia itself was a vast flat expanse of snow which stretched for several miles in every direction though broken in places by fierce looking peaks. Most of the latter were not marked on the map, and some difficulty was encountered

in locating the few surveyed points which had been sighted by the Indian survey from the Rimo glacier, and by the Workman expedition from the opposite Siachen side of the area. Unfortunately, resected positions obtained from one side did not tally very accurately with those obtained from the other. This did not matter unduly as the aim, with the short time available, was to map roughly with the photo theodolite as much of the area as possible and only attempt to fix accurately the positions of three or four of the more important summits not already located from the other surveys.

There was, above camp, a more or less horizontal ridge of about 22,000 ft. in height, which blocked the view to the north to the Shaksgam and Chinese Turkestan and the morning after arrival it was decided to place the first station on this ridge, from where it should have been possible to see most of the surrounding country and plan the positions of the next stations. The climb up to the ridge started up very steep slopes of hard snow on a very fine and calm morning. The upper half of the climb was in soft, powdery snow which steadily grew deeper as the sun went higher. Cratchley was completely off his normal energetic form and began to feel very tired; a few hundred feet from the crest of the ridge he was forced to give up and Gravina had to carry on alone,

leaving Hassan with him.

The crest of the ridge was not the summit originally hoped for, this being 500 ft. higher and about a mile away along the jagged crest of the ridge. The view was, however, unique. To the north another great flat snowfield, the whole of it over 20,000 ft. high, led to the Chinese border five miles away, beyond which could dimly be seen the barren hills of the Shaksgam. In complete contrast the southern horizon was hemmed in by a line of jagged giants which will probably never be climbed simply because there are so many to choose from. Gravina carefully fixed his position by identifying as many known points as possible - a very tricky job when so many of the largest summits were not marked at all. He also took bearings to the nearby peaks which would be useful in the survey, and took a round of photographs on the survey camera before descending to join the others and returning to camp.

In order to make the most of the time left on the Col Italia before supplies gave out, it was decided not to move camp any further but to conduct the survey from it in lightly laden day-trips. Thus it was hoped to cover the maximum amount of country. This unavoidably ruled out the hoped-for trip to the pass leading down to the Shaksgam, but a day was spent surveying the frontier ridge and the country leading up to it.

Then turning to the south, two stations were set up at about 20,500 ft. in order to position the peaks surrounding the col itself. After only three fine days' work the weather began to break, and reluctantly the hopes of exploring the complicated ice-world beyond, leading to a col and then south to completely unknown territory, had to be abandoned. One more day was spent gazing hopefully through the theodolite at the massing clouds before descending to join Amos at his camp lower down. Here again a pause was made in the hope of better weather, but dwindling food supplies forced a return to Base Camp without any possibility of continuing the work. However, the most had been made of the last fine weather of the whole expedition.

SURVEY REPORT

G.C. Bratt.

The survey work done by the expedition may be conveniently described in the following three sections:-

(1) Plane table survey by I.A. Qureshi from the Pakistan Survey Department.

(2) Photo theodolite work by Shipton, Miller, Bratt, Cratchley and Gravina.

(3) Compass sketch mapping by Cratchley and Gravina.

(1) It was originally intended that Qureshi should carry out table work in the valleys diverging from Goma - Ghyari and Chulung. But, because of the narrowness of the valleys, a fix was difficult to obtain so he accompanied the main party to the Bilafond La and worked down the Bilafond glacier covering the Naram and Chumih glaciers as well as the areas mentioned above. Once his survey had been firmly established under the supervision of Shipton, he was left with four porters to carry on alone. Because of a number of inconsistencies in his work, it is doubtful if his map has any advantages over the Survey of India sheets. A copy of his work had not been obtained as yet but is still being sought for by Mr. A. Stephenson.

(2) For the photo theodolite work a total of eighteen

positions were occupied. These positions were distributed approximately as follows:-

6 surrounding the head of the Lolofond glacier.

5 in the upper sections of the Teram Shehr glacier.

2 on the Siachen glacier.

3 in the K.12 glacier (glacier draining the snow basin at the northern side of K.12).

2 near the Naram glacier.

The initial work of preparing the photographs, locating the fixed points and plotting the station positions of the Lolofond and Siachen photographs has been done by Bratt and the detailed plotting is now being done by Miller.

Difficulties have arisen with the Teram Shehr photographs because the camera back opened on several occasions causing blackening of many frames. It is doubtful if an extremely accurate map can be produced but a sketch map is being produced by Gravina. Some of the areas covered by this work are of especial interest since the Survey of India map appears incorrect.

The K.12 and Naram glacier area photographs are not being dealt with at present because of the inability to fix the stations precisely. It may be possible to fix these stations when the examination of the other photographs is

complete, or if the results of Qureshi's work can be used.

Several points should be mentioned since they may be of help to future parties.

1. Pakistan surveyors should not be entrusted to carry out the work without supervision.

2. An elastic band or some other device should be used to secure the backs of the Ilford Advocate cameras used on the R.G.S. photo theodolites.

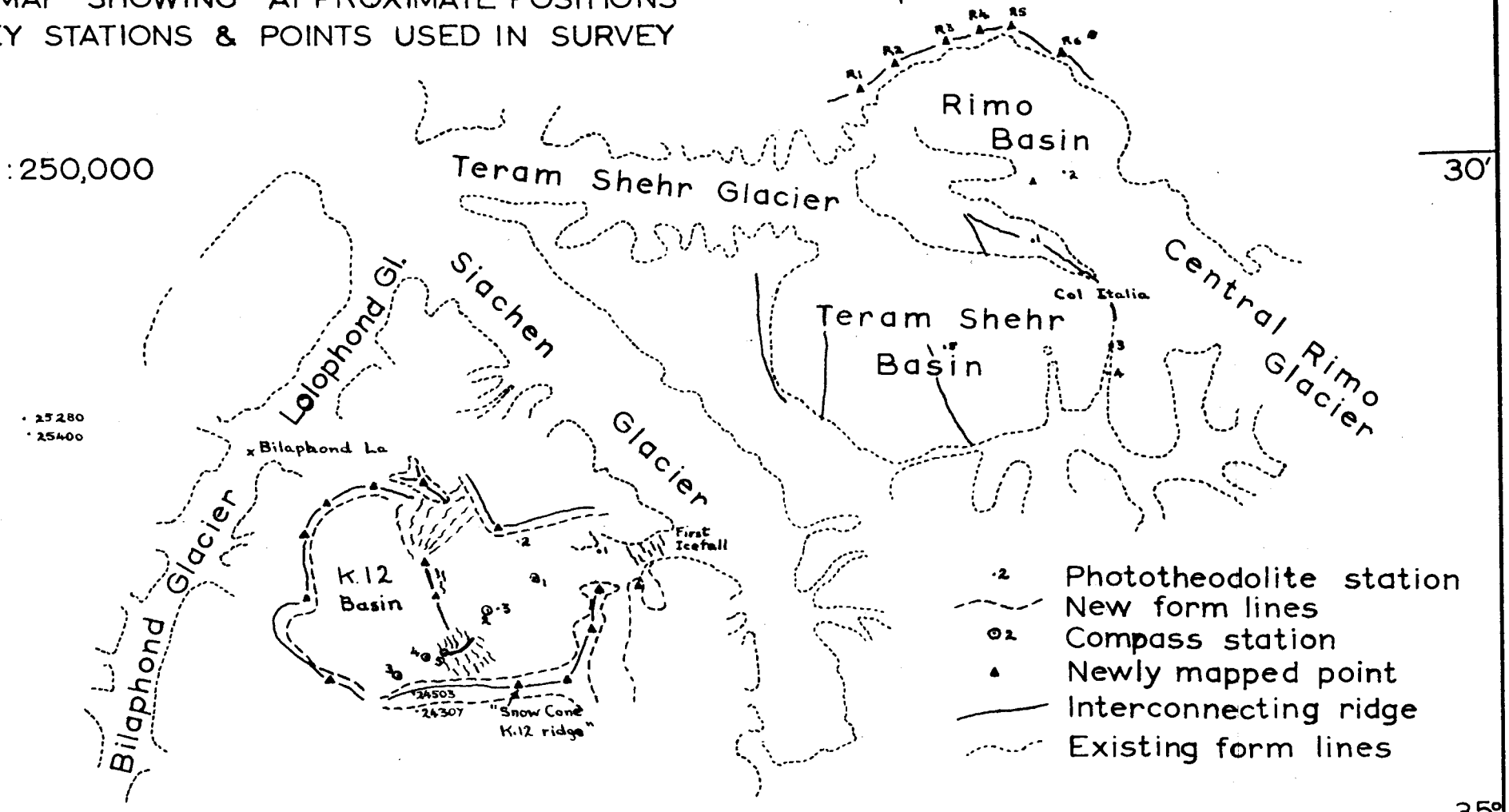
3. An umbrella and a good support for the tripod are essential in hot weather in snow country. A ply-wood board painted with aluminium paint and having holes for the tripod feet would be a reasonable support.

4. Film should be sent directly to Hunting Aero Survey for development and printing. Poor development by Ilford Ltd. has caused troubles with the enlargements of the photographs.

(3) Compass and hand camera work by Cratchley and Gravina had yielded a sketch map of the boundaries of the K.12 basin. Further details will be added to this map when photographs from other stations have been examined. A detailed survey of this basin was prevented by prolonged bad weather and visibility.

SKETCH MAP SHOWING APPROXIMATE POSITIONS
OF SURVEY STATIONS & POINTS USED IN SURVEY

SCALE = 1:250,000



GEOLOGICAL REPORT

B.J. Amos.

P.H. Grimley

Introduction

This is a preliminary report on the field geology done during the course of the recent Imperial College Expedition to the Karakoram. It is written without access to specimens and without the results of laboratory work.

Poor weather conditions prevented the geologists from visiting many of the areas which were originally scheduled for inspection and the necessity for Europeans to carry their own loads was found to severely limit the time available for scientific work.

The area visited by the expedition was centred on the middle reaches of the Siachen Glacier, twenty-six miles N.E. of Goma, the last village in the Saltero Valley in the Province of Beltistan. The actual area surveyed included the Chulung Valley (S.E. of Goma); the Ghyari Valley from Goma to the Bilafond La; the Siachen Glacier and the rocks on either side for sixteen miles down-stream from its junction with the Teram Shehr Glacier; and the Teram Shehr Glacier and Basin to within a short distance of the Col d'Italia.

The topographical maps available were the ¼" Survey of India maps, sheets 52 A and 52 E. For geological work, these

sheets were enlarged to two miles to the inch. While valuable for a general picture of the ares, they were by no means accurate in detail. This is especially true of the Chulung Valley. Consequently, until the topographical maps being produced by the survey parties of the Expedition are available, an accurate geological map of the area cannot be presented. A preliminary geological map is attached to this report; it is based only on a tracing of the Survey of India map.

The geological results are based partly on direct observation of the rocks in place, partly on examination of moranic material and partly on examination of the rocks at a distance.

The report is divided under three headings:-

(a) The Stratigraphical Succession;

(b) The Rock Types;

(c) Structure.

(a) <u>The Stratigraphical Succession</u>

The stratigraphical succession as far as could be determined is given below:-

Triassic Rocks . . . . . .?

Crystalline Limestone. . . . . Permo-Carboniferous ?

Shale and Mudstone Group. . . . Silurian-Devonian ?

Crystalline Schists. . . . . ?

Gneiss . . . . . ?

Granite

Basic Dyke rocks

The position of the granite in the table cannot be given with accuracy. It was intruded after the deposition of the Lower Paleozoic, probably after the Upper Paleozoic and possibly after the Trias.

The exact position of the basic dyke rocks is also uncertain except that they are post-Lower Paleozoic.

(b) Rock Types

(i) Granite.

Moderate to coarse grained biotite or biotite-hornblende granite forms three major bands running approximately N.W. - S.E. across the whole area, and form many of the highest peaks. Almost the whole of the Bilafond and Lolofond Glaciers are bordered by one of these bands. It weathers to form acute, often fantastically thin spires and ridges, reminiscent of the Chamonix Aguilles on a far larger scale. Pegmatite veins bearing tourmaline, apatite, beryl and pink garnets are very common. A beautiful orbicular facies of the granite, formed of alternating rings of felspar, biotite and tourmaline, occurs at the mouth of the Bilafond Glacier.

(ii) Gneiss.

On the S.W. flank of the Siachen Glacier occurs a strip

of biotite gneiss some 300 - 400 ft. wide. It has considerable variation of grain size and composition. The relationship between it and granite is not known. It has a sharp boundary with the granite for most of its length, but near the K.12 Basin it appears as a marginal facies. It is our opinion that it is unconnected with the granite and is probably the oldest formation in the area.

(iii) Crystalline Schists.

Exposed along most of the length of the Slatore Valley from Dansam to Goma is a belt of schists and gneisses of a fairly high degree of metamorphism. They are banded rocks intruded by granitic and granodioritic sheets and dykes. Several rock types occur in this series including biotite schist and gneiss, siliceous grits, calo-silcate rocks and an almost pure marble. This series is also found in the Chulung Valley and at the head of the Bilafond Glacier where it is well exposed on Tawiz Peak.

(iv) Lower Palaeozoic.

These beds occur on the north-east flank of the Siachen Glacier and in the Teram Shehr Basin and are well exposed to the south of the area in the Chulung Valley. They have been divided into Upper, Middle and Lower beds.

The Upper Series were not examined in place but apparently consist of black shales and phyllites. They were separated

for convenience from the Middle Series by an abrupt change in strike across a fault zone in the middle reaches of the Siachen Glacier, midway between the Lolofond and K.12 Glaciers (see map).

The Middle Series are composed almost entirely of black, grey and dark brown mudstone and phyllites occasionally bearing chiastolite needles. The upper beds contain lenses and bands of a crumbly siliceous limestone.

The Lower Series were only exposed in the Chulung and Goma Valleys and consist of green chlorite, actinolite and talc schists, with occasional bands of black shales and mudstones. They are very friable and weather light to dark green. They are separated from the Middle Series by what appears to be a slight unconfomity. The unconformity may not be a stratigraphical one, however, as the junction is a fault zone containing a very beautiful green jadeite or actinolite breccia.

The dating of these rocks as Lower Paleozoic is taken from an account published by Danielli on the results of the Italian Expedition to the Karakoram in 1913-14. No fossiles were found in our region.

(v) Crystalline Limestone.

This particular series was never seen in place, although the moraine coming from the small basin below

Teram Kangri (immediately north of point 16,360') was composed almost entirely of this rock.

It is a compact, poorly bedded limestone of varying colours, red, light green, pink, but predominantly white or pale grey. It was often brecciated. These rocks are thought to belong to the Upper Paleozoic marble series of Desio (2).

(vi) Triassic Rocks.

According to Danielli, Triassic rocks are exposed in the same basin as the Crystalline Limestone but they were not visited during the expedition.

(vii) Basic Rocks.

Moderate to fine grained lamprophyric dyke rocks were found intruding the Lower Paleozoic rocks in the Siachen area and the Chulung Valley.

(c) Structure

The grain of the country runs approximately N.W.-S.E. with alternating bands of intrusive granite, sediments and metamorphics. The sediments in most cases dip away from the granite and are generally conformable in strike to the contact. The granite is usually exposed therefore as cores to major anticlines, the axes of which run approximately N.W.-S.E. There is also a minor fold system, the axes of which run at right angles to the major trend.

The granite was apparently not in a very active state during intrusion. The Lower Palaeozoic rocks examined at the Teram Shehr Oasis and in the Chulung Valley are altered only slightly, in most cases only baked and hardened near the contact.

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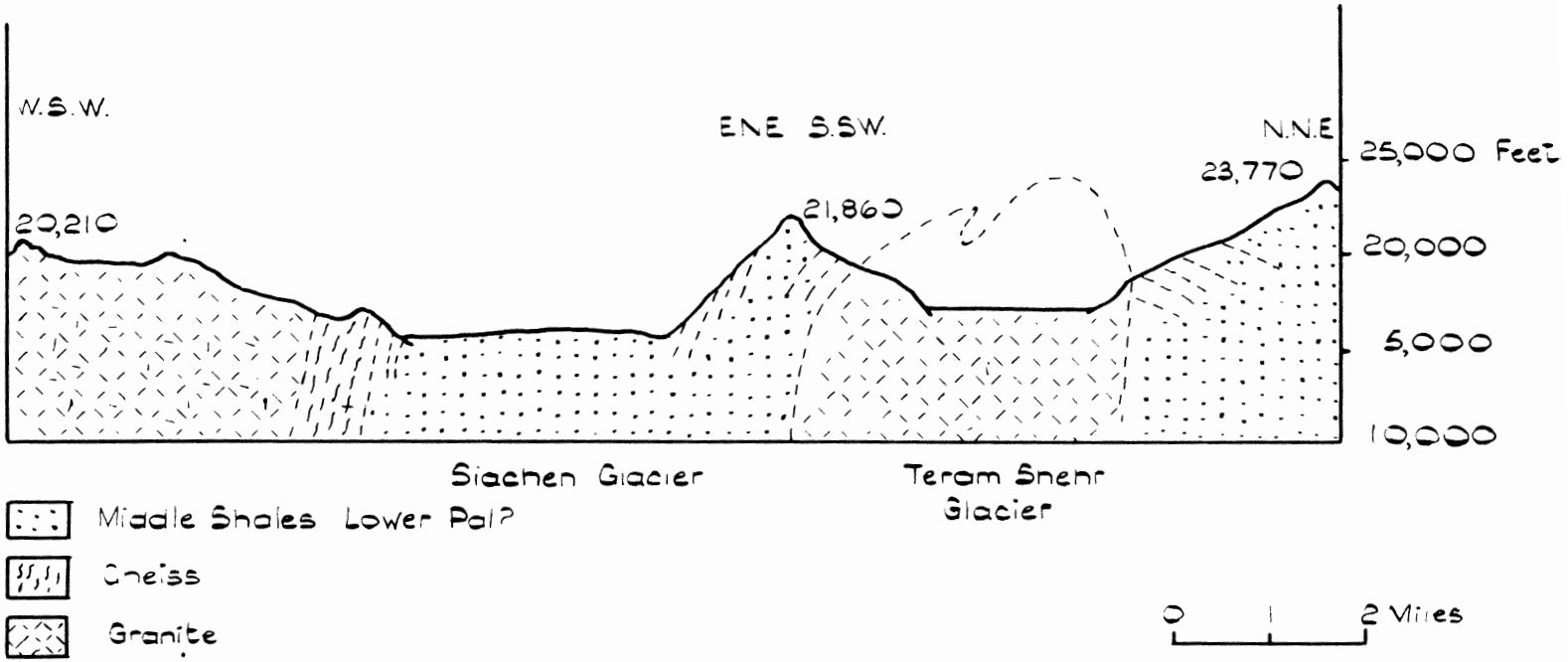

SECTION ACROSS THE SIACHEN AND TERAM SHEHR GLACIERS

GLACIOLOGICAL REPORT

G.C. Bratt.

The chief work intended was the measurement of the velocities and depths of the principal glaciers of the region. This was undertaken by Cratchley. Because of the width of the glaciers, especially the Siachen, he proposed to locate his maker stakes by resection. Most of these stakes were removed by porters between the visits of Cratchley so that the work had to be abandoned. The depth work which was expected to be done using a Worden gravimeter could not be done because the gravimeter was undergoing repairs when required.

Observations were made on the periodic emptying of a lake at the Teram Shehr oasis and are being compared with the findings of Danielli in 1932.

Comparison of phographs of K.36 and Tawis Peak taken by Mrs. Bullock Workman in 1911 with those taken on the present expedition indicate that little change in the ice cover of these peaks has occurred. Sir John Hunt had suggested that considerable changes in the ice cover had occurred when he visited the area in 1935.

Although no measurements were made on the size (thickness) of glacier tables it was noticed that rock slabs of

about 2" thick rested on the surface, while anything less melted the ice beneath more rapidly. Pedestals appeared only to be formed with rocks greater than one foot in thickness. A crude attempt to calculate the critical thickness for the formation of a pedestal is given below. It is hoped to refine this method and also to measure some of the sizes of tables from existing photographs.

Approximate Treatment of Glacier Tables

1. Assume that radiation is the major contributing mode of heat transfer. Then the heat received by rock and ice will be given by

$$q_1 \text{ (sun to rock)} = 0.173\ F_s F_r \varepsilon_s \varepsilon_r \left[\left(\frac{T_s}{100}\right)^4 - \left(\frac{T_r}{100}\right)^4\right]$$

$$q_2 \text{ (sun to ice)} = 0.173\ F_s F_i \varepsilon_s \varepsilon_i \left[\left(\frac{T_s}{100}\right)^4 - \left(\frac{T_i}{100}\right)^4\right]$$

2. Since $T_s >>> T_r$ or T_i, it may be assumed that the amount of heat re-radiated by the rock and ice is small compared with q_1, q_2 above.

3. Assume that the drainage of the ice is perfect so that T_i is constant.

4. Assume that T_s and F_s are constant during the hours of daylight. Now it may be written that

$$q_1 = K F_r \varepsilon_r \left[\left(T_s^1\right)^4 - \left(T_r^1\right)^4 \right]$$

$$q_2 = K F_i \varepsilon_i \left[\left(T_s^1\right)^4 - \left(T_i^1\right)^4 \right]$$

where $T_s^1 = T_s/100$ etc.

5. Assume that initially the upper surface of the table is at T_i and that the base always remains at this temperature, then the rate of heat transfer through the table by conduction will be

$$\frac{dQ_{cond}}{d\theta} = -K A \frac{dt}{dn} = -K A \frac{T_r - T_i}{l}$$

where A = surface area and l = depth or thickness of rock forming table.

Case 1.

Consider values of l sufficiently small so that

$$\frac{dQ_{cond}}{d\theta} \gg \frac{dQ_{radn}}{d\theta}$$

Then T_r will remain constant and almost equal to T_i. Under these circumstances the formation of tables will be governed by the relative values of q_1 and q_2.

For tables to form

$$q_2 \geqslant q_1$$

i.e. $K F_r \varepsilon_r \leqslant K F_i \varepsilon_i$

If both the ice and the upper surfaces of the rock have equal view factors, the condition for table formation reduces to

$$\varepsilon_r \leq \varepsilon_i$$

The ice will have an emmissivity near to that for liquid water ($\varepsilon_{water} = 0.95$). Emmissivities for rocks are rather sparse but some values are given below.

Aluminosilicate	+ 0.4% F_iO	0.43 - 0.61
	+ 1.7% F_iO	0.62 - 0.73
	+ 2.9% F_iO	0.68 - 0.78
Asbestos board		0.96
Red rough brick		0.93
Carborundum		0.82 - o.92
Commercial sheet aluminium		0.09

From these values it is evident that:

(1) If the material is rough surfaced or dark in colour, it is unlikely that glacier tables will be formed.

(2) If the colour is lightened or the surfaced smoothed, then glacier tables are likely to form even for thin sheets.

N.B.

It should be noted that the values of the emmissivities

are dependent on temperature and that for non conductors at low temperature, the emmissivity is expected to be above 0.8. Hence it is unlikely that glacier tables will form from thin slabs of any natural rock.

Case 2.

Consider values of l such that

$$\frac{dQ}{d\theta} \leqslant \frac{dQ_{radn}}{d\theta}$$

At some time dO after radiation reception by the slab has commenced when the surface temperature is T_r, but no heat has yet passed completely through the slab.

1. Assume that there is a linear temperature gradient through the rock. Then the heat received by the rock as radiation can be obtained from

$$\delta Q_{radn} = \rho A.\ l\ Cp\ \frac{T_r - T_i}{2}$$

and the rate of conduction will be:

O = time $\qquad \frac{dQ_{cond}}{d\theta} = K\ A\ \frac{dt}{dl} = K\ A\ \frac{T_r - T_i}{l}$

Eliminating $T_r - T_i$ between these two equations

$$\frac{dQ_{cond}}{d\theta} = \frac{K\,A}{l} \cdot \frac{2\,\delta Q_{radn}}{\rho\, A l C_p}$$

$$= \frac{2\,K}{\rho C_p l^2} \cdot \delta Q_{radn}$$

2. Assume that the rate of reception of radiant heat is constant. (This will be almost so since variations of T_r^4 will be small compared with T_s^4.)

Then

$$\delta Q_{radn} = \int_0^{\theta} Q_{radn}\, d\theta = Q_{radn} \int_0^{\theta} d\theta = Q_{radn} \cdot \theta.$$

$$\therefore \quad \frac{dQ_{cond}}{d\theta} = \frac{2\,K}{\rho l^2 C_p} Q_{radn}\theta$$

For glacier tables to form

$$\frac{dQ_{radn}}{d\theta} = Q_{radn} \geq \frac{dQ_{cond}}{d\theta}$$

i.e. $$Q_{radn} \geq \frac{2\,K\,Q_{radn}\theta}{\rho\, C_p\, l^2}$$

or $$l \geq \sqrt{\frac{2\,K\,\theta}{\rho C_p}}$$

$$l \geq \sqrt{2\alpha\theta} \qquad \alpha = \frac{K}{\rho C_p}$$

Melting of the ice beneath the slab will only take place if the time 0 which it takes the heat to be conducted through the slab is less than the length of day.

That is the maximum t ickness of the slab for the non formation of tables or the minimum thickness for the formation of tables will correspond to a θ value of the length of the day. If it is assumed that a value of 0 = 12, this critical thickness would be slightly over-estimated. Inserting this value in the condition above, the following is obtained:

$$l \geq 4.89 \sqrt{\alpha}$$

Or for granite $l \geq$ 1.1 ft.

That is glacier tables would only be expected to form (from natural rock slabs) if the slab thickness exceeds one foot.

MEDICAL REPORT

G.M. Budd.

General Account

On any given expedition, there are certain medical conditions which are likely to occur. Certain others are unlikely. But very few are impossible. One realises this dismaying fact when trying to decide what medical supplies, and how much of each item, to take.

Assuming adequate funds, where one draws the line between likely and unlikely depends on the mobility of the party. One constantly working from a base camp easily reached by porters (as is the case in attempts on many major peaks) can take a large quantity of equipment, adequate for even the most unlikely conditions. This can be dumped at base camp and the men can take small kits for immediate needs to the higher camps, secure in the knowledge that whatever happens the necessary supplies are to be found at base camp. In this case the weight of medical equipment is usually near 200 lb., excluding oxygen.

A party requiring mobility, or dealing with long distances, is more limited. Even where expense is no objection, the logistic problems of maintaining large numbers of porters make weight restriction essential. In this case the more unlikely conditions have to be left unprepared for. The

equipment necessary to cover the more probable conditions weighs about twenty pounds; that for the most probable, about five pounds.

The expedition's medical supplies went through all these phases. In the beginning, when it was intended to march an army of porters across the Bilafond La to the Siachen glacier, established base camp there and send most of them home, a fairly comprehensive medical kit was assembled. The distance of porterage was about 120 miles. The equipment was shipped from London in four wooden boxes, and weighed 200 lbs. Oxygen was not taken.

The expedition was over before this kit was seen again. When the expedition's general supplies arrived in Karachi, three weeks late, it had still not come and no more time could be lost. The Attock Oil Co., in Rawalpindi, very kindly supplied us with our second kit (see Appendix A). This kit weighed about 20 lb. Even had the original kit arrived, by this time radical revision would have been necessary, as the drain on funds caused by the delay necessitated weight reduction to save porterage. A further change in plan was that the majority of the porters returned from Ali Bransa, leaving all Siachen supplies to be relayed over the pass by the small numbers remaining. By the time this twenty pound kit had been relayed from Ali Bransa to

Bilafond La, from Bilafond La to Siachen base, from Siachen base to K.12 glacier, then back from K.12 glacier to Siachen base to Mid-Bilafond camp to Ali Bransa to Haram to Gagulu, the modest kit had assumed elephantine proportions in everyone's minds; it seemed the height of luxury, and, since much of it was never used, rather unnecessary. For the return march the "working kit" (appendix B) was in a small satchel and weighed about 5 lbs., while another 5 lbs or so of reserve stores travelled in a Gypsona plaster tin and the Thomas Splint, shameless as ever, flaunted itself on top of one of the loads.

Details of Conditions met with.

1. Diarrhoea:

This began soon after our arrival in Pakistan, and most men suffered from it intermittently throughout the expedition, even on the glaciers. Treatment with dietary restriction and Kaolin was generally effective; cases not responding to this were treated with Thalazole, and one case with Aureomycin, with good results. Guanimycin was effective, but was heavy and bulky and supplies did not last long.

On return to London, six of the eight members of the party attended the Hospital for Tropical Diseases. One, who

had persistant diarrhoea, was found to be suffering from a paracolon bacillus (Shigella alkalescens) infection. Three others, who had had relatively few attacks of diarrhoea, were found to be suffering from Intestinal Amoebiasis.

Emetine was not included in the expedition's supplies. Although it is specific in Amoebic Dysentery and can be valuable in a fulminating attack, it is very dangerous as it can damage the heart; in addition there is the difficulty of diagnosing any dysentery as being Amoebic in origin without laboratory facilities.

2. Indigestion:

Magnesium Trisilicate proved effective in the few cases of this which occurred. High-altitude nausea was rare, and removal of the precipitating causes - such as cold gluey porridge - usually resulted in improvement.

3. Respiratory Ailments:

Coughs and sore troats were common at high altitudes. Linctus was more soothing than pastilles but was heavier; still, a pint or two divided among several small plastic bottles is to be recommended. Hibitane lozenges (I.C.I.) proved excellent for the relief of a dry cough. Orthoxine was used successfully to ease bronchial spasm in one case.

Antibiotics were included in small kits issued to independent field parties, mainly in case of pneumonia. However, oral antibiotics such as Aureomycin take nearly twenty-four hours to achieve full effectiveness, and in high altitude pneumonia one can die in eight hours. It is strongly recommended that a few cartridges of injectable antibiotic be carried to high camps, preferably a broad-spectrum one such as Tetracycline. It is unwise for any man with severe cough to climb to high altitude.

4. Headaches:

These were very severe in the first week above 14,000 feet, and not very responsive to treatment. They were probably due to altitude rather than sum. Thereafter they were infrequent and responded to Disprin.

5. General Aches and Pains:

Disprin was used extensively and effectively. When necessary - as in snowblindness - it was augmented with barbiturates. A few cases occurred of a migrating Myalgia, affecting intercostals and abdominal muscles. Warmth and Disprin gave some relief, and it cleared up in a week or so.

6. Insomnia:

Large quantities of assorted barbiturates were included in the supplies, but were used rarely. Some men slept poorly at altitude, but no camp was made above 20,000 feet, and insomnia was rarely bad enough to require drugs.

7. Injuries:

No fractures or severe injuries occurred. Minor infections, cuts, blisters, etc., were treated with Cetavlex cream - an excellent preparation - and an adhesive plaster dressing. Cuts were slow to heal above 10,000 feet. It is a good idea to take some bright antiseptic such as brillant green or gentian violet for treating the local population.

8. Cerebellar Thrombosis:

One man developed moderate ataxia and nystagmus while crossing the Bilafond La on the return journey. He was still able to walk, and descended to 10,000 feet in the next few days. No specific treatment was given and during the next fortnight the symptoms cleared.

9. Malaria:

Paludrine was taken regularly at first, and gradually discontinued. No cases have occurred in the party to date. Whether malaria is endemic in Baltistan is for the writer an open question at present.

10. Fleas, Lice, etc.:

These are acquired en route through the villages. DDT powder is to be recommended. We had Gammexane powder, which was effective but unpleasant.

11. Sunburn:

Despite the liberal use of glacier cream, this was severe.

12. Vitamins:

These were consumed in haphazard fashion. Coloured vitamin pills were valuable placebos for the local population.

13. Water Sterilising Tablets:

Used by most of party in lower valleys, until above the villages.

Appendix A. Second Medical Kit

Disprin, 1,000 tablets.

Magnesium Trisilicate, 4 ounces.

Kaolin Pulv. ½ lb.

Thalazole, 500 tablets.

Epsom Salts, 4 ounces.

Seconal Sodium, gr. 1½ - 100 capsules.

Amytal Sodium, gr. 3 - 100 capsules.

Amytal, gr. ¾ - 100 tablets.

Omnopon 'Tubunic' syringe-tubes, gr. ½ - 12.

Needles, curved cutting 3" - 2.

Linen tread No.60 (fine) - 1 small reel.

Dissecting forceps, non-toothed - 1 pair.

Artery forceps Spencer Wells 5½" curved - 2.

Dressing scissors - 1 pair.

Cetavlex Cream - 4 tubes.

Gentian Violet solution - 1 small bottle.

Gentian Violet jelly - 1 small tube.

Tetanus Toxoid - 12 ampoules.

ATS - 12 ampoules.

Gantrisin (Sulfafurazole, sulfisoxazole) - 100 tablets.

Tetracycline 250 mg. - 100 tablets.

Tetracycline Intramuscular - 12 ampoules.

Procaine penicillin, dry - 4 mega units.

Water for Injection B.P., 2 cc. - 25 ampoules.

Xylocaine 2% plain - 20 cc.

Xylocaine 2% with 1:80,000 Adrenalin - 20 cc.

Zinc Oxide Dental - 2 ounces.

Oil of Cloves - 1 ounce.

Dental forceps, Upper Universal - 1.

Dental forceps, Lower - 1.

Clinical Thermometers, round bulb, in metal cases (not plastic) - 6.

'Mycil' Tinea powder - 2 tins.

Gee's Linctus - 1 pint.

Vaseline - 1 small tube.

DDT - one pound.

Quinine gr. 5 - 100 tablets.

Albucid eye ointment - 2 small tubes.

Albucid eye drops 20% - 1 bottle.

'Record' syringes, 5 cc. - 2 needles to fit, 2"-2½", fine bore, - 6.

Scalpel, with blades to fit.

Camoquin, - 200 tablets.

Gauze, 12 yard roll - 2.

Triangular bandages - 2.

Cotton Wool - 2 medium sized rolls.

Crepe bandages, 6" - 4.

Gauze bandages, 4" - 6.

Gauze bandages, 2" - 6.

Gypsona plaster-of-Paris bandages, 6' and 4" - 4 each.

Plain adhesive plaster, 3" - 2 rolls.

Elastoplast, 3" - 4 rolls.

Lint - 1 roll.

Thomas Splint - 1.

Stethoscope.

Orthoxine - 100 tablets.

This list differs in a few respects from that actually used, but in general is the same. The alterations have been made with the object of making the list a better guide for future use if needed.

Appendix B. "Working Kit"

+++ Kaolin.

\+ Magnesium Trisilicate.

+++ Disprin

Seconal sodium

Tetracycline, Camoquin, Thalazole, Morphia - in small tin.

++ DDT.

Thermometer

++ Scissors.)

++ Cotton wool, gauze, lint.) Cuts and Blisters Department

++ Adhesive plaster.)

++ Cetavlex.)

Crepe bandage.

Safety pins.

Frequency of use varies with number of '+' marks.

Appendix C. Kits issued to each man before leaving London.

Sterile wound dressing - for primary treatment of frostbite.

Guanimycin - 1 bottle.

Vimagna - 100 tablets.

Paludrine, 100 mg. - 100 tablets.

Chloramine, 5 mg. (water sterilising tablets) - 50

Nivea cream - 1 tube.

Hibitane lozenges - 1 tube.

Glycerin and Blackcurrent lozenges - 1 tin.

Gee's Linctus pastilles - 1 tin.

Ketofax - 1 tube.

Appendix D. Useful items for party without a Doctor.

DDT.

Disprin. Seconal.

'Rennies' or Mag. Trisilicate.

Kaolin. Thalazole.

Gee's Linctus.

Cetavlex, Cotton Wool, Lint, Adhesive Plaster, Scissors.

Bandages, Gauze and Crepe - with safety pins.

Thermometer, in metal case.

Oral antibiotic.

Brilliant Green and vitamin pills.

Appendix E. Acknowledgements.

Pharamaceutical firms were very generous in supplying drugs and dressings, in almost all cases free of charge. British Drug Houses, Ltd., not only supplied a large proportion of all drugs required but also stored, packed and despatched the medical equipment, even making special boxes for our needs. At all times they were extremely helpful.

Allen & Hanbury's Ltd., donated £20 towards the cost of the surgical instruments, which came to roughly £57.

Smith & Nephew supplied all the dressings.

Other drugs were supplied by the following:

Burroughs Wellcome.

Imperial Chemical Industries

Lederle Laboratories.

Parke Davis & Co.

Reckitt & Colman.

Roche Products.

Eli Lilly & Co.

Duncan Flockhart & Co.

Upjoin of England.

May & Baker.

PROVISION REPORT

B.J. Amos.

1. Basis upon which the quantities of food were calculated.

The expedition was planned to last a period of ninety days, of which twenty-two days would be spent passing through inhabited valleys, where supplementary supplies could be obtained, and the remaining sixty-eight days would be spent beyond the last village, where the expedition would have to be entirely self-supporting.

There were to be eight Europeans and one Pakistani who was considered as a European for dietary purposes. This gave a total of 900 man/days, divisible into two periods, one of 220 man/days and the other of 680 man/days. In addition, food had to be supplied for twelve permanent porters for sixty-eight days; these provisions were not to be supplied from England, but purchased locally.

Because plans included an attempt on the 25,400 ft. peak K.36, extra quantities of some foods were taken for an assault period of fourteen days for eight men.

2. Calculated quantities of provisions.

The weight of each food consumed by one man in one day was estimated by studying reports of previous expeditions and by taking advice from people with first hand knowledge.

Some of these estimates had to be revised more than once when new facts or fresh advice came to hand. The varieties of food to be taken were arrived at in the same way, but the choice was continually modified in accordance with what was available.

With these estimates, four alternative schemes were devised for provisioning the expedition. Plan 1 allowed for a large proportion of the diet to consist of native foods obtainable locally (rice, atta, sattu, dahl, ghee) with only essentials not obtainable readily in Pakistan to be purchased in England. In Plan II, all the provisions were to be brought from England and Plan III only differed from this in that the food was to be in War Office "Compo" rations. Plan IV was a modified version of Plan I, in which there was a small addition of English bought non essentials to the diet.

Each of these plans had its own disadvantages: I and IV, by introducing a large proportion of monotonous and uninteresting native food with which expedition members would not be familiar, would cause serious upset stomachs and affect morale. Furthermore, all food bought in Pakistan would have to be paid for in cash, with no likelihood of any substantial reductions. II and III, by reason of the relatively greater bulk to be transported

from England, would incur more expense in freight charges. "Compo" rations would be even heavier and more expensive than products packed in a normal fashion. Eventually Plan II was adopted, and the list of provisions was drawn up as shown in Table A. The following is a list of the sources from which information relating to the provisioning of expeditions was obtained.

The Ascent of Everest. J. Hunt

Kamet Conquered. Smythe.

The Mountaineers Weekend Book. Showell Styles.

Proceedings of the Nutritional Society 1954 No.1.

(The Provisioning of Expeditions in the Field.)

The Untrodden Peak. Charles Evans.

Upon that Mountain. E. Shipton.

Personal communications:

Cambridge University Mountaineering Club Himalayan Expedition.

Mr. Eric Shipton.

Members of the expedition.

3. Suppliers of the provisions.

A firm of wholesale provision merchants (Andrew Lusk

& Co. Ltd.) was approached at first, but as no satisfactory reply was forthcoming from them, it was decided to deal with firms directly for all the foodstuffs we required, and there is no doubt this led to a considerable saving in expense. Many firms offered us our requirements free of charge, and many others were prepared to let us have them at very large reductions. When first offers were unfavourable others firms were approached, and usually by this means, more economic terms were obtained. Table B lists all the firms who supplied us with provisions and the terms they offered us.

A few products were unobtainable at significantly reduced prices, the most important of which was meat. Pemmican was offered to us at a substantial reduction (33½%) but even then cost 8/-d a lb.; other tinned meats were also expensive. The dehydrated meat we finally settled on came from the Ministry of Agriculture, Fisheries and Food's Experimental Factory in Aberdeen, and cost us the price of the original fresh meat. It had great advantages over any other type of tinned meat, however, being very light and providing a large variety. Chocolate was another expensive item.

4. Packing for Transport.

All the provisions were shipped by boat from England

to Karachi, and from there to Rawalpindi by train, at the hottest time of the year. Consequently, they had to be packed in such a fashion that they would withstand handling, shipping, tropical and sub-zero temperatures without spoiling. At an early stage in the arrangements, Wilts United Dairies were asked about the possibilities of vacuum packing in plastic containers for a number of the powder-type provisions such as sugar and porridge. There was, however, a strong probability that this would be expensive and the matter was dropped. Table C shows the manner in which each product was packed.

The provisions were packed for travelling into plywood tea chests, cut down until they were such a size that, when filled, they weighed just 60 lbs. The food was divided between the boxes in such a way th t it would not be necessary to open more than a few boxes at a time. Each box was nailed down and numbered. They stood up to travelling remarkably well.

Some of the individual packages did not stand up to handling so well as the boxes. The chocolate, supplied in ¼ lb. bars, was packed in very thin cardboard boxes holding a dozen bars, and they just disintigrated and fell apart during the journey, with the consequence that many of the bars of chocolate were damaged. The chocolate was

also badly affected by the heat of the tropics, which caused the cocoa butter to melt and come to the surface; some bars went to powder. This is an unavoidable result of exposing chocolate to temperatures of 90° F or more for any length of time, and no type of packaging will prevent it.

The sugar was supplied in the normal retail 2lb. cardboard cartons; by the time they were unpacked in Pakistan many of these cartons had burst and their contents had run out.

The tomato ketchup and the mustard was supplied in tubes, and these were placed loose in the plywood packing cased in which the other provisions were packed. A large number of these tubes burst, and it was undoubtedly because they were compressed by the shifting of the other provisons within the packing cases.

The lemonade powders were packed in small individual paper and metal foil packets, but a large number of these allowed moisture to penetrate and as a consequence the powder 'caked'.

The other food packs were entirely satisfactory and gave adequate protection to their contents on the trip from England to Pakistan.

5. Packing for the field.

Most of the provisions were contained in sealed airtight tins of convenient size, and did not require repacking. Food that came in weak and permeable containers, such as sugar and porridge, were transferred to large plastic bags that could hold 30 lbs. or more, and these in turn were placed in sacks and kitbags for protection against sharp rocks and rough handling. The lemonade powder and tea were similarly packed in smaller plastic bags. At intervals during the expedition other foodstuffs such as dehydrated meat and vegetables, and biscuits, were kept in plastic bags when the large tins in which they were supplied were opened and the contents split up between several groups. Food packed in this way suffered no ill effects.

The soup powders were contained in 2 lb. metal foil packets, and these were sometimes punctured by rough treatments. It would have been better to pack them in tins as the extra weight would have been negligible.

There were two varieties of cheese in the expedition stores. One was a processed cheese in 1 lb. tins (Chedlet), the other was in the form of whole 5 lb. cheese, wrapped and packed in flimsy cardboard boxes (Black Diamond). The packing of these large cheese stood up to the journey from

England, but began to distintigrate after being made up in porters' loads. The large size of the cheese and the absence of any protection against the elements proved a disadvantage; long before a cheese could be finished it had developed a very 'ripe' flavour and odour. Once it had been cut into, it began to crumble and became difficult to transport. On one occassion, one was left outside the tents during the day and was liberally sampled by a large bird, solely due to a lack of adequate protective packing.

All the other foodstuffs were satisfactorily packed.

6. Local native foods for the Europeans.

The food available at native villages during the march in (17 July - 1 August) was as follows, with approximate prices:

Chicken	2 - 2½ Rs.	(4 - 5 Rs. high up valleys)
Eggs	1 Rs. per dozen	(2 Rs. high up valleys)
Radish tops	4 as.	
Ghee	1 Rs. per ¼ seer.	
Atta	1 Rs. per seer, but prices go up further up the valley.	
Sheep (poor)	20 Rs.	
Apples, Apricots,	Free.	

On the return march the same foods were available with the exception of radish tops and apricots; in addition, new potatoes, melons (unripe), grapes (mostly unripe - very small round variety just right), spring onions (rare), dried apricots and walnuts were available. (16th - 22nd September).

The advance party supplemented these with food purchased at the Skardu F.S.D. (Forces Supply Department), consisting of flour, sattu, rice, tinned vegetables, sugar, tea and salt. Most of these were difficult or impossible to obtain beyond Skardy; sugar could be bought at Kiris, but not beyond that, salt could be bought in small quantities in most places, flour and sattu were obtainable up to Haldi, but not beyond, and only with difficulty. The others were not obtainable at all.

Beyond the last village the Europeans ate European food, only occassionly varying the diet by using some of the porters flour for chupattis or atta balls and more often having sattu in their tea.

7. Porters' provisions.

Local instructions state that porters for an expedition buy their own food up to the last big village, out of their own wages. In practice, food is not easily obtainable above Khapalu and sufficient rations should be purchased for the

rest of the trip.

For the expedition proper, official ration scales are laid down for ordinary and high-altitude porters. The 1956 scales were as follows: (the 1957 scales demanded increased quantities of some of the items)

	1 day's ration for ordinary porters.	High-altitude porters.
Atta	32 oz.	24 oz.
Sugar	2 oz.	4 oz.
Salt	1/6 oz.	1/6 oz.
Dall	2 oz.	4 oz.
Ghee	1 oz.	2 oz.
Tea	¼ oz.	¼ oz.
Milk	2 oz.	4 oz.
Fresh meat	-	8 oz.
Rice	-	8 oz.
Onions	-	¼ oz.
Condiments	-	1/6 oz.
Cigarettes	2	5
Vitamin tablet	-	1

The ration scale for high altitude porters is quite unrealistic, amounting in all to nearly 3½ lb. of food a day.

On this expedition the porters did not go high enough to qualify as high altitude porters and we are able to feed them on the ordinary porters' ration scale. Twelve porters were retained, but four of them worked with the surveyor in the inhabited valleys and we only had to provide rations for eight. As the expedition was delayed three weeks we had a surplus of three weeks food, and we were able to provide the porters with sugar and some of their ghee from this surplus. The rest of their rations were purchased from the P.S.D. at Skardu, and replenished by a runner who went down and brought up a maund of sattu from Khapalu. (1 Maund = 80 lb.)

Porters were given three cigarettes a day on the march in and march out, and five cigarettes a day in the field. For this purpose 10,000 cigarettes were very kindly supplied by the Pakistan Tobacco Company, free of charge. (5,000 Red Lamp, 5,000 King Stork). No arrangements had been made for the supply of these cigarettes before the expedition left England, so a call was made upon the Karachi manager, Mr. Nasimullah, who was very co-operative and went to a lot of trouble to obtain the cigarettes at once for us. He pointed out, however, that on future occassions it would be easier if the Pakistan Tobacco Company were contacted in England before the expedition started, so

that the cigarettes would be ready packed and waiting when the expedition reached Karachi.

8. Palatability of the provisions.

a) Dehydrated meat and vegtables.

There was a large variety of these; they reconstituted well and had an excellent flavour and consistency. They went a long way towards making the diet interesting and were great favourites. (A copy of the official report to the Ministry is attached).

b) Soup powders,

Very good, very popular. Easy to prepare, filling.

c) Biscuits.

All very good, but sweet biscuits became slightly nauseating after a period. Unsweetened biscuits (Lifeboat biscuits) were excellent, and so were semi-sweet biscuits such as petit beurres.

d) Oatmeal blocks.

Excellent - very pleasant, satisfying.

e) Tinned Cake.

Superlative, but a luxury. Good as a morale booster or for celebrating.

f) Pemmican.

A good concentrated food, but not very appetising. Best used as flavouring to dehydrated potato, or as soup

with lots of tomato ketchup and salt.

g) Dehydrated potato powder.

Very good.

h) Chocolate.

Spoilt by going through the tropics and no longer very appetizing.

i) Porridge.

Unappetizing when made by porters, but otherwise very good.

j) Kendal Mint Cake.

Very good. Unspoilt by going through tropics. Would have been better to have had more of this and no chocolate.

k) Salt.

Provided in tablet form for sucking to relieve salt deficiency. Very awkward when powdered salt was required.

i) Cheese.

Tinned cheese mild, acceptable at all times. Large cheeses rather strong.

m) Lemonade powder.

Excellent, both as a cold drink and as a hot drink with added sugar. Single packets not sufficient for one glass.

n) Jam and Marmalade.

Very good. Plenty of variety (blackcurrent, strawberry, apricot, greengage, gooseberry, orange marmalade).

o) Margarine.

Good on biscuits and for frying etc. Not too hard in low temperatures. As good as butter.

p) Milk.

Full cream powdered milk, very good if the trouble was taken to prepare it properly. Rich and creamy taste. If it is not prepared in the advised manner, lumps can be avoided by mixing the dry powder with the sugar before adding the hot water.

q) Sweets.

Very good. Barley sugar was sticky and very difficult to unwrap. Fruit drops also rather difficult to unwrap. Butterscotch much easier. Golden Mints too good, were eaten too quickly.

r) Coffee.

Nescafe. Good, but not so popular as tea or milo. When made with milk there is a white floculated sediment; the milk manufacturers say this is the insoluble residue always present in the milk but not usually visible.

s) Milo.

A cocoa-type drink with added vitamins. Very pleasant, rather rich and filling. Some people got tired of it but not all.

t) Condiments.

Tomato ketchup, English mustard and French mustard. Very useful for adding interest to poorly flavoured dishes, or dishes that had become tasteless by constant repetition.

u) Tea and Sugar.

Essentials.

9. Superfluities and Insufficiencies.

It is difficult to assess what may have been basically superfluous as a three weeks' delay gave the expedition three weeks' supply of food in excess of requirements. It seemed clear, however, that there was too much dried milk and too much Milo, and probably too much tea. There may have been too much porridge, but this is more questionable.

Insufficiencies were easier to detect. The lemonade powder was exhausted several weeks before the expedition enddd. Soup ran very low despite the three weeks' backlog and the Lifeboat biscuits ran out before the end. Mashed potato powder was also exhausted.

Jam and marmalade were also greatly in excess of what was required and probably the sweet biscuits, though as most of these were left in the last village in order to cut down weight, it is difficult to be certain. Coffee comes in the same category as the sweet biscuits.

10. Observation and Conclusions.

To offset any possible deficiencies in the diet, vitamin

capsules were included in the rations. They were obtained free of charge from a number of sources, and there eventually were over 6,000 vitamin capsules in the stores of various makes. This enabled everyone to indulge their fancies, and to choose whatever appealed to them by colour or taste, but the large number of unused capsules proved embarassing as they had to be kept from falling into native hands; an overdose might result in Vitamin A poisoning.

A number of firms who supplied their products free of charge requested photographs of their products in use, when replying to our first enquiries. A number of other firms, however, have requested photographs after the expedition had returned, when no such photographs had been taken. In future, it might be advisable to take suitable photographs of all products, whether a request has been received or not, to avoid embarrassment or any appearance of ingratitude for the firms' support after the expedition is over.

For the protection of products during shipping, it would be better to repack the sugar in something more substantial and to put the condiment tubes in boxes and not drop them into packing cases loose. As an additional precaution, the lemonade powders should be kept in plastic bags, tightly shut.

Since chocolate is such an expensive item, and there is no way of keeping it from spoiling when going through the

tropics, it would probably be best not to take any at all but to substitute something else.

If any loose material, such as sugar, is packed in a large plastic bag in large quantities, it tends to splite the bottom of the bag when it is lifted. It is a good policy always to keep these plastic bags inside something more resistant.

The packing cases are designed to be the usual porters' load of 60 lb. If the provisions are kept in these cases, continual opening and closing of the cases results in the gradual loss of the nails which fasten them. A good supply of spare nails would be an advantage.

The advance party lived for thirteen days entirely off native food, and suffered no ill effects. It was, however, extremely monotonous and depressing and would have been a great deal worse if chickens had not been available, or if the tinned vegetables had not been obtained. It is possible that morale would have been seriously affected if Plan I had been adopted, in which a large proportion of the diet was to have been native food.

Matches should always be purchased in England. As the expedition matches, supplied by Bryant and Mays, were lost en route between England and Pakistan, a further supply had to be purchased in Pakistan. These proved to be useless, and it

frequently happened that twenty-five or more matches were struck in an attempt to get one to light.

Cigarettes for the Europeans were supplied by W.D. and O.H. Wills, who also supplied the pipe tobacco. Both these and the matches were supplied "Under Bond" in order to avoid paying Customs Duty on them.

TABLE A

	1	2	3	4	5	6
Sugar	6.0	6.0 (14.0 assault)	83	311	394	(394)
Milk	3.0	3.0	41½	127½	169	(170)
Tea	0.5	0.5	7	21	28	(30)
Margarine	1.4	1.4	19	59½	79	(80)
Jam	2.6	2.6	36	110½	146	(144)
Chocolate	3.0	3.0	41	127½	169	(168)
Sweet biscuits	1.8	1.8	25	76½	102	(100)
Oatmeal blocks	0.9	0.9	12	38	50	(50)
Boiled sweets	0.53	0.53	7	22½	30	(31)
Cheese	0.8	0.8	11	34	45	(44)
Porridge	2.5	2.5	34	106	140	(140)
Pemmican	-	0.94	-	40	40	(40)
Dehydrated meat	-	1.8	-	77	77	(77)
Dehydrated vegetables	-	1.2	-	51	51	(51)
Soup	-	680 servings	-		680 servings	
Dried fruit	-	1.25	-	54	54	(54)
Lemonade powder	-	0.94	-	40	40	(40)
Potato powder	-	0.66	-	28	28	(28)
Cake	-	1.2	-	51	51	(54)

TABLE A.

Kendal Mint Cake	-	3.2	-	136	136	(135)
Coffee						
Milo						
Salt					11	(12)
Mustard					48 tubes	
Matches					4 gross boxes	
Cigarettes					5,400	
Tobaco					3½ lb.	

1. Ounces per man/day, approach and return marches.

2. Total weight in lbs. " " " "

3. Ounces per man/day on glaciers.

4. Total weight in lbs. "

5. Sum of 3 and 4 in lbs.

6. Quantity actually received, in lbs.

TABLE B

Tate and Lyle	Sugar	Free of charge.
Glaxo	Milk	"
Glaxo	Vitamin capsules	"
Huntly and Palmers	Sweet biscuits	"
Huntly and Palmers	Oatmeal blocks	"
Huntly and Palmers	Tinned cake	"
Pascalls	Boiled sweets	"
Pascalls	Chocolate	£28.14.0
Bovril	Pemmican	£16. 0.0
Ministry of Agriculture, Fisheries & Food	Dehydrated meat	£42. 7.0
Ministry of Agriculture, Fisheries & Food	Dehydrated vegetable	Free of charge.
Cerebos	Salt	"
Knorr Swiss	Soup powders	"
Australian Dried Fruit Board	Dried fruit	"
Reckitt Colman	Mustard	"
Reckitt Colman	Mashed potato powder	£2.16.0
Reckitt Colman	Lemonade powder	£8. 0.0
Quaker Oats	Porridge	Free of charge
Chivers & Sons, Ltd.	Jam and marmalade	£4.10.0
George Romney Ltd.	Kendal Mint cake	£8. 7.0
Van den Berghs ltd.	Margarine	

Nestle Co. Ltd.,	Milo	
Nestle Co. Ltd.	Nescafe	
Brooke Bond Ltd.	Tea	£6. 0.0
Scott and Bowne, Ltd.	Vitamin capsules	Free of charge.
W.D. and O.H. Wills.	Cigarettes and Tobacco	"
Bryant and May	Matches	"
Jarrs	Lifeboat biscuits	Free of charge (Left over from previous expedition.)

TABLE C

Margarine	Sealed tins, 8 oz.
Jam	Sealed tins, 1 lb. and 2 lb.
Lifeboat biscuits	Sealed tins, square, 11 lbs.
Sweet biscuits	Sealed tins, square, 5 lb. and 10 lb.
Oatmeal biscuits	Sealed tins, 10 oz. Biscuits individually wrapped in cellophane.
Cake	Sealed tins, 4 lb.
Boiled sweets	Sealed tins, 7-9 lb.
Pemmican	Sealed tins, 1 lb.
Dehydrated meat	Sealed tins, 1 lb-5 lb.
Dehydrated vegetables	Sealed tins.
Coffee	Tin, push-on lid, inner paper seal. 4 oz.
Milo	Tin, push-on lid, inner paper seal. 1 lb.
Salt	Tin, push-on lid, 1 lb.
Mashed potato powder	Sealed tin, 11 oz.
Milk	Paper wrapped in tin with push-on lid, tape seal, 1 lb.
Cheese	Sealed tin, 1 lb.
Sugar	Cardboard cartons, 2 lb.
Porridge	Cardboard cartons, 1½ lbs.
Chocolate	¼ lb. bars in metal foil, paper slip, dozen bars in cardboard carton.

Kendal Mint Cake	Bars in waxed paper, dozen bars in cardboard box.
Soup powder	Metal foil carton, 2 lb. and metal foil wrapped compressed cubes.
Lemonade	Metal foil and plastic and paper sachets.
Tea	Repacked in linen bags.
Cheese	Corrugated cardboard box.
Vitamin capsules	Bottles, tins, metal foil strips.
Cigarettes	Airtight tins of 50.
Tobacco	Airtight tins, 2 oz.

Urdu (phonetic spelling)	English
Atta	Native-ground wheat flour.
Ghee	Clarified butter.
Sattu	Roasted barley or millet.
Dhal	Lentils.
Marsala	Curry powder.
Anda	Eggs.
Moorgu	Chicken.
Khabani	Apricots.
Dudle	Milk.
Alloo	Potatoes.
Halim	Porridge.
Cheeri	Sugar.
Kushu	Apples.
Pini ka'pani	Drinking water.
Maund	Measure of weight, 80 lb.
Seer	Measure of weight, 2 lb.

DEHYDRATED FOODS REPORT

B.J. Amos.

A. Background Information

1. The purpose of the expedition was a topographical, geological and glaciological survey of as large an area as possible in the Karakoram area, centred on the Siachen Glacier, the second largest glacier in the world outside polar regions. The expedition Base Camp on this glacier stood at about 16,000 ft. and during the time in which these dehydrated foods were consumed the expedition worked at heights from 10,000 ft. (on the approach) up to 22,000 ft., chiefly between 16,000 and 20,000 ft. This period was seven weeks in duration and all this time, with the exception of some four days, were spent on the surface of various glaciers.

2. The expedition had eight members, all male, whose ages were 22, 22, 24, 26, 26, 29, 35, 50.

3. Every-one slept under canvas, at all times, with double sleeping bags and air beds. Often three men slept in a tent designed to hold two.

4. All the cooking was done by Europeans on one-pint Primus stoves with silent burners and self-pricking/ regulating attachments. Fuel (paraffin) was plentiful. Pressure cookers were used almost invariably and were

considered almost essential.

5. During the first two or three weeks the weather was predominantly fine, very warm during the day and freezing hard at night, with occasional days of snow. Thereafter snow showers were frequent, though of brief duration and local occurrence. The sun lost most of its heat, so that surface snow did not melt, and the nights were colder. Heavy falls of snow were not infrequent.

6. Daily activity consisted of six to eight hours' walking over rough ground (including badly crevassed glacier, crevassed loose moraine, deep loose snow etc.) carrying 40-50 lbs. Occasionally this was extended to nine hours or even twelve hours, but this was rare.

B. Suitability of Dehydrated Foods

1. The tins supplied were in general too big, because although it was a large expedition, it tended to split up into small groups carrying only enough food to make them independent for a few days. Also the labelling of the tins was not clear or durable, and many of the tins completely lost their identification before half way through the trip.

2. None of the meat deteriorated but the remains of a large tin of carrots was kept for a fortnight in a plastic bag, during which time it became moistened and developed a

sour smell. They were discarded.

3. For the most part the meat and vegetables were cooked together in a pressure cooker to form a stew, as in the recipe given for a beef stew, but without the onion powder. Cooking time was thirty minutes, but often the ingredients were soaked previously for periods up to two hours, and then twenty minutes cooking was sufficient. When a pressure cooker was not used, the carrots were found to be difficult to cook until tender, particularly the carrot slices - even after eight hours' soaking, they were still a little tough with twenty minutes cooking. Occasionally a spoonful of curry was added before cooking, and this made an excellent variation to the stew.

The pork steaks were sometimes fried, together with potato strips, after soaking, but on the whole these soaked up too much fat during cooking and were rendered slightly unpalatable, due to the dislike of fat and grease which became a noticeable feature of our appetites at high altitudes. The pork chops were preferred stewed with the addition of a little soup powder to thicken the liquid.

Some of the raw minced cooked mutton was used to prepare a recipe of native origin, which made an excellent change once in a while. A thick sauce of butter, salt, curry and milk was simmered in a pan for about ten to

fifteen minutes and then the minced meat and the water in which it had been cooking were added and simmered for another ten minutes. Finally, a large number of small balls of thick dough were added and whole mixture simmered for a further ten minutes and then served.

C. Acceptability of Dehydrated Foods

1. The impression of each member for each of the dehydrated foods is indicated in the attached table. Comments of the individual members are given below, verbatim, under letters corresponding to those in the table.

a) (Doctor) The minced beef was rather rubbery. Carrot and cabbage seemed to be indigestible, and produced uncomfortable intestinal over-activity and vast amounts of colonic flatulence. They were useful for adding bulk to the stew, but as the weeks passed this came to seem not worth the ensuing discomfort. This applies chiefly to the cabbage - the carrots were simply regularly observed in the stool, apparently unchanged.

Potato strips were excellent, especially when boiled with onion and ghee (clarified butter).

The minced meat was best curried.

Brussel sprouts seemed more digestible then cabbage. (N.B. Not everyone agreed in attributing the intestinal discomfort and flatulence to the cabbage; at least four of the expedition blamed something other than one of the dehydrated foods).

b) Dislike of carrots is purely personal and long established.

c) Lamb cubes impossible to cook at high altitudes without a pressure cooker - soaking and cooking in an ordinary vessel made them tough.
Carrots were slightly indigestible.
Cabbage slightly lacks flavour.
Brussel sprouts had a very good flavour indeed.
Tins were rather bulky - cabbage was good in this respect.

d) I found the meat excellent to eat both raw and cooked. Raw it made a very good marching ration. Altogether it is one of the best forms of dried meat I have met.

e) Food generally good and sufficient, but variety, especially in vegetables (i.e. smaller tins) would have been appreciated.

f) The fall off in popularity of cabbage and carrots was chiefly due to their being eaten at almost every main meal for six or seven weeks. At the beginning of the

trip, cabbage was quite popular; one day a mistake was made and three blocks (thirty-six helpings) were cooked for eight people, and it was all eaten. It did, however, tend to be a little tasteless - would it be possible to use white cabbage instead of the green variety, as it is much more palatable and tasty in normal circumstances?

The carrot slices seemed rather large - would the smaller, younger carrots have more flavour? They always needed a lot of cooking, even in a pressure cooker (thirty minutes if not previously soaked, twenty minutes if they had been soaked for an hour or more) - would the younger, smaller carrots alter this?

Brussel sprouts were excellent, both in flavour and in texture. They benefitted from being the small sprouts rather than large sprouts which are always coarse textured and flavoured.

The beetroot was very good on the one occasion we tried it.

The potato strips lacked flavour when eaten alone; they were best when cooked in a stew or with some flavouring added during cooking, such as onion.

Minced meat was very good in stews and in curries, but it tended to be slightly rubbery when not cooked in pressure cooker. Lamb cubes were also very good.

Pork steaks were excellent. They soaked up rather a lot of fat when fried, and seemed best when done in a pressure cooker. They kept thier shape well, but didn't yield much gravy and to make up for this a little soup powder was sometimes added.

Smaller tins would have been an advantage - once opened they lasted a long time and were consequently a problem to keep dry. Frequently they had to be split up and put into smaller tins with tight fitting lids.

2. The dehydrated foods compared very favourably in palatability with the rest of the provisions, the majority of which were sweet rather than savoury. The only similar canned products in the expedition stores were pemmican and mashed potato powder.

The pemmican had great value as a concentrated food, but we did not find it very palatable, and we were unable to enjoy it without the addition of some other flavour. The dehydrated meats were always eaten in preference to pemmican.

The mashed potato powder, however, was very easy to prepare, and in addition to making a very pleasant form of mashed potatoes, it also served as an ideal thickener for soups. The ease with which it could be prepared was an advantage over the dehydrated potato

strips, and if potato was to be cooked separately, the potato powder was generally preferred. The potato strips, however, were used for cooking in stews.

As regards palatability, the potato powder was preferred to the strips by most members of the expedition - it seemed to have slightly more flavour and a more attractive appearance and texture.

C. Acceptability of Dehydrated Foods.

Table of impressions of individual members for each food

	Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like nor dislike	Like slightly	Like moderately	Like very much	Like extremely
Pork Steaks								g	abed efh
Raw Lamb Cubes							g	bcd efh	a
Raw Minced Cooked Mutton							deg	abfh	
Raw Minced Cooked Beef							ag	befh	
Potato Strips						e	bfh	cig	a
Carrot Strips			a	b	eg	dh	c	f	
Carrot Slices			ab		eg	dh		f	
Cabbage Blocks			a		be	g	cdfh		
Brussel Sprouts							e	abdg	cfh
Beetroot							e	abc dfh	
Peas					d	ga	be		

D. Place of Dehydrated Foods in the Dietary.

1. The dehydrated foods formed the main constituent of the evening meal, which was the main meal of the day and were eaten every day of the seven weeks we were on the glaciers. Frequently some of the cooked dehydrated food, in the form of stew, was deliberately preserved from the evening meal, and in the morning re-heated for breakfast. Hot stew was found to make an excellent and sustaining breakfast, much more palatable than porridge.

2. Approximately 20% of the diet was from dehydrated foods.

3. Other food supplies included:

Milo	Biscuits (Lifeboat, sweet, Oatmeal)
Nescafe	Dried milk
Tea	Soup (powder)
Lemonade powder	Pemmican
Mashed potato powder	Porridge
Chocolate, sweets	Jam
Sugar	Cake
Margarine	Condiments
(Flour)	Vitamin capsules
Cheese	

4. Fresh food was not obtainable during the period in which dehydrated foods were being consumed.

5. Breakfast 5 a.m. - 6 a.m. (occasionally 4 a.m.)
Lunch (snacks) 11 a.m. - 1 p.m.
Supper 5 p.m. - 7 p.m. (occasionally as late as 9 p.m. but rarely.)

E. Health and Well-being

1. Some members of the party lost weight, on an average about 6 lbs., but at least one member of the party put on weight, again about 6 lbs.

2. Morale of the party was good, but all members suffered from time to time from upset stomachs. At no time did any one suggest that dehydrated foods might be the cause of this, and there did not even appear to be any connection.

3. Dehydrated food was always the major constitutuent of the main meal of the day, in the evening, and our hunger was always satisfied at this meal.

4. It is difficult to assess whether in fact dehydrated foods made us more thirsty, as we were always thirsty, and consumed large quantities of liquids, but there was no noticeable increase in thirst after eating dehydrated food.

5. On the average, every-one slept well on the expedition,

though there were occasional disturbed and sleepless nights for every-one, as would be expected.

EQUIPMENT REPORT

P.H. Grimley.

C.M. Gravina.

The equipment taken was, in general, adequate for the conditions encountered. More items were taken than were actually required, but very few things were forgotten. There follows a detailed account of the different items, with their good and bad points.

Tents

The Meades and Whymper were made from Green Millerain cloth. This was fairly cheap, but leaked very badly in rain or wet snow. However, the addition of a flysheet made them fully weather-proof. Treating the cloth with "Mesowax" etc. would probably have been very worth-while. The Wyncol Meade was first-class, being both light in weight and weather-proof.

The Whymper tent was well-designed and roomy, and economical in weight. Six porters could be squeezed into it. A double guy at each end would be an advantage in exposed sites.

The large Meades proved satisfactory, sleeping two in comfort and three without undue difficulty. They were easy to erect and stable in the worst weather experienced, this

being largely due to the use of 'A' poles. However, the apex piece was awkward to fit. This piece is dispensed with in the Wyncol, with no disadvantage except when using a flysheet.

The ridge-poles were especially useful when pitching a tent in deep. soft snow, where pegs were of little use. A full-length eave would be useful, but would mean extra guy-ropes. The sewn-in ground-sheets were, of course, essential and a zipped flap is useful when cooking. Sleeve-extrances at both ends are recommended.

Some 'C' Meades were also taken, being useful for short light-weight trips, but too small and uncomfortable for long periods. One other type of light-weight tent was used - a Black's "Mountain" tent made from Wyncol cloth. It was very roomy for its size and very light and also weather proof to a marked degree. Its system of guy ropes and external poles is poorly designed, making it unlikely to stand up to a strong wind.

To summarise:- The large Meade is a very good all-round expedition tent, but light-weight tents may also be required for higher camps, and the Whymper is ideal for Base Camp.

Sleeping Bags

Two types were used: Edgington's "Himalayan" and Black's "Icelandic Special", both comprising an inner and an outer bag.

Adequate warmth was experienced, but the down tended to shift, leaving bare patches in places. Smaller "Boxes" in the quilting and more down would solve this, but would also add to the expense and weight. Zips and tapes on both bags were more of a nuisance than they were worth, zips coming undone during the night. The design of the Icelandic was otherwise very effective, with a shower-proof cover and nylon lining on the larger bag.

Air Mattresses

These were supplied by "See-esta", and were full-length with pillows. They were robust and comfortable, but fairly heavy. A hip-length bed would probably have been sufficient. Repairs were made with Tyre patches and "Jiffytex" adhesive. Life of an airbed on an expedition is not long.

Stoves

Primus stoves were obtained from Condrups. 1-pint and 2-pint types were used, the 1-pint being collapsable and stowing neatly into their metal box, the 2-pint being more awkward to carry. Both "roarer" and "silent" burners were taken. The "roarer" type were very liable to get clogged, due to the poor quality paraffin which had to be used. They were then difficult to repair, the nipples taking a long

time to remove and replace. Two types of "silent" burner were used. The 2-pint were very efficient, never going wrong and very powerful. They were fitted with automatic prickers. The 1-pint type were, perhaps, even more powerful, though pricked manually. Their nipples sometimes clogged up, but were very easy to remove and clean. All burners were designed or modified for high altitudes.

Most faults which occurred could be traced to the use of poor fuel. Many spares were taken, but none used apart from nipples and prickers. Pump washers, when new, were hard and ineffective, but softened up after glacier cream was applied several times.

To prime the primuses, Meta fuel was obtained, but lost on voyage. Methylated spirits was then used, but a great deal was wasted from evaporation and leakage.

Cooking Pots

Gilwell canteens were taken, and proved satisfactory for use as eating bowls, and for cooking for two men in conjunction with some larger pan. Several "Prestige" pressure cookers were taken, and proved indispensible for cooking dehydrated foods. They were not essential when cooking other items, but their sealed lid prevented accidental spillage. A number of local cooking-pots (detchies) of aluminium were purchased, and were very satisfactory.

Ropes

Those taken were medium and full-weight nylon. They experienced considerable wear during the expedition, but otherwise were very suitable. Nylon line was used for Prussik loops.

Pitons, etc.

These were taken with the intention of using them for fixed ropes, etc. on the ascent of a major peak. None were, however, used. The Piton hammers made good lightweight geological hammers.

Marker Flags

Used for marking dumps, routes, etc.

Torches

Lightweight torches were supplied by "Ever Ready", and were very satisfactory. Water proof, sealed-type cells were used and were reliable under all conditions. Candles were not taken, but a small number would have been useful.

Matches

English matches should invariably be taken, the local variety being useless.

PERSONAL EQUIPMENT

Footwear

The expedition climbing boots were purchased from Bally's

Switzerland, and proved to be outstanding from nearly every point of view. Though ordered by post, all pairs fitted perfectly, and were easy to take on and off, even when frozen. They provided sufficient warmth when fitted with plastic insoles and proved durable - though, towards the end of the expedition, the stitching was starting to fray. A better expedition Boot than this would be hard to find. Two pairs of socks were usually sufficient.

For conditions of soft snow, canvas overboots were supplied by Edgingtons. These are supposed to keep ones' boots dry and warm. However, they soon wear out, often in two or three days, and are not really suitable for an extended expedition. When new, they are effective. Great difficulty was experienced in removing them when frozen; if shaped like a small sack they would have been better. The stiff string used for tying them on tended to freeze solid and became difficult to untie. Normal woven-type boot-laces would have been better.

Windproof Clothing

Anoraks and windproof trousers were made specially by Aquascutum Ltd. for the expedition. They were made of Wyncol nylon-cotton cloth, which not only stood up to bad weather very well, but showed little wear during the expedition. The trousers were not, in fact, worn very often.

The jacket was designed (by Sir John Hunt) in the style of a ski-jacket, with zipped front, spacious pockets and a hood which folded away into a pocket at the back. Good points were the elastic cuffs fixed by press-studs, the front zip, nylon lining and padded shoulders for pack-carrying.

The hood was not only ineffective but difficult to erect or button up with cold fingers. It would be better to use the normal anorak-type hood, with press-studs up the throat. For expedition use, the pockets should have zips and the buckles at the sides should be replaced with elastic.

Trousers

Most members wore knee-length climbing breeches. Though these are best for rock-climbing, socks tend to get wet quickly under snow conditions. Shipton advocates windproof trousers over pyjamas. One member wore ski-ing trousers and found them very warm and waterproof but not very hard-wearing.

Down Jackets

Duvet jackets from Alpcan (France) were almost indispensable, providing a great deal of warmth for their weight. Down hoods should also have been taken.

Other Clothing

Wolsey provided one sweater per member, which was adequate. They were snug, smart and hard-wearing. Shirts were given by "Double Two" and proved highly popular, being warm and servicable. Most members only took one shirt beyond the last villages. String vests were worn and gave much warmth for their weight.

The Everest-type mitts, supplied by Messrs. Allen Bostick and Billson, proved satisfactory, two pairs being worn with a windproof over-mitt in extreme conditions.

Other Equipment

Crampons were taken, but only used once. There was much discussion of their usefullness, and it seems that on a similar type of expedition where lightness is essential they are not worth their weight.

The Glacier Cream, supplied in tubes by TAO was easy to apply and effective in use.

Equipment was, in general, packed in kitbags and gunny-sacks and carried on pack-frames, obtained ex-WD.

Note on Paraffin Consumption

The average consumption of paraffin on the expedition depended on many factors. When snow has to be melted, consumption increases severely. Porters also tend to waste fuel and their cooking seems to take longer than that of the "Sahibs". However, the following examples give a good

idea of the consumption to be expected:-

a) Two porters, three "Sahibs", cooking together, water available though high altitude:
1 Quart fuel = 6 Man/days.

b) Two porters, two "Sahibs", cooking separately, melting snow, fairly high altitude:
1 Quart fuel = 4 Man/days.

c) Two "Sahibs", no porters, water available:
1 Quart fuel = 8 Man/days.

Note on Equipment for Bad Snow Conditions.

During the expedition, a great deal of deep, soft snow was encountered and discussions took place on the use of skis or snow-shoes under these conditions. Skis would undoubtedly have simplified reconnaisance work considerably, but their transporting would have a high nuisance value elsewhere; and porters would also have to be issued with them if they were to be widely used. The same would apply to snow-shoes, but no actual experience has yet been obtained with them in the Himalayas.

Several continental expeditions now use ski-sticks instead of ice-axes for the ascent of steep snow-slopes and future expedition would be wise to take them. It might be possible to fit ice-axes with detachable webs to prevent them sinking into the snow.

List of Equipment

Tea-Chests

120 lb.	16 Pairs overboots	
	15 Marker flags.	
	2 Water buckets.	
	Tent repair kit.	
	7 Full-weight ropes.	
	4 Medium-weight ropes.	
	3 Nylon lines.	
	23 Ice pitons.	Small kit-bag.
	9 Rock pitons.	
	2 Hammers.	
	7 Spare pegs.	
	Box Polythene bags.	
57 lb.	4, Primuses, small.	
	4 Primuses, Large.	
	2 Boxes spare parts.	
	2 Spare burners.	

57 lbs. (contd.)	12 Panscrubs.
	4 Towels.
	2 Small pressure-cookers.
	25 Tins, assorted.
	3 Kit-bags.
115 lb.	2 Groundsheets.
	10 Air-beds.
	Air-bed spares.
	9 Canteens.
	1 Large pressure-cooker.
	1 Icelandic Outer.
	1 Good companion.
	8 Sets Mitts (in kit-bag).
	7 Kit-bags.
60 lb.	9 Outer Sleeping-bags.
	2 Inner Sleeping-bags.
78 lb.	88 Pairs goggles.
	2 Pairs boots.
	1 Vest.
	2 Pairs overmitts.
	2 Anoraks.
	2 Overtrousers.
	2 Pairs gloves.
	2 Balaclavas.
	1 Tin Copydex.

78 lbs. (contd.)	1 Packet tin-openers (small).
	4 Pairs Double mitts.
	3 Porters' Sleeping-bags.
	1 Kit-bag.

Bales

120 lb.	3 Large Meade tents.
	1 Whymper tent.
	1 Pack frame.
97 lb.	3 Pack frames.
	1 Large Meade tent.
	1 Mountain tent.
	1 Small Meade tent.
	5 Porters' Sleeping-bags.
	2 Kit-bags.
66 lb.	15 Pack frames.

Cartons

33 lb.	4 Porters' Sleeping-bags.
62 lb.	4 Small Meade tents.
	1 Weighing-scales.
	4 Kit-bags.
57 x 3 lb.	2 Pairs boots.
	4 Pairs socks.

57 x 3 lb. (contd.)	2 Windproof suits.
	2 Vests.
	2 Pairs long pants.
	2 Clasp knives.
	2 Pairs goggles.
	2 Shirts.
	2 Pairs mitts.
	2 Pairs gloves.
	2 Pairs stockings.
	2 Sweaters.
	2 Balaclavas.

Wooden Boxes

38 lb.	4 Ice-axes.
42 lb.	72 U2 Cells.
	10 Torches, large.
	24 Bulbs.
	3 Torches, rubber.
	30 1-pint Paraffin bottles.
	1 2-gallon Paraffin bottle.
	5 Tin-openers, rotary.
	1 Kit-bag.
49 lb.	Meta-fuel.) In tins. Matches.)

Total number of Cases. 16.

Total weight. 1,108 lb. = 18.5 loads of 60 lb.

REPORT ON THE PAKISTAN SURVEYOR AND THE PORTERS

G.C. Bratt.

Pakistan Surveyor

Mr. I.A. Qureshi from the Survey of India was deputed to accompany the expedition as a plane tabler. The Survey of Pakistan supplied him with normal clothing and survey gear and paid air fares and field costs. The expedition supplied him with mountaineering clothing, tents and food.

See survey results for remarks on work.

No separate liaison officer was attached to the party and Mr. Qureshi did little in this respect. Mr. Shipton, who speaks Urdu, carried on most of the dealings with the local population.

Porters

Local Balti people were employed as porters for this expedition. They were hired in Skardy except for a few hired in villages further along the valleys. For porters carrying 60 lbs. the payment was Rs 3/- per day and Rs 4/- per day for a few who chose to carry 80 lbs. No special high altitude porters were selected at Skardu but at Gagolu, the last village halt, twelve permanent porters were chosen and given full equipment. From then on these porters were paid

Rs 5/- per day for the rest of the journey. Non permanent porters who carried from Gagolu to Ali Bransa (about thirty-four) were paid Rs 4/- per day for the upward journey and half pay for the return journey. All porters used beyond Gagolu were supplied with rations and the permanent porters were insured for Rs 2,000/- each through the College insurers at 15/- per head. (Insurance of Europeans - all risks including frostbite was at £5 per head).

The specifications of the food to be given to the porters by the Ministry of Kashmir Affairs was unreasonable in weight and in the variety of items. Negotiations were carried on with the porters and it was agreed that the following would be adequate.

130 lbs	ata	For 12 porters for 1 week.
7 lbs	chocolate	
10 lbs	sugar	
6 lbs	ghee	
10 lbs	dahl	
2 lbs	salt	
2 lbs	pea	
+	marsala	

These amounts were not rigidly adhered to but the porters were given free hand in dealing with the ata, dahl, ghee, marsala and salt. The dispensation of tea, chocolate and especially sugar had to be rigidly controlled. Other items, such as dehydrated meat, pemmican, were given as

required or available.

The porters were in general reliable, cheerful and willing. Towards the end of the trip petty pilferage became ripe but this could not be blamed entirely on the porters as large quantities of stores were being dumped, so that to them it must have been difficult to distinguish between dumped and wanted materials.

The highest any of the porters reached was approximately 20,000 ft. at which stage they were still fairly cheerful and energetic. Their natural ability in rough country is remarkable and they take readily to snow and ice travel, although they are a little haphazard in the use of a rope.

FINANCE REPORT

G.C. Bratt.

INCOME

Imperial College Exploration Board	£2,961
Mount Everest Foundation	1,000
Members' personal contributions	240
English Electric Company	52
K.J. Miller, Esq., (From lectures)	4
D. Tate, Esq.,	1
Resale of equipment	42
	£4,300

EXPENDITURE

Air fares to Karachi & return	£1,968
Rail fares to 'Pinfi & return	81
Air fares to Skardu & return	55
Personal transport total	2,104
Freight, London - Karachi & return	184
Karachi - 'Pindi & return	54
'Pindi - Skardu & return	145
Freight total	383
Porter transport, to dump at Ali Bransa	281
Permanent transport	240
return transport	23
Porter transport total	544
Equipment - In England	659
In Pakistan	22
Equipment total	681

Food - In England	165
In Pakistan	76
Food total	241
Accommodation etc. in Karachi, Rawalpindi and Skardu	146
Films	67
Maps, photo theodolite enlargements	21
Insurance, personal porters, equipment	92
Miscellaneous, stamps, telegrams.	21
	347

£4,300

Comparison of Estimates and Actual Expenditure

Items	Estimates 28/10/'56	Estimates	Actual
Transport	£1,909	£2,100	£2,104
Freight	200	330	383
Porters	610	650	544
Equipment	600	610	681
Food	450	430	241
Insurance	466	130	92
Film		60	67
Local Expenses		200	146

INTERIM REPORT OF THE 1957 IMPERIAL COLLEGE KARAKORAM EXPEDITION NOTES ON SCANNED COPY

(A.) EXHIBITS

There are two Exhibits included with the original report, as follows:

(1.) Sketch Map Showing Approximate Positions of Survey Stations & Points Used in Survey. Scale 1 / 250,000. (After page 18)
(2.) Section Across the Siachen and Teram Shehr Glaciers. (After page 25)

Item (1.) is included in this document after page 18 and Item (2.) is included after page 25.

(B.) SCANNING

This document was scanned by Robert Lloyd, a member of the Imperial College Exploration Board, at the request of Nigel Wheatley, Honorary Secretary of the Board. The scanner used was a Plustek OpticBook 3600.

15 March 2009