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CONTENTS

VOL. CXVI. NOS. 1–3 *JULY–SEPTEMBER* 1950

VOL. CXVI. NOS. 4–6 *OCTOBER–DECEMBER* 1950

KARAKORAM SURVEY, 1939: A NEW MAP

P. G. MOTT

DETAILED ACCOUNTS of E. E. Shipton's 1939 expedition to the Karakoram [1] have already appeared. The surveys carried out on the expedition were compiled during the winter of 1939–40 in the offices of the Survey of India at Dehra Dun, and were in course of being embodied into the standard quarter-inch sheets 42.P, 43.N, 42.L and 52.A when interrupted by more vital work for the armed forces. Nothing further could be done towards the publication of the map until the war was over, when arrangements were made for the return of the original plane-table sheets and records from India to the Royal Geographical Society. Several attempts have been made since then to have the map fair drawn and reproduced, but they failed through lack of funds. Not until a decade after completion of the field work has it become possible to bring the results of the Expedition's work to a logical conclusion by the publication of the map. The necessary funds for this work have been subscribed by the Society, with a contribution from the Himalayan Committee.

The area covered by the map is one of considerable interest geographically, comprising as it does two of the longest glaciers outside polar regions and containing what is probably the greatest concentration of high peaks in the world. Before Shipton's Expedition the only maps of the region were based on sketch surveys by Conway and, later, the Bullock-Workmans, which provided only a hesitant outline (often wildly in error) of this vastly complicated piece of terrain. Due to the political changes in India since the expedition took the field, it seems unlikely that an opportunity will occur again for many years for the employment in the Himalayas of a fully trained survey team on a private venture of this nature. Added to which, the recent developments in Sinkiang and the present uncertainty in Kashmir must necessarily give the map an added importance. The following notes are intended to fill in some of the technical details which could not be included in previous more general accounts of the expedition.

The Hispar Triangulation

While the methods used were not original, the scale of the country involved us in a number of problems the magnitude of which was not at first appreciated. Most of our troubles arose from the initial mistake of not adhering to Shipton's original plan to begin the survey from a measured base on the Lukpe Lawo ("Snow Lake") and thence extend a triangulation outwards which would be tied on to the few existing G.T.S. points in the area. The Survey of India, to whom we were much indebted for having lent us two experienced plane-tablers and for contributing generously to our funds, was anxious to establish if possible a connection between the G.T.S. stations in the Hunza valley, belonging to the Indo-Russian triangulation carried out by Mason in 1912–13, and the few isolated points in "Snow Lake" area such as peak 18/43M ("Ogre") and peak 9/43M ("Ganchen"), which belonged to the much older Kashmir series carried out in 1855–60.

Had there been sufficient time, instruments and personnel available, the

[1] E. E. Shipton, "Karakoram, 1939," *Geogr. J.* 95 (1940) 409; P. G. Mott, "1939 Karakoram expedition," *Himalayan J.* 13 (1946) 9.

Survey of India plan would have been by far the most satisfactory way of tackling the job, but we had only one theodolite accurate enough for a triangulation of this order and one surveyor to use it. Moreover the majority of the triangulation stations lay between 6000 and 8000 feet above the valley floor. In addition the observations had to be computed fast enough to keep two plane-tablers busy. Although Shipton assisted me greatly both by his profound knowledge of the country and a remarkable gift for recognizing peaks from widely different angles, the difficulties in carrying an accurate network of triangles over a distance of 60 miles in such country in the space of a few weeks need no elaboration. To have completed the task satisfactorily in the time at our disposal, at least three observers and a computer must have been available.

To add to our troubles the weather was often unfavourable and we were many times held up for several days by mist, rain and dust avalanches. Water and fuel are scarce in the region, making camp sites hard to find and adding to the exertion of the climbs. Even in the best circumstances it took two days to complete a single station, while on occasions five days were taken up by one point.

As things turned out the time spent on the triangulation was disproportionate to the work of the Expedition as a whole. Much interesting exploratory work behind the south Hispar Wall and north of the Upper Biafo watershed had necessarily to be curtailed, nor were we able to make a detailed survey of the Alchori and Chogo Lungma glaciers which were included in our programme. Sadly enough, despite these sacrifices the primary object of establishing the connection between the Indo-Russian and Kashmir series, which had caused our change of plan, was never completed on account of an accident to the Wild theodolite.

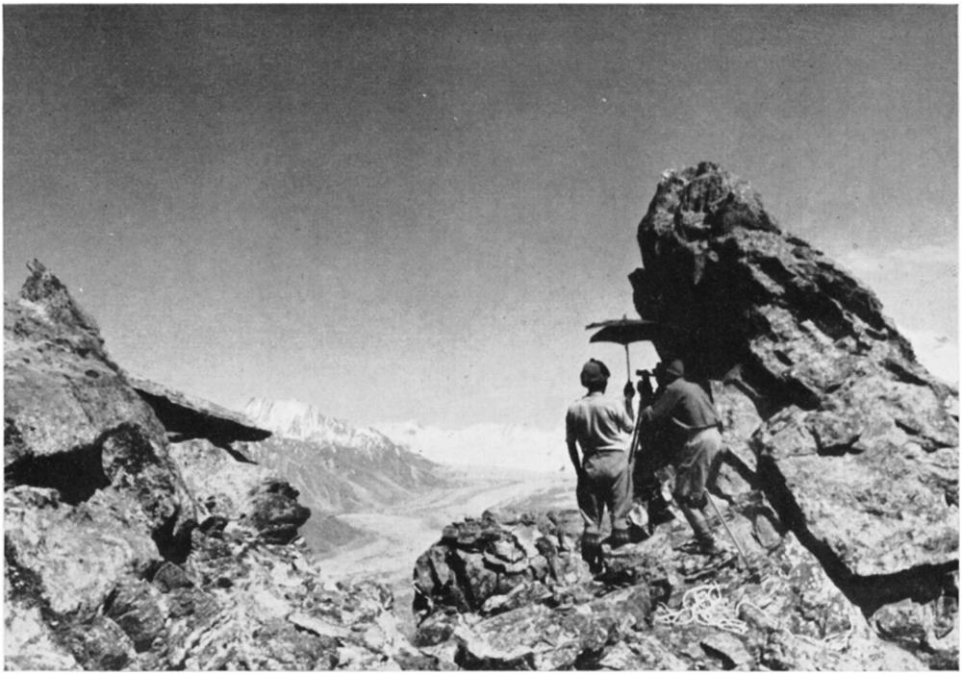
Some confusion and delay was due to the Survey of India triangulation pamphlet 42.L, which gives a very misleading description of both the stations belonging to the Indo-Russian series in the Hunza valley which we had hoped to use as a base for the commencement of the survey. "Zangia Harar" is not, as described, "on the higher and more northern peak" of the hill of that name but is at least 50 feet below the top and 100 yards to the east. Still less is "Buru Harar" on the "highest accessible point of the ridge"; it is situated on a very inconspicuous spur in the Hunza valley 2000 feet below the summit of the ridge (climbed by us without difficulty) and was invisible even from a mile away to the west without the use of a helio. Misidentification of the latter station involved us in a great deal of trouble and delayed us by nearly a week. Finally we were obliged to abandon this station altogether and lay out a fresh base near Nagar, south of the Hispar river. The new base was later connected with Zangia Harar so that spherical co-ordinates could be computed. No reflection is cast on the Indo-Russian triangulation which was a fine piece of work carried out in extremely severe country. Nevertheless it seems a pity that, in a region where there existed little or no triangulation data, the stations were not selected on more conspicuous points that would have been of service to other surveyors.

The Nagar base was laid out by double extension from a Wild subtense bar. The Survey of India had offered us a Hunter "Short Base" before our departure (a more accurate apparatus than the subtense bar and ideally adapted for this type of work); regrettably we did not take it on account of the added weight.

The speed of progress prevented us from measuring all three angles of every triangle of the network. However, the work was computed as it progressed and a constant check maintained not merely on the stations but also on the intersected points which could be verified by the plane-tablers. The usual trouble

20,000 foot peaks bordering the Hispar glacier on the south

Plane tabling at 16,000 feet; Sosborne glacier



Triangulation station above the Hispar glacier

in exploratory triangulation of being unable to reconnoitre ahead necessitated a number of satellite stations, and corrections had to be made for these. Eight-foot cairns were built on all stations and proved sufficient for the longest ray (10 miles). A lime wash on the cairns would have been of great assistance in identification and would have added little weight to our loads. The stations were established in all cases on conspicuous points, mainly above 16,000 feet. Even without the cairns it should be possible for anyone to find most of them in the future from the description of the points, copies of which are held by the Survey of India, and by the Society's Map Room. We had neither the time nor the material to construct more permanent marks, but the cairns were strongly built and should last unless pulled down by local shepherds.

Accident to the Wild theodolite

After five weeks of intensive work the triangulation was within 10 miles of the Hispar pass. We were camped on the northern bank of the Hispar glacier below a hill that had been given the name "Dromedary Humps" on account of two small excrescences on the top. A spell of bad weather had just begun and the first day I was unable to observe owing to cloud; I went up a second time alone and set up the Wild on the southern of the two Humps, which consisted of an enormous pile of heterogeneous boulders. The uppermost rock, on which I was standing, must have weighed several tons and appeared securely lodged, but rain and thaw had undermined the stability of the pile and as I transferred my weight on to the outer edge of the boulder in order to level the instrument there was an ominous rumble beneath and the whole mass suddenly gave way. I was thrown downhill, the theodolite following closely behind. I escaped unhurt from the fall but the Wild received damage to its main axis and was out of action for the rest of the summer. The main object of the triangulation was thus brought to an untimely end. Fortunately we still had the small Zeiss TAL photo-theodolite reading to $1\frac{1}{2}$ minutes which was used to supply the plane-tablers with control by a series of resections, making use of those points already established with the Wild T.2. before the accident, in addition to the G.T.S. points provided by the two Kanjut peaks (Pk 11/42P and Pk 12/42P) and the unnamed peak 18/43M.

Plane-tabling

Most of the detailed mapping was carried out by two Indian plane-tablers, Fazal Ellahi and Inayat Khan, lent by the Survey of India to assist the expedition during the summer programme. Fazal Ellahi had already fourteen years' experience in Himalayan mapping and it would have been difficult to find his equal for accuracy, speed and resourcefulness. His out-turn was quite remarkable and can be gauged from the fact that in the course of three months' work he surveyed in great detail a total area of approximately 600 square miles, much of it above the snow line at 14,000 feet, and including the entire area of the Lukpe Lawo ("Snow Lake"), the whole of the Biafo glacier and two-thirds of the Hispar. Inayat Khan although a younger and less experienced man also produced some excellent work. As he was unwell for the first few weeks, probably due to slow acclimatization, he was left to complete the lower third of the Hispar glacier, the Kunyang and Gharesa glaciers and some of the country around Nagar.

Both surveyors suffered to some extent in their work from an insufficiency of control points. Due to the accident with the Wild, Fazal Ellahi was obliged to work his survey of the Biafo glacier (an area of some 200 square miles) off not more than six triangulated points. For the greater part of the time the surveyors were left entirely to their own resources. Much of the work had necessarily

to go unchecked, but whenever examined it proved of an extremely high standard. Fazal Ellahi's clinometric heights of the Hispar pass and most other points in the Snow Lake area agreed almost exactly with my triangulated values. It was definitely established that the Bullock-Workman's estimates of peaks on the south Hispar Wall and in the vicinity of the Snow Lake were in error on the high side, by as much as 3000 feet in some cases.

After completing the triangulation, Russell and I crossed over from the Biafo into the deep-cut valley of the Sokha (old "Cornice") glacier, said by the Workman's to have no outlet. Here I was faced with an awkward problem. There were no fixed points whatever available, while only a week had been allotted for a very difficult and intricate area. Luckily we had with us the Wild telescopic alidade which I used to build up a graphical "triangulation" from an assumed base across the glacier. Azimuth I obtained from observations of *Polaris* at (or near) elongation. The plane-table was oriented correctly over a known station just before the computed time of elongation. The alidade was then moved until the vertical cross-hair of the telescope was on *Polaris*. True north was thus indicated by the edge of the sight rule, plus or minus a correction which could be obtained from the *Nautical Almanack* and laid off graphically on the board. Later I "tied on" to two points on the south Hispar Wall which enabled me to reduce the whole survey to a known scale and transfer relative form-lines to contours of known value. The method is not one that commends itself except as a last resort in the absence of any triangulated points; with an ordinary sight-rule it would have been impracticable.

Leaving the Sokha and Solu area, Russell and I travelled to Askole where we parted company. With one Sherpa and two local men I then began the survey of the Hoh Lungma and Sosbon glaciers from the south. Here my task was very much easier. From the summit of a high ridge west of the Hoh Lumba valley one overlooked the whole of the Sosbon and Hoh Lungma glacier systems. Peaks 12/42P, 18/43M, 9/43M, were all visible and the survey began with an accurate fix. Several other points that I had hoped to make use of for plane-table fixings proved either untrustworthy or non-existent. The Workman's 22,000-foot Peak "Meru," between the Hoh Lungma and Biafo glaciers, was mysteriously absent. Koser Kunge (35° 37′ 10″ N., 75° 39′ 00″ E.) was visible far to the south, but did not appear reliable either in height or position. Mango Gusor (Pk. 21/43M) was not visible. The survey was necessarily of a rapid nature but it may be fairly claimed that the glaciers and surrounding ridges are accurately placed. At each station a round of photographs was taken on 35 mm. film which cover nearly the whole area of the survey. With the help of these it has been possible to work up all the detail left out in the field.

Photographic survey

The Panmah, Choktoi and Nobande Sobande glaciers were surveyed by Shipton, using the Zeiss TAL photo-theodolite, which had been obtained on loan from the makers. Later, at Dehra Dun, the photographs were plotted and the result is highly satisfactory; the method used, that of plane-tabling from single photographs, is one of the earliest forms of photo-surveying. It is ideal for use in high open country when time in the field is limited and personnel not highly trained. An account of the methods used is added as an appendix to this paper, and is based on our experiences with the Panmah survey. Save for a small area at the head of the Gharesa glacier, surveyed by Fountaine, and some pictures taken of the head of the Khurdopin, no other photo-survey was carried out. The programme of stereo-survey planned for the winter never materialized on account of the war.

APPENDIX

The single picture method of photographic mapping

The instrument used was the Zeiss TAL photo-theodolite, which is admirably designed for exploratory surveys of this type. The instrument in its case with all accessories and stand has a total weight of $14\frac{1}{4}$ lb. Horizontal and vertical angles are read in grads with a direct reading to one-tenth grad and an estimation to one-hundredth. In practice the horizontal angle was found to be accurate to within $1\frac{1}{2}$ minutes. For the sake of lightness we used film pack instead of plates, which worked satisfactorily. The size of the contact negative is $6{\cdot}5 \times 9$ cm. The method employed was based on the combined use of the instrument both as a theodolite and as a photo plane-table, and is to be recommended wherever time in the field is more important than convenience in office compilation, and also in cases where stereoscopic photogrammetry is impracticable due to lack of trained personnel or insufficiency of time. The area mapped by this means covered the whole of the Panmah, Choktoi and Nobande Sobande glacier systems, an area of some 200 square miles, mostly lying between 13,000 and 24,000 feet. The whole of the field operations and photography were carried out by Shipton in the course of three weeks' work, the total number of stations occupied being approximately twenty. In the selection of these stations the following points were borne in mind:

The higher the station the less dead ground there is and the wider is the valley separation.

Pairs of stations were so placed as to obtain good intersections on the country mutually embraced by them.

Points in the area included by one station must be recognizable when seen from the second station. The surveyor (in this case, Shipton) must be constantly identifying himself with a plane-tabler faced with the problem of cutting in small points of detail he has observed from a previous station.

Whenever possible the stations were intervisible. On arrival at a station the first consideration was given to the photographs. These were taken near midday if possible, when shadows were absent. If however there was any danger of low cloud forming, the photography was carried out immediately on arrival and the pictures repeated again later if conditions improved. Horizontal and vertical angles were taken to as many prominent peaks as time permitted, including all points triangulated by Spender[1] in 1937 and the old G.T.S. points.

The following records were kept:

(*a*) A list of all control points observed with a reference number and a description of each, and the station number from which they were observed.

(*b*) A list of all photographs taken at each station with their serial numbers, the angular interval of their principal planes and the displacement of the horizontal axis of the camera from its central position (equivalent to tilting the axes in other types of instrument).

(*c*) Horizontal and vertical theodolite readings.

For convenience and to save space all three sets of recordings were kept in one small notebook.

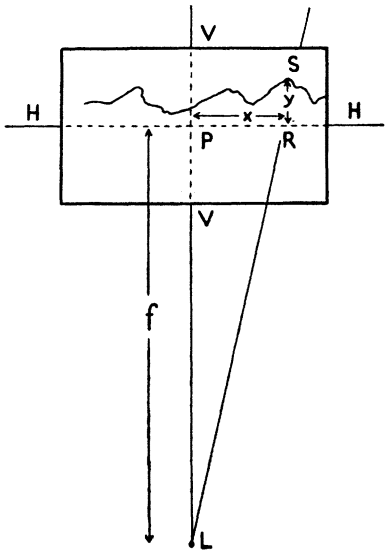
On the return of the expedition to Dehra Dun, the compilation of the Panmah map was immediately begun and took, in all, three months to complete. The compilation and drawing of the map was carried out in the following stages:

1. *Existing control.* All existing triangulated points were first plotted on a sheet of backed or "rectostat" paper to a scale of half an inch to one mile.

[1] *Georgr. J.* 91 (1938) 331.

2. *Kodatrace protractors.* A number of Kodatrace protractors were prepared of at least 5 inch radius. These were printed in ink on the glazed side of the Kodatrace, the circle being divided in degrees and tenths of a degree, every ten degree interval being numbered, so that when the protractor was viewed from the reverse (matt) side the numbers appeared the right way round and progressed in a clockwise direction from 0 to 360. There was one such protractor for each station, the number of which was marked in the corner.

3. *Resection of stations.* All observed angles from the stations were next set out on the matt side of their respective protractors, the number of each ray being marked against it on the outside of the circle. The resection of the stations then began. That station from which the greatest number of existing trig. points had been observed was taken first and, by sliding the protractor over the plot so that each of the trig. points lay on its respective ray, the resected position of the station was found graphically, pricked through, marked with a circle, and numbered on the plot. The remainder of the rays were then marked in pencil off the edge of the protractor on to the plot with their numbers. The principal lines of all photographs from the station were also transferred to the plot. In the same way the position of the second most favourable station was found and any common points between the two stations so far taken were intersected and used as additional control for fixing the third station, and so on until all the stations and new control had been plotted.



The stations were marked with small crosses in red ink and control points circled in black with their numbers in pencil. The heights of all points and stations were next computed and a height trace prepared. Everything on the plot was then erased leaving the stations, control points and principal lines of the photographs and any odd rays, the points of which had not been intersected. (These latter rays of course remained in pencil.)

4. *Photographic prints.* All prints were full plate enlargements ($8\frac{1}{2} \times 6\frac{1}{2}$ inches). Two prints were made from each negative, one matt and one glossy. Each enlargement was carefully checked to make sure there was a minimum of distortion in the print; especially with distant points, small errors of measurement on the print may amount to very large errors on the plot. As apparatus was not available to ensure that each print was enlarged by exactly the same amount, it was necessary to compute the principal distance for each individual picture. This was entered up in ink on the back of the print. The collimation axes were then drawn on the glossy copies *only*, using a fine pen or pricker.[1]

[1] If f_1, h_1, v_1 are respectively the focal length of the camera, the horizontal distance between the collimation marks, and the vertical collimation distance referred to the pressure plate; while f_2, h_2 and v_2 are the corresponding values for the enlargement (f_2 is the principal distance in this case) then it is clear that:

$$f_2 = \frac{f_1 \times h_2}{h_1} = \frac{f_1 \times v_2}{v_1}$$

5. *Plotting of detail.* On the glazed side of a piece of Kodatrace a cross was then drawn (see figure) and a distance equal to f_2, the principal distance of the enlargement, was marked off along the tail of the cross. This was placed in position on the plot with L on the station and LP along the principal direction of the photograph as marked on the plot. The ray to any point S on the photograph was next drawn by transferring the distance x from photograph to Kodatrace, laying a straight edge along LR, and ticking the ray off on the plot sheet. At the same time the distance LR was measured on the Kodatrace and y on the print: these were entered up on a form (y/LR is the tangent of the vertical angle to the point). Any control points that could be identified on the print were used to check the accuracy and the direction of the principal line, and also the presence of any distortion in the photography.

All photographs relating to a particular area were finally assembled and points of detail picked out and marked up with numbers in red ink on the matt copies. Glossy prints were used for measurement only and were not marked or defaced in any way except for inscribing the collimation axes. The drawing of the map then resolved itself into straightforward plane-tabling, in the drawing office instead of the field, and requires no further description.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45′
36° 30′
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24,238
19,061
Atabād
17,011
Baltit
(Hunza)
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Ganesh
Altit
14908
Buri Harar
14,602
Nagar
14,179
14,470
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Tukurkhai
Gharesa C.G.
Gharesa
17,522
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Minapin
Zangia Herar 14,031
Minam Ghucham
Shakoshāl
Hakalshāl
16,454
Borushāl
Hokshāl
Barpu Giram
Hura
Hapa Kund
Chhashuti C.C.
Tagaya
Khacheli Shabran C.C.
Hapa Kund
Hāmdār
15,066
Gutens
Rash Phari L.
16,527
Phahi Phari
Miar
Chukutans
Minapin Pk.
23,861
Girgindil
22,390
22,260
21,570
21,570
Yengut
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76°
77°
78°
Miles
20 0 20 40 60 80
37°
37°
Limits of map sheets containing surveys


75°00′
15′
23,620
Momhil Sar
24,090
Distaghil Sar
25,868
Trivor Pk.
25,330
22,170
17,610
23,320
22,130
21,750
20,020
19,000
Pumarikish
24,580
Bularung
C.G.
25,762
Khinyang
Chhish
Mashish
Chipurghutum
C.G.
16,620
Hispar
Laq
Falolingkish
Dattanas
C.G.
Bitanmal
C.G.
Menchhish
Chukutans
Turmati
Dachigam
19,075
Chandir Chhish
15,993
Makrong
Shirin-
chhish
C.G.
Makrong Chh.
21,680
Haigutum
21,020
20,820
Oyumeungpari
Yengutz Har Pk.
23,056
To Arandu
Uyum Haghuch P.
16,370
18,050
19,962
BAL CHHISH RANGE
20,088
19,528
20,48
20,280
20,470
18,354
16,318
20,998
Haghura
Shanga Lichang
17,055
16,527
17,870

30′ 45′

HISPAR - BIAFO

(KARAKORA

Surveyed by Mem
Karakoram

76°00′ 76°15′

36° 30′

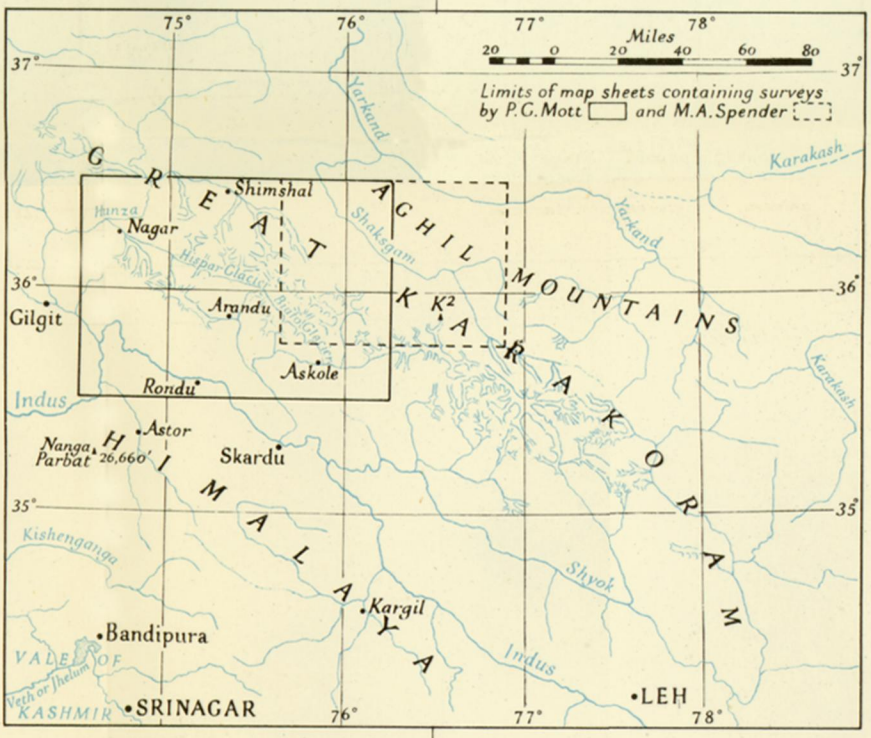
FO GLACIAL REGIONS

KORAM HIMALAYA)

d by Members of E.E. Shipton's
rakoram Expedition 1939

15′

36° 00′



Malubiting 24,470

36° 00′

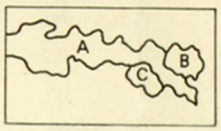
45′

35° 30′

74°30′

45′

RELIABILITY DIAGRAM



A *Deliberate plane-table Surveys by Fazal Ellahi and Inayat Khan of the Survey of India, based on a triangulation by P.G. Mott.*

B *Plotted from Photo-Theodolite Survey by E.E. Shipton.*

C *Rapid plane-table Surveys by P.G. Mott.*

Scale 1:253.

2 1 0 2

5 0

Co

Pro

E.W. Yeates, del.

Scale 1:253,440 or 4 miles to One Inch

0 2 4 6 8 10 12 Miles

0 5 10 15 20 Kilometres

Contour Interval 250 feet

Projection Polyconic

Pack Trac

Routes fo

Pass

Grazing G

Traveller's

Huts: per

Contours

Snow and

Triangula

Points fix

Other int

75°00′

15′

Published by the Royal Geograp

LEGEND

Pack Tracks

Routes followed by expedition

Pass

Grazing Ground: Camping Ground — G. G. — C. C.

Traveller's Bungalow — T. B.

Huts: permanent: temporary

Contours: Rocky slopes

Snow and Ice forms — 1 glacier 2 moraine 3 crevasses 4 scree 5 perpetual snow

Triangulation Stations — △ 19,560

Points fixed by theodolite — ⊙ 25,761

Other intersected points — · 19,570

the Royal Geographical Society


Bobisghir
21,050
17,940
17,320
20,910
Skamri Pks.
22,100
15,650
36°
00′
18,260
19,840
14,630
CHOKTOI MTS.
20,230
16,516
Brakk
21,440
23,320
22,790
17,030
LATOK MTS.
18,670
21,180
18,630
19,110
Chaumrisha
17,590
Dongbar
20,610
18,200
Panmah
G.G.
Soblang
Dongbar L.
Mango
Mango Brakk
17,470
45′
Bullah
20,650
Bulukpai Khar
Namla
G.G.
Shinlep Bluk
18,100
Drinsang
Korophon
L.G.
Laskam G.G.
10,200
To Askole
Biaho Lungma
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30′
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NEW BRITISH EXPLORATION IN NEPAL

PETER LLOYD

THIS STRANGE KINGDOM of Nepal is a magnet to draw any traveller. It is a country with a violent and dramatic history, the last century dominated by the epic figure of Jang Bahadur who, having taken power from weaker hands, survived the many plots of his adversaries and ruled the country so firmly and so wisely that the office of prime minister became hereditary to his family. It is a country closely linked to our own by ancient alliance and by the long association of the Gurkha regiments, but yet aloof, holding the western influence at bay and retaining a simple, even a medieval, character. Like the rest of Asia, it has now to face a new test, the impact of Communism on a poor and illiterate peasantry. Nepal is the birthplace of the Buddha, but is ruled by a Hindu dynasty, influenced by both China and India, yet independent of both. And Katmandu the capital has its own contrasts. It is set in a lovely and fertile valley at some 4,000 feet, but from any viewpoint a fine day will show to the north and north-east the clear line of the Himalayan peaks. The pagoda-like temples, both Buddhist and Hindu, are set beside the palaces and barracks of a later and western style. In the bazaars of the old town with houses decorated by the traditional Newar wood carving, the factory products of Calcutta and the surplus stores of the American army lie beside the grains and fruits of the Nepalese cultivators.

But of these things, fascinating though they are, I have but little to say, for it was as mountaineers and naturalists that we went to Nepal in 1949, drawn to a sight of this four hundred mile stretch of the Himalayan chain which includes so many of the giants: Everest with its satellites, Makalu, Kanchenjunga, Daulagiri and Anapurna, the great mountains of the world; and drawn especially by the lure of new country. It was a century since Hooker's classical journey to Eastern Nepal and since then no western traveller had seen much beyond the capital and the bordering foothills of the country. We counted it a rare privilege and opportunity to be able to go.

The area which the Nepal Durbar had given us leave to explore was that of the Langtang and Ganesh Himal, ranges on the Tibetan frontier eight days' journey to the northward of Katmandu, and I remember the faint regret that I felt on first realizing that this was, by Himalayan standards, a region of lesser peaks rising to not more than 24,000 feet. But I need not have concerned myself, for in the event we came much closer to one of the giants—Gosaintham—than the map had suggested, and in any case the smaller peaks were more than a match for us.

The Nepalese Government had made it a condition of our journey that, apart from exploring and climbing, we should also do some scientific work, and so paradoxically Tilman, the leader and organizer of our party, who has so often railed against the pretentions of science, found himself in charge of a scientific team. But I who had been climbing with him for many years had long since realized that Tilman's technique of Himalayan travel is in fact a

highly scientific method, exact as well as exacting, and I was not entirely surprised when Tilman showed that he was in fact an ardent and avid collector. Not only did he pounce upon the first *Meconopsis* or *Primula* of any seemingly new species that grew in his path, or for that matter on the crags above his path; he also slaughtered and preserved, all in the name of science, enormous numbers of miniature beetles. As for myself, I am a scientist by profession but it was as a mountaineer that I went on this journey, my objective a search but never a research.

Our botanist was Oleg Polunin of Charterhouse and our geologist Hamish Scott of St. Andrews University (whose secondary qualification it is to play Rugby football for Scotland) and at the appointed time the four of us, having crossed on foot the two passes that lead to the capital, duly assembled at Katmandu. Here we were most hospitably entertained by Lieut.-Colonel R. R. Proud of the British Embassy; his knowledge of the country and his generous help in a score of ways helped us over many difficulties and, after some hurried days of packing and preparation with the briefest visits to the palaces and temples of the valley, we set our faces to the hills. Our stores were carried by thirty local coolies, for Nepal in marked contrast to Tibet is seemingly a country without pack animals and all commodities—food, firewood, building timber—are laboriously man-carried from village to village. Our four Sherpas were in charge of Tensing, a much-travelled man who was already known to Tilman and me from the Everest expedition of 1938, and we had in addition an escort of Nepalese sepoys under the command of Lieutenant Sher Bahadur Malla, which had been put at our disposal by the Nepalese Government.

It was the end of May, for though we had been warned against travelling in the monsoon, the importance of our botanical work made it essential for us to cover the flowering and seeding seasons. But for the present it was typical pre-monsoon weather, hot in the valley and with occasional thunderstorms as the only reminder of the rains that were to come.

Our first night out from Katmandu was a memorable one, for on a clear evening we looked out from our camp, set in the terraced fields of what might have been a Garhwal village, across the long forest-covered ridge of the Gosainkund Lekh to the snow peaks for which we were bound and, as the night came on, the fields were as bright with fireflies as was the sky with stars. We were not to know that this was to be our last starlit night for many weeks.

The road to the frontier lay up the valley of the Trisuli which, as the Bhote Kosi, cuts its way like the Arun through the main Himalayan range. Along the ridges to the east of us ran the parallel trail that the pilgrims follow in their annual journey to the holy lakes of Gosainkund. Here Mahadeo, having drunk up the poison with which Siva sought to destroy the world, stabbed the ground with his trident spear and made the lakes to slake his thirst. Our lower road led us first across the fertile fields of Nawakot and Trisuli Bazaar; then, as the valley narrowed, across the terraced slopes and deciduous forests of its middle reaches, and at last to the upper gorge. As we found later, this part of Nepal is indeed a country of gorges and ravines and swift flowing streams, a country hard enough to traverse along the grain but surely heart-breaking across the grain of ridges which are often steep, and rivers which are often

unbridged and unfordable. More often than not the rocky trails escape from the steep slopes of the lower valleys and run along the ridges, a device that makes for quicker movement but can have its disadvantages for travellers without local knowledge of the springs and water courses. But it is just this difficulty of travel which gives Nepal its character and variety, for each valley, cut off from its neighbour, has developed and perpetuated its own speech and custom. Even within the limits of the Trisuli and Bhote Kosi valley systems we found the greatest variety of race and character, each village seeming to have an atmosphere of its own. And the few phrases of Nepali which I had learnt before leaving England were of but limited value to me, for the dialects that we heard spoken in the villages bore little resemblance to the *lingua franca*.

The Bhote Kosi cuts through the main range between the Ganesh and Langtang groups. Rasua Garhi, the frontier post at 6000 feet in the bottom of the gorge, is within 6 miles of a 21,000-foot mountain. The hundred-year-old fort on the Nepalese side of the frontier is a reminder that these rough trails have at no distant time been roads for invasion, for in 1792 the Chinese, angered by the Nepalese incursions into Tibet, sent a force down the Trisuli valley and penetrated as far as Nawakot before peace was signed; and again in 1855, the period from which the present fort is said to date, the Nepalese advanced into Tibet to withdraw a year later after inconclusive fighting. But now there is an air of make belief about the little fort, so much less formidable than a Welsh castle, and about its little garrison. The embrasures stare vacantly across the frontier line at the empty valley which leads up to Kyirong and the Tibetan plateau.

But our road lay first up a side valley, the Langtang, to the more easterly of our two ranges and two days' ascent brought us above the rain forest to a most picturesque and attractive village, with well-built houses of wood and stone and long Mani walls set among fields of wheat and barley, buckwheat and potato. (This latter was first introduced to Nepal from the garden of the British Resident at Katmandu.) The village was essentially Tibetan in character and the people were, as we soon learned, of Tibetan origin, hailing from Kyirong. They were Buddhists and indeed stricter Buddhists than are most of the Tibetans, for though they were mainly herdsmen, their wealth being made up of the yaks, cows, horses and sheep that grazed the upper meadows, they would take no life nor suffer others to take life within the valley. It was for their wool and milk that the flocks and herds were kept, butter being the most important commodity. This scruple about the slaughtering of beasts was something of a blow to us who had counted on buying an occasional sheep for the pot, and it meant that while we were in the Langtang valley our fresh meat ration was limited to the carcass of a sheep killed by an impious bear and to the infrequent by-products, monal pheasant or snow pigeon, of Polunin's collecting.

The middle part of the Langtang was a long glacier-worn valley bounded to the north by steep rock walls rising abruptly to Langtang Lirung (23,771 feet) and its satellites, while to the south gentler slopes led to lesser mountains of some 19,000 feet. It was a valley rich in flowers and shrubs, dominated when we arrived by a slender iris, later by anemone and fritillary, and later still by a delphinium lovelier even than the gentians. On the southern slopes,

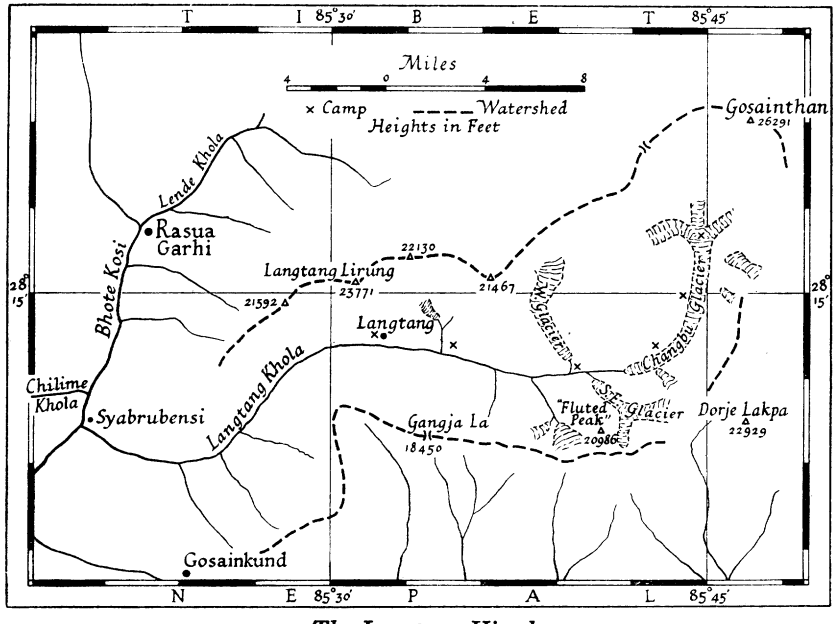
remote from the main area of cultivation and grazing, were woods of birch and rhododendron, dotted with clumps of a sweet-scented *Primula* and alive with finches. Higher up on the moraines and screes it was the flowering shrubs that predominated, dwarf *Rhododendron* in many colours and varieties, *Spirea*, *Cotoneaster*, juniper and a sweet-scented *Lonicera* which on a still day would fill the air with its fragrance. Many of these plants that we found in the Langtang had been collected by Hooker on his journey through Eastern Nepal to the Walung pass, and several of his descriptions could equally well have been applied to the Langtang. One of the most intriguing, which appeared later and at higher altitudes, was what we at first called the "woolly cabbage" and Polunin later identified as a *Saussurea*. Hooker found this, or another of the same genus, on the top of the Walung pass and writes of it: "it forms great clubs of the softest white wool, six inches to a foot high, its flowers and leaves seeming uniformly clothed with the warmest wool that nature can devise." The woolly leaves form a shield over the flower with only a small central opening through which the insects can enter.

But while enjoying these pleasures, we had our eyes raised to higher things, for there were mountains here to climb and new country to explore. The existing map, made by native surveyors of the Survey of India in the course of two short seasons, was good enough within its limitations, but showed an understandable vagueness in its delineation of the upper part of our valley, while to the northward in the direction of Gosainthan, the holy mountain with which the lakes of Gosainkund are associated, there lay a big area invitingly marked "unsurveyed." I had somewhat rashly agreed, in spite of complete inexperience in these arts and of the obvious difficulty of working in monsoon conditions, to bring out a photo-theodolite and attempt a survey, and now before the weather broke was the obvious opportunity. Tilman might have been, but I was certainly not yet fit for any real climbing, for I had first to live down the effects of an eleven years' interval of absence from the big mountains and of a sedentary month spent among the fleshpots of Australia.

Our first and most obvious thought was to climb to the cols on the main frontier ridge overlooking the unsurveyed territory to the northward, and several cols were visited with this intent. The views that rewarded these exertions were not always helpful, for more than once we found ourselves overlooking, not the new country on the Tibetan side, but some tributary glacier of our own valley system. But one of these false cols, the first high survey station that I established, did at least give a general view of our own valley with its tributary glaciers and its mountains. It showed us in particular Langtang Lirung (23,771 feet), the highest peak of the group with relatively easy snow ridges above but steep rock below; "Fluted Peak," the shapeliest in the valley, and a mountain with which we were later to become intimate; and away at the head of the Langtang glaciers a great rocky bastion curiously reminiscent of Gosainthan as we had seen it from a view point in the Katmandu valley, but not separated from us by any frontier ridge. It showed us too that the main Langtang or Changbu valley was joined, not far below the snout of its long glacier, by two big tributaries, one which we directly overlooked flowing from the north-westward and giving access to the

frontier ridge, while the other drained the mountains at the eastern and south-eastern end of the group. This junction of three valleys where the great moraine of the north-west glacier debouched across and almost blocked the main valley was a focal point which made a useful base for later explorations of the two branch valleys and the cols to which they led.

Having failed in our first attempts to reach the frontier ridge in the region of the middle Langtang, we made it our next objective to explore the main valley and reach the head of its glacier system. Starting from a camp just below the junction and making some surveys on the way, it took us three marches to get there, and again we found a junction of three main glaciers each sending in its tributary stream of ice and rock, and making such a desert



The Langtang Himal

of moraines as only the Himalaya can produce; a horrid prospect of rotten shattered rock. But above this glacier world of decay and disintegration rose the steeper snows and the fine mountains of the watershed, dominated by a big wedge-shaped mountain that we later identified as the same "mock Gosainthan" that we had seen from the earlier survey station. And from the valley head we were able to push up a bivouac within reach of two easy cols and so at last to set foot on the main ridge; it was June 20 and, thanks to the lateness of the monsoon, the weather was still fine. But the view that we saw gave no simple answer to the topographical problem. A tangle of unnumbered lesser peaks stretched away toward the Tibetan plateau, but of Gosainthan and its satellite which we had expected to see dominating the view to the northward there was no sign. Below us on the Tibetan side a big glacier flowed westward to feed some tributary of the Bhote Kosi. To the south-

westward lay the peaks of the middle Langtang, their configuration confused by the sharp northward bend of the upper Changbu glacier.

A second and higher col on the main ridge and a number of other survey stations in the vicinity failed to provide much further evidence and now the worsening weather was making many difficulties in this work. Survey stations had to be established at dawn or soon after, and even then the clouds would often come up too fast to allow of useful observations; by mid-day the snow on the upper glaciers was so soft as to make their crossing a purgatorial journey. These difficulties, reinforced by the exhaustion of our supplies, made us turn back toward our base for there was little more that we could do.

The results of this work seemed inconclusive, but combined with other observations taken later from the middle Langtang it has at least shown certain things. The upper Langtang valley system extends far beyond the limits marked on the present map and drains a large part of the "unsurveyed" region. A second large glacier northward of the Langtang and of the Tibetan frontier also flows westward from Gosainthan draining towards, and presumably into, the Lende Khola; a conclusion which confirms the earlier maps. Gosainthan itself cannot be far north of the frontier and is most probably the dominant peak on the main ridge, in which case the Langtang valley and hence Nepalese territory must run right up to it, again confirming the drawing of the earlier maps.

It was now the end of June and time for us to start thinking seriously of a mountain. Our thoughts turned first to Langtang Lirung which, as seen from the Katmandu valley, had appeared an easy snow mountain with a long gently sloping western ridge. But from close range, the mountain did not look so easy; the west ridge seemed quite inaccessible from the south, the long south-east ridge though not impossible looked to need a long assault by a strong party, and the east ridge though it finished easily was again inaccessible from the Langtang side. Under these circumstances, our decision was to try an approach from the north and with facile optimism we reminded ourselves that the northern slopes, further removed from the origin of the monsoon, would give us better weather.

The move down to a new base at Rasua Garhi, which was to be the starting point for this attempt, was soon made and we found without difficulty a guide who offered to lead us across the steep slopes which run down from the mountain to the Lende Khola. But the story of the attempt is soon told. A three days' climb brought us to a misty lake, the Dudh Kund, at some 12,000 feet. But the mountain which rose above it was not Langtang Lirung but its 21,000-foot neighbour, a mountain of steep faces and jagged ridges which did not in any way invite a change of objective, and to reach the Lirung itself we had a long rising traverse to make over steep and broken ground seamed by the deep gulleys and rocky ridges plunging to the Lende Khola below. Our attempt to force this route, in the course of which we descended some thousands of feet without finding a feasible way across what was evidently but the first of many obstacles, convinced us without question that the route was impossible and we returned through heavy rain in acknowledgment of our defeat. The Lende Khola, which might have provided an alternative road to the base of the mountain, was of no help for its southern wall rivalled

the Rishi gorge in steepness and the northern bank up which the trail ran was closed by the political barrier of Tibet.

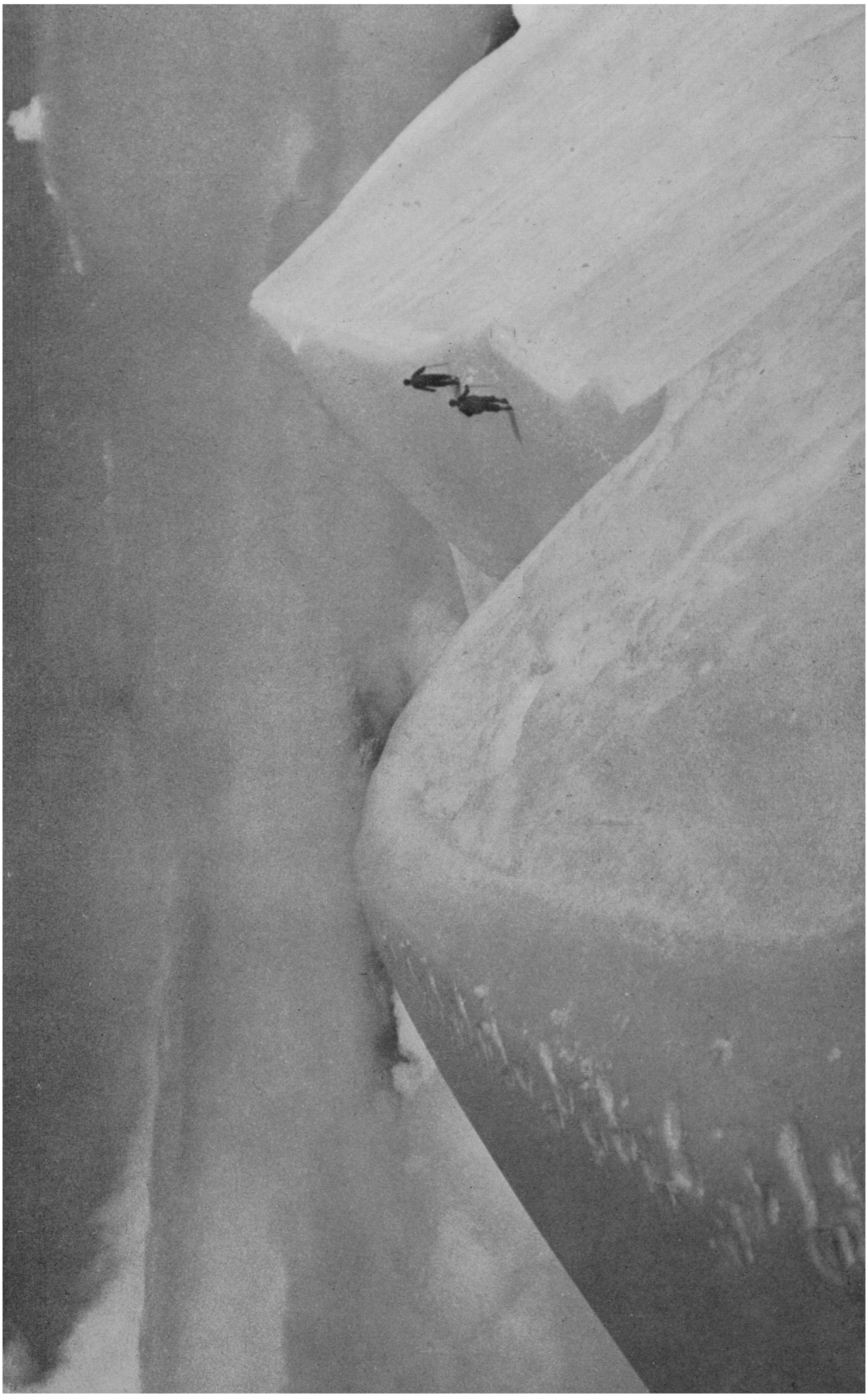
And so, baulked in our climbing plans, we adopted the traditional tactics and moved to a fresh area, the Genesh Himal, lying westward of the Bhote Kosi gorge. We found at once that this was territory of a very different character, for the Chilime valley, unlike the Langtang, was open and fertile in its lower reaches with its main villages set below the 6000-foot contour. The people were Tamangs, cultivators rather than herdsmen, with that difference in character and temperament that the easier life of the lower altitude seems to imply. The local coolies whom we recruited here bore no comparison with the sturdier men of Langtang and their villages were crowded and dirty. But the place had its compensations for us in plentiful supplies of eggs and potatoes, maize and honey.

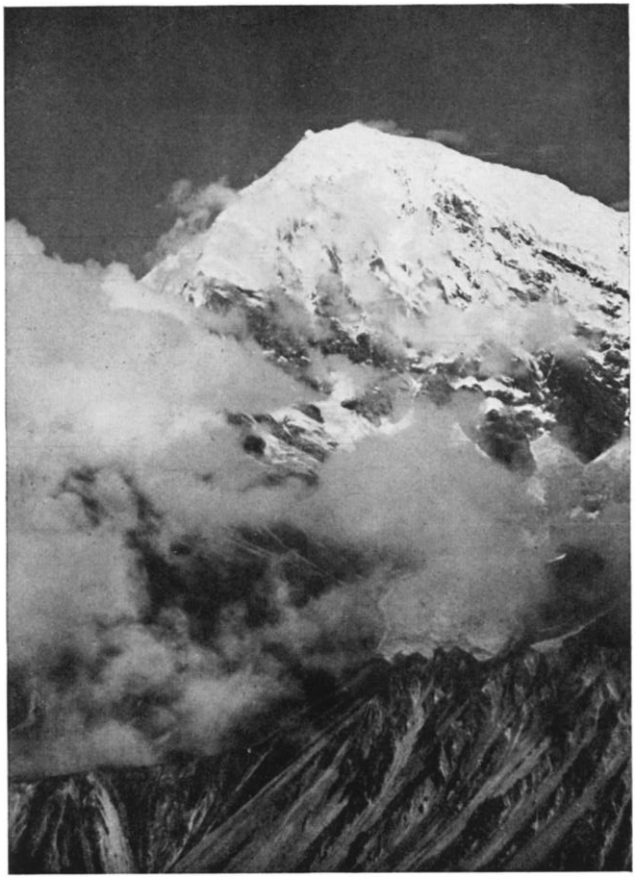
Down here the valley still held the sun, which seemed to cut its gully of light through the pervading cloud, but as we climbed up through the rain forest we came quite suddenly into a sullen world of cloud and rain and dripping vegetation. On our first night here my tent had such a battering from the rain focused on to it by the trees that it gave up all pretence of waterproofness and I spent the night awash. We had had leeches before and were to have them again, indeed we even had the horror of leeches that invaded our tents and sleeping-bags at night, but never were they so numerous or so cunning as here. They were a malignant presence, continually threatening and having that uncanny, sightless sense that leads them to their victims. And when after a three days' march from the valley we at last got above the leech-infested zone and found the welcome shelters of the shepherds who worked the upper grazings, the rain was still unabated. They told us that it rained most days and had in any case done so for the past eight. All our tents, made for snow rather than rain, were by now giving at the seams and leaking steadily, and we found ourselves preferring the more adequate shelter of the bamboo matting which the shepherds used to roof their huts; indeed we spent many an hour squatting and slowly drying ourselves in these huts over the smoky fire, with the shepherds sucking their "hubble-bubble" pipes and the lambs and kids penned beside us. We blessed too the light-weight tarpaulins which we had brought, for these, rigged over an abandoned hut or the end of a convenient rock, could always be relied on to make a dry cookhouse.

But even this world of cloud had its dry intervals and in the first of these, as soon as we could pick up bearings, we made an attempt on Paldor (19,451 feet), the most southerly point of the Ganesh chain and the most accessible to us. This gave us our first and as it proved our only mountaineering success; for after camping at some 17,500 feet in some doubt as to the whereabouts of the mountain we were seeking to climb, we found ourselves blessed with a fine day and with a route unfolding happily and without difficulty before us. But though we climbed in sun the clouds were piled all round us and a glimpse of an unidentified snow peak to the westward was all our view.

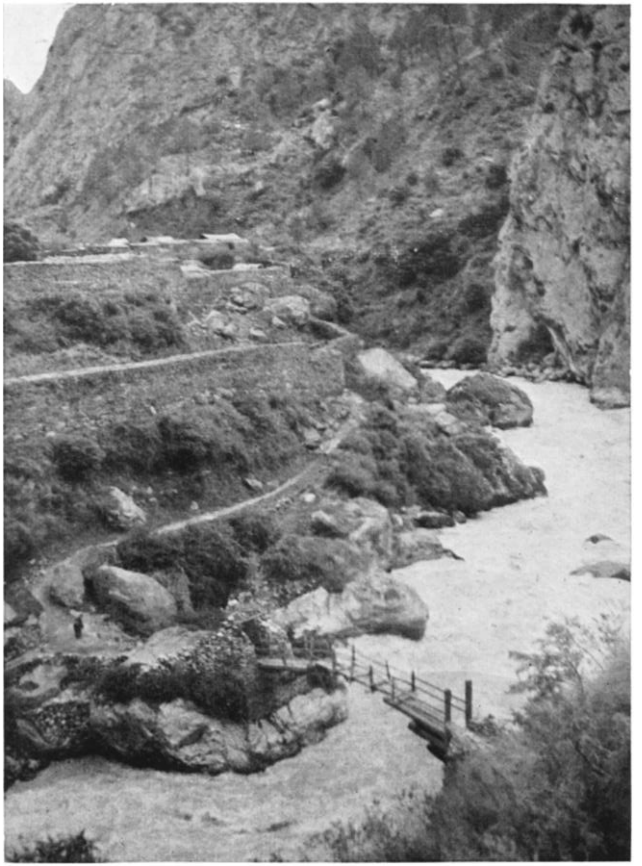
The rest of our time in the Ganesh went to collecting, to the study of the ice structure of a typical glacier and to the hopeful search for a feasible route up the main peak of the group, a fine 24,000-footer on the Tibetan

The summit of Paldor





Langtang Lirung from the "Red Coolin"



The Tibetan frontier: bridge over the Lende Khola

frontier. But the two routes that we found each had their drawbacks. The first had a steep passage low down on the ridge which would have taxed a very strong party, the second seemed to have little climbing difficulty but was protected in its lower part by a long rocky passage swept by falling ice, and at this season of warm nights, with no frost even at 19,000 feet, there was no period safe from this threat. Earlier or later in the season the risk could well have been taken, but not now. Our retreat to the valley was made in the same whole-hearted rain that we had learned to expect of the Ganesh and at the end of a long day's march we witnessed what I had thought never to see, a Sherpa unable to make a fire go.

Back in the Langtang valley on August 1 we had three weeks left before the party was due to break up. The first task was to round off the survey work, and in spite of the monsoon weather I got some useful observations in the middle Langtang region and also made a reconnaissance of the south-east valley, reaching a col on the southern watershed. In the meantime Tilman explored the north-west valley and confirmed that this led to a col overlooking the big westward-flowing glacier which we had already found. The Tibetan side of this col was too steep to be descended with coolies. The south-east valley contained a feasible-looking mountain, and we were also drawn by the idea of forcing a passage of the col at the head of the north-west valley, but after long debate we decided against both these plans, unable to resist the alternative attraction of Fluted Peak. Though barely 21,000 feet, this was the dominant peak of the middle valley and a lovely thing with its narrow ridges and furrowed faces of steep snow. We had seen it from every side save the south and knew that there was one possible route, from the west, up a long snow ridge broken at about 20,000 feet by a great flat step that looked a quarter-mile long. We went up into yet another side valley to find the ridge foot. Thick weather had become the rule, even in Langtang, and we now struck such a spell of it that for two days we were quite unable even to locate our mountain and spent our time in arguing pointlessly over its whereabouts, a process for which a doubtful map gives endless scope. But at last, on the third day, a momentary clearing gave us the bearing we needed and let us establish a comfortable base camp on the grassy floor of a little valley beside the glacier.

The next day we carried up the little "Meade" tent to make our final camp. We set it on a little rock platform at about 19,000 feet, just below a steep lift in the ridge, for though we would have preferred it higher we found ourselves having to choose between wet snow lying on ice and rocks so rotten that the whole mountain seemed in danger of falling about our ears. Neither place was right for laden porters. The little tent seemed somehow much smaller than the similar one in which we had last camped together on Everest.

But we were driven down next morning by a fall of snow in the night that made climbing conditions hopeless, and our second attempt, using a rather better line of approach to avoid the ice cliff, was little more successful. Again it was a frostless night with periodical rock falls down the gullies. Above our new camp site was a rock spur, steep and rotten but quite feasible, and up this we made good progress; but it petered out just below the step of the ridge, leading us out on to snow. As we had feared, this was sodden slush,

lying insecurely on its bed of ice with a trickle of melt water running through it, the very stuff that avalanches are made of; indeed, we could see the scars of the recent avalanche tracks on the slopes above us. Even ignoring the avalanche hazard we could only climb on by the slow process of cutting steps through to the underlying ice, an impossible task at that height and on a mountain of that size. The decision to turn back was inevitable.

A few days later Scott and I, with Angtharkay and three local men, crossed the Ganja La on the direct route for Katmandu and the plains, and for a send-off the mountains gave us the wettest week of the whole summer. Tilman and Polunin stayed a fortnight longer for the seed harvest before they too followed us.

It has been a disappointing ending to a season of limited achievement, a year of rains and moraines, of bad rock and rotten snow, but each of us in his different way had found compensation. Polunin especially had a tangible result to show in his collection of some 2000 flowering plants and ferns, 300 butterflies and moths, 500 other insects, 270 bird skins and so forth. and when these have been sorted and examined there should be an interesting story to tell. Scott too had his material results, and if the geological structure was less varied than he had hoped to find, there were some interesting rocks and minerals. To me it will remain a memorable year in that it gave me a fuller appreciation and understanding of the life and character of a mountain region than I had ever got before.

DISCUSSION

Evening Meeting, 20 February 1950

Before the paper the PRESIDENT (Sir HARRY LINDSAY) said: Mr. Lloyd is a scientist on the staff of the Ministry of Supply but he has also an interest in mountaineering, as will be illustrated in his paper. He has won a reputation as an experienced Alpine climber and he accompanied the Everest Expedition in 1938, reaching a height of over 27,000 feet. It so happens that I have a personal link with Mr. Lloyd, for to reach Nepal on the expedition he is about to describe he had to pass through my old district of Muzaffarpur in Bihar. That is purely a personal reminiscence to which I do not now propose to add.

Mr. Lloyd then read his paper

The PRESIDENT: We are indeed grateful to Mr. Lloyd for a most fascinating account of his journey and for wonderfully good photographs. The coloured photographs fitted in so well with each other and exactly described the lecturer's remarks. We were to have had the pleasure this evening of the company of H.E. The Nepalese Ambassador; unfortunately he has been detained in Paris, but he is represented by the Chargé d'Affaires, Professor R. B. Manandhar. We welcome him with great pleasure and we also welcome the Provost of Eton and President of the Alpine Club, Mr. Claude Elliott. The expedition described by Mr. Lloyd was led by Mr. Tilman, on whom I now call.

Mr. H. W. TILMAN: I am sure we are all extremely grateful to Mr. Lloyd for his lecture and certainly I can assure you that I am myself profoundly grateful to him because had he not spoken to you to-night I should have had to do so, and I notice here a somewhat formidable gathering of scientific folk in whose presence I might have felt it somewhat embarrassing to speak.

As you will have gathered, the climbing we were able to attempt was disappointing to both Lloyd and me, and that quite apart from the weather which is always a convenient scapegoat to all unsuccessful mountaineers. One reason for our failure was the lack of singleness of aim, by which I do not mean to imply that the presence of the scientists impaired our aim, but that we were perhaps trying to combine the exploration of a large mountainous area, in which we were fairly successful, with the climbing of the peaks. As a result our efforts on the peaks were somewhat hurried and off-hand, whereas in the Himalaya the climbing of a peak usually demands a great deal of time and undivided attention. Personally, I think that in new country such as we traversed, the urge to explore is hardly to be withstood and that the climbing of peaks becomes a rather secondary aim.

Another disappointment was our failure to get a definite line on that elusive peak Gosainthan, 26,291. As you have heard, we think the picture you saw was not the false Gosainthan but probably the true one, in which case it will stand on the frontier ridge, and not a good many miles north of it as shown on the present maps. It also stands on the watershed between the Sun Kosi and the Trisuli. There is no doubt whatever that the glacier from which we looked down into Tibet drains into the Lende Khola and may possibly drain the western side of Gosainthan. I am confirmed in my opinion that it drains into the Lende Khola by a map I have seen recently, drawn by Aufschnaiter and shown me by Colonel Tobin, Editor of the *Himalayan Journal*. Aufschnaiter is an Austrian climber who did some mountaineering in India in 1939. When war broke out he was interned at Dinajpur, but escaped with several others and got clear away into Tibet, and in the course of time—pretty nearly two years—arrived at Lhasa where he still is, running the power station there. In the course of that extraordinarily interesting journey he stopped at Langtang for ten months, exploring the surrounding country and making a map. He visited the snout of the big glacier at which we looked and he shows it draining into the Lende Khola, but even on his map there is no indication whatsoever of Gosainthan.

The only criticism I have of Mr. Lloyd's lecture, which was far more lucid and more neutral than I should have made it, is that the slides were rather personal and that neither the scientists nor the mountaineers showed to much advantage! I hope none of the laymen present to-night are sufficiently irrelevant and simple-minded as to ask of Little Peterkin, "What is it all about?" because I should have to reply, with Old Caspar, "I cannot tell." We hope to produce some maps, and there are a great many plants and other things in a building in Cromwell Road awaiting resurrection. There are a large number of pieces of the Himalaya up at St. Andrews where they are, no doubt, being scrutinized by means of microscopes by those few people there who do not play golf! What the final upshot will be and whether the journey has been worth while—I personally am sure it was—I must leave to some of our more learned speakers to decide.

I see the Nepalese Chargé d'Affairs here and I should like to take this opportunity of assuring him that we were most grateful for the permission to visit Katmandu and for the great kindness and help we received when we were in that part of the world.

Mr. POLUNIN: Of particular interest in the area we visited were the sacred lakes of Gosainkund which lie to the south of Langtang, an area where Hooker, one of the earliest and most renowned of botanists, collected in 1820. This inspired us to bring back plants, for those described by Hooker represent some of the earliest ever received from Nepal and very few plants have since been

collected from these mountains. In 1927 the Maharajah of Nepal kindly arranged that two Nepalese collectors should go to the mountains and send back plants and seeds to England as a present to King George V. They made an interesting collection, including the beautiful *Meconopsis Regia* named after King George and one or two excellent and delightful *Primulas*. The collection included both pressed plants and seeds, and some of them are now in cultivation in Great Britain. It was therefore of particular interest to me to search for the same plants and for other new ones. When we returned I found that there was nothing new in the collection of particular interest to the horticulturists, though it contains some interesting plants. I also set out to collect birds, because again our collections date from the time of Sir Brian Hodgson who was British Resident about a hundred years ago. He collected a large number of birds from the valley of Katmandu and employed native collectors in the hills. Various problems as to the distribution of species and races have not so far been resolved and I hope that some of the birds I collected in the mountains will help to solve them. So far the specialists have not got their claws into the birds and I cannot give any details.

Mr. D. BAGLEY: As a guest of Nepal on two occasions, I was particularly interested in Mr. Lloyd's remarks on a part of the country unknown to me, covering an area to the north of the valley. Hitherto, the limits assigned to the foreign visitor were usually the valley boundaries and the direct approaches, and these reveal the agricultural and industrial tendencies of a well-defined district, which one suspected would be in marked contrast to others as Mr. Lloyd has disclosed. Hooker indeed gives us some information of the western parts of the country, but to what extent these have changed in the intervening years only the Nepalese authorities can say.

With a view to the furtherance of exploration I discussed with H.H. the Maharajah's predecessor, about twelve years ago, a somewhat similar expedition to that undertaken by Mr. Tilman and Mr. Lloyd. At that time His Highness had in mind the utilization of the waters of the Sun Kosi and I later sent him a copy of Wager's paper on the drainage pattern of the Himalaya,[1] with a recommendation that further exploration would yield most useful data. His Highness was on the point of retiring, and thus no action was taken, but I sincerely hope that His Excellency the Ambassador will be able to advise a continuance of this exploratory work.

A glance at the map of Nepal reveals probably one of the most mountainous countries in the world. Fortunately for her economy she is blessed with wise rulers and doubtless the supreme questions of food and employment constantly engage their attention. Nepal's natural resources have not been fully explored. The potential hydraulic power from the principal rivers is immense, yet the difficulties of harnessing this source of energy are great, and include the probability of seismic disturbance. A controlled water supply would greatly increase the possibilities of irrigation, and land hitherto regarded as useless might be brought under cultivation. Cheap power might be provided for industry and for the production of fertilizers, and an exportable power surplus would be welcomed by India. Last but not least, it would prevent some part of the loss of soil now carried away to the Bay of Bengal.

The PRESIDENT: It only remains for me now to ask you to pass a most hearty vote of thanks to Mr. Lloyd. We have all thoroughly enjoyed his lecture and his slides and we do most sincerely express our gratitude to him.

[1] *Geogr. J.* 89 (1937) 239–50.