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A NOTE ON THE TOPOGRAPHY OF THE NUN KUN MASSIF IN LADAKH

Major Kenneth Mason, R.E., Survey of India

AFTER the early reconnaissances of the Nun Kun in the sixties, little attention was devoted to the region for many years; only the lower valleys around the base of the massif were visited by sportsmen. In 1898, however, Majors C. G. Bruce and Lucas climbed the lower slopes of the Ganri glacier, and the former crossed the Sentik La on to the Barmal glacier, and followed it down to the Bhot Khol (Major Bruce in the *Alpine Journal*, 1899). In 1902 Dr. A. Neve and the Rev. C. E. Barton ascended nearly the whole length of the Shafat glacier lying to the east of the massif, and during the same year they crossed the basin of the Barmal glacier from Tongul, *viâ* the Sentik La, descending south-westwards into the valley of the Bara Zaj Nai ('Thirty Years in Kashmir,' p. 179, by Dr. A. Neve). In 1904 Dr. Neve again crossed this glacier (*Ibid.*, p. 189).

In 1903 Dr. Sillem, a Dutch mountaineer, explored this region, and reached and photographed the high snow plateau crowning the massif. In 1906 Dr. and Mrs. Bullock Workman visited the district, claimed to have discovered Dr. Sillem's plateau, and made a complete tour of the mountain knot. Unfortunately their work was not based on the few trigonometrical points fixed in the region; their results led to much controversy, and some of them were not accepted. Since those days a certain amount of evidence has been collected on the points of difference raised by them.

The peaks referred to by various travellers are here summarized in tabular form with the accepted values of latitude, longitude, and height, deduced from the triangulation of 1859–60:

New number.	*Name or old number.*	*Latitude.*	*Longitude.*		*Height.*
		° ′ ″	° ′ ″		Feet.
Pk.1/52 C	Nun, Nana, or Ser	33 58 55·8	76 01 31·1	...	23,410
Pk.7/52 B	Kun, Kana, or Mer	34 00 47·6	76 03 22·4	...	23,250
Pk.6/52 B	Pinnacle Peak	34 01 22·0	76 04 50·1	...	22,810
Pk.12/43 O	Snowy Peak "D 41"	33 58 44	75 58 03	...	—
Pk.11/43 O	Snowy Peak "D 42"	33 59 07	75 55 41	...	—
Pk.39/43 N	Snowy Peak "No. 10"	34 00 22·2	75 50 30	...	19,830

It will be remembered that in her published account ('Peaks and Glaciers of Nun Kun,' p. 85), Mrs. Bullock Workman claimed to have ascended to 23,300 feet, to the summit of a peak which she named Pinnacle Peak, and which she persistently referred to as "the second highest peak" of the group. Her heights and this statement were at variance with previously triangulated values, and a review of her results (published in the *Pioneer* of 14 Feb. 1910), pointed out the view of the

Survey of India, namely, that Pinnacle Peak was the third highest, and Kun (or Mer) was the second highest peak of the district.

This was answered by Mrs. Bullock Workman in the *Pioneer* of 6 May 1910; she claimed that her hypsometric height obtained at the summit of Pinnacle Peak and compared with simultaneous observations at Dras, was more accurate than the Survey height.

The question of the height of Pinnacle Peak relative to others of the neighbourhood was decided by the retriangulation of the peaks in 1911, though in 1910 Dr. A. Neve again visited the region and took some observations with a clinometer lent him by the Survey for that purpose. These observations of Dr. Neve were worked out at Dehra Dun, and indicated that Kun was approximately 480 feet higher than Pinnacle Peak.

The original triangulated values made Kun approximately 440 feet higher than Pinnacle Peak, which was therefore believed to be the third highest peak in altitude.

The re-triangulation of the peaks in 1911 from different stations and from a different series than the original one gave the following completely independent values for the three peaks:

	° ′ ″	° ′ ″				Feet.
Nun	33 58 47·5	76 02 05·6	...	...	...	23,506
Kun	34 00 52·6	76 02 56·2	...	...	...	23,114
Pinnacle	34 01 22·2	76 04 49·8	...	...	...	22,741

The triangles from which these results were obtained were ill-conditioned, especially for the longitudes of the peaks, and the new observations for position were now computed in conjunction with the old. Almost perfect triangles of observation were obtained, and the resulting co-ordinates of the three peaks became:

	° ′ ″	° ′ ′				Feet.
Nun	33 58 56·3	76 01 30·6	...	...	...	23,357
Kun	34 00 47·8	76 03 22·6	...	...	...	23,220
Pinnacle	34 01 22·2	76 04 50·1	...	...	...	22,742

Here we see that Kun is 478 feet higher than Pinnacle Peak. In fact, in every case, Pinnacle Peak is several hundred feet lower than Kun. These last values agree very well with those hitherto accepted, and although they may be nearer the truth than the older ones, the objections to making changes in accepted values of heights, when fresh evidence produces unimportant variations, are so serious that the original values have been retained in all Survey of India publications. The old height of Pinnacle Peak (22,810 feet) was deduced with a coefficient of refraction 0·05, while that used with the modern observations is 0·07. By using the latter coefficient (0·07) for the early observations, the height (22,810 feet) becomes 22,738, and closely agrees with the new height, the weighted mean becoming 22,741 feet, using 0·07 for all observations. Similarly the old heights of Nun and Kun are in excess of those obtained above,

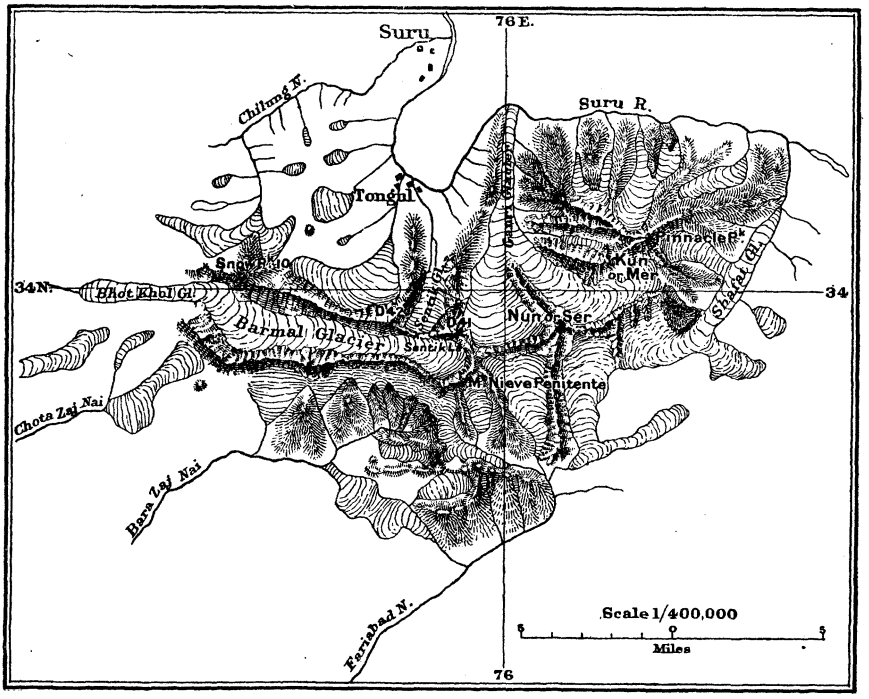
owing to the coefficient 0·05 being used instead of 0·07, and the old observations give heights closely in accordance with the later ones, if 0·07 is used. The point at issue is, however, the relative values of the three peaks, and is unaffected by any adopted coefficient of refraction.

Another point brought out in the review of Mrs. Bullock Workman's book was one originally noted by Major C. G. Bruce after his expedition in 1898, and raised by Dr. A. Neve after his journey in 1902. The old Survey map showed the Barmal glacier rising in a mountainous cirque south of Snowy Peak No. 10 (34° 00′ 22″, 75° 50′ 30″), flowing eastwards, bending north-eastwards immediately west of Peak D 42 (33° 59′ 07″, 75° 55′ 41″), and finally draining into the great bend of the Suru river near Tongul. Dr. Neve pointed out that the glacier rose in a rocky cirque south of D 41 (33° 58′ 44″, 75° 58′ 03″), flowed westwards, south of and past D 42, and, at a point almost due south of Snowy Peak No. 10, it changed direction north-westwards and joined the Bhot Khol glacier. He established the connection of Peaks No. 10, D 42, and D 41 by a rocky wall, asserted that the Barmal glacier was the Upper Bhot Khol, and, perhaps rather loosely, referred to the whole extent of ice as the "Great Western glacier of Nun Kun." No new edition of the Survey map was published, but Dr. Neve's amendment was admitted by the Survey to be probably correct, and it was supported by Major Bruce's account in the *Alpine Journal.*

The Workmans during their visit in 1906 made some notable ascents on the western outliers of the massif, but they did not follow the Barmal glacier down to its tongue, as had been done by Major Bruce. Yet in their published account they accused Dr. Neve of "erasing" the rocky wall south-west of Snowy Peak No. 10, "correctly charted by the Survey," in order to show the Bhot Khol–Barmal connection; and they maintained that Dr. Neve's "assertions were not in accordance with fact," and that the Barmal glacier drained into the Bara Zaj Nai; their map was drawn accordingly.

The Survey of India review, mentioned above, referred to the undeserved reprimand of Dr. Neve, pointing out that at any rate the travellers agreed as to the main course of the glacier, though they differed as to the actual hill-stream into which it drained. Dr. Neve, however, was determined to prove or disprove the correctness of his topography, and in 1910 again visited the district. In a letter from Dras, dated 25 September 1910, he wrote: "We ascended the Barmal glacier from the Bhot Khol and took photos and observations from a point due south of No. 10 . . . I then made a complete circuit round No. 10 *viâ* Bhot Khol, Suru, and then up the Tongul–Sentik route; camped at 17,500 feet on the Barmal glacier, and climbed D 41 in spite of the fresh snow. It was cloudless to the west, north, and north-east, and I got a circle of compass bearings. . . . At the bend of the Barmal glacier south of and west of Peak No. 10, I have three photos showing the continuation of the range on the south and

south-west side (Bara Zaj Nai)." This is the range erased by the Workmans. In his book, 'Thirty Years in Kashmir,' Dr. Neve gives a detailed account of this journey. He mentions that during his early expeditions to these parts he was not aware of Major Bruce's journey of 1898, an account of which had been published in the *Alpine Journal* of 1899. But the conclusions of their two expeditions were identical. In 'Twenty Years in the Himalaya,' Major Bruce gives his account of the Barmal glacier to the Bhot Khol, and on p. 99 he says: "In front of us lay the only question of the tramp: *a large and broken icefall* (see photo)." Opposite p. 100 is the photo referred to. This is almost identical with the



Sketch-map of the Nun Kun Massif

photo in the Workmans' book on p. 148; here, however, this icefall is singularly described as a "glacier-covered mountain wall separating it (*i.e.* the Bhot Khol) from the Barmal which lies on the south of the wall. This is the wall erased by Dr. Neve from the Survey map to indicate the junction of the Barmal and the Bhot Khol."

Major Bruce descended this icefall. Dr. Neve both ascended and descended it. The Workmans only saw it in the distance. Dr. Neve has not only proved that the Barmal is the Upper Bhot Khol glacier, but his photographs also show that there is no drainage outlet from the Barmal into the Bara Zaj Nai, which was the contention of the Workmans.

Dr. Neve also maintained that his assertion that the Barmal glacier

came "all the way from Nun Kun" was justified, since it rises in the cirque formed by D 41, the Barmal Ridge, and Mount Nieve Penitente, the western boundary and buttresses of the Nun Kun massif.

In addition to this, Dr. Neve, from the summit of D 41, found Nun almost due east of D 41, as originally shown on the Survey map (lat. of D 41, 33° 58′ 44″; lat. of Nun, 33° 58′ 56″). The Workmans had stated that D 41 was a mile too far south on the Survey map, and had therefore displaced this fixed point to another position west-north-west of Nun.

It is difficult to place much reliance on maps that have been based on the shifting of triangulated points: probably the only advance in topographical knowledge gained from this expedition of the Workmans was the indication of a route up the "North-west Nala" from the Fariabad Nala to the Barmal glacier; and even here the enclosing of a glacier in an amphitheatre of mountains with no outlet for drainage tends to shake confidence in the topographical details of the map.

To sum up: the alterations which should be made on the map of this district published by the Workmans are as follows:

(1) Pinnacle Peak should be 22,810 feet and not 23,300 feet high.

(2) D 41 and probably the whole glacial basin of the Upper Barmal should be placed a mile further south, as indicated by Dr. Neve.

(3) The connection of the Barmal glacier with the Bara Zaj Nai should be erased (proved by Dr. Neve's photographs), and an icefall connecting the Barmal and Bhot Khol glaciers in place of the mountain ridge should be shown at the bend of the Barmal glacier south and south-west of Snowy Peak No. 10 (proved by Major Bruce and Dr. Neve independently).

(4) The drainage of the glacier south-east of Mount Nieve Penitente should be connected with the "North-west Nala."

From a mountaineer's point of view, the fact emerges that the height reached by Mrs. Bullock Workman was not so great as 23,000 feet.

CLIMATIC CONDITIONS ON THE IMPERIAL AIR ROUTES

Prepared by the Meteorological Office (Air Ministry), and communicated by the Controller-General of Civil Aviation

THE diagrams here reproduced show by gradations of tint the meteorological conditions month by month along the Imperial Air Routes —the white space representing a month with less than 30 per cent. of days of rain, fog, gales, or thunderstorms, and the light and dark tints months with 30 per cent. to 60 per cent. and over 60 per cent. respectively of such days. The diagrams are only approximate, and bad-weather factors represented by equal tints at different places or for different months are not necessarily the same. Thus the same tint may represent rainfall in one case and fog in another. The diagrams, however, by showing at a glance the

then unknown. The officer in command of the Zouar camel corps, having been informed after my visit to Bardai that I was desirous of seeing him, came to meet me, and we reached Tottous on the same day. He was accompanied by the chief of the Tomagras, the noblest tribe among the Têda-tous, the aged Guetty, who had made his submission to the French authorities a few months earlier. Guetty was a handsome old man with a white beard and a skin less dark than usual. He was tall and regular featured, but his keen sly face inspired me with no great confidence; he was suspected of double-dealing, and of supplying the rebels with fuller information about our movements than us about theirs. During two days we had long conversations about the restitution to their families of the women and children that his fellow-tribesmen had carried off in 1913 in the course of a razzia on an Arab tribe of Kanem; but the old rascal either could not or would not fall in with my wishes, declaring truly or falsely that the luckless captives had been sold as slaves and sent away for the most part to the Senoussists of Cyrenaica.

The Return Journey to Borkou.—The exhaustion of my camels had reached such a point that I had to stay five days in the grazing-grounds of Tottous. I profited by the delay to explore the course of the Wadi Domar for about a score of miles in company of the Zouar camel corps, who were going back to their station. My food supplies, which had not been renewed for two months, were coming to an end, and I could not further prolong my excursions in the valleys of Tibesti. Besides, the greater part of the rebels had concentrated in the region of Abo, at the north-western end of the massif, twelve whole days' march away from Tottous.

Starting on November 4 for Faya, by a route hitherto unreconnoitred, we covered 120 miles of desert in six days before reaching the oasis of Kirdimi, near Ain Galakka, by the last and utmost effort our camels were capable of. On November 12 at nightfall I found myself back in my post of Faya, whose stout clay huts seemed to me for a whole week afterwards, if not absolutely the last word, at least the last word but one of comfort and civilization in the heart of the Sahara.

(*To be continued.*)

THE VALLEYS OF KHAM

F. Kingdon Ward

Read at the Meeting of the Society, 17 *May* 1920.

YUN-NAN—"Land of the Southern Cloud"—has been called the link between India and China. The province is most easily entered from the south-east by means of the French railway through Tonkin; or from the south west *viâ* Rangoon and the Irrawaddy. In either case it is a long arduous journey to the north-west corner, across some of the most mountainous country in the world. Geographically it

is impossible to think of north-west Yun-nan without including adjacent areas; on the western border, the Tibetan province of Charong, and northern Burma, where the Irrawaddy rises; on the eastern border, part of Szechwan province.

The starting-point for our journey is the famous and beautiful city of Tali-fu, almost in the centre of the province. It is built on an alluvial bank between the lake and a range of mountains, whose foothills slope down to the city walls. All round are fields of rice, beans, and flax. From Tali-fu two roads lead northwards. One follows the right bank of the Yangtze, crosses over into the basin of the Mekong by a low pass, and reaches that river *viâ* the city of Wei-hsi-t'ing. It then follows the Mekong valley due north to A-tun-tzu. The second crosses to the left bank of the Yangtze at the bend by Likiang city; ascends to the Chung-tien plateau, and dropping again to the Yangtze crosses it a second time. Finally it crosses the Mekong–Yangtze divide by a high pass, and descends to A-tun-tzu.

Immediately to the east of A-tun-tzu, then, the Mekong–Yangtze divide rises to an altitude of 19,000 or 20,000 feet. Beyond it flows the Yangtze. To the west are, in turn, the Mekong river, Mekong–Salween divide, Salween river, Salween–Irrawaddy divide, and Irrawaddy or Taron. In this latitude (28° N.) these rivers and ranges are all strictly parallel to one another, and are compressed within a belt of country only 70 miles broad. This is the gateway of Tibet.

I will deal first with the valleys. If we compare the two extremes, the Yangtze on the east, the Taron on the west, we find certain fundamental resemblances, combined with certain startling yet really superficial contrasts. In their structure they are alike. Both are deep wall-sided gorges, at the bottom of which flow boisterous rivers. In both the rock is largely granite or slate. But the surface vegetation in them is so different that it gives rise to a quite different appearance.

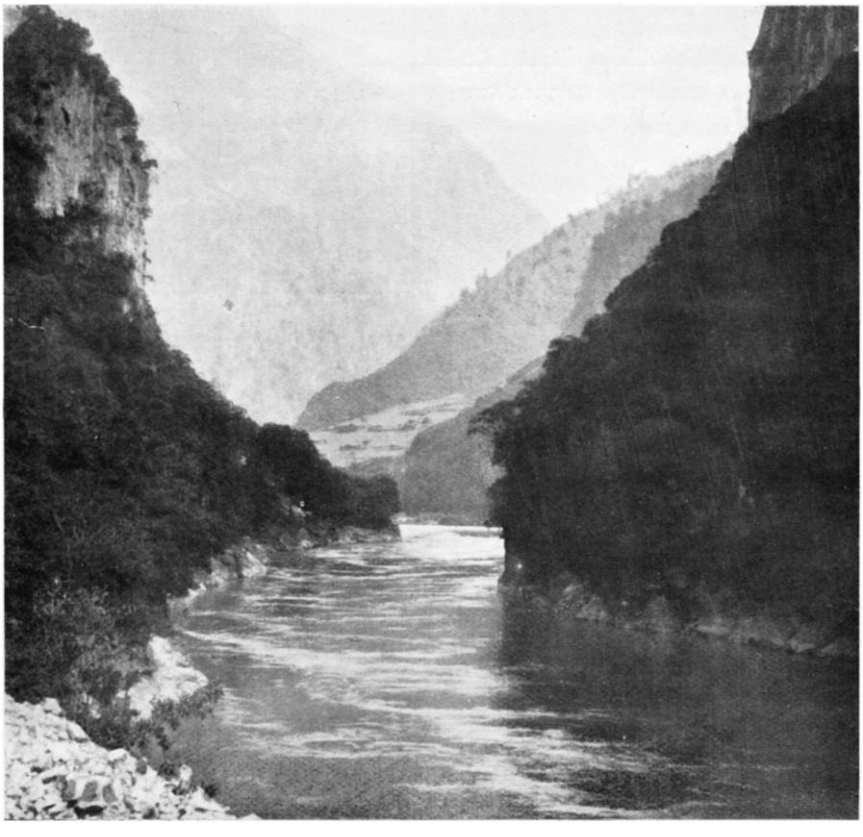
The Yangtze is extremely arid. There is no tree growth, and only a scanty covering of highly specialized vegetation on the slopes. Hence the appearance is that of a long grey or khaki-coloured corridor. The Taron valley, on the other hand, is clothed with forest wherever trees can find foothold. Every gully is clothed with a luxuriant growth of forest right down to the water's edge, while a succession of ponderous spurs foreshortens the view down the valley, breaking up the distance.

It might be expected that between these extremes, forest in the west and desert in the east, a simple gradation would be observed in the intermediate valleys. But the fact is not so simple. The Mekong, except in the deepest gorges, is as arid as the Yangtze. The Salween, on the other hand, has the characters of both the Taron and the Yangtze. In the south it is almost as well forested as the Taron, though it is more cultivated. In the north it is as arid as the Mekong or Yangtze; and the change from forest in the south to desert in the north is abrupt.

PITU MONASTERY AND VILLAGE; WI-CHU IN FOREGROUND, CHARONG

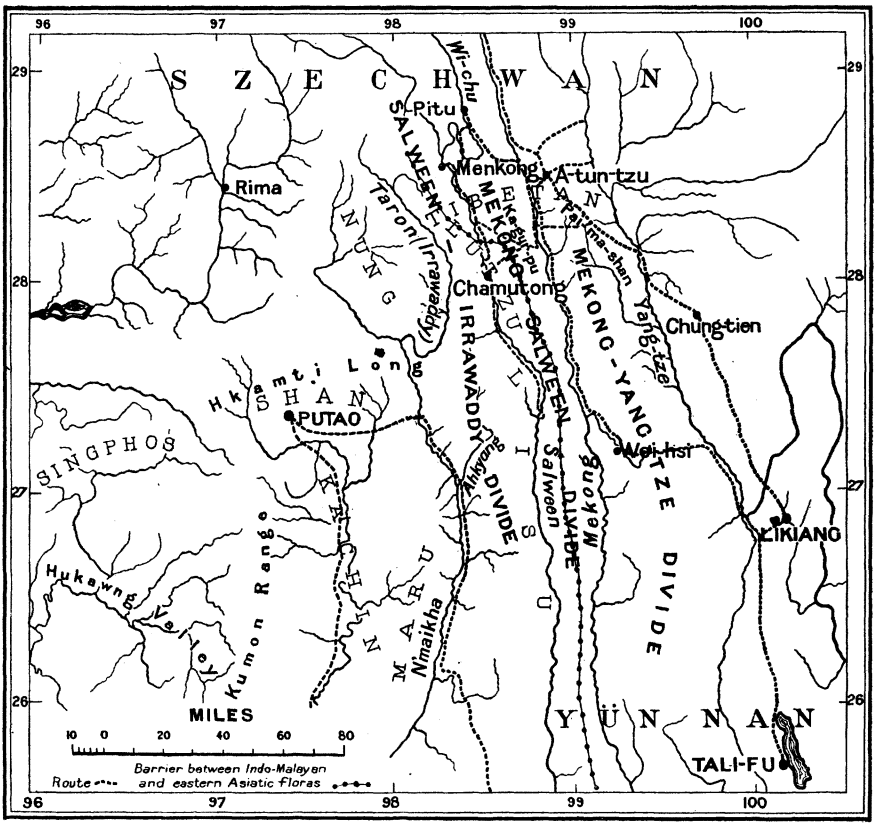
RICE TERRACES AT CHAMUTONG ON THE SALWEEN, MONSOON REGION

THE SHUEH-LA (CHU-LA), 17,000 FEET, LOOKING WEST ACROSS THE CHARONG TO SALWEEN-IRRAWADDY DIVIDE IN DISTANCE



THE SALWEEN AT SUKI, MONSOON REGION

This change takes place in the course of a few miles. Roaring through south-eastern Tibet the Salween enters a granite gorge, and when it emerges at the lower end, exhausted after its struggle, it has been tamed. Now it flows placidly between wooded slopes. The path climbs over an endless succession of rounded spurs, dropping into village after village tucked away in the folds. Incessant rain falls. To pass from this green monsoon region northwards into the stony gorges of eastern Tibet, it is usually necessary to leave the river, cross a low col, and descend to



Sketch-map of Kham.

the river again above the granite gorge. In winter however, the Salween waters being low, it is possible to keep to the river, penetrating the granite gorge itself. Cliffs have to be scaled by means of notched poles, chasms crossed on rickety bamboo ladders. The former are rather alarming, and I had to take off my boots before I could negotiate one.

Much of the journey is performed by canoe. These dug-out canoes are big and heavy, ours carrying sixteen men besides my eight loads. Rarely were we able to progress by paddling. Generally men had to scramble along the rocks, or wade through the shallows, hauling us

upstream by means of a bamboo rope. At one point we had to disembark while the canoe was bodily lifted over a fall. The Tibetans said that coming downstream these canoes sometimes got out of control and were upset, and then of course the occupants were drowned.

In the cold winter months, when even in the valley it freezes at night, the monkeys come down from the forests above and live in the gorge. On a cold January morning I saw them playing about on the granite cliffs, some 7000 or 8000 feet above sea-level. In the forests in summer they may be seen at 10,000 feet. I think this is the Tibetan leaf-eating monkey, *Semnopithecus roxellanæ*.

South of the granite gorge, then, we can recognize a fairly well-marked gradation in the valleys from west to east. In the north there is none. You leave the forested Taron, and crossing the intervening range drop straight down to the arid Salween; just as, following up the Salween itself, you pass directly from a region of palms, bamboos, and terraced ricefields into parched rocky gorges. It is clear that these differences in the vegetation and surface features depend in the first instance on differences of rainfall.

Next let us compare the dividing ranges, which I have called, from east to west, the Mekong–Yangtze divide, Mekong–Salween divide, and Salween–Irrawaddy divide. The Mekong–Yangtze divide carries peaks 20,000 or 21,000 feet high, but there are very few glaciers, such remnants as are found being in an advanced state of dissolution. There are however records of extensive glaciation in the past. Dead glacier valleys abound, and may be recognized by many of the familiar relics of a bygone glaciation. For example, the Pai-ma-shan peak is about 21,000 feet high. Its shrunken glaciers cling fungus-like to the rock slopes, and with blunt arms outthrust crawl solemnly forward. They resemble gigantic frozen amœbæ. Far below the present glacier tongue is an ice-scoured valley. The crest of the range is sierra-like. Below are conifer forests and evergreen oak. There is very little deciduous-leafed forest, or bamboo, and no meadow.

The Mekong–Salween divide also carries peaks up to 20,000 feet high, but they are needle-like when compared with the bludgeon-headed peaks of the Mekong–Yangtze divide. They are more graceful in outline, delicately curved, less rugged. Here we can recognize the influence of water, softening the harsh outlines of splintered rock. Glaciers are more numerous on the Mekong–Salween divide, but here also are abundant symptoms of decay.

All the glaciers on this range that I have seen have one striking feature in common. At some point every glacier crashes over a cliff, at the base of which the staggering procession of séracs are cemented together again and flow placidly on. It is a peculiarity of the valleys rather than of the glaciers. Every valley has its back broken, so to speak. It seems to be a structural feature of the district, for in many

valleys whence the glaciers had withdrawn to the upper parts, I found such cliffs exposed. Even on the Mekong–Yangtze divide, in valleys long since deprived of their glaciers, I found these escarpments.

Such naked scarps are invariably cut through. Were these slits made during the life of the glacier, or afterwards? Now it happens not infrequently, in the case of the still living glacier, that as it plunges down the cliff the ice peels away from the rock completely in places, leaving a bare scar. It seems therefore quite likely that glacier water, flowing over such an exposed surface, would begin to cut grooves in it, while elsewhere the rock would be protected by the icy covering. Eventually the cliff might be sawn right through. In the old glaciated valleys of the Mekong–Yangtze divide there is always a rock basin just above the cliff, the water from which overflows through the channel.

The Mekong–Salween divide is covered with coniferous forests and dense thickets of bamboo brake above; with mixed forests, in which deciduous-leafed trees predominate below. There are broad alpine meadows too.

Finally we come to the Salween–Irrawaddy divide, carrying peaks up to about 18,000 or 19,000 feet high. These also are covered with eternal snow, and are well glaciated. I have on several occasions gazed upon them from the other side of the Salween, but have not yet attained them. Below, these mountains are covered with forests right down to the river valleys, and with meadows.

The snow-line on the Mekong–Yangtze divide is about 19,000 feet; on the Mekong–Salween divide about 17,000 feet; on the Salween–Irrawaddy divide about 15,000 feet. These altitudes are approximate.

On these dividing ranges also we find the same gradation of rainfall that we noticed in the case of the valleys. Not only so, but we see on the Mekong–Salween divide the same change from a southern wet half to a northern dry half that we remarked in the case of the Salween valley. The southern part is more glaciated, and covered below with mixed forests. Here the snow-line is lower. The northern part is little glaciated, and covered below with coniferous forests, resembling in fact the Mekong–Yangtze divide. This climatic change in the Salween valley, and on the Mekong–Salween divide, begins immediately behind the block of high mountainous country at the foot of the Tibetan plateau, whence issues the Irrawaddy. North of the wide re-entrant formed by the Ahkyang river, the Salween–Irrawaddy divide itself rises above the snow-line for the first time. Immediately north of that again, the Mekong–Salween divide is uplifted in the Ka-gur-pu peaks; and due east of that is the Pai-ma-shan snowy range on the Mekong–Yangtze divide. That is to say, the elevation of these three ranges above the snow-line takes place in approximately the same latitude, the snowy peaks standing face to face on opposite sides of the valleys.

The climatic changes observed in the Salween valley and on the

Mekong–Salween divide, correspond with this uniform elevation of all the ranges. Remembering that the rain-bearing winds blow up the Assam and Hukong valleys from the south-west, it appears that in the south they can get through at least as far east as the Mekong–Salween divide. In the north, however, they impinge on the snowy ranges which one by one rob them of their moisture; so that, having crossed the Salween–Irrawaddy divide, the ranges to the east get a much smaller share of the precipitation, while the deep and narrow gorges between them are quite arid.

The gradual desiccation observed corresponds to the decreasing precipitation and increasing altitude. In the north it is the Salween–Irrawaddy divide which forms the dividing line; but for 500 miles in the south it is the Mekong–Salween divide. So splendidly unconquerable has this barrier proved itself, that for hundreds of miles it separates flora from flora, fauna from fauna, and almost race from race.

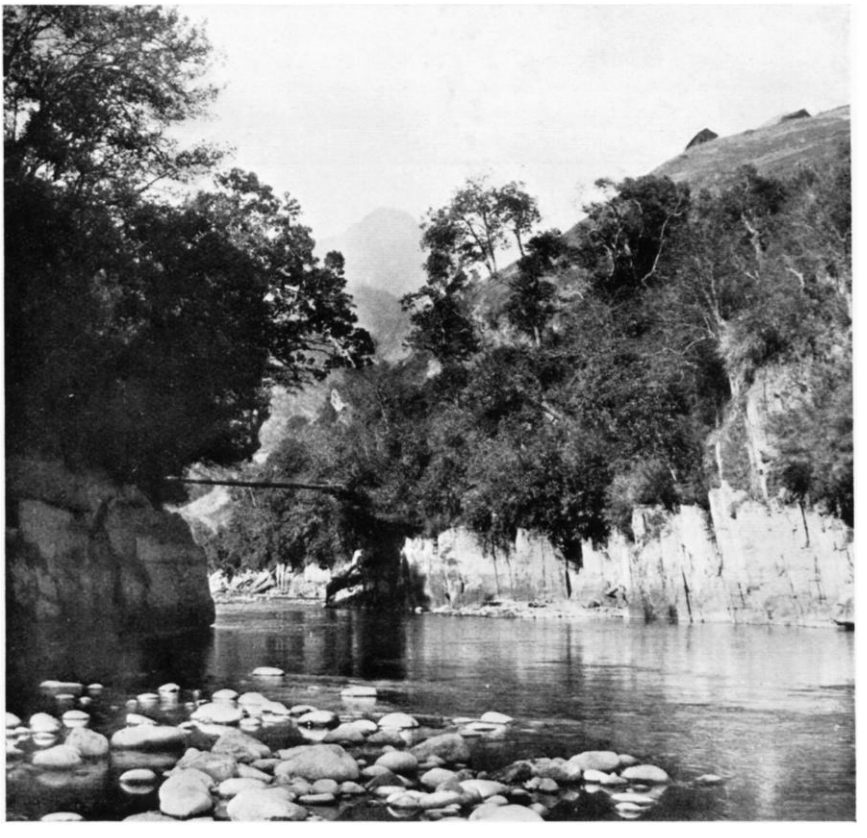
North-western Yunnan is occupied almost exclusively by Tibetans, in a broad sense. In the Yangtze, Mekong, and Salween valleys they extend as far south as the 28th parallel. West of the Mekong–Salween divide tribes of Tibeto-Burman origin are found—Lisus in the Salween valley, Nungs in valleys at the sources of the Irrawaddy, Kachins and Marus further south. East of the Mekong–Salween divide the people are all of Chinese, T'ai, or Mon Khmer origin.

The monsoon Salween is occupied by the Lisu tribe. Following down the Salween valley out of south-east Tibet, just as the Kachin tribes came down the Irrawaddy, they have spread westwards, where dwell the more uncouth tribes of Tibeto-Burman origin. But this invasion of the Irrawaddy jungles is recent. They have also spread eastwards from the Salween into T'ai or Mon Khmer territory, though not to any great extent.

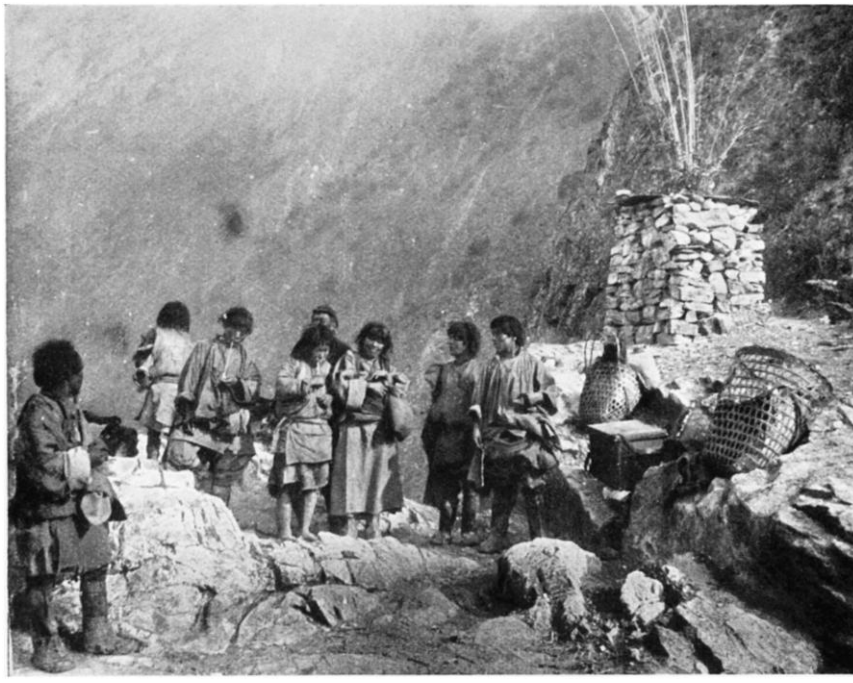
Between the Tibetans in the arid Salween and the Lisus in the monsoon Salween is wedged a small tribe concerning whom there has been some misapprehension. These are the Lutzu. They are simply Nungs from the Irrawaddy, mixed up with Tibetans and Chinese immigrants. The Tibetans take slaves from the Nungs, and the Lutzu have resulted from the mixed marriages. Of their Nung origin there can be no doubt.

The Mekong–Salween divide, then, roughly separates the people of Tibeto-Burman origin from those of Siamese–Chinese, or Mon Khmer origin. This line of cleavage is the more remarkable when we consider that the people of south-western China have been thrust back in two directions; westwards by the advancing Chinese, southwards by the encroaching Tibetans overflowing from the most fertile and prosperous valleys of Tibet. Crushed up against the battlemented towers of the Mekong–Salween divide, they have failed to cross it, but have been squeezed out southwards down the Mekong and Yangtze valleys, just as

PAI-MA-SHAN, MEKONG-YANGTZE DIVIDE



JUNCTION OF TRIBUTARY WITH SALWEEN: SUKI, MONSOON REGION



DWARF NUNGS (KIU-TZU), SALWEEN VALLEY: SLAVES TO THE TIBETANS

TIBETAN PORTERS OF LONDRE, MEKONG VALLEY

the Tibeto-Burman tribes have flowed down the Irrawaddy and Salween valleys.

Thus it appears that the Chinese have advanced steadily westwards, damming back the south-flowing current of Tibetans (who elsewhere are not found nearly so far south). But they have not reached sufficiently far westwards to impede the progress of the Tibeto-Burman tribes, who under cover of their jungles have therefore continued to move south down the Irrawaddy valleys without interruption. The Mekong–Salween divide marks in fact the natural westward extension of the Chinese.

Or we may look at it in this way. The present occupants of south-east Asia are immigrants. They have wandered by devious ways from a common cradle, placed probably in southern Tibet, at the apex of a triangle formed by the headwaters of the Irrawaddy. Thence they have followed three routes: (i) South-east into Yunnan, *viâ* the Mekong and Yangtze valleys. (ii) South into Burma, *viâ* the Irrawaddy valleys. (iii) South-west towards Assam, *viâ* the Zayul and Brahmaputra valleys.

Those who followed the first route comprise the Shans and the Mon Khmers. Having reached the lower mountains and open plateaux of the south, they spread out east, west, and south. Those who followed the second route, comprising the bulk of the Tibeto-Burman family, finally reached the lower Irrawaddy. Those who followed the third route, including the Abors, Mishmis, and Nagas, found the plains of Assam already occupied. Hence they were unable to emerge from their mountain fastness, and were lost in the wilderness of mountains.

Thus route (i) has been the greatest highway into south-eastern Asia, route (ii) the next greatest, while route (iii) has played no part at all. The inference is that their importance in the past corresponds to their relative difficulty, as suggested.

Of these wandering peoples, the T'ai were by far the greatest, with the Mon Khmer second. These founded empires all over south-east Asia because they came through the bracing gorges of the eastern rivers to the fertile plateaux of Yunnan. Their empire did not endure only because it was open to attack from the east, where a still more powerful people dwelt. But they died greatly, waging war against enemies on three sides; cut their way through to the China Seas, drove a wedge into the Mon Khmers who had preceded them, and conquered Assam.

It is clear from history that neither the Brahmaputra, Zayul, Irrawaddy, nor Salween valleys offers a natural route into Tibet. The natural way is the longer way, by the Mekong or Yangtze valleys to the 29th parallel, at the head of the Assam–Burma re-entrant; then westwards. But the other routes also have been used.

I need hardly point out the strategical and political advantage to the power holding the apex of this triangle, whence diverge the three great historic high-roads into south-east Asia, as well as the main road east into China itself, and two roads converging on Lhasa. Though it has been a

cradle of mankind in the past, it is in a fair way to become his coffin in the future, owing to the incessant guerilla warfare along the border.

In connection with the Tibetan inhabitants of the arid valleys, there is an interesting point to notice. The population appears to be much more sparse than is actually the case. This is due to the peculiar structure of the country. High up within the enclosing ranges the streams eat out broad valleys. Then, approaching the dry gorges of the great rivers, they gnaw their way through the cliffs. Looking up such gorges from the main valley, one sees just a boisterous torrent, filling the gorge from wall to wall. But climb over the spur and drop down to the valley higher up; the stream will be found to have swung through a right angle—it is now flowing *parallel* to the main river. At the bend the valley is broad and open. There is a village in the angle where the streams join, perhaps others higher up. The main stream flows from the north always, the smaller one from the south. Owing to this seclusion, the population of the arid valleys is probably double what it appears to be.

This peculiarity of the tributary streams is taken advantage of in another way. Frequently the road which follows the main valley is carried a short distance back into the mountains, and follows the tributary stream northwards to its source. It then crosses the spur, and follows the stream down the opposite slope, returning thence to the main valley. In this way, the most impracticable gorges on the great rivers are turned. But it is as a barrier against animal and plant migration that I particularly want to emphasize the Mekong–Salween divide. West of this barrier lie the Indo-Malayan jungles. Here grow the sago palm, climbing palm or rattan, screw pine, banana, tree ferns, mangosteen, birds' nest fern and many more characteristic Indo-Malayan plants. None of these cross the divide. To the east lie the savannahs and open scrub-clad plateaux of Yunnan, with quite a different flora. It will be sufficient to mention the snowdrop tree (*Chionanthus chinensis*) and the large yellow jasmine (*J. primulinum*) as typical Yunnan plants which do not cross the barrier.

This Indo-Malayan flora, with of course an increasing admixture of temperate forms, extends at least as far north as the 28th parallel, in the Irrawaddy basin. West of the Irrawaddy, in the Dihang valley, it extends even further north, to about the 29th parallel. East of the Mekong–Salween divide we must go far to the south, into the heart of Indo-China, before an Indo-Malayan flora is picked up again.

The same separation is found with the fauna. The Malay tapir, Javan rhinoceros, Indian elephant, barking deer and sambur all occur in the Irrawaddy basin, but none of them cross the Mekong divide eastwards. Two genera of monkeys, the gibbons (Hylobates) and Macacus, are confined to the western jungles; and a third genus, the leaf-eating monkeys (Semnopithecus), is also confined to the west of the barrier save for a single species which ranges north-eastwards into Tibet. Of animals

confined to the east side of the barrier, it will be sufficient to mention the Siberian mink (*Mustela siberica*) and the marmot (*Arctomys*, sp.), both common in north-west Yunnan.

In short, we may say that over ten degrees of latitude the Mekong–Salween divide forms a formidable obstacle to plant and animal migration from east to west. And if we follow the Salween–Irrawaddy divide north-westwards, far into Tibet, we shall probably recognize that it is the barrier for several hundred miles more.

Prince Kropotkin, in his 'Orography of Asia,' supposes the Himalayan axis to be continued north-eastwards to the Pacific at Kamchatka. And it must be confessed that, in order to account for the distribution of animals and plants between the Himalaya and China, some such continuous range seems essential. But Kropotkin reduces the Burma–Yunnan ranges, as well as the China divide between the Yangtze and Yellow rivers, to a very insignificant position. Indeed they scarcely appear on his map. Yet the Himalaya are certainly a natural boundary between two regions botanically and zoologically distinct; whereas their supposed continuation in the Great Khingan scarcely separates one sub-region from another sub-region, even in the animal kingdom. On the other hand, the despised China divide is regarded as a dividing line between two zoological regions, at least in the west; thus ranking equally with the Himalaya.

A range of mountains of such an age as still to be a barrier against plant and animal migration, must surely be of fundamental importance in any system of continental structure. While therefore Kropotkin is probably right in his conception of a prolonged Himalayan axis, he is probably wrong in supposing that the Great Khingan is the continuation of that axis. The more natural prolongation is the China divide, forming the watershed between the Yellow and Yangtze rivers.

The question then arises, Does not the Mekong–Salween divide, which has also been shown to be an important barrier, play an equally important rôle in the structure of Asia? It is no part of my subject to go deeply into the question of geographical distribution now. I mention the point because in north-west Yunnan we have possibly a key to several problems, as any one who has worked at the distribution of animals and plants between India and China will admit. It will be sufficient to remark that the flora and fauna of north-west Yunnan are more closely related to those of the Himalaya than they are to those of the adjacent regions—central Yunnan on the one hand, the Irrawaddy basin on the other.

This rather surprising conclusion emphasizes the important fact that the distribution of animals and plants over a continuous land area is not itself necessarily continuous. Moreover, mountain chains must be regarded not so much as barriers, but rather as a system of arteries, allowing free communication between widely separated areas. The student of geographical distribution should not aim at dividing the world

up into watertight compartments, characterized by certain flora and fauna, but try to cross the world with high-roads of migration.

We have, in fact, long since reached a stage in the world's history when, to the naturalist at least, every man, beast and plant is a foreigner. And there I must leave the matter.

I have called Yunnan the link between India and China. Let me explain. In the old days the European nations had what were called spheres of influence in China, and this country's sphere of influence was the largest of them all. It comprised the whole of the Yangtze valley. But the days of spheres of influence are past. Our position not merely as caretakers of the Yangtze valley, but our entire mercantile supremacy in the Far East is in jeopardy. Yet the importance of the great Yangtze waterway is not lessened. Can we then reach the Yangtze and the markets of central and western China by any other route? I think we can. The way to the Yangtze, however, lies through central Yunnan; a discussion of the matter does not fall within the scope of this paper.

On the other hand, our established position on the North-East Frontier brings us to the very threshold of north-west Yunnan, whence three great highways from China converge on the most fertile part of Tibet. These roads circle round the great jungle bay of Burma–Assam. But they never penetrate that bay.

Just beyond our frontiers, the trade of China has ebbed and flowed for centuries, on its way to Lhasa, and thence across Tibet to India. Why has it not poured straight down through Burma and Assam? For reasons already given; the jungles were not safe. They were full of robbers, and of invisible armed men. Above all, there were no roads. In the second place, such roads, had they existed, would have led nowhere. They would have led seawards, and to the people of interior Asia the sea meant, if it meant anything at all, the limit of habitation.

Now it is different. The strength of this Empire has pacified all the border country. Roads, which a few years ago would have been regarded as visions, are being built. Our sea-borne commerce plies patiently outside, still seeking its way slowly but surely to the heart of Asia. Though we may never see railways built in such a country, roads can and will be made. And with the wonderful development of mechanical transport, I can see British trade striding across the Burmese hinterland to the wide spaces beyond.

Before the paper the PRESIDENT said: The lecturer this evening, Captain Kingdon Ward, is a son of the late Prof. Marshall Ward, Professor of Botany at Cambridge. He has made several journeys on the Burma and Chinese frontier, his primary object being the collection of plants, during the years 1911, 1913, 1914, and 1919. In the interval between the last-mentioned years Captain Ward has been employed on active service with the Indian Army in Mesopotamia. He is known to you as the author of the book 'The Land of the Blue Poppy,' and received recently one of the Society's Awards. I have very great pleasure in introducing him to you.

Captain Kingdon Ward then read the paper printed above, and a discussion followed.

The PRESIDENT: You heard the lecturer mention General Davies as having travelled in that region some years ago. During this present war he commanded that splendid old regiment, the 52nd, the Oxford Light Infantry. He served during the whole of the war in France, and at the end commanded a Division. He is present here, and we shall be very grateful if he will make a few observations.

Major-General H. R. DAVIES: When I was asked to come here this evening and make a few remarks after the lecture, I began to think of the time when I was travelling in that part of the world, and it came as rather a shock when I recollected that it is now exactly twenty years since I was in the country Captain Ward has described. But any one who has travelled in that magnificent borderland, however long he lives afterwards, will never forget it; and I must thank the lecturer for bringing back so vividly to my recollection, by his words and by his photographs, the splendid scenery of that country. During the last twenty years, but chiefly during the last twelve, there have been several explorers there, and some of the best work has been done by Captain Ward himself.

The success of the traveller in that part of the world depends a great deal on the political situation at the moment. It is a country where the frontier between China and Tibet varies from time to time. There was a Tibetan rebellion some years ago which altered the boundary-line. The Tibetans overran China first of all, and then the Chinese came back and defeated the Tibetans, and retook what they had lost and a little more country than they had before. Wherever Chinese influence penetrates it is much easier to travel than where the country is purely Tibetan; for the Tibetan lives in a land where there is not much law and order or settled Government, and he very naturally—I do not blame him—resents the appearance of strangers. It would be very interesting if Captain Ward or any other gentleman here could give us an account of the present situation: whether the Mekong is still the boundary between China and Tibet, or how things are at present. To gentlemen who intend travelling, I cannot recommend any country more than this borderland of China and Tibet. Whether they go as explorers and surveyors, as naturalists or sportsmen—for there is good shooting in the country—or more especially if they are interested in the different tribes, I do not think they could find a more interesting country or one where on the whole there is still so much left to be done. I hope that many other travellers will follow the example of Captain Kingdon Ward, and give us the results of their experiences.

The PRESIDENT: There is a member of the land "silent service" who could give us exactly the information that General Davies is asking for, but I do not know if he has to remain silent or not. We should be very glad if Mr. Shuckburgh could speak.

Mr. J. E. SHUCKBURGH (Political Secretary, India Office): I may say at once I am not going to say anything on the point raised by the last speaker about the present boundary between Tibet and China. It is very difficult to answer, and I do not propose to try. But I should like to say one thing *apropos* of General Davies's remark that the Tibetans objected to strangers. That undoubtedly used to be true, but I am not sure it is quite so true now. Among all the beautiful photographs we have seen on the screen this evening of mountains and river-valleys, there is one that stays in my memory more than any of the others, and that is the picture of the smiling Tibetan; that and

another photograph to which he introduced us a little later—of a group of smiling Tibetan children. I think that the fact that Captain Ward can travel through these remote regions among a Tibetan population apparently without encountering any opposition or hostility is rather remarkable, and marks a striking and very welcome change, when we remember what the Tibetan attitude used to be toward strangers, even quite a few years ago. I think that the change that has come over them is largely due to the increased contact between Great Britain and Tibet, which the political events of the last few years has brought about. Before the Tibetans knew us they suspected and mistrusted us. Since they have known us better, that attitude has given way to more and more friendly feelings. I think all of us here as members of the Royal Geographical Society will find it very gratifying to remember that it was our distinguished President, Sir Francis Younghusband, who in the course of his memorable mission to Lhasa sixteen years ago took the first decisive step towards breaking down that barrier of suspicion and distrust that separated Tibet from her Indian and British neighbours. No doubt some nations are best kept apart, but I do not think that applies to Great Britain and Tibet. Everybody who has been brought in contact with Tibetans is agreed that there is a very natural sympathy between Englishmen and Tibetans, and that sympathy, it may be hoped, will be further developed as the years go by. There are many grounds that might be brought forward for saying that the future of Anglo-Tibetan relations is a hopeful one. Perhaps I may be allowed to refer to one. It is pretty generally known that some time ago, about a year before the war, the Lhasa Government sent four Tibetans to be educated in England. That novel and interesting experiment is just coming to an end. Three of the Tibetans have already gone home to Tibet; the fourth is about to follow his companions back to his own country. I think those four young men got on exceedingly well, and made friends everywhere. They were all at Rugby for about three years—one, I think, became quite a good football player. It remains to be seen what influence they will be able to bring to bear on the future of Anglo-Tibetan relations. Speaking from personal knowledge of all four, I will only say I feel very confident about it.

Major POOLE: My experience of Yunnan is not as great as that of either General Davies or of the lecturer to-night. It began in 1911, when I went on the Abor expedition; and I was so interested in the north-east frontier that after the Abor expedition I went to Myitkyina and Bhamo and got still more interested, so I decided, in 1913, after reading General Davies' book, to go through Yunnan. I went by French Cochin-China and on to Tali-fu, and Tengyueh, where a very interesting development took place: a revolt of Chinese troops. After the Tali-fu troops had mutinied, the Tengyueh mandarin inquired of a certain other town whether their troops were staunch and loyal, and the answer came back that they were loyal, for they had just been paid. The situation then became so obscure that eventually the Tengyueh mandarin was asking the Commissioner of Chinese Customs for his advice. In the end a loyal force moved from Yunnan-fu towards Tali-fu and put down the rebellion, but before the loyal troops arrived there some of the revolted troops turned loyal again and produced the charred corpse of the leader of the rebellion to the commander of the loyal troops. I asked permission from Simla to stay on, as events were getting so interesting, but it was a bad mistake to make, because they recalled me. Then came the great war, and I have not been able to follow my explorations in Yunnan any further, but I think everybody will agree that a more fascinating part of China would be very hard to

find. The mixture and variety of races, the change in scenery, where one minute you are in tropical surroundings and very shortly afterwards on snow-clad mountain-tops, is remarkable. Marco Polo says that in the Salween valley region the air is so impure that any foreigner who goes there is certain to die. That idea he may have got from the inhabitants, as the Chinese have a very great dread of the Salween valley in the summer. On my journey through, my muleteers refused to go on after a certain time because they feared they might have to sleep in the valley.

The PRESIDENT: I am sure from what you have heard you will realize that there is hardly in the world a more interesting region geographically. Here, in a distance which you could travel in five days, you have four of the great rivers of Asia compressed together. It is a most astounding thing that you have got rivers like the Yangtse, the Irrawadi, the Salween, and the Mekong included within so narrow an area. Captain Ward has given us some idea of the tremendous gorges, of the wonderful variety in vegetation, in animal life, and in the inhabitants. He referred to many of the inhabitants as of the Caucasian type, but it is really very difficult to imagine how men of the Caucasian race migrated from Central Asia right over the ranges and plateau of Tibet down to that remote region in the southern part of Asia. But years ago in the Hindu-Kush I did find supposed remains of Alexander the Great's army. Certainly the people of the region of Gilgit considered themselves to be descendants of Alexander the Great and his troops. The chief of the Hunza, when I asked him whether he had been down to India, said No; great kings like himself and Alexander never went out of their own country. I asked what he knew of Alexander, and he promptly replied he was a descendant of the great king. They are exactly like Greeks in appearance, and it was very easy to believe that they really are descendants of the Greeks. But that is a long way off from the region which has been described to-night. General Davies referred to the splendid work done by Captain Bailey, and I am very glad he did so, because a finer traveller it is very difficult to find: I do not know any better living at the present time. We all hope to see him home here before very long. He has just escaped from the Bolshevists. He had been hiding from them for a year and a half, but by his wonderful resource he managed to get away, after actually being in their employ as a captured Albanian officer! He was one of the men most instrumental in establishing that good relationship with the Tibetans to which Mr. Shuckburgh has kindly referred. You have seen from the slides that these smiling Tibetans are very amiable. But the Tibetans referred to this evening are not directly under the Lhasa Government: more or less independent, but of the same race and religion. Captain Ward made some interesting observations about the effect of Buddhism, and I endorse what he has said. It is a most extraordinary thing: I have observed among the Mongols and among the Tibetans, that Buddhism acts like an opiate. It seems to sap the vitality out of a people. There is every kind of interest in the country—geographical, ethnographical, botanical—and I hope that many of our Fellows will be going there, and giving us as interesting lectures as has been given us this evening by Captain Ward.