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THE SITE OF ALEXANDER'S PASSAGE OF THE HYDASPES AND THE BATTLE WITH POROS

SIR AUREL STEIN, K.C.I.E., F.B.A.

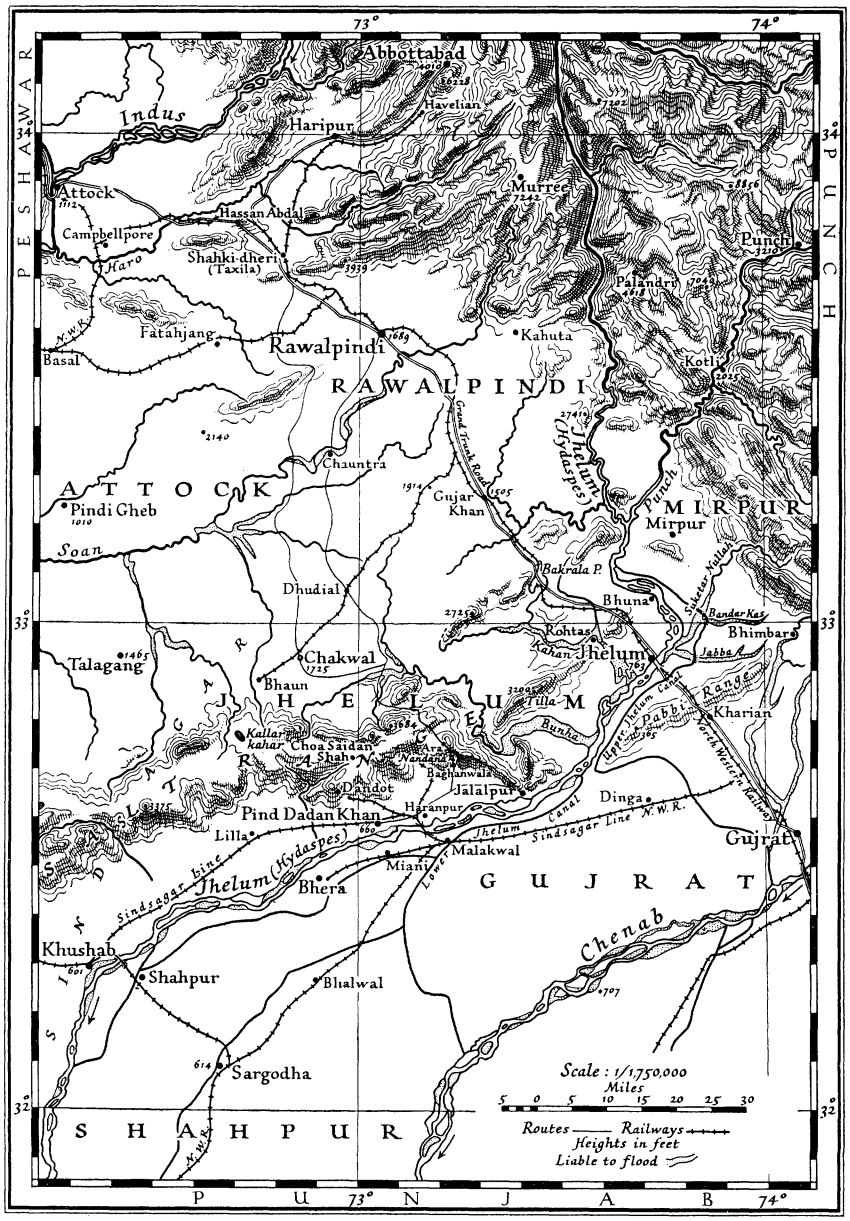
THE question of the ground where Alexander secured his bold passage of the Hydaspes and fought his great battle with Poros has been long discussed, but no definite solution has been reached and opinions have remained divided. This has been the result of conflicting locations having been proposed by those officers who in days long past had occasion to visit one portion or another of the ground where routes from the Indus crossing the Salt Range lead down to the Jhelum. Scholars working far away from India in their study could scarcely do more than try and weigh those opinions in the light of the interpretations they were led to put upon the records of Alexander's classical historians. Neither those early visitors to the ground since the days when Sir Mountstuart Elphinstone's famous Mission passed the Jhelum in 1809, nor the scholars discussing the proposed locations, had enjoyed the advantage of such accurate topographical and antiquarian information as the excellent maps produced in recent times by the Survey of India, and the records embodied by British administrators in District Gazetteers have placed at the disposal of the critical student.

Judging from what prolonged experience elsewhere had taught me, I felt convinced that even with the help thus afforded careful examination on the ground would be needed if a definite conclusion was to be arrived at. The opportunity for such an investigation had been desired by me for many years. But necessary freedom for it offered only last autumn while I was awaiting a start on the archaeological explorations in Southern Persia which the generous support accorded by Harvard University and the British Museum has now placed within reach for me.

There can be no doubt about the interest which for the historical student and even a wider public in the West attaches to this question of ancient topography. The scene of what was probably the most hazardous among the many amazing exploits of the great Macedonian's campaigns could claim more than romantic glamour if correctly located. For as a great strategist and student of history (Hellmuth von Moltke) has justly observed: "The locality is the surviving portion of reality of an event that has long ago passed by. . . . It often restores to clearness the picture which history has preserved in half-effaced outlines."

And certainly Alexander's passage of the Jhelum or Hydaspes when swollen in flood, and his subsequent decisive victory on the other bank over the vastly superior Indian army which opposed him, represent an event of lasting historical importance. It is true Alexander's victorious advance into the Punjab did not result in permanent conquest. But it was the first among the numerous successful invasions of India from the north-west frontier which history records, and by reason of the cultural influences for which it opened the door it marks an epoch in the past of India.

There is no need to discuss here the successive stages in that extraordinary campaign which had brought the Macedonian army across the Indus and



Country between the Indus, Jhelum, and Chenab: Rawalpindi Division

ultimately carried it victoriously to the bank of the Hyphasis or Beas where Alexander was obliged to give way before the war-weariness of the hard-tried troops and to acquiesce in the return westwards. Nor can I find room to set forth all the details presented by the extant records as regards the outstanding event which concerns us here. It must suffice to examine those briefly which may help to locate its scene. They are mainly to be gathered from Arrian. His account, derived to a great extent from contemporary sources, is the fullest and on the whole the most reliable.

Alexander, after his passage of the Indus, had been hospitably received at Taxila, whose ruler had before tendered his submission. There he learned of the opposition which Poros, the king of the region beyond the Hydaspes, the present Bihat or Jhelum, was preparing to offer to his advance into the Punjab. The mention of Taxila as the place whence Alexander's move to meet Poros was begun supplies us with an absolutely safe starting-point for his route.

The position of Taxila, the Takshasila of early Indian texts, was long ago correctly identified by General Alexander Cunningham with the ruined site of Shahki-dheri, between Hassan Abdal and Rawalpindi. Epigraphic finds and Sir John Marshall's brilliantly successful excavations have since placed this location beyond all doubt. The march thence to the Hydaspes must have taken Alexander across the Salt Range and the much broken tableland to the west of it. In many places the ground here offers difficulties to the progress of a large force. But there is no record of armed resistance having been met with until "Alexander encamped on the banks of the river and Poros was seen on the opposite side, with all his army and his array of elephants around him," as Arrian tells us.*

Alexander "clearly saw that it was impossible for him to cross where Poros himself encamped near the bank of the Hydaspes." Other points affording chances of a passage were also being carefully watched by detachments of the enemy. So he resorted to a series of demonstrations in different directions along the river bank to divert and wear out the Indian enemy's attention while he was trying to find a place where it would be possible for him unobserved to steal his passage across the river. It was the early summer when the waters of the river, swollen by the rains and the melting snows of the mountains, rendered fording impossible.

About the place which Alexander finally chose for the intended crossing, we are told by Arrian: "There was a headland (ἄκρα) ascending from the bank of the Hydaspes at a point where the river made a remarkable bend, and this was thickly covered with all kinds of trees. Over against it lay an island covered with jungle, an untrodden and solitary place. Perceiving that this island directly faced the headland, and that both places were wooded and adapted to screen his attempt to cross the river, he decided to take his army over this way. Now the headland and the island were 150 stadia distant from the great camp." Curtius's description of the place which Alexander selected for crossing states of the island that it was larger than the rest of the numerous islands in the river, and adds an important detail: "A deep ravine (*fossa praealta*) moreover, which

*McCrindle's translation in his 'Invasion of India by Alexander the Great,' 1897, is followed in the quotations from Arrian and Curtius, with needful modifications as suggested by the original text.

lay not far from the bank in his own occupation, was capable of hiding not only foot soldiers but also men with horses."

Arrian records at some length the dispositions made by Alexander to deceive the Indians as to his planned crossing. A portion of his forces under Krateros was left in the camp with orders to cross to the opposite bank as soon as Poros was seen to have withdrawn from it his formidable array of elephants; for these would have made it impossible for the horses unaccustomed to their sight to land. Another portion was posted between the island and the main camp and ordered to cross in detachments as soon as the Indian army were seen fairly engaged in battle. Alexander himself with selected troops of horse and foot "marched with secrecy, keeping at a considerable distance from the bank that he might not be seen to be moving towards the island and the headland from which he intended to cross over to the other side."

There skin rafts were carefully got ready during the night. There, too, most of the boats previously brought across from the Indus in sections had been conveyed and secretly pieced together. During the night a heavy storm came on, drowning the noise of the preparations with its thunder and rain. Towards daybreak the rain stopped and the troops moved across on rafts and boats in the direction of the island. "They were not seen by the sentries posted by Poros till they had passed beyond the island, and were not far from the bank." Alexander himself embarked on a thirty-oared galley with his bodyguards and other selected men. "As soon as the soldiers had passed beyond the island they steered for the bank, being now in full view of the enemy."

While the sentinels posted by Poros galloped off to carry the tidings, Alexander disembarked, himself the first, and at the head of the landed cavalry moved forward. "Owing however to ignorance of the locality he had unawares landed not on the mainland, but upon an island and that a great one . . . separated from the mainland by a branch of the river in which the water was shallow; but the violent storm of rain which had lasted the most of the night had so swollen the stream that the horsemen could not find the ford. When at last the ford was found, he led his men through it with difficulty."

There is no need for us to follow the details recorded by Arrian, mainly from the reliable account of Ptolemy, Alexander's general and the future king of Egypt, as to the events that followed the successful crossing. A brief summary of them including such points as may have a topographical bearing will suffice for our purpose. Alexander, leading forward his cavalry, some 5000 men, had no difficulty in routing the inferior force of horsemen and chariots which had been first sent ahead by Poros under his own son. The chariots proved useless in the action, having stuck in the clay, and were all captured. On learning of this rout and of the attack being launched by Alexander himself with the strongest division of his army, Poros decided to leave only a small force in camp to watch the troops of Krateros and to march against Alexander with all the rest of his army. He is said to have taken "all his cavalry, 4000 strong, all his chariots, 300 in number, 200 of his elephants, and 30,000 efficient infantry."

As regards the order of battle in which Poros drew up his army, we are given information which, as we shall see, affords a useful topographical indication. He "posted his elephants in the front line at intervals of at least a plethron

(101 feet)." Behind them he drew up his infantry in a second line. "He had also troops of infantry posted on the wings beyond the elephants, and on both sides of the infantry the cavalry had been drawn up, and in front of it the chariots." There is nothing stated that could suggest that this very extensive line of battle rested its flanks on any protective physical feature such as the river bank or higher ground might have afforded. It is important to note this point as it has its bearing on the tactical development of the battle and the light this throws on the topography of the ground where it was fought.

Alexander being superior in cavalry, opened the battle by attacking the cavalry on the enemy's left wing with the greater part of his horse. "The Indians meanwhile had collected their horsemen from every quarter and were riding forward to repulse Alexander's onset." Thereupon two regiments of cavalry under Koinos, whom Alexander had detached to his right, in accordance with his previous orders, appeared in their rear. The Indian cavalry thus forced to face both to front and rear was thrown into confusion, and completely broke when Alexander, instantly using his opportunity, fell upon it. Obviously the outflanking attack of Koinos was made possible only by the Indian left wing being at a distance from the river.

This initial success, gained as on other occasions by the trained skill of the Macedonian cavalry and the genius of its leader, decided the issue of the day. The elephants, to which the Indian horsemen had fled for shelter, on moving forward were met by the Macedonian phalanx which had come up. The latter, though unaccustomed to face elephants and suffering serious losses from their onslaughts, held fast. Alexander's cavalry, being free to operate from all sides, made great carnage wherever they fell upon the enemy's ranks, though the Indians fought very bravely. "The elephants being now cooped up within a narrow space, did no less damage to their friends than to their foes."

Finally surrounded by Alexander's cavalry and pressed by the Macedonian infantry advancing in phalanx the whole Indian host was cut to pieces or fled "wherever a gap could be found in the cordon of Alexander's cavalry." On seeing that victory was being gained by their king, the troops left behind on the right bank of the river crossed and took up the pursuit, doing great execution among those who had escaped from the slaughter.

Finally Poros, who had valiantly fought through the battle, was forced to surrender. After recording Alexander's generous treatment of the vanquished king, Arrian tells us: "Alexander founded two cities, one on the battlefield, and the other at the point whence he had started to cross the river Hydaspes. The former he called Nikaia, in honour of his victory over the Indians, and the other Boukephala, in memory of his horse Boukephalos, which died there," as Arrian states, from age and exhaustion.

From the account of this hard-contested battle, the first recorded in history among the many by which invaders from the north-west successfully fought their way into the plains of India, we may now turn to the question which concerns us here. It is that of the ground which was the scene of this the greatest perhaps of Alexander's military achievements. I shall now proceed, in a succinct way such as befits this place and the time at present at my disposal, to indicate the new observations, partly topographical, partly archaeological, which I believe will help to settle the question. Before this however I must

briefly state the two contending opinions which have prominently figured in the discussions devoted to it.

Both have had distinguished scholars among their champions. One, first propounded by Sir Alexander Burnes and M. Court, one of Ranjit Singh's French generals, would make Alexander reach the Jhelum at the town from which the Hydaspes, the ancient Vitasta of the Rigveda, derives its modern name. He is supposed to have marched there from Taxila across the Salt Range by the route which the present Grand Trunk Road follows. This view had been advocated at some length by General Abbott, the founder of Abbottabad, as long ago as 1852. It had been overshadowed for many years by the rival theory of General Cunningham, to be mentioned presently, but was revived with many a learned argument and widely propagated through the late Mr. Vincent Smith's very meritorious 'Early History of India,' and other publications based on it.

In a lengthy appendix specially dealing with the question Mr. Vincent Smith placed Alexander's crossing at Bhuna, some 10 miles above Jhelum town (see general map). There the river, after leaving the foothills, makes a bend though not a marked one. But, as any large-scale map would show, there is no "headland ascending from the bank of the river" to be found there, nor any deep ravine such as Curtius specially mentions. In accordance with this location Mr. Vincent Smith was prepared to look for the battlefield on the comparatively narrow stretch of riverine flat which to the east of the river intervenes between its left bank and the much broken ground at the foot of the Pabbi range of hills.

Before Mr. Vincent Smith took up the question at Oxford, with quasi-legal acumen but without close study of the ground, the theory put forth by General Alexander Cunningham in his 'Archaeological Survey Report for 1863' held the field. He placed Alexander's camp at Jalalpur, a small town on the right bank of the river about 30 miles below Jhelum. There one of the several routes leading across the Salt Range south-west of the Grand Trunk Road debouches, and there, as the general map shows, the river leaves the foot of a rugged projecting spur of the Salt Range which it washes for a distance of about 8 miles higher up before finally emerging into the open alluvial plain.

General Cunningham sought the place selected by Alexander for the crossing at the village of Dilawar at the upper end of the river's course along the foot of the spur just mentioned. But the distance between Dilawar and Jalalpur is only 8 miles and hence would not agree with the 150 stadia, or 17½ miles, which Arrian definitely mentions as the distance between Alexander's camp and the place of his crossing. In order to meet this difficulty about his assumed locations General Cunningham felt obliged to make Alexander's troops perform a night march by a very devious route. This he supposed to have taken them from Jalalpur up a narrow winding ravine that debouches there (see Plate 1), and then across its head by a difficult track into another winding ravine and thus finally down to Dilawar (see detail map). On this route the desired distance of some 17 miles would indeed be arrived at. But how a large force could be taken over this distance, across such difficult ground, in the course of a single stormy night, remained unexplained.

The Nestor of Indian archaeology had taken pains to study the ground and

1. Mouth of Kandar Kas torrent bed, seen from hill slope to north-west

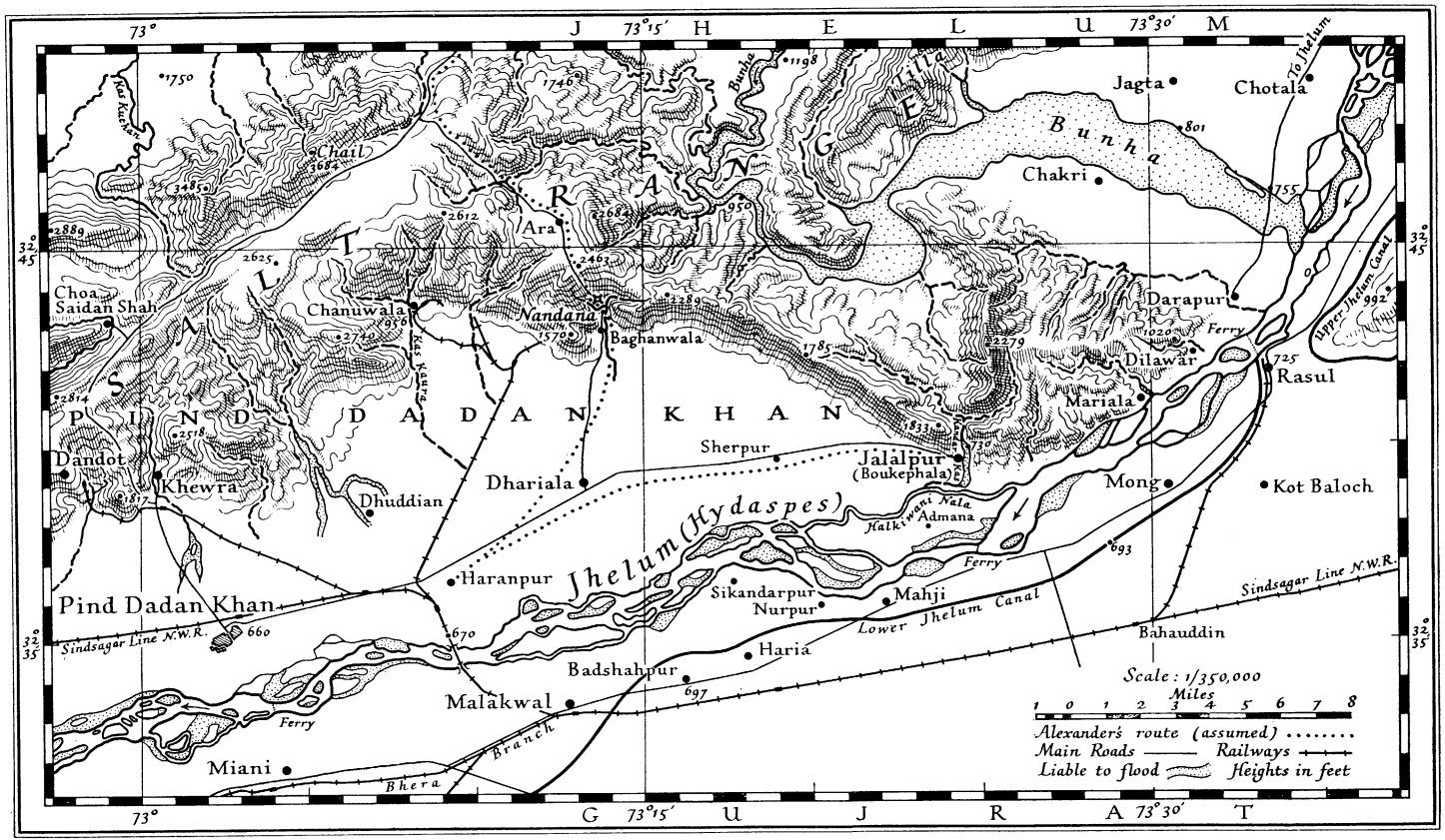
2. Ruined Hindu temple on ridge of Nandana, from north-west

had endeavoured to strengthen his theory by arguments drawn from such scanty topographical data as classical authors apart from Arrian and Curtius afford regarding Alexander's operations. Thus he rightly pointed out that the southerly direction indicated by Strabo for Alexander's march from Taxila as far as the Hydaspes distinctly points to a route having been followed that lay to the west of one leading to Jhelum town, like the present Grand Trunk Road. He also recognized that the distance of 120 Roman miles from Taxila to the Hydaspes, as recorded by Pliny from the measurement of Alexander's surveyors, is considerably greater than that measured to Jhelum, whether by the line of the Grand Trunk Road or by that of its predecessor which led there past the fortress of Rohtas. He rightly saw that this distance points to a route striking the Jhelum river lower down.

But the serious difficulty already hinted at about General Cunningham's locations remained, and some of the minor arguments adduced by him in support of them could not hold good against a critical examination such as Mr. Vincent Smith felt obliged to apply to them. It was certain that both the rival theories involved serious difficulties. What alone could offer a chance of clearing the question was a careful scrutiny on the spot of the recorded historical data in the light of topographical facts and of whatever definite antiquarian indications might be found there.

The search made by me with this object started towards the close of November in the vicinity of the town of Jhelum. Close examination of the ground to the east of the river conclusively proved that the battle with Poros could not possibly have been fought there as assumed by Abbott and Vincent Smith. Within 3 miles above the area opposite to the town, where according to their assumption the camp of the Indian army must have stood, there begins a series of marshy flood beds, which stretch right across the narrow riverine belt and with short interruptions extend for over 4 miles up the river. These beds of the Jabba, Bandar Kas, and Suketar Nullahs receive the drainage of numerous torrents descending from the Pabbi, Bhimbar, and Mirpur hills. They are from $\frac{1}{2}$ to over $1\frac{1}{2}$ miles in width where they pass across the riverine flat before joining the Jhelum. Quicksands remain in them even after the rains of the "hot weather" months have passed. During those months they are quite impassable whether on foot or horseback. A crossing can then be made only by keeping to the much broken ground at the foot of the hills to the east and by thus making great detours. The difficulties of this ground are well illustrated by the numerous and elaborately constructed bridgings and barrages over which the Upper Jhelum Canal taking off higher up the river had to be carried here.

It would have been an impossible proposition to take the large army of Poros with its chariots and elephants over such ground in the season of rains. It has proved equally certain in view of topographical facts clearly shown by the Survey of India's $\frac{1}{4}$-inch and larger scale maps that the limited width of the flat ground to be found beyond the marshy bed of the Suketar Nullah could nowhere suffice for a battle array such as Arrian records of the Indian army. This ground between the river bank and the broken foot of the hills is nowhere more than $3\frac{1}{2}$ miles across and farther up steadily narrows. Taking Arrian's detailed figures the front line of infantry alone, protected by 200 elephants at a distance of a plethron, or 101 English feet, from each other, would have



Eastern End of the Salt Range: Route of Alexander

stretched over close on 4 miles. The chariots and the 2000 Indian cavalry drawn up at each of the wings must have extended the line greatly. And in addition to this there would have to be allowed sufficient room for the out-flanking movement executed by Koinos's cavalry.

In view of such plain topographical facts there is no need to discuss at length other grave objections to the theory learnedly set forth by Mr. Vincent Smith. Such is the absence at Bhuna of anything in the shape of a "headland ascending from the bank of the river" or the fact that the distance from Jhelum to Bhuna is only about 10 miles instead of the $17\frac{1}{2}$ miles mentioned by Arrian between Alexander's camp and the headland. But a brief reference may be made to the improbability of the leader of an army relying largely on the use of elephants and chariots having chosen the narrow stretch of tolerably flat ground between the river's left bank and the broken hills and ravines of the Pabbi range at his back as the place where to meet a formidable invader.

The route leading from Taxila to Jhelum is the shortest in the direction of such old centres in the plains as Lahore and Sialkot, and its use is attested from mediaeval times onwards. But before the Grand Trunk Road was constructed it was by no means the easiest route. Of this I had occasion to convince myself on an interesting excursion I made from Jhelum along the old line of the route. This passes the great fortress of Rohtas, which the Emperor Sher Shah constructed in A.D. 1542–3 to guard the narrow exit from the Salt Range into the riverine plain, and thence ascends towards the Bakrala pass.

To the south of Rohtas a steep portion of the eastern branch of the Salt Range culminating in the sacred hill of Tilla bars convenient access to the Jhelum for about 20 miles. There is no regular route leading across it, and for the same distance the near approach of the Pabbi hills to the left bank of the river and the broken nature of the ground at their foot preclude the idea that the place of Alexander's crossing and the field of battle with Poros could possibly be looked for there.

It is quite different with that portion of the Salt Range which beyond the Tilla hills continues for a considerable distance westwards. There it is crossed by a succession of routes which an invader coming from the north-west could conveniently use to reach the Jhelum and the open plain beyond the river. Apart from the route descending to Jalalpur, the only one to which Cunningham and his critic make any reference, there are at least four routes practicable for laden animals, including camels, to be found in regular local use between the wide bed in which the Bunha river, usually dry, makes its way to the Jhelum above Darapur (near Dilawar), and the route descending past the coal mines of Dandot.

The last-named route was undoubtedly used by the Emperor Babur when coming from the Peshawar side in November 1519. He then made his first successful inroad into the Punjab across the Salt Range, moving past the lake of Kallar-kahar upon the town of Old Bhera on the right bank of the Jhelum. It is not necessary to concern ourselves with each of the other routes I have just referred to, though I have taken occasion to visit them in parts. For fortunately there is one among them to which historical notices of an invasion far older than that of Babur's were bound to attract my special attention from the start.

Muhammadan chronicles repeatedly mention the fort of Nandana and the

pass in the Salt Range guarded by it in connection with the campaigns of Mahmud of Ghazna, that early invader of India, and also with later events down to the thirteenth century. The merit of having first correctly located this place, examined its surviving remains and recognized the importance of the route passing it belongs to my friend Mr. W. S. Talbot, C.S.I., late of the Indian Civil Service. While in charge of the Jhelum District and in the course of the Settlement conducted by him there, he took a special interest in its antiquities and historical past. He found the name Nandana still attaching at the present time to a remarkable hill stronghold (see Plates 2 and 3) which completely closes a route leading down steeply from a plateau of the outer Salt Range to the village of Baghanwala and the open riverine plain beyond it.

Before I discuss the historical interest attaching to Nandana and the bearing of its position upon the question of Alexander's route to the Hydaspes and of his subsequent passage of the river, I may conveniently quote the brief but very apt description of the position from Mr. Talbot's 'Gazetteer of the Jhelum District' (p. 46): "About fourteen miles due east of Choa Saidan Shah, between the villages of Baghanwala and Ara above, the outer Salt Range makes a remarkable dip; the road over the hills winds up the face of a steep rocky hill, with perpendicular precipices at the sides; so that in former days the holder of this hill had the absolute command of what is one of the most obvious routes across the range."

Nandana is repeatedly referred to in the accounts of the successive invasions of the great conqueror Mahmud of Ghazna. The events in connection with which it is mentioned leave no doubt about its position and about its having been an important stronghold of the last rulers of the Hindu Shahiya dynasty after it had been forced to retreat to the extreme north-west of the Punjab from its former possessions to the west of the Indus. Here it will suffice to refer only to those mentions of Nandana which at present can be checked in critically made versions from contemporary sources as presented in Dr. Muhammad Nazim's 'Mahmud of Ghazna' (1931). Thus we are told of Sultan Mahmud having in the spring of A.D. 1014 "marched to Nandana which, situated on the northern spur of the Salt Range, commanded the main route into the Ganges Doab" (p. 91).

A subsequent account records in some detail the defence offered at Nandana by the Hindu king's son in the "strong position between two hills at the junction of which the fort was situated." It tells us how after prolonged fighting beyond the upper entrance of the pass the defenders were driven back into the fort, which was then besieged and ultimately taken by the Sultan. The importance attaching to the route thus opened is attested by the special mention made of the Muhammadan commander to whom Mahmud entrusted Nandana when he returned to Ghazna after having pursued the fugitive Hindu king into the mountains south of Kashmir (p. 93). An earlier notice relating to A.D. 991 gives Nandana as the name of a whole district adjacent to Jhelum, and thus helps to bring out the importance of the place and the route past it.

I shall further on briefly mention the interesting archaeological observations which our survey of the Nandana fort and its ancient remains yielded. But here I may turn at once to the very useful indications which this oldest of historically attested routes across the outer Salt Range affords as regards the

location of Alexander's camp on the Hydaspes and the place of his crossing the river. A look at the map will show that the road descending the pass of Nandana to the pleasant village of Baghanwala will, if continued south past its abundant orchards and across the gently sloping alluvial plain below them, bring us to the bank of the river close to the large village of Haranpur. Now, at a distance of about 17 miles measured from there along the main road towards Jhelum, we come to the small town of Jalalpur, occupying a position that corresponds in a very striking fashion to Arrian's and Curtius's description of Alexander's crossing-place.

The town of some three thousand inhabitants is built on rising ground at the foot of a small outlier of the range which close behind it rises to a triangulated height of 1833 feet, or a little over 1000 feet above the river-bed. Immediately to the east of it there lies the wide winding mouth of the Kandar Kas (see Plate 5), a torrent bed with sandy bottom descending from the range and joining the river. Within less than a mile there passes a northern branch of the Jhelum, carrying much water at the time of the summer floods and known as the Halkiwani Nala. Jalalpur marks the south-western corner of that projecting spur of the Salt Range which, as already mentioned above, is washed at its foot by the river for a distance of about 8 miles between Dilawar and Jalalpur. Nowhere else along its course after debouching from the mountains does the Jhelum touch ground which could possibly be described as a headland or promontory (ἄκρα).

The spur all along falls off very steeply to the river and is broken by many narrow ravines. Only at the mouths of the latter is there room for scanty fields cultivated by three small hamlets. The road to Jhelum town, which used to run along the very foot of the spur and is still marked in Survey maps down to 1921, has been so badly broken in places by recent floods that it had to be re-aligned with no small trouble across the difficult ridges and ravines farther up. It can be safely asserted from the appearance of the cliffs above the river that the course of the latter must in historical times have always set against the foot of the spur.

The consequent difficulty of maintaining communication along it deserves to be specially noted, for it precludes the idea that demonstrations by large numbers of troops, such as Arrian and Curtius relate to have been made from Alexander's camp, could have taken place here. Yet Cunningham's location of this camp at Jalalpur would presume this. In the same way it would have been impossible to find room here for the force under Meleager, which we are told was posted by Alexander halfway between his camp and his selected crossing-place, if these had really been at Jalalpur and Dilawar, respectively, as assumed by Cunningham.

At Jalalpur, on the other hand, all physical features are in closest agreement with the facts recorded about Alexander's place of crossing.* There is the

*See above, pp. 33 *sq.* This close agreement of the physical features had been correctly noted already by Sir Mountstuart Elphinstone, who reached Jalalpur in July 1809 on returning from Peshawar across the Salt Range. Referring to its hills he says: "They came to the edge of the river, which, being also divided by islands, presents exactly the appearance one expects from the accounts of the ancients. So precisely does Quintus Curtius's description of Poros's battle correspond with the part of the Hydaspes where

headland overlooking the river at a marked bend; there are still plenty of such trees and bushes as the arid climatic conditions of the present day permit of, growing on the slopes east of Jalalpur; there is the ravine of the Kandar Kas between Jalalpur town and the point where the spur turns off sharply from the river; and what deserves to be specially noted, there is a large island stretching down from opposite Jalalpur between the Halkiwani and the present main bed farther south.

The winding bed of the Kandar Kas is overlooked here on either side by bold hillocks rising up to 300 feet (see Plate 5). At its nearest bends there adjoin stretches of fairly level ground now under cultivation. Thus the bed corresponds exactly to the *praealta fossa* or deep ravine which Curtius mentions as lying not far from the river bank and "capable of hiding not only foot soldiers but also men with horses." There are large groves of trees and tamarisk bushes growing on the ground which separates the town from the river-bed and which would thus admirably serve to screen preparations for an intended crossing.

The Halkiwani bed was partially dry where we crossed it on November 26 close to the mouth of the Kandar Kas, and about 55 yards wide. But from the middle of April until August it carries a large volume of water and is then quite unfordable. For the last three years great floods had come down from Kashmir and the current had set increasingly towards Jalalpur. On the opposite bank we found the ground of the island uncultivated for over 500 yards and large trunks of timber left on it by the flood. The island is occupied by the hamlet of Admana and some scattered homesteads belonging to it. Its length is now approximately $4\frac{3}{4}$ miles and was slightly greater when the last survey was made, the 1-mile-to-the-inch map of 1911 showing it as $5\frac{1}{4}$ miles. Its maximum width is now about $1\frac{1}{2}$ miles. High tamarisk bushes cover a good deal of the ground left uncultivated, while a thick wood has grown up in a "Reserved Forest" area. About half of the island is included within the boundary of the Gujrat District to the south, which suggests that at a time not very distant the main bed of the river lay farther north.

But however this may be it is certain that the island as it exists now is by far the largest of any which survey maps show on the Jhelum within the whole length of its course that can come into consideration here. This point has also its interest. Though islands in a river like the Jhelum are liable to changes, yet the course of the river and the general character of its bed are not likely to have changed here greatly during the last two thousand years; for they are largely determined by such permanent geographical features as the Jalalpur hill spur and the high ground at the end of the Pabbi range facing it. And Curtius (VIII, 13) tells us of an "island larger than the rest, wooded and suitable for concealing an ambuscade."

If then we assume that in Alexander's time there lay close below Jalalpur an island much of the same type as the present island of Admana, it is easy to

we crossed that several gentlemen of the mission, who read the passage on the spot, were persuaded that it referred to the very place before their eyes." (Cf. Elphinstone, 'An Account of the Kingdom of Caubul and its Dependencies, in Persia, Tartary, and India,' revised edition, 1842, i, p. 108). Not in vain has it been said of that great administrator and student of geography that "he could look through the mountains."

follow the successive phases of the crossing as recorded by Arrian. Moving down the channel approximately corresponding to the present Halkiwani, the boats and rafts would carry Alexander's troops to the junction of that bed with another more southerly river branch. Then on being rowed across the united channel his rafts would let them land on what might well appear to them as the mainland on the river's left bank. In reality it proved another island "separated from the mainland by a branch of the river in which the water was shallow." Arrian's account brings vividly before us the most critical phase of the whole boldly conceived enterprise and how it was met by Alexander's unflinching determination and the wonderful pluck of his hard-tried Macedonians.

Our own experience helped curiously enough to illustrate this episode. We crossed the sandy main bed of the river from the point where the Halkiwani joins it and found it nearly a mile wide. But apart from large pools it held water only in one shallow channel about 250 yards across at the time. Then we passed for close on a mile over ground which had all the appearance of mainland, being in part treated as a "Reserved Forest" area, before we came unexpectedly upon a small channel with flowing water, only 50 yards across. Shallow at the time, it was said to be quite unfordable during the time of the summer floods. It had obviously formed since the last survey was made in this area some twenty years ago. Beyond it the fertile tract, now irrigated by the Lower Jhelum Canal, was entered near the village of Nurpur.

It is on this absolutely open and flat ground stretching south of the left bank of the river that we must assume the battle with Poros to have been fought. But it is quite impossible to determine the exact position of the battlefield. We have no definite indication as to the distance from the place of landing at which the main force of Poros was encountered, though Plutarch in his 'Life of Alexander' (Chap. lx) mentions that Alexander had ridden some 20 stadia ahead by the time he fell in with the small Indian force of horsemen and chariots first sent against him. Two points however must be noted. One is the perfect openness of this ground which allowed ample room for the extensive line in which Poros marshalled his army. The other is that room was left between its left wing and the river for Koinos's outflanking movement.

Now with regard to the latter point it is of interest to observe that the present river-bed beyond Nurpur makes a considerable bend to the north-west, the triangular stretch of ground having its apex near the small village of Sikandarpur. If this bend existed already in antiquity it would make it easy to understand why Poros did not rest his left flank on the river. For if his army started from a place somewhere opposite Haranpur where Alexander's camp may approximately be located, *i.e.* from some point near the present towns of Malakwal and Miani, the direct line for an advance to meet the landed Macedonians would, as the map shows, have kept the Indian army away from the river anywhere near that bend.

Since we cannot exactly locate the battlefield it is also impossible to indicate the site of Nikaia, the town which Alexander is said to have founded there to commemorate his victory. Along the river's left bank, below the point where it may be assumed to have been reached by Alexander crossing from Jalalpur, there are to be found now the large villages of Majhi, Haria, and Badshahpur. They are all built on mounds rising well above the alluvial plain and marking

prolonged occupation. But I found no definite indication which would justify even a tentative identification of any of them with the site of Nikaia.

As regards Boukephala, the town founded by Alexander on the right bank, we are in a better position. Since Strabo distinctly places it at the point where Alexander embarked for his passage, and Arrian's reference (see above, p. 35) is compatible with the same interpretation, we may safely locate it at Jalalpur.* In support of this it deserves to be noted that coins found at Jalalpur include issues of the Greek kings who ruled in parts of Afghanistan and the north-west of the Punjab. As already recorded by General Cunningham, the numismatic evidence afforded by these coins and the still more frequent ones dating from Indo-Scythian rule clearly proves occupation of the site during the centuries immediately before and after the Christian era.

There still remains to give a brief description of the route leading down from the Salt Range through the pass of Nandana and of the remains of the ancient stronghold, a true *chiusa*, which guarded it. This route starting from Ara may in view of the explanations given above well claim our interest as the main one that saw Alexander's columns descend to the bank of the Hydaspes. There the outer or southern one of the two more or less parallel chains of hills into which the highest portion of the Salt Range here as elsewhere is divided, dips down steeply towards the riverine plain.

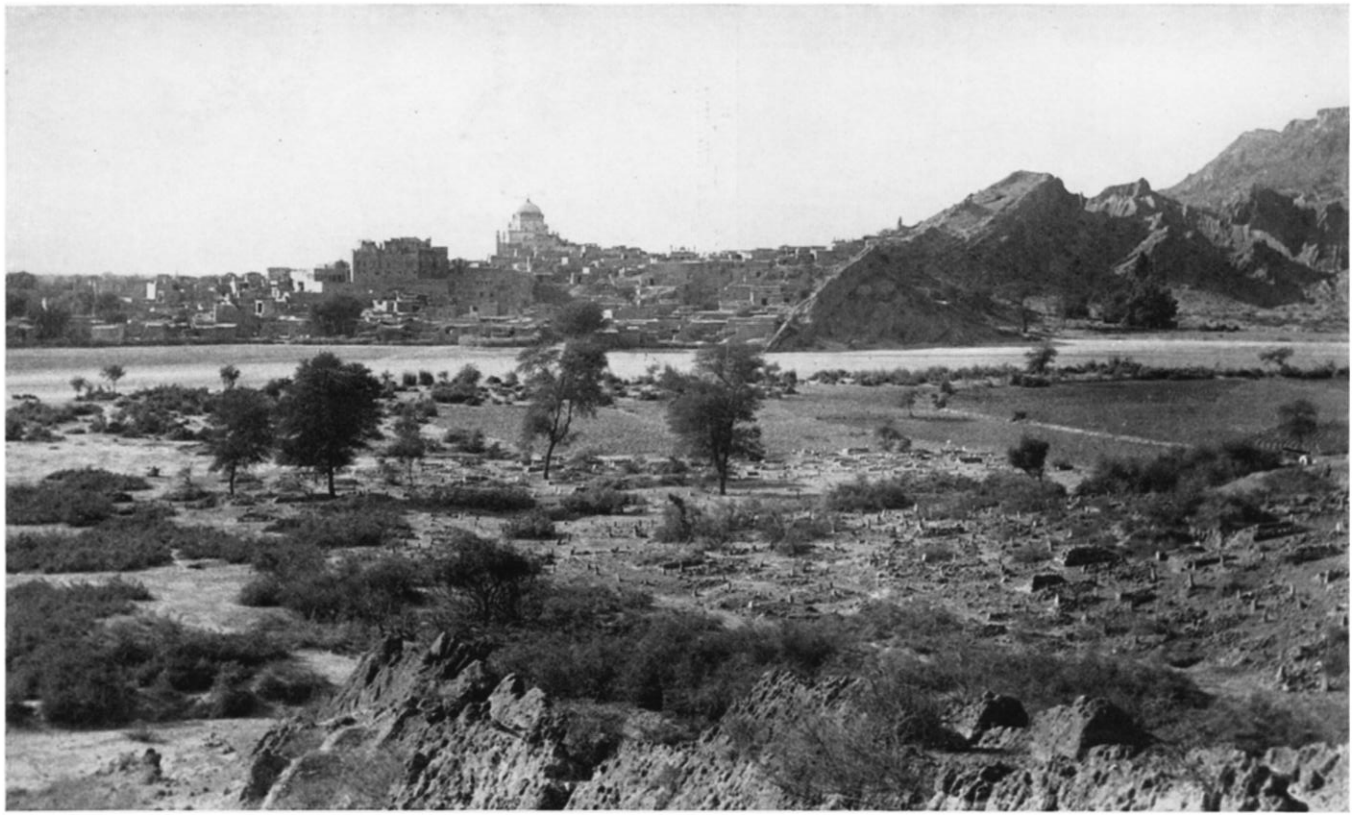
Between the two chains there extends a series of small open valleys fertile at their flat bottoms and situated at elevations between approximately 2000 and 3000 feet. Approach to them is easily gained by roads which traverse the broken, but all the same for the most part cultivated, plateaus stretching to the west of the Grand Trunk Road and the railway line between Taxila and the town of Jhelum. Five or six marches of ordinary length would suffice to cover the distance, approximately 80 miles in a straight line, but of course longer by road, between Taxila and Ara. Which of the several practicable routes between the two places Alexander's forces are likely to have followed, past Chakwal or Rawalpindi, Chauntra and Dhudial, and other places of larger size, we shall never know, since no definite indications are recorded.

Near the village of Ara an almost level plain, over 2 miles across and well provided with water, would have offered a very convenient camping-place for a force before starting on the descent to the river. It is here that we must assume, more than thirteen centuries after Alexander's passage, to have taken place that battle between Mahmud of Ghazna and the Hindu ruler which the Muhammadan chroniclers mention as having preceded the former's siege of the fortress of Nandana in A.D. 1014. From the elevated rim of the Ara plateau, at a height of about 2400 feet, a steep winding road leads down over the rocky scarp of the range for close on 2 miles to where a narrow depression at an average level of 1300 feet extends between two small valleys uniting farther south below the ruined stronghold of Nandana (see Plate 2).

*Already General Cunningham had rightly identified Boukephala with Jalalpur. But he apparently did not realize that by doing so and yet looking for the place of passage at Dilawar he came into direct conflict with Strabo's definite statement. We have here one of the instances where a kind of true antiquarian instinct led that distinguished first explorer of India's ancient sites to arrive at identifications which have proved right in spite of the inconclusive or otherwise defective arguments he advanced for them.

3. Ruined bastion at eastern end of fortified ridge, Nandana

4. Eroded hills above Kandar Kas bed



5. Jalalpur, from across the mouth of the Kandar Kas

The road so far, though very stony, is perfectly practicable for laden animals, including camels, even in the neglected state in which it has fallen since most of the local traffic from this part of the Salt Range to the river has been diverted to the Grand Trunk Road in the east and to the road practicable for carts between Chakwal and Pind Dadan Khan in the west. The road in a number of places shows distinct marks of having been cut into rocky ledges to secure a better gradient. Though perhaps not so well aligned, it reminded me of the ancient roads constructed in Buddhist times across the passes connecting Lower Swat with the Peshawar Valley.

Immediately above the depression just mentioned, forming a kind of natural fosse, there rises very abruptly a rocky ridge bearing on its top the ruined structures of Nandana and along its precipitous northern slopes the remains of a boldly built line of wall (see Plate 3). This fortified ridge completely bars further descent on the route; for the two small valleys already mentioned turn on either side of it into deep and extremely narrow gorges flanked for some distance by almost vertical rock walls, hundreds of feet high (see Plate 2). These gorges are completely commanded from the ridge and would allow of no passage even to men on foot as long as the ridge were defended. Nor could the heights towering above them be readily climbed and the ridge reached from them by arrows or similar missiles.

The wall running along the north face of the ridge for about 300 yards was very massively built with large uncut slabs of stone quarried on the spot. But owing to the steepness of the slope its foundations have given way over most of its length. But some circular bastions solidly built with slanting walls and large slabs of cut stone have stood their place in great strength and bear a look of considerable antiquity. The slopes below the top of the ridge and within the defences are covered with the debris of rough stone walls wherever there was room left for dwellings, and between them there passes the road across a shoulder of the ridge.

The highest portion of the ridge rises some 200 feet above the depression previously referred to. Its top bears the ruins of a Hindu temple (see Plate 2) and at its other end the remains of a large structure too badly injured for safe determination of its character (see Plate 3). The temple probably dates from the times of the Hindu Shahiyas, but the very high and massively built terraces on which these ruins rise are certainly of far greater antiquity.

The southern face of the ridge is for the most part lined by cliffs so steep as scarcely to need defences. But where the road winds down it in steep zigzags it is guarded by a very imposing round bastion built with large and carefully set slabs. About 500 feet below the top of the ridge the road thus defended reaches the valley bottom where the two spring-fed streams descending the gorges unite. The rivulet formed by them runs for half a mile in a picturesque narrow valley before it is caught at its mouth in small canals to carry its life-giving waters to the orchards and fields of the large village of Baghanwala. Appropriately called after its gardens, Baghanwala looks a veritable oasis at the otherwise arid foot of the frowning hill chain. It might have well provided a very suitable place of residence in times of peace for whoever held charge of Nandana, that ancient gate of the Salt Range.

Ten miles across the alluvial plain below Baghanwala bring us to that point

near the village of Haranpur where the Jhelum, flowing in a single well-defined bed, offers a particularly convenient crossing-place. This is proved also by the position of the bridge over which the Sindsagar branch of the North-Western Railway here passes the river. It is here that we may look for the place where Poros guarded the river passage and where Alexander's main camp stood facing that of his adversary.

I have already had occasion to point out that the road distance between Haranpur and Jalalpur corresponds exactly to the $17\frac{1}{2}$ miles recorded by Arrian between Alexander's camp and the place where his passage of the Hydaspes took place. It only remains to add that, as the map shows, the present road between the two places runs at such a distance from the river as would have effectively screened the final move of Alexander's force from the enemy's observation, a point specially mentioned by Arrian.

As I stood by the rocky brink of the range near the rest-house of Ara and let my eyes sweep down the defile of Nandana to the glittering line of the waters of the Hydaspes and across the vast fertile plain beyond it, I felt as if caught by the thoughts with which some of Alexander's brave war-hardened Macedonians might well have viewed this great vista. The mountains and deserts across which they had so valiantly fought their way under their young king over vast stretches of Asia, lay now behind them. But would not these interminable plains stretching away to the Ganges, inviting as all the riches and strange things there might appear to their incomparable leader, ultimately set a limit to the world conqueror's ambition and force him to give way before their longing to return to their distant homeland?

ALLEGED CHANGES IN THE CLIMATE OF SOUTHERN TURKISTAN: *A paper read at the Afternoon Meeting of the Society on 14 March 1932, by*

LIEUT.-COL. REGINALD C. F. SCHOMBERG, D.S.O.

THE aridity of the Tarim basin has been frequently discussed, and the following paper is based on a recent journey, in 1930–31, to the south and south-east of Chinese Turkistan. Conditions in this part of Central Asia have suggested to some geographers a certain abnormality in climate, and they have sought to prove that deserted cities, vanished rivers, and slowly drying lakes are due to a decrease in the water supply of the region.

Before proceeding further it may be well to state that all remarks in this paper refer to conditions in historical times, and it is difficult to understand how the supporters of the theories of climatic changes in this period can invoke the tectonic uplift of the Himalayas during post-glacial times, or connect the dwindling of the ice residue of the glacial period with the gradual disappearance of dead and fossil ice, and the consequent shrinkage of rivers.

The argument in this paper is that no such climatic changes have ever occurred, and that the state of southern Sinkiang gives no basis for the somewhat far-fetched arguments adduced, but is explainable by simple and natural causes. That Professor Penck, at the Society's centenary meetings, denied any such changes encourages the hope that the following observations made in 1930–31 may be of value.

The Tarim basin is a clumsy term, which might well be replaced by the word Kashgaria: but let it stand. Before proceeding farther a brief account of the Tarim basin is desirable. This basin lies between the southern slopes of the Tien Shan and the northern slopes of Kunlun, two ranges which have on these particular slopes a permanent defect in moisture, whether snow or rain, because the Himalayas in the south and the northern Tien Shan to the north impede very considerably the moisture-laden breezes from the Indian Ocean and Siberia respectively, thus limiting precipitation to local condensation for the most part. If this is realized, together with the equally important facts that the chief source of the rivers is the Pamirs and not these two mountain ranges, the problem becomes simple. The Kunlun snow supplies only two important agricultural tracts, Khotan and Keriya, and the Tien Shan only one, Kucha. The belt of cultivation from Qarghaliq westwards *via* Yarkand and Kashgar to Aqsu draws its water from outside the Tarim basin proper; and there is no evidence whatever that there has been a progressive shrinkage of these rivers.

There are three river systems south of the Tien Shan: (1) The Tarim and its tributaries which provide the bulk of the water and drain the area from Qarghaliq to Kurla; (2) the Charchan, in the south-east; (3) the Konche, which, though flowing into the Tarim and exercising a profound influence on the drainage of the basin, rises in the Yulduz valley and is free from any climatic influences of southern Turkistan.

The arguments brought up to support the theory of diminishing water supply are: (1) the drying up of Lop Nor; (2) the disappearance of the Keriya river; (3) the general changes in riverine condition in the south-east; (4) the

evidence of dead forest, dead reed, ruined cities and abandoned towns, derelict cultivation, and, in brief, many signs of lack of water all eloquent of a drier climate.

Now, if all these were really proofs that the climate was becoming more arid, they would only show that certain parts of the Tarim basin, and that not merely the smaller part but the most inaccessible and unattractive part, had been so affected. At the most it would be found that certain rivers have dried up: a very different matter from proving that the whole area had suffered a

Sketch-map of part of Chinese Turkistan

climatic change, and surely an inadequate foundation on which to raise the theory of the impetus of nations. Before dealing with the above arguments it is suggested that some easily explained causes of desiccation be mentioned and also two main characteristics of the Tarim basin.

In a previous paper it was remarked how the great mass of sand that perhaps formed the Taklamakan enabled rivers to wander uncontrolled, and how the rivers themselves were exposed to influences that militated against permanency in their courses. The argument from old sites is far from convincing, and may be most fallacious. Sites are abandoned for many reasons:

(1) disease; (2) war or rebellion, of which many examples are found north of the Tien Shan, especially on the main road from Manass to Ili, and where there has been usually no attempt at re-settlement; (3) excess of water, *e.g.* Qaraqum, south of Kurla; (4) salt in the soil; (5) dispersion, failure, or disappearance of the water, more frequently due to artificial causes than to natural; (6) better land available elsewhere; (7) sand; (8) squatting.

This last is particularly prevalent nowadays, as under present regulations a peasant opening new land is given free seed and pays no taxes for three years; and thus there is a regular practice of squatting on land and at the end of every triennial period moving elsewhere. In a land where building costs almost nothing, and land and wood are free, abandoned houses exist everywhere: so much so that it is easier to build a new house than to repair the old. Settlements are moved also because they are inconvenient. For instance, the people moved from old Domoko in the Khotan district about 120 years ago because the present site of new Domoko proved more convenient. As an old man at Domoko said to me, "We know more than we did then in the old days," referring to irrigation, shelter, soil, and the like.

It is always argued that old sites are farther from the mountains than present ones (cf. old and new Domoko), and consequently that the rivers flow less far than of yore. Yet as a general rule modern sites are far more extensive than the present settlements, and we must bear in mind that without irrigation cultivation in the Tarim basin is not possible, and the maximum is gained close to the skirt of the foothills where sub-surface water wells up.

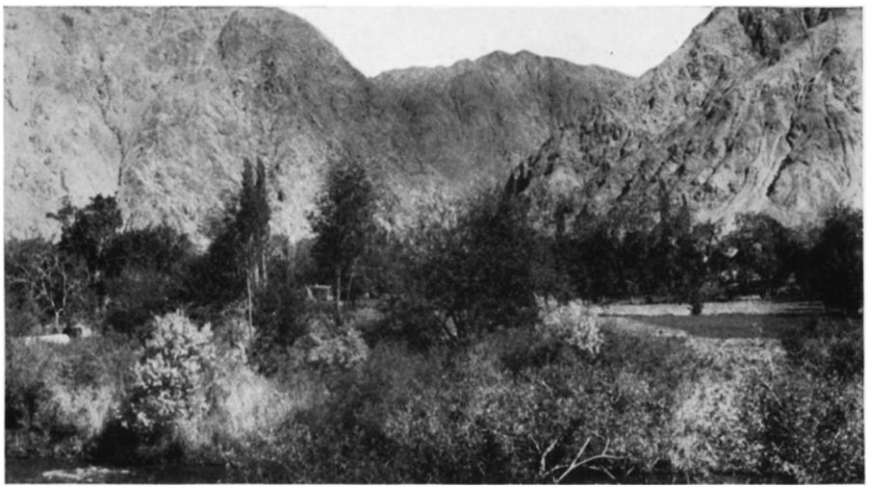
Another example is that of old Niya. The Niya river supports a flourishing population 60 miles to the south of the old town and near its place of issue from the hills, and the river still flows within 10 miles of the old site, being towards the end considerably canalized. At times however, owing to inadequate snow in the mountains, the river fails to get so far, but there is never a shortage at New Niya, though there may be farther down, and this points to a leakage and loss of water between the two sites. Thus a defective snowfall would prevent cultivation at old Niya but would be enough for the new settlement, and the water supply of the Niya river proves that not a regular but only an occasional defect takes place. It is interesting to note that after old Niya was abandoned there was an interval of many years before the modern town was established, which for many years was a Waqf or charitable endowment for the renowned shrine of Imam Ja'far Sadiq, south of the old town. Why old Niya was abandoned I do not know; but it is absurd to pretend that climatic changes were the cause when at the latter part of the last century the present town was formed. It may have been loss of water, certainly not defect in water.

It is worth noting that the cultivators at the Niya river end complain that a very heavy snowfall prevents the water from reaching them, as the flooded stream breaks down the banks at Toghrasu, 30 miles north of modern Niya, and inundates the country. Signs of such an overflow were very evident in 1931. The people say that they at once go to repair the damage and to coax the river back into its normal channel, but while they are doing this their crops perish from lack of water, as the flooding naturally occurs at the hottest time of the year. Of course the present settlement must affect the supply to the fields at the end of the river. After examining carefully the Niya river I could

Cultivation and houses destroyed by sand at Tashmalik, near Kashgar

Keriya River, east of Tashkalik Chap

Yartungaz or Aqtash River, March 1931



Gorge of the Konche River, between Qara Shahr and Kurla

Junction of Konche and Tarim rivers

Bed of the Tarim River, Lop district, April 1931

find no evidence of climatic change, but considered the behaviour of the river in every way normal.

Another reason why sites in Turkistan are brought nearer the hills is that the people are less pastoral and more agricultural. The ends of rivers in that country are a delta of reed and brushwood, affording admirable grazing grounds, and to this day are so exploited, though in many cases suitable riverine pastures are almost deserted, which in old times carried many flocks, as at Endere.

It is doubtful if old sites prove anything in Kashgaria always excepting difficulties of culture. All the large towns are situated where canalization is possible and the Yarkand, Tarim, Kashgar, and other rivers roll to their death without a single town on their banks, and well-nigh ignorant of mankind. Sometimes, as in the case of Loulan, a town has been abandoned because a river has changed its course, though here again the river is flowing in its former bed; but as a general rule towns in Turkistan are independent of the vagaries of rivers, and the few abandoned sites that have been made to prove so much are the exception. Small isolated settlements, especially if endowed with Buddhist remains, *e.g.* Rawak, near Khotan, have been chosen rather for religious isolation than utilitarian purposes, and undoubtedly in some cases have been abandoned because the water failed.

Mr. P. S. Nazaroff, a capable Russian geologist, well acquainted with Central Asia, and now in Africa, has dealt very curtly with the abandoned sites of Turkistan. He says: "The ancient cities and civilizations of Serindia perished from the destruction of their irrigation system in war" (*Blackwood's Magazine*, June 1931, p. 790, column 2).

The face of Chinese Turkistan is littered with ruined and abandoned settlements, but in a country with a small population compared with the land available there is no incentive to combat the onslaught of nature. It is easier to yield and go elsewhere. If, as at Tashmalik, near Kashgar, a sandstorm destroys the fields and smothers the houses; or if another village taps the water supply; or if the land turns sour from too much salt in the water; or if news comes of better land close at hand; or if a garrison of soldiers is established, the remedy for all these worries is to clear out. It costs nothing, there is no one to prevent it, and so it happens. Thus it is not too much to say that abandoned sites prove next to nothing and seldom what they appear to prove from a casual survey.

Having dealt with the arguments deduced from old settlements, it is well to proceed to other factors that interfere with or menace the water supply of the country. The various "köls," or lagoons, of Turkistan have been ignored as to their influence on the geography of the Tarim basin. The köls are large pans formed either by the overflow of a river or by a change in a river's course. In the former case the river breaks its banks, floods an area, and forms a large shallow lake which persistently draws from the parent stream a large volume of water until the river subsides, when the channel between the river and the lagoon silts up and there is no flow of water except by seepage for perhaps many years.

This was the case of the so-called Lop river (really the Charchan) when in 1930 the river failed to reach the hamlet of Lop, 31 miles north of Charkhliq;

it was said that the whole river turns into a large lagoon west of a line Charkhliq–Lop-ortang, and only when this is filled and the river has parted with the majority of its flow does it resume its channel. If it is asked why the lagoon does not receive merely the surplus water, leaving the normal stream to its appointed course, the answer is that the lagoon is at a lower level than the river, and the increased flow thus diverted from its proper channel causes the latter to be filled up. The above-mentioned case of old Niya shows the damage that this process can cause.

When these lagoons are formed by changes in a river-bed (a regular but less frequent cause than by overflow) two sets of köls are formed. One köl is the old river-bed which becomes a backwater, usually of little breadth, with a tendency to decrease by evaporation and filling up as the steep banks fall in. The second series is caused by the river being unable to carve out its new course quickly enough, so that it overflows and forms new lagoons.

The general influence of these lagoons in the life of the country is considerable. They tend to form smaller subsidiary lagoons, resulting in a dissemination of moisture over a large and often desert area, enabling reed, brushwood, and trees to grow, and adding to the available pasture. At times these lagoons go quite dry, but they are generally damp enough to support acres of reed which present a remarkable prospect like some field of giant corn, swaying rhythmically in the wind, a beautiful sight with the yellow or green sweeping the blue horizon. Old köls are nearly always brackish: new ones are fresh, so that it is easy to distinguish one from the other. Lagoons which are formed by a perennial stream must be excepted from this category. The influence of these pans on the river system is noteworthy, as they are liable to deprive the feeder-river of its flow, curtail its length, and, if not detected, lead to erroneous theories as to the behaviour of the stream.

A reference to the Khotan river will throw some light on the river system that is derived from the snows of the Kunlun. This stream, formed north of the city of Khotan by the confluence of the Yurungqash and Qaraqash rivers, flows due north into the Tarim or Yarkand, but it is by no means a perennial stream, and ceases to flow from October to March inclusive. It is then quite dry beyond the Mazar Tagh ridge, and frequently above it, and the only water found in its bed is in pools close to the bank, where it is frozen hard and so preserved from evaporation.

Of the river's two tributaries, the Qaraqash dries up at the end of autumn, so far as its flow into the Khotan river is concerned. The Yurungqash river provides the water that reaches, and then very precariously, the Mazar Tagh. The difference between these two rivers is caused by the Qaraqash supplying a much larger irrigated area than its neighbour; as its water diminishes, the cultivator takes off for his own use the whole amount.

The Khotan river is thus a purely regional stream, and would never be anything else even if it received the entire flow of its two affluents, which would be unable to furnish a sufficiently strong or abundant current to reach the Tarim. The Khotan river thus exercises little influence on the Taklamakan through which it flows, and hardly anywhere is the riparian vegetation—chiefly reed and thorn with some toghraqs (*populus balsamifera*)—more than 2 or 3 miles in depth: indeed in some places the desert extends along the very

verge of the river bank. The seasonal flow however when the melting snows provide a large surplus of water, even after agricultural needs have been met, is very strong, as is shown by the curious delta at the end of the river. The old river-bed on the east is a broad, desolate, arid channel, filled with hummocks of sand piled up by the wind and bordered with fine toghraqs. No water has flowed, not even a small surplus from the main stream, since 1921, and the old bed is so silted up that even a considerable flood would be impeded in its efforts to enter the old channel.

When, in course of time, cultivation is extended in the Khotan district, there is every likelihood that this river will never, except in years of exceptional snowfall, flow throughout its present course. If it does not so flow for one season its bed will be so affected by aerial action that it will probably furrow a new course in the yielding desert—a much easier task than flowing over sand-dunes.

The reason why the Quruq Darya at Yingpan has again, after a thousand years, become a living stream is that the amount of water far exceeds that which the Khotan could ever conceivably carry.

The Keriya river, which once flowed into the Tarim across the desert, parallel to and east of the Khotan river, provides a constant subject for discussion. How often and how abundantly it flowed is not known. But one thing is certain. The abundant water east of Keriya shows no sign of local desiccation. Beyond Niya the country is dreary in the extreme, but certainly not arid, with its luxuriant reed grazing extending many miles to the north, and enabling the road to Charchan never to traverse the desert. To the south the peneplain is dry and barren, but the water-level is not very deep, and the supply good. From experience it was found that at 3 or 4 feet a newly dug well yielded rapidly a copious flow, and digging such wells satisfied the requirements of a party of ten men and twenty animals. The vegetation was universally abundant, and besides reed, there were tamarisk, toghraq, sarigh buya (*sophora* sp.), and thorns.

To continue the description of the country east of the Keriya river: it was found that the Yartungaz and Endere rivers were considerable streams even during the winter, when springs were frozen and the water supply is at the lowest. The Endere in particular was most impressive, flowing in a bed 80 to 120 yards wide, between cliffs 40 to 50 feet high, at the base of which were frequent springs. At the end of this river is a settlement of two hundred families, whilst at the end of the Yartungaz the houses only number fifty. The truth is that there is no inducement to settle in such out-of-the-way places when there is plenty of more convenient land available, and many well-off farmers have left Endere for this reason. Cultivation higher up the courses of these rivers, especially in the case of the Endere, is not possible as the rivers are too deep for irrigation. Both these rivers provide pasture for many sheep.

The above account of the country east of the Keriya river should be borne in mind when the present state of that river is further discussed.

The Charchan river is remarkable as having a basin of its own, a definite course, and an interesting end in Lop Nor, and is distinct from all other river systems of southern Sinkiang. It was a fine stream, even in March, 1931, and that it had suffered no defect in supply was evident from the abundant lagoons

on both sides. The Chong Köl, in particular, was a very large lagoon full of water, and the lesser lagoons showed that they were regularly supplied with water. The Charchan receives hardly any water from its tributaries to the east, for they flow but occasionally when some rainstorm in the hills or the melting of the scanty snow fills them. Still less are the lagoons filled to the river. The river has low banks and irrigation is possible. Indeed, the settlement of Charchan is growing rapidly, and immigrants are attracted by the good land and abundant water.

Although the Toghraq, or Desert poplar, was discussed in a previous paper, it is so constantly invoked in favour of the desiccation theory that a further reference may be pardoned. The more this truly remarkable tree is studied, the more difficult it is to discuss the causes of its growth to maturity and its death, and consequently the more hazardous it is to base any arguments on its condition. There is one thing certain. Dead toghraqs do not imply necessarily a lack of water. They may do so, they often do; but again, toghraqs are found alive where unquestionably there is no water. The explanation escapes me, though the facts are evident enough, and an investigation into the life habits of this tree, and the possibility of its introduction into other countries, would be of great value.

The following examples of its vagaries amplify these remarks. On the Yurungqash, between the Eghriyar and the Qoshlash langars, was a low ridge of sand, on which were dead, dying, and living toghraqs. There were dead toghraqs with living tamarisks growing by them, and the proximity of the Momen Köl assured enough moisture. Near Atbash, on the left of the Khotan river, about 18 miles north of the Mazar Tagh, there was a forest of dead toghraqs which have not been smothered by sand, as they were growing on the top of dunes. The water was close by, and there were no signs of flooding. Five miles from the left bank of the Tarim river, between Kunchuk oldi ("the dead bitch") and Rahman Köl, is a large forest of dead toghraqs which have a curiously whitish appearance that distinguishes them from trees which have merely lost their leaves. Although 5 miles from water, of which these particular trees need little, tamarisk, saxaul, and sophora were growing, and the neighbouring plain, equally remote from the river, carried numerous though scattered living trees. Many other instances could be given of the death of toghraqs for no apparent reason. There is a Turki saying, not unlike ours of the oak, that toghraqs take a thousand years to grow, and a thousand years to die.

I would hazard, though very dubiously and reluctantly, a few suggestions as to why these trees die. To begin with, toghraqs dislike salt efflorescence, which is often due to excess water. Secondly, the tamarisk by its rapid growth absorbs the scanty water supply, and thus kills the adjacent poplar. Dead toghraqs and living tamarisk are frequently neighbours. Third, maybe subsoil changes in the water supply, too much or too little; fourth, disease; fifth, human agency. So far the last has had but little effect on the trees, but it is increasing. Poplars are often killed by the shepherds burning off the old reed to hasten the growth of the new. Undoubtedly dead toghraqs often denote lack of water; equally they often do not. The point to bear in mind is that the state of these trees really proves nothing, and as an argument it is worthless.

This recent journey round the Tarim basin enabled me to realize still more the singularly erratic behaviour of the Tarim and Yangi rivers, but it is not necessary again to discuss this as it was dealt with in a previous paper.

It is now appropriate to deal with the questions mentioned earlier in this paper, questions which are the very life-blood of the theory that Chinese Turkistan is drying up.

Lop Nor is not drying up. I was prevented, owing to political disturbances, from reaching the lake itself, but a casual visit would have proved nothing, as examination of the sources of supply is the more desirable. The Quruq river, flowing by Yingpan and Loulan, was the chief feeder of the lake. When it changed its course and its waters amalgamated with those of the Tarim, Lop Nor did not receive the same share as before. This was because, although the Tarim did and does feed Lop Nor, the intake of the lagoon was diminished because (*a*) the water reached the west of the lake and failed to reach the part which the Quruq river supplied; (*b*) cultivated areas increased and so the supply available for the lake correspondingly decreased; (*c*) extensive lagoons east of a line north and south through Shahyar absorbed much water. In other words, Lop Nor after the defection of the Quruq received a part of that river's water *via* the Tarim, and the normal supply from the Charchan river. The lake thus decreased by the difference between the whole of the Quruq Darya and the proportion that reached it through the Tarim. Climatic influences did not enter at all into the matter.

What is now happening is that in 1931 the Tarim river had lost its fortuitous increase of water which came when the Quruq changed its bed, because that river has returned to its old channel, and is reported to reach Lop Nor in 1932. If this happens Lop Nor will receive its former quota of water. The point to bear in mind, and which seems to dispose of this lake as a factor in the desiccation theory, is that the waxing and waning of Lop Nor have nothing whatever to do, and never could have had, with its three constant sources of supply—the Charchan, Konche, and Tarim rivers. As these have never decreased in volume, and as the lake is only fed by them, how can any alteration in it be due to climatic changes?

I do not believe that the Keriya was ever a perennial river, and the analogy of the Khotan river encourages me to this conclusion regarding a much smaller stream. It flowed for a time, and then dried up, perhaps again flowing in periods of flood. The toghraqs at its northern end are nourished by the seepage from the Tarim river. It has been shown that the rivers and country to the east of the Keriya river show no signs of aridity, and it is difficult to regard the isolated case of this river, which now supplies a large arable district and thus diminishes its available flow north, as a serious contribution to the argument. Its decrease would at the most only afford evidence for a local climatic change, and that hardly a convincing one. So long as its neighbours in the west, and more so those on its east, flow with undiminished vigour, the Keriya river seems to me to prove nothing. Surely the failure of one river is not to be adduced as the proof that a vast area has suffered a climatic change.

There is next the argument of general changes, *i.e.* a diminution in the volume of the rivers of the south-east Tarim basin, but what is produced to support this? The lack of population seems to have provoked this very con-

venient theory, but at no time, past or present, have settlements in that region been other than scanty, sporadic, and insecure. It may have been the old silk route, but where are the settlements along it? Few and scattered are the remains. The reason why south-east Turkistan has been left alone is not lack of water or poorness of the soil, but a lack of amenities. Burans or dust-storms are unusually frequent, insect pests are notorious, the winters are colder and the summers hotter than elsewhere, the sand makes communication difficult, there is ample land in more favoured neighbourhoods, so there is no inducement to settle down in this dreary quarter. In spite of its remoteness, Charchan, Charkhliq, and Vash-shahri are increasing as pressure of population drives out the enterprising and energetic peasants from older settlements. There is nothing, then, in the south-east area of the province to help the desiccation theory.

The evidence of dead vegetation has been dealt with, and generally such evidence seems inconclusive.

It can hardly be hoped that the above remarks will lay, for good and all, the ghost of the desiccation theory, on which arguments and theses of a far-reaching nature have been founded. This ghost still haunts the geographical discussions of Chinese Central Asia and its phantom shrieks have driven off much valuable observation. It has even been alleged that the climatic changes of southern Sinkiang have affected or indeed caused the great human migrations of Central Asia. Both premise and hypothesis seem fantastic. So far as migrations go, if the whole of Turkistan had become as dry as its great desert, the result to mankind would have been quite insignificant.

This country has been called the land of withering rivers, a picturesque but wholly mistaken piece of imagery. There is only one river that is withering, and that is the southern reaches of the Tarim river, because it has had to give up the water that once flowed by the town of Loulan, itself often invoked by the aridity theorists. The rivers of Turkistan are fickle and untrustworthy, two Turki characteristics, but they are not withering. It is likely enough that the Yangi river will, by some caprice, return a second time to the Tarim. It certainly will if the cultivators in the lands of the lower Tarim prevail in the courts of heaven which they are deafening with their appeals for water for the ever-withering fields, just as doubtless a thousand years ago the folk of Loulan prayed for the return of their river.

DISCUSSION

Before the paper the PRESIDENT (Admiral Sir WILLIAM GOODENOUGH) said: Colonel Schomberg spoke to us more than a fortnight ago at an Evening Meeting about his travels in the Far East, and this afternoon he will speak to us of the climate there.

Colonel Schomberg then read the paper printed above, and a discussion followed.

Sir FRANCIS YOUNGHUSBAND: I have not really made a study of this subject, although it is a most interesting one, in spite of what the lecturer has said as regards its dryness. The problem is whether the rivers in Turkistan really do dry up and general desiccation takes place. But all I can say to you this afternoon will be merely observations that occurred to me in the course of the lecture.

Colonel Schomberg seems to be pretty certain that there is not a general

desiccation of that part of Central Asia, but I am wondering whether, although there may not be a steady desiccation going on, as it were, in a straight line, beginning with a very wet period and ending with an extremely dry one, there may not have been fluctuations—whether what is going on in Central Asia is not a fluctuation of dryness and wetness, and whether that may not have been caused by the advance or retreat of the glaciers in the Kunlun range south of Chinese Turkistan. I think all the rivers with which the lecturer dealt were running down from the Kunlun range, and I can recall that Dr. Emil Trinkler, a traveller who lectured to this Society, went up to the Kunlun range for the purpose of studying whether the glaciers were advancing or retreating. The advance or retreat, the diminution or augmentation of the glaciers, would account for the fluctuation in the amount of water in the rivers which come down from the range. Perhaps there may be a fluctuation extending over a period of ten to twenty years. That glaciers do vary is confirmed by one's experience in the Himalaya, the glaciers there advancing and retreating to a considerable extent within our knowledge. I have on various visits seen great fluctuations in the glaciers there; it may be the same in the case of the Kunlun range. It may have been going on for thousands of years and during recent historical times. That may be one cause of the fluctuation in the amount of water in the rivers.

Then, of course, there is the sand problem. The sand, while not retiring, very often advances in strange places; that may also have some effect in damming up the course of a river and turning it off into another direction. That is a point which the lecturer, in his full paper, has taken into consideration. In his recent lecture before the Society Colonel Schomberg cited the case of the forests being attacked, as he thought, by some insect pests which caused their destruction. That may have an effect also on the water supply. Then of course there may be fluctuations of population due to disease, or to war; that may also be a cause of the disappearance of cities.

The above are just a few points that struck me as I listened to the lecture. I think the point about glaciers is one that should be taken into careful consideration.

Major L. V. S. BLACKER: Colonel Schomberg has opened the door to a most interesting subject and one which consideration will show must have had a vital fundamental effect on the history of the movements of the population of the Old World through a number of centuries past. Before going further I venture to make a small contribution to the evidence on the subject, and that is that I observed some years ago coniferous trees in a valley called Bulun between Pokhpu and the Kunlun in a position which is, I think, considerably farther east than they have been observed before, north of the Himalayan axis.

I think that if one looks at the Old World generally one will observe a dry belt running obliquely roughly from north-east to south-west. In the extreme north-east is Outer Mongolia and the Gobi. Tracing it farther along you come to the Taklamakan desert, with which Colonel Schomberg has been dealing; and, still farther, the Qizil Qum, Qara Qum, and Golodni Step of Western Turkistan; and then the arid areas of Baluchistan, South Afghanistan, Persia, 'Iraq, Arabia, Sinai, the Sudan, the Western Sahara right into the Atlantic at Rio de Oro, a vast belt stretching right across two continents which it is impossible to match anywhere else in the world. There is little doubt that the dryness or wetness of the belt as a whole must have been altering during the last few hundred years. There are a number of phenomena for which it would otherwise be impossible to account. It is more than possible that the lowest point, the Nadir of desiccation, had been reached some little time ago in the Taklamakan, and we hear to-day that the humidity of the climate is now on the upward trend. I think Dr. Roy

Chapman Andrews described in Outer Mongolia a spring growth of green grass, something quite different from the scenery of which previous travellers in the last century or the century before gave one any conception.

Another point that has to be accounted for is the change in the course of the Oxus from the Caspian to the Sea of Aral, which I believe is about 150 to 200 years old. Further, there is the decay of the rich and prosperous cities of Maverunnahr and Khorezm, at the present moment sites in the country where the wells are 700 and 800 feet deep. I refer to the deserts south of Merv between Charjui and the Afghan border. I was fortunate enough in 1920 to see the remains of what must have been a section of the Golden Road between Meshed and Samarqand; that ran through what is now completely uninhabited dried-up salt-encrusted country which must in the old days have borne some vegetation and population.

Again, in Persia there is much evidence in all parts to show that a change of some sort has taken place. In Baluchistan you have, no doubt, evidence from the pages of Arrian to the effect that the Hanna valley was thickly grown over with jungle where the country is now almost waterless; water has been introduced artificially. Five hundred years ago the Emperor Akbar shot rhinoceros in the Yusafzai valley. It is difficult to find rhinoceros there now. Farther southwards and westwards you come to a country once called *Arabia Felix*, a designation hardly appropriate in view of its present state; but even here Bertram Thomas has recently described the fertility in the coastal belt, along what is, in effect, the eastern or southern edge of the great belt.

I suggest with diffidence the possibility that this dry belt is moving, and that the Taklamakan and Qizil Qum mark the eastern confines of it. Lop Nor and Keriya are now benefiting by the swing of the pendulum; the dryness is moving to the south and to the west, whilst the vegetation, which brings with it rainfall, is coming in from the east. Also, it should not be forgotten that during the last half-dozen years the Indian monsoon has regularly crossed the dry belt of the North Punjab to the Peshawar valley.

Another explanation of this cycle of cause and effect is the fact of the growth of Islam which being in its early days a non-materialistic creed undoubtedly led to deforestation, and deforestation possibly led to the diminution of rainfall and the ensuing vicious circle of denudation and destruction of vegetation and movements of population.

Mr. L. C. W. BONACINA: I cannot speak from any personal knowledge, but I would like to say that I have enough faith in the general stability of the climate over long periods to think that Colonel Schomberg is on the right lines in refusing to invoke the aid of climatic change to explain phenomena that can be explained by other factors. And yet there is something to be said for the other side. The evidence is steadily accumulating that climate is really made up of very irregular see-saw fluctuations from one century to another, which may have very important effects—rather longer fluctuations than Sir Francis Younghusband, I think, had in mind. In fact, so much evidence is accumulating to that effect that statistical meteorologists are losing their most cherished possession, that is to say, their standard averages or normals. These really do not exist to-day, and meteorologists are finding themselves in a somewhat awkward predicament, since there is no guarantee that a fifty-years' rainfall average in one century will be the same as that in another. I think there is evidence that the Caspian Sea has gone through many changes of level from century to century, and its last high phase was in the sixteenth and seventeenth centuries. Surely that points to an increase of rainfall in that period which was likely to have been pretty general over Asia. Supposing the rainfall at that period in the dry Tarim basin—where the rainfall is now only

a few inches a year—were 50 per cent. higher; though that is not much in actual quantity of water, the effect is likely to have been magnified on those Pamir mountains where the snow comes down, which is the source of most of the rivers which Colonel Schomberg has been speaking about.

Therefore the conclusion I have come to is that Colonel Schomberg is right as far as he goes, but that he should allow for the possibility of collateral effects due to the probability of the century-wide fluctuations in question.

The PRESIDENT: Colonel Schomberg, I would like to ask you a question which you can answer "Yes" or "No" to, and that is, whether you think the advance of the peak of the glaciers necessarily means fluctuation in the rivers. Perhaps you would like to answer that question now.

Colonel SCHOMBERG: No, I would not like to answer it!

The PRESIDENT: There are many others we would like to have heard to-night—Sir Aurel Stein, Mons. de Margerie, and others—and it is quite possible that on some future occasion we may be able to hear them. There is one we cannot hear, that is the traveller mentioned by Sir Francis Younghusband, Emil Trinkler. He was killed a year ago in a motor accident; a very great loss to science. He was thirty-five years of age and a man who had a power of thought and research which is not given to everybody.

As I have nothing original to add to this most interesting and, indeed, important business I would like, with your permission, to read from the Appendix of Trinkler's book entitled 'The Storm-swept Roof of Asia.' He says: "Much has been written on the subject of the desiccation of Central Asia. There can be no doubt that some two thousand years ago several of the rivers coming down from the high mountains fringing the Tarim basin penetrated farther into the desert. The Niya river was about 70 miles longer, and the Keriya, which is now gradually drying up in the sands, very probably at one time reached the Tarim basin. What was the cause of the decrease in the volume of water which used to flow in these rivers? The best answer to give is that we do not yet know. It will only be possible, with very exact observations covering long periods of time, for us in the future to state whether there has been any substantial decrease in the rainfall or in the size of the glaciers." And a little farther on he says: "The theory has been advanced that, some three thousand years ago, there was still ice left from the last glacial period, especially on the high plateaux and mountain ranges bordering the Tarim basin, and that these ice reserves have now melted. This theory, which has been put forward by Burrard and Rickmers, and which has also been accepted by Sir Aurel Stein, certainly deserves careful consideration. . . . There is no doubt that the desiccation of Central Asia is one of the most difficult problems that awaits solution in this part of the world."

Colonel Schomberg spoke of Mr. Nazaroff, and what Mr. Nazaroff said was: "The ancient cities and civilizations of Serindia perished from the destruction of their irrigation system in war." I happened to ask Sir Aurel Stein about that, but I did not use the word "war." I said I had been informed—for my knowledge in these matters is negligible—that it was possible that the water had been cut off by "political action," and there was no doubt about Sir Aurel Stein's reply, for he said: "If anybody told you that, my dear Admiral, he told you wrong," and there was an end of it.

You have opened a very important and interesting subject, Colonel Schomberg, and I ask you, on behalf of this audience and also of all the members of the Royal Geographical Society, who read your articles with great interest, to accept our very best thanks for the care and trouble which you have taken on this and many other occasions.

Professor LYDE, *who was unable to be present, writes:* Colonel Schomberg's treatment of the so-called "evidence" from dead forests and reed-beds and derelict towns and fields seems to me quite admirable. I traced that upstream movement in Western Turkistan forty years ago. There might be political ends in view, but everywhere—*e.g.* along the Kopet Dagh as well as the Hindu Kush—there was an economic retreat upstream for the reasons he gives, *e.g.* excess of water breaching the river-bank higher up, or irrigators there extending their tillage, or the downstream people themselves tending to agriculture and needing six or seven times as much water as before.

The statement that "the chief source of the rivers is the Pamirs" seems an error. The Pamir eastward drainage is almost negligible; even the Tagldumbush "Pamir" does not get its water mainly from the Sarikol. The overwhelming proportion of the Yarkand (Rastram) supply comes from east of the Shimshal Pass; you can call it Karakoram or Kunlun, but not Pamir! So, too, the overwhelming proportion of the Kashgar (Qizil) comes from east of the Qizil Art, *i.e.* from the Trans-Alai and the Terek, not the Pamirs.

I assume that every one accepts the evidence of the retreat of the cover in both regions. If so, its power to supply must be less than it once was; and it seems very probable that it is actually supplying less now, and quite certain that decrease must eventuate. But the proof of this, I agree, is to be found not in the Lop Nor region, but round the sources and in the upper valleys of the Rasham and the Qizil.

Colonel SCHOMBERG *has sent us the following additional note for publication:* Mr. W. B. K. Shaw, late of the Sudan Forest Department, kindly writes to say that he has noted action similar to that described in my paper in the desert vegetation of the Sudan. His letter reads: "I think the enclosed photograph* may be of interest to you in connection with your remarks on p. 319 of the *Geographical Journal* for April 1930. I took it in the Bir Natrun Oasis in the southern part of the Libyan Desert in November 1927. It shows—not very clearly—two groups of 'sellim' trees (*Acacia Ehrenbergiana* Hayne); those in the foreground quite dead while those in the left centre and background are alive. The former are on the lower level where the sand shows dark in places owing to moisture, the latter are raised on low sand mounds. The water-level in an adjacent water-hole is close to the surface, some 6 to 10 feet below the level of the dead trees. There are salt-pans in other parts of the oasis with a vein of salt formed just below ground-level, and it appeared to me that the trees in the foreground had been killed by excessive salinity in the soil brought about by a salt-crust forming there after evaporation of moisture. The loose sand of the mound, on the contrary, formed a 'mulch' which prevented great evaporation and consequent salinity. Under what conditions the now dead trees were once alive is not so clear; possibly the constant wind action had removed the sand from around them and formed the low dunes behind for the now living trees. The water in the well has only a very slight taste and is quite drinkable. Near by, though out of the photo, is tamarisk growing on mounds just like those in the pictures facing p. 317 of your article. I think you are quite right in your reply to Mr. Hinks on p. 322 in saying that this species is reproduced by seed."

Note.—The spelling Kara-Kash in the map was copied from several previous maps of this district in the *Journal;* it seems probable however that the name is better spelled Qaraqash (= black jade) as in the text.—ED. *G.J.*

*Unfortunately the photograph is not sufficiently clear for reproduction.—ED. *G.J.*

rich contrast in vegetation to the rest of the Division. It is regrettable that the nature of the writer's duties did not permit more than two hurried visits to these falls and that geographical notes then taken have since been lost.

THE MOUNT EVEREST EXPEDITION AND THE MOUNT EVEREST FLIGHT

THE fourth Mount Everest Expedition is now completely organized and some of the party of fourteen have sailed for India on the s.s. *Comorin* with Mr. Hugh Ruttledge; others followed a week later, and at Darjeeling will meet those members already in India. About March 20 they will leave Darjeeling on the long march through Tibet, probably by the Chumbi valley, as in former years, though perhaps if transport can be arranged by the shorter but less frequented route *via* Gangtok and the Serpo La. They should be at the old base in the Rongbuk valley, above the monastery, some time after the middle of April, and may hope to have established the advanced base at Camp III, or even perhaps at the North Col, by the middle of May. One must pray that this year they will not be driven out again by unseasonable storms, as their predecessors were in 1924, and lose essential time and strength in re-establishing themselves.

The leader has from the Mount Everest Committee only the most general instructions. He will be free to choose his route and his plan of attack; but there is no reason to anticipate that there can be any deviation from the route of 1922 and 1924 as far as the camp below the Northeast Shoulder. No one has ever found a better way: arguments have been heard in favour of climbing the whole way from the head of the glacier by the north-eastern arête, cutting out the North Col Camp with its approach that is usually nasty and has been at times dangerous. But one may conclude from former experience that the North Col has one great merit as a place for Camp IV, if it has not changed very much: that there is a terrace of ice below the crest, which gives some shelter from the prevailing west wind, and might even provide a site for ice caverns in the style of Bauer's on Kangchenjunga.

On the other hand, one must bear in mind the possibility that the topography of the North Col may have changed so much since 1924 that it is no longer a sheltered terrace but offers only a wind-swept crest defended by crevasses. No one has ever, we think, explained why the North Col is as it is. The slopes which it connects are steep and nearly bare of snow. There is no collecting basin for the ice which fills the eastern slopes. It must therefore come from accumulations of snow gathered in the lee of the crest. But why then is it glacier ice in solid masses, deeply crevassed, instead of the névé snow usual in such a position? That is a problem which invites solution: a little burrowing into ice caverns may help in its solution, and it will be perhaps the only geographical problem to be solved by this expedition, which is resolutely unscientific.

There were some who had ambitions to see the photo-theodolite which did such good work in the Shaksgam applied to the detailed survey of the mountain.

The highest summit of the world deserves cartography more precise, if it could not be more beautiful, than the map which M. Charles Jacot-Guillarmod drew from the not too precise surveys and the admirable camera pictures of former expeditions. If two of the party could have been chosen for this stereo-survey, and left to deal with it while the others climbed, that would have sufficed. But it has been from the first the policy of the Committee to keep this year one single object in view, to gain the summit, and nothing has been allowed to divert any part of the strength from that objective. It will therefore be a sombre and strenuous business, with no scientific relief; nor, if we understand the intention of the leader, any of those other diversions which have been a little conspicuous in some Himalayan climbs. No gramophones will affront the silence of the mountains on the pretence that they amuse the porters. No man with a kinematograph camera will be allowed to pose a party for a good shot, still less to stage in a convenient crevasse any scenes of climbing the ice walls that guard the summit. There will be no film at all of standard size, and nothing of the beautiful pictures so boldly made and so little staged by Captain Noel in 1922 and 1924. A few cine-kodaks there may be in the hands of the party, enough perhaps to enliven and elucidate the account of the earlier stages in the operations. But it is doubtful if they will get beyond the North Col. Indeed, if one recalls the events of former years, one seems to remember that though there were V.P.K. cameras on the high climbs, they produced very few pictures. Somervell took a few in both years, being of that resolute character that could pull out a sketch-book also and make a pastel drawing at 26,000 feet: the drawing which is preserved in one of the frames that hang in the corridor on the first floor of the Society's house.

The present expedition has had the good fortune to find in its leader a man who was able and willing to devote his whole time to the job from the day of his appointment early in September, and to have as its secretary a traveller of great experience in the Arctic. It is certain therefore that every detail of the equipment and stores and clothing has been most carefully considered. It was early determined that no great supply of oxygen should be carried: there was only too much reason to fear that the outfit of 1924 had contributed to failure rather than success. But a much smaller and lighter oxygen apparatus will, if circumstances permit, be carried to the highest camp, and then used if it seems desirable, for a final stimulus or restorative.

The expedition will carry a field receiver for W/T reports of the progress of the monsoon, but will have no transmitting apparatus. Despatches will be sent back from the base camp from time to time, with photographs, and the world rights in these despatches have been purchased this year by the *Daily Telegraph*, to which our readers are referred for the latest news of the expedition. The *Journal* will, as in former years, publish each month from April or May a summary of the news.

The expedition is commanded by Mr. Hugh Ruttledge, formerly of the Indian Civil Service, who has climbed for many years in the Himalaya round Nanda Devi. His party is made up of the following gentlemen whose names are given in alphabetical order: Captain E. StJ. Birnie, of Sam Browne's Cavalry, one of those of the Kamet Expedition who reached the summit; Major Hugh Boustead, Commandant in the Sudan Camel Corps, who made an

expedition to Lhonak in the Eastern Himalaya to prepare himself for Mount Everest; Mr. T. A. Brocklebank, stroke of the Cambridge boat for three years, and well known in the Alps; Mr. Colin G. Crawford, who made an attempt on Kangchenjunga in 1920, and was a member of the Mount Everest Expedition in 1922; Dr. C. R. Greene, one of the two medical officers of the expedition, another of the Kamet party who gained the summit; Mr. J. L. Longland, of Durham University, one of the best known of the younger generation of British guideless climbers in the Alps; Dr. W. W. McLean, recently appointed to the English Mission Hospital in Jerusalem, the second medical officer of the expedition, and a member of the Alpine Club; Mr. E. O. Shebbeare, of the Indian Forest Service, transport officer of the Mount Everest Expedition of 1924; Mr. E. E. Shipton, another member of the Kamet party, who recently climbed Mount Kenya; Mr. F. S. Smythe, a member of the Dyhrenfurth Expedition to Kangchenjunga in 1930, and leader of the successful expedition to Kamet; Mr. L. R. Wager, one of Mr. Watkins's expedition in East Greenland in 1930–31, who took part in the strenuous climbing of Mount Forel; Mr. G. Wood-Johnson, also a member of the Dyhrenfurth Expedition to Kangchenjunga, who will be one of the transport officers of the expedition; and Mr. P. Wyn-Harris, who was a companion of Mr. Shipton on climbs in Kenya and Ruwenzori.

By a coincidence which may be either happy or embarrassing, as events will prove, the organization of a British flight to Mount Everest has matured at such a time that a powerful machine, fitted with survey cameras, may fly over the summit from the south while the climbing expedition is approaching it from the east and north. The plans submitted to the Council of our Society by Colonel Blacker in preliminary form in the spring of last year have since been greatly modified and improved, thanks to the generosity of Lady Houston, whose financial support has made it possible to plan the flight without having as its first and compelling object the production of a saleable film. The Council expressed to the Secretary of State for India the opinion that good photographs of the massif of Chomolung from the south would be of scientific interest and importance, and we understand that the principal object of the flight as now organized, under the command of Air Commodore Fellowes with the Marquess of Clydesdale as chief pilot, and Colonel Blacker as principal observer, will be to secure these photographs, vertical and oblique. They will have more importance than can be realized immediately. The problem of plotting a map from a series of photographs in which the ground scale will vary so rapidly must be soluble, but at present cannot be considered fully solved. It is therefore very necessary that the cameras shall be calibrated with all possible precision and the plates carefully preserved after they have served their immediate purpose. The ground control must at present be insufficient: but there is no reason why in some future time it should not be possible to make it sufficient by stereo-survey from ground stations, even at great distances, as for example from the Singalila ridge.

The two expeditions are complementary. The climbers are permitted to pass through Tibet, but have always been refused entry to Nepal. The airmen have received permission from the Nepalese Durbar to fly high over Nepal, and have undertaken not to trespass over the border of Tibet.

The Society will wish both expeditions all success, and will hope that about July it may be possible to illustrate the climbers' conquest of the summit by a photograph from the Mount Everest flight.

SCIENTIFIC RESULTS OF DR. TRINKLER'S CENTRAL ASIAN EXPEDITION

WISSENSCHAFTLICHE ERGEBNISSE DER DR. TRINKLER'SCHEN Zentralasien Expedition. Band I (viii+134+xvi *pages*). Geographische Forschungen im westlichen Zentralasien und Karakorum-Himalaya. By [the late] EMIL TRINKLER; nach dem nachgelassenen Manuskript herausgegeben [by ILSE TRINKLER and GÜNTHER KÖHLER]. Band II (x+196+xxii *pages*). Geologische Forschungen im westlichen K'un-Lun und Karakorum-Himalaya. By HELLMUT DE TERRA. *Berlin: Dietrich Reimer and Ernst Vohsen* 1932. 12×9 *inches; illustrations and maps. M.*32 *and* 44 (*two vols. together M.*70)

IT is sad that the learned author of the brilliant study which forms the first of the two volumes here noticed should have been the victim of a motor accident. The book, which has been edited by Frau Ilse Trinkler and Dr. Günther Köhler, contains admirable descriptions of the country seen during the journey Dr. Trinkler made during 1927–1928 with Drs. H. de Terra and W. Bosshard across the Tibetan Highlands and over part of the Tarim Basin. But it is something much more than a series of descriptions of country, for it contains philosophical discussions of a variety of problems regarding Central Asia to the development of which the author has brought great erudition, wide experience, and shrewd judgment. For such a compendium of geographical observations it is unusually readable on account of the judicious mixture of fact and theory.

The first part of the work is concerned with the lofty highlands lying between the Upper Indus Valley and the Tarim Basin. In the second part attention is directed to the Tarim Basin itself, and to a short synthesis embracing all of Central Asia. The route is at first described stage by stage from Leh on the Indus, *via* the Chang pass, Tankse, Pangong, Shyok, Marsimik, Chang Chenmo, Lanak Lingzitang, Laktsung, Aqsaichin, Yang pass, and Qaraqash to Sanju, and then back *via* Kilian, Suget, Baksum Bulaq, Karakoram pass, Depsang, Burtsa, Sasir pass, Panamik, and Kardung pass to Leh. From there the party followed the well-known route *via* Nurla, Kargil, and Dras to Srinagar. In this region three main topographical units were distinguished. The Karakoram bundle of ranges lies in the south-west, the western Tibetan Highland plateau including Lingzitang and Aqsaichin in the central part and the Kun Lun mountains with their foothills to the north-east. The topography supplies abundant evidence, which is lucidly described, that the present features are a result of ice and frost action upon an older preglacial surface of normal sub-mature character. The original hills and valleys were subjected to extensive glaciation which rounded off some of the protuberances and scoured out some of the depressions. When the ice melted great masses of gravel were deposited in the upper parts of the valleys and much fine-grained detritus was swept out to the plains and deposited as outwash fans or mud-flats. The gravel was then consolidated into conglomerates and fanglomerates, after which an advance of the ice occurred and

THE ITALIAN HIMALAYA EXPEDITION, 1913–14

THE ITALIAN EXPEDITION TO THE HIMALAYA, KARAKORAM, and Eastern Turkestan (1913–1914). By FILIPPO DE FILIPPI. *London: Edward Arnold & Co.* 1932. 10×7½ *inches;* xvi+528 *pages; illustrations and maps.* 50*s*

THIS book is a mine of information. It has been worth waiting eight years to get an English translation. It is more than a translation, for the text has been thoroughly revised, and a chapter has been added on the scientific results. It is a scholarly work, containing the best bibliographical notes and references yet published on this region. We have to go back to 1875 and Drew's 'Jummoo and Kashmir' to find a comparable volume. Yet the narrative exhales the very air of Ladakh, and the enduring spaciousness of travel and sojourn in High Asia. The translation is extremely well done. The successful conversion of the place-names from the Italian into the recognized English spelling has involved great care and labour. The reviewer can only find one misprint. On p. 320 Vigne's date is given as 1873 instead of 1837. The General Index is full, and the separate Bibliographical Index quite invaluable to every one interested in the region, constituting a complete bibliography of the literature of the Eastern Karakoram, Ladakh, and Baltistan, together with much of that of Chinese Turkistan.

The book falls naturally into three parts—Baltistan and Ladakh, the Rimo glaciers, and Chinese Turkistan. It is arranged almost on the plan of a series of articles, each complete in itself, but connected together by the thread of travel. After a survey of the origin and organization of the expedition, we are quickly taken through Kashmir into Baltistan. Chapter III describes a winter in Skardu, and Chapter IV, by Professor Dainelli, winter excursions into little-known corners of Baltistan. Dainelli is emphatic that the Baltis, although speaking Tibetan, do not possess Mongolian characteristics. He made some three hundred measurements, and separates the Balti type altogether from the Brokpas and Dards of the Indus. The whole expedition left Skardu for Leh in February (1914), snow being often troublesome, though frozen portions of the Indus in some places made the route easier than in summer. A very beautiful panoramic view of Lamayuru is published opposite p. 142, and the whole of this chapter (VI) is lavishly illustrated. Two more chapters (VII and VIII) by Dainelli follow, Chapter VII dealing with two almost unvisited sections of the Indus valley. The ethnology of the Brokpas and Purigs is discussed, and there is a good account of the castle of Chiktan, the interesting stronghold of the ancient Dard princes of Purig. Chapter VIII describes winter visits to Rupshu, Lake Pangkong, and the Zanskar Valley. But is it really certain that the morphology of the Pangkong Lake is due to glacial excavation and not to irregular subsidence (pp. 267–8)? In Chapter IX Sir F. De Filippi describes the journey up the Shyok Valley to the Depsang Plateau. Here again the illustration of the route surpasses that of any previous publication; the photographs of the great peaks of the Nubra–Shyok divide will be of particular interest to mountaineers.

Owing to the almost complete absence of feed about the Rimo and the sources of the Yarkand river, it is impracticable to explore this country with horses. De Filippi therefore sent his animal transport back as soon as he had dumped all his stuff on the Depsang plain, from henceforth depending entirely on coolie transport, and that necessarily reduced to the lowest possible numbers. After a description of the establishment of the base on the Depsang plain, with some account of the meteorological and physical observations carried on there, we begin the exploration of the Rimo glacier. This is illustrated by eight very fine

panoramas in a pocket at the end of the book, which, with the map, enables the reader to follow in detail this fine piece of exploration: the complete delineation of the last great glacier system of the Karakoram then remaining unexplored, and one of the main objects of the expedition. The Italian success was certainly complete, and this despite very bad weather. There was great delay over the survey work owing to continued snowstorms on the upper Rimo, and De Filippi bears generous testimony to the devotion to duty of the surveyors, Jamna Prasad and Shib Lal. In Chapter XII Dainelli describes a dash to the Lingzi-thang, a visit to the Aqtash and Kumdan glaciers, whose recent advance again has once more dammed up the waters of the upper Shyok, and his visit to the Rimo source of the Yarkand river. In some ways the most startling geographical discovery of the expedition was that the source of the Yarkand river is a tongue of the Rimo glacier which overflows northward across the water-parting, and it is typical of the competence of the membership that the leader's main Rimo survey party, Wood and Spranger's northern survey party, and Dainelli's small caravan, all independently made this same discovery one after the other. Chapter XIII is contributed by Spranger, and describes the exploration, with Major Wood of the G.T.S., of the sources of the Yarkand river. It was these explorations that led afterwards to Professor Mason's expedition. Chapter XIV sums up the topography of the Rimo and the sources of the Shyok and Yarkand rivers: not only is very full acknowledgment made, in the historical portion, to the work of previous travellers, but a line-map showing Dainelli's Siachen-Rimo traverse of 1930 is added to bring information right up to date.

Chapters XV to XVII form a third portion of the book, dealing as they do with the Karakoram, Suget, and Kökart passes; the Raskam Darya, where further exploration was stopped by the flooded river; and the journey from Surkowat to Kashgar and thence to Russian Turkistan. Chapter XVII contains an interesting résumé of the historical vicissitudes of Turkistan. It is pleasing to find it recorded (p. 479) that Kishen Singh's determination in 1873 of the longitude of Kashgar agrees almost exactly with that obtained from wireless by De Filippi. So remote and isolated are these regions that it was not until September 30 that the expedition received details of the opening phase of the Great War. They had received news on August 16 that war had broken out, but that Italy and England were not involved: nevertheless Alessio, Antilli, and Alessandri had felt compelled to return to duty, and left the expedition. The War brought the expedition to a premature close, though Abetti and Ginori completed the geophysical work at Tashkent, closing the series of stations commenced at Dehra Dun. For the benefit of English readers unable to tackle the *Relazioni Scientifiche* it may be said that the closing chapter on the scientific results is disappointingly brief. Yet the feat of compressing into 500 pages the narrative of such a journey, so long and so fruitful in results, compels admiration.

A charming feature of this book is the author's attitude to previous travellers. So far from endeavouring to enhance his own achievements by depreciating, or omitting reference to, the work of his predecessors, he goes out of his way to draw attention to them: a generosity by no means universal amongst travel writers of any generation. The same note is struck by his praise of Petigax; by his appreciation of Rasul Gulwan—"the ablest, most upright and companionable *caravan-bashi* that ever was"; by his care of and gratitude for the services of his coolies, both Baltis and Ladakhis; and by his care for his horses (p. 304). Italy has every reason to congratulate herself on the uniformly favourable impression left behind by the great Italian expeditions to the Himalaya. They have the art of travel; and a large part of that art consists in getting the best out of the native population, a result entailing the exercise of unlimited patience, combined with

a regard for local prejudices which it is sometimes not easy for the traveller to produce perpetually. Particularly in Dainelli's more ethnological contributions to the book do we see the essential value, to the traveller who would understand what he sees, of sympathy with the people of the country.

Throughout the book there is a wealth of illustration. The frontispiece is a good reproduction of a beautiful painting by R. W. Spranger, which, though made from a photograph, successfully recalls the upper Shyok flowing clear and placid in spring, before the melting of the snows has transformed it into a malevolent flood. The second coloured plate, of the lake discovered by Hayward in 1868 near the source of the Yarkand river, is a welcome introduction to the second part of the book. But it must be noted with regret that Antilli's beautiful photographs in the text have been massacred by the English publisher. Fortunately the panoramas were printed in Milan, and leave nothing to be desired. Nothing could be better than "Lamayuru," at p. 142, an Italian reproduction; while Dainelli's arresting picture of the Castle of Chiktan, on p. 243, is ruined by bad English reproduction. But, poorly reproduced as they are, the text illustrations form a very fine series and add enormously to the value of the book both for the specialist and for the general reader. For the glorious panoramas, seven in the text, and eight of the Rimo glaciers in a portfolio at the end, no praise is too high. As the scope of exploration becomes more limited it must become more intensive in method. Complete illustration of the country becomes more and more desirable in the published report or narrative. In combination with the maps these panoramas mark a standard of excellence for the emulation of future travellers.

There is a useful general map of Kashmir, from Lahore and Pindi up to Kashgar and Andijan, which shows the enormous length of route travelled by the expedition, and makes it quite easy to follow the numerous and interesting side excursions of subsidiary parties, extending all through Baltistan and Ladakn to Rupshu and the Aqsai Chin. But the main achievement of the expedition is the map on the scale 1 : 250,000 of the Rimo glaciers, and of the sources of the Yarkand river. The former enabled Professor Dainelli, in 1930, to make the first crossing of the main Karakoram axis east of the Muztagh Pass, from the Siachen to the Rimo; and the latter, the exploration and mapping of the three western upper tributaries of the Yarkand river offering the possibility of approach to the Shaksgam, was the mainspring of Professor Mason's expedition of 1926. The delay in the publication of an English edition has enabled De Filippi to incorporate references to these later expeditions, including that of H.R.H. the Duke of Spoleto, when (1929) Colonel Balestreri succeeded in joining Sir Francis Younghusband's farthest point with that reached by the late Major Minchinton, of Mason's expedition. Thus, by a fortunate chance, the English edition is of even greater value and interest, both to geographers and mountaineers, than the original Italian edition. T. G. L.

A NEW MOUNT EVEREST EXPEDITION

ON the Mount Everest Expedition of 1924 Colonel Norton reached a point only about 800 feet below the summit, and we like to hope that Messrs. Mallory and Irvine may have gained the summit itself, though unhappily they did not return. Resolved to complete the task undertaken in 1921 the Mount Everest Committee remained in being, but has been met, until recently, by disinclination of the Dalai Lama and Tibetan Government to any further expedition. Apart from general dislike to passage of travellers through their country they had a particular dislike to interference with the high summits on which their divinities dwell, and they doubtless felt that the loss of life on all three expeditions was an indication of divine displeasure. Inquiries made from time to time by the good offices of the Government of India through the Political Officer in Sikkim had given little hope that this attitude would soon be changed, and it was therefore with particular pleasure that the Mount Everest Committee received during August a notification from the India Office that Colonel Weir had been able to obtain from His Holiness the Dalai Lama permission for a new expedition in 1933. So soon as the news was confirmed by cable, and a copy of the letter from the Dalai Lama was received by the Committee, immediate steps were taken to organize a new expedition. At a meeting on September 2 the Committee formally resolved to undertake the task, and asked the Secretary of State to convey to the Government of India, and through the proper channels to the Dalai Lama, their high appreciation and thanks for his undertaking to grant the necessary passports; they asked at the same time that the particular thanks of the Committee should be conveyed to Colonel Weir, Political Officer in Sikkim, who had been successful in obtaining the consent. The Committee then addressed themselves to the responsible task of selecting a leader, and having learned from Brigadier Norton that his military duties made it impossible for him to accept the leadership, and from Major Geoffrey Bruce that he also was unable to consider an invitation, the Committee resolved to invite Mr. Hugh Ruttledge, late of the Indian Civil Service, to undertake the leadership, and was fortunate to secure his immediate acceptance.

On September 3 a letter to the Press signed by the President of this Society and by General Bruce on behalf of the President of the Alpine Club, then abroad, announced that the necessary permission had been received, and that the Mount Everest Committee had undertaken to prepare an expedition for 1933. On the same day an article in *The Times* by Sir Francis Younghusband dealt with the conditions under which the new enterprise would start. The Mount Everest Committee has steadily maintained its determination to renew the assault, and has also preserved its resources. By the sale of news and photographs of the expedition, by lectures and by books, it has made the expeditions pay for themselves, so that the amount of nearly the whole of the £5000 originally subscribed to start the first expedition is in hand to start the fourth, and it will fortunately not be necessary at the present to make any public appeal for funds, although this is not to say that financial support or guarantees would not be both welcome and useful.

The high climb of Colonel Norton and Mr. Somervell, made without oxygen, shows that climbers of suitable physique can be acclimatized to reach over 28,000 feet, and that there is no reason to fear that the last 900 feet are impossible with resolution based upon past experience and reasonable good fortune.

During the last seven years, until his recent retirement, Mr. Hugh Ruttledge, as Deputy Commissioner of the Hill District of Almora, in the Kumaon Division, has distinguished himself for his resolute exploration around Nanda Devi. In 1926, under orders from the Government of India, he crossed the Lipu Lek Pass into Tibet, and while waiting for a meeting with a high Tibetan official he performed the *parikarma* or ceremonial circumambulation of the sacred Mount Kailas, thereby acquiring a virtue which gives him the great advantage of high standing both with Hindus and Buddhists. The next year Mr. and Mrs. Ruttledge, with Dr. Longstaff, explored the glaciers of the western base of Trisul, and convinced themselves that in this neighbourhood there was no practicable route to the untrodden glaciers surrounding Nanda Devi; a paper on this expedition was read to the Society on 9 January 1928. This summer, after his retirement from the Indian Civil Service, Mr. Ruttledge has been climbing again in Garhwal.

The leader's first task will be to select and recommend to the Committee the members of the climbing party, and this is well in hand. An office for the Expedition has been established in the House of the Society, and the Committee has been fortunate in securing the services of Mr. J. M. Scott as Secretary of the Expedition. The Mount Everest Committee has elected the President of the Society to be its Chairman, and is meeting frequently for consideration of the many problems of personnel and equipment which arise. The important questions of news service and publications are in the hands of a sub-Committee under the Chairmanship of Sir Francis Younghusband, and great attention is being given to the complicated problem of securing wide distribution of news and photographs. Announcements will be communicated to the Press from time to time, and a statement will be made to the Society by the President at the first meeting of the Session on the evening of Monday November 7.

All communications for the Expedition should be addressed to Mr. J. M. Scott, its Secretary, at the House of the Society; the telephone number of the Expedition is Kensington 5053.

THE RECENT ASSAULTS ON KANGCHENJUNGA

IM KAMPF UM DEN HIMALAJA. By PAUL BAUER. *Munich: Knorr und Hirth* 1931. 9¼×7 *inches; 174 pages; illustrations, panoramas, and maps. M.*9.40

THE KANGCHENJUNGA ADVENTURE. By F. S. SMYTHE. *London: Victor Gollancz* 1930. 9½×6 *inches;* 464 *pages; illustrations and sketch-maps.* 16*s*

HIMALAYA: UNSERE EXPEDITION, 1930. By G. O. DYHRENFURTH. *Berlin: Scherl* 1931. 9×6 *inches;* 380 *pages; illustrations, panorama, diagram, and map. M.*16

KANGCHENJUNGA, "the five treasuries of the great snow," lies on the frontier of Sikkim and Nepal, and is, as far as can be ascertained at present, the third highest mountain of our Earth. Secure behind its almost inaccessible outer ramparts—the great range carrying Kabru and extending southwards to the Singalila ridge, the eastern range, carrying the icy summits of Simvu and Siniolchu, and the western ridge dividing at Kangbachen to the crests of Jannu and Ramthang—it has remained an object of worship to the inhabitants of Sikkim for centuries and of admiration to the British ever since the occupation of Darjeeling as a hill station nearly a hundred years ago.

This is not the place to describe in detail the history of the early exploration of the approaches to Kangchenjunga. Such an exploration must be a gradual process, and many have had a hand in it. Hooker, Harman, Tanner, Claude White, all had a share in paving the way for Mr. Douglas Freshfield's great circuit described in 'Round Kangchenjunga,' and each in turn benefited by the work of his predecessor. At the beginning of the present century enough was known of the approaches to begin a reconnaissance of the mountain itself.[1] Mr. Freshfield showed that the two highest summits, 28,146 feet and 27,803 feet, rise from a stupendous range running approximately north and south. West of the northern summit and east of the southern, great ice-clad buttresses support the massif and enclose the ice-basins of the four main glaciers of the group. The Kangchenjunga glacier fills the north-western quadrant and drains the whole western side of the northern range as far north as the Jonsong La; the Yalung glacier fills the south-western quadrant and drains the western face of the southern range almost to the Kang La. Both these glaciers are wholly in Nepal. The Talung glacier clothes the south-eastern face and quadrant; and the Zemu, with its now well-known tributaries, the north-eastern. These four glaciers form the only approaches to the mountain; and from these approaches, on all sides, Kangchenjunga is defended by precipitous walls 6000 feet high before the gentler gradients above 23,000 feet can be attained.

If we analyse these four quadrants we find that the south-eastern and south-western are the nearest to Darjeeling. Compared with the other two they are however much more exposed to the full impact of monsoon storms, and certainly from mid-June to mid-October no periods of settled weather can be expected. The faces of the mountain on these southern sides are ice-armoured and, as Raeburn said of the Talung Saddle, "vicious in the extreme, defended everywhere by overhanging masses of ice." It is nothing short of madness to attempt to climb either of these faces, especially during the monsoon period. The two northern quadrants lie protected to a large extent from the worst of the monsoon storms, and Mr. Freshfield showed that there was no great difficulty in reaching

[1] For a brief history of exploration in the Kangchenjunga region see *Himalayan Journal*, ii, 1930.

the head of the Zemu glacier. There however he experienced bad weather and was unable to carry out a detailed reconnaissance. He approached the north-western quadrant from the north and is frequently quoted as having expressed his opinion that the only direct route to the summit was from this direction. What he actually said was that the great snow-terrace lying at about 27,000 feet, which is continuous to the north ridge, afforded in his opinion the only practicable route. He made no recommendation that this terrace should be attacked from the north-east or from the north-west.

The first twenty-five years of the century added greatly to our knowledge of the approaches to the central massif. Messrs. Raeburn and Crawford proved the impracticability of the Talung Saddle, and indeed the inaccessibility of the whole ridge separating the south-eastern and south-western quadrants, as far south as the Kang La. The investigations of these two and of Messrs. Tombazi and Boustead and Lieut.-Colonel Tobin left no doubt that the southern quadrants were raked by avalanches and that it would be most unwise to force a line of communication to the Zemu glacier by way of the Para Chu, the Guicha La, the Talung, and the Tongshyong glaciers and the Zemu Gap, though Dr. Kellas had reached the latter from the north without much difficulty in 1910. The explorations of Dr. Kellas in 1907, 1909, and 1910 also showed that a direct passage from the north-eastern quadrant to the north-western, by way of the Nepal Gap, was impracticable for laden porters. The upper regions of the four quadrants were thus shown to be isolated from each other. The very serious objections to attempting to climb the mountain from the north-west are, firstly, that there is difficulty in obtaining permission to approach it through Nepal, and secondly, that an attack from that side means a very long line of communication over several high passes, including the Kang La, which is liable to be blocked by bad weather. From all these considerations mountaineers had, by 1929, come to the conclusion that the north-eastern quadrant offered the most likely line of successful attack, with a comparatively easy line of communication by way of the Tista valley and Lachen.

Herr Bauer and his team of young Bavarians arrived in India in July 1929. They were fully equipped for strenuous climbing in the high Eastern Himalaya. They had studied all the available literature on the subject, learnt the lessons of the Mount Everest expeditions, consulted authorities on high Himalayan mountaineering; they had been trained in a difficult school and were absolutely fit. They sought advice and took the best they could get; and at the end they generously acknowledged it. Some of the most experienced and trustworthy native porters of the Mount Everest expeditions had been collected by the Himalayan Club for them, and after a halt of only three days they pushed on by Freshfield's route by the Tista valley and the Poki Chu to the Zemu glacier.

The first of the books under notice is an extremely modest account of this first Bavarian expedition, which has been described subsequently by an experienced Alpine Club member of the Mount Everest Expeditions as "a feat without parallel, perhaps, in all the annals of mountaineering." It is not too long, especially when dealing with preliminaries and ground well known to mountaineers; yet it is sufficiently detailed throughout to enable the reader, whether experienced or not, to realize the tremendous difficulties encountered and overcome. It is so well illustrated that it may be used usefully to supplement the briefer but no less thrilling accounts in English written by Herr Bauer for the *Alpine Journal* and the *Himalayan Journal*.[1] Herr Bauer sticks to essentials; there is no attempt at journalism; the men who played their part on the lines of com-

[1] *Alpine Journal*, xlii, 1930, p. 185; *Himalayan Journal*, ii, 1930, p. 13.

munication and in the lower camps receive as much praise as those who formed the storming party. A fine spirit of camaraderie permeates the book as no doubt it permeated the adventure. The actual account of the climb, which occupies some sixty pages out of a hundred and seventy-four, is of intense interest. It tells how, after a month's hard work spent in laying a forward base, Camp VI was pitched near the head of the glacier, where, after several reconnaissances the North-East Spur, a subsidiary buttress of the great North Ridge, projecting eastwards, was selected for the assault.

Three attempts to reach the crest of the Spur were frustrated by overhanging masses of ice. On September 6 the crest was conquered. A violent blizzard caused the gains to be relinquished and the whole route was obliterated. The party was driven back to Camp VI. "We were now ready to start the real assault," writes Bauer, and on the 16th the crest of the Spur was reached for the second time, after many days of hard step-cutting. The route now turned westwards along the North-East Spur and a track fit for porters had to be cut to circumvent the series of great ice-pinnacles which crowned the spur. Great masses of ice had to be cut away, tunnels had to be pierced, and caves dug to serve the duties of Camps VIII, IX, and X, the last of which was established on October 2 at 23,030 feet. It had taken a month to attain Camp X from Camp VI at 16,860 feet.

Kangchenjunga was stirred at last. Her icy solitudes had been violated by men of science, determination, and skill. On the night of October 3 came a fierce wind, a bitter blizzard, and intense cold. The storm lasted for four days. To economize food four of the party had started down. A second party began the descent, while one forlorn attempt was made to go higher. On the 7th, when all three parties were isolated on the mountain, cut off from each other and the base, $6\frac{1}{2}$ feet of snow fell. It is almost impossible to conceive the difficulties and dangers of the descent as described by the leader in his book. The storm endured was one of the worst experienced in Sikkim for years.[1]

The three parties descended, each unaware of the fate of the rest. In one account of the descent Bauer writes: "The descent appeared humanly impossible, yet the attempt had to be made. Roped at the fullest possible distance we fought our way down, leaving behind us a furrow a man's height in depth. . . . Our unfortunate porters, laden each with some 80 lbs., sank so deep that we, with our 40 lbs., had often to pass them and jerk them loose from below. The steeper slopes mostly peeled off as the leader, tightly held from the rear, stepped on to them. The great and most dangerous slope, thank Heaven, had already avalanched. . . . Another slope, however, parted with Allwein and the two porters on it, but with a final desperate effort I was just able to hold them. For ten minutes or more we lay motionless and exhausted before we could resume the fight. On our arrival at Camp IX we had to dig for half an hour before we could clear the ice-cave's entrance, buried in seven feet of snow."

Beyond Camp IX the descent became more difficult, but after jettisoning half the loads by casting them to the Twins Glacier, 5000 feet below, the last party reached Camp VII and comparative safety. The party of Beigel and Aufschnaiter probably had the hardest time. They were caught between Camps IX and VII, the most dangerous part of the descent, during the worst weather experienced on the expedition. Alternately leading, each was swept off his feet by avalanches. Once, when traversing slightly below the crest, the leader slipped and was held only by the second man leaping into space on the reverse slope. This manoeuvre

[1]The writer of this note was in Sikkim at the time. Much destruction to roads was caused by this storm, and travel became impossible.

led to the loss of loads and bivouac material, and the party had to spend the night on the ridge with no provisions or shelter of any kind. The whole party was eventually reunited and reached the Zemu glacier, whence the return was made by the Tista to Darjeeling.

Thus ended Bauer's first attempt, a brilliant effort, defeated by the break-up of the weather at the critical point. It is safe to say that the exhibition of mountain craft can rarely, if ever, have been equalled in the history of mountaineering.

In 1930 took place the next attack, this time by an international expedition of ten members, of German, Austrian, Swiss, and British nationality. The second and third books under notice are the accounts by the leader, Professor Dyhrenfurth, and Mr. Smythe. Briefer accounts by these two members of the expedition have also appeared in the *Himalayan Journal* (Professor Dyhrenfurth) and in the *Alpine Journal* (Mr. Smythe).[1] Plans were based on the experiences of previous expeditions and the assistance of the Himalayan Club was invoked, albeit rather late. Preparations were made to attack the mountain again from the north-east, but at Darjeeling permission was received to pass through Nepal, and at the eleventh hour it was decided to change the programme. This unfortunate change was the cause of much subsequent dislocation on the long and difficult line of communication by the Kang La and other high passes to the north-west quadrant. In order to take full advantage of the pre-monsoon period an early start was made, but having planned the transport arrangements suitable for the Tista valley route it was not possible to equip completely the many additional porters required for a longer route involving four passes between 13,600 and 15,000 feet, and one over 16,400 feet, all under snow and none practicable for pack animals. The transport officers were called upon to face an impossible task and the communications became disorganized.

By the end of April however the difficulties had been overcome, though not perhaps without some misunderstandings, and plans were made for the assault. From a base camp a little to the west of Pangperma, at a height of 16,570 feet, opposite the tremendous north-west face of Kangchenjunga, Camp I was to be pitched at the upper end of the flat portion of the Kangchenjunga glacier and Camp II on the névé under the north col. From here a camp on the great ice-wall near the north end was to be established on the first terrace where a staircase, requiring several days' hard work, would be cut to the north ridge.

It is easy to be wise after the event; but the lessons of previous high attempts do not seem to have been fully appreciated. There is probably no greater danger in the Himalaya than working on ice-walls below the high ice terraces. The plasticity of the ice above is deceptive, and without warning thousands of tons may suddenly be let loose in the form of a terrible ice-avalanche. There is no hope of escape for any one caught below; the huge ice-blocks hammer and batter and eventually crush him to death. For this reason ridges are to be preferred to faces. On May 9 the ice-wall was almost conquered when the ice avalanched. A great mass of the terrace above broke off and the huge blocks came crashing down. Smythe, a spectator of the disaster from below, describes it vividly in 'The Kangchenjunga Adventure.' Had it occurred five minutes before or five minutes later the whole party must have been obliterated. As it was, Chettan, the most gallant of the Mount Everest "Tigers," was caught and crushed to death, and further climbing on this face had to be abandoned, though some brilliant climbing was accomplished on the great west ridge and some outstanding exploits carried out farther north. A good deal of exploration, supplementary to that of Mr. Freshfield, and survey, supplementary to that of Professor Garwood, was accomplished.

[1] *Himalayan Journal*, iii, 1931, p. 77; *Alpine Journal*, xlii, 1930, p. 202.

The accounts of these lesser explorations and the beautiful map of M. Marcel Kurz are the most valuable parts of Professor Dyhrenfurth's book. A bold experiment had been made to climb one of the most difficult of the Himalayan giants with an international team of leading mountaineers; it deserved a greater measure of success than it attained. The change of plan at the last moment, the consequent and inevitable dislocation of the communications, the difficulties and disappointments of attempting the impossible, did not make for complete harmony, such as is essential for success. It is not surprising, in view of the fact that Mr. Smythe's book was published first, that the British member of the party does not seem to have collaborated in the production of this book.

In some ways Mr. Smythe's book is brilliantly written, but in a rather journalistic style. The preliminary chapters are drawn out, and not till p. 200 or thereabouts is the Base Camp reached. There is also perhaps a tendency to claim omniscience and infallibility of judgment on the part of the author, while pointing out the errors of other members of the expedition. One grows a little tired of criticisms on equipment, especially when repeated.

We understand that M. Kurz was equipped with a Zeiss phototheodolite and intended to plot a stereo-photogrammetric survey. M. Kurz's map is naturally an improvement on the one drawn by Professor Garwood on Mr. Freshfield's more hurried expedition of 1899, which has rightly held first place for so long. M. Kurz has borrowed much from this and from the Survey of India map; he has corrected and added a lot of information in the north-west quadrant, but the appearance of the contours does not suggest that they were plotted stereographically: rather that they are sketched from spot heights. Stereographic survey can be of the greatest value for mountain surveys. It will be interesting to see the results of Herr Karl Wien's survey by this method carried out during the Bavarian expedition of 1931 and now being plotted under the direction of Herr Finsterwalder.

The year 1931 witnessed a further attack on Kangchenjunga by Bauer. Once more a fine team of young Bavarian climbers was collected: six of the 1929 party and four new men, all with considerable climbing experience to their credit. The full account will be looked forward to with the greatest interest. The following notes are from the preliminary accounts published in the *Alpine Journal* and the *Himalayan Journal;*[1] by the kindness of Signor Sella we are able to illustrate the route of this and of their previous attempt by two photographs which he took when he was with Mr. Freshfield in 1899, on which he has marked the approximate positions of Bauer's camps.

The North-East Spur was again selected for assault, and the same route was taken as in 1929. The main attack commenced on July 14, when stones and avalanches were still extraordinarily active. Abnormally warm weather rendered the snow conditions more dangerous than in 1929, and an observation post was formed to ascertain the safest time of day on which the route to the site of the old Camp VII could be traversed. Then all went well till the route to Camp VIII had been prepared, though an intermediate camp (Ridge Camp) had to be established between Camps VII and VIII. It was on August 9, when moving up to occupy Camp VIII, that a serious accident occurred. Two Bavarians had attained the terrace of Camp VIII; Herr Schaller followed after carefully cleaning the steps. Next to him came an experienced porter, Pasang. A third porter remained behind to pay out the rope. Suddenly Pasang shot down the steep gully, followed immediately by Schaller. The rope broke and both men were killed.

[1] *Alpine Journal*, xliv, 1932, p. 13; *Himalayan Journal*, iv, 1932, p. 116.

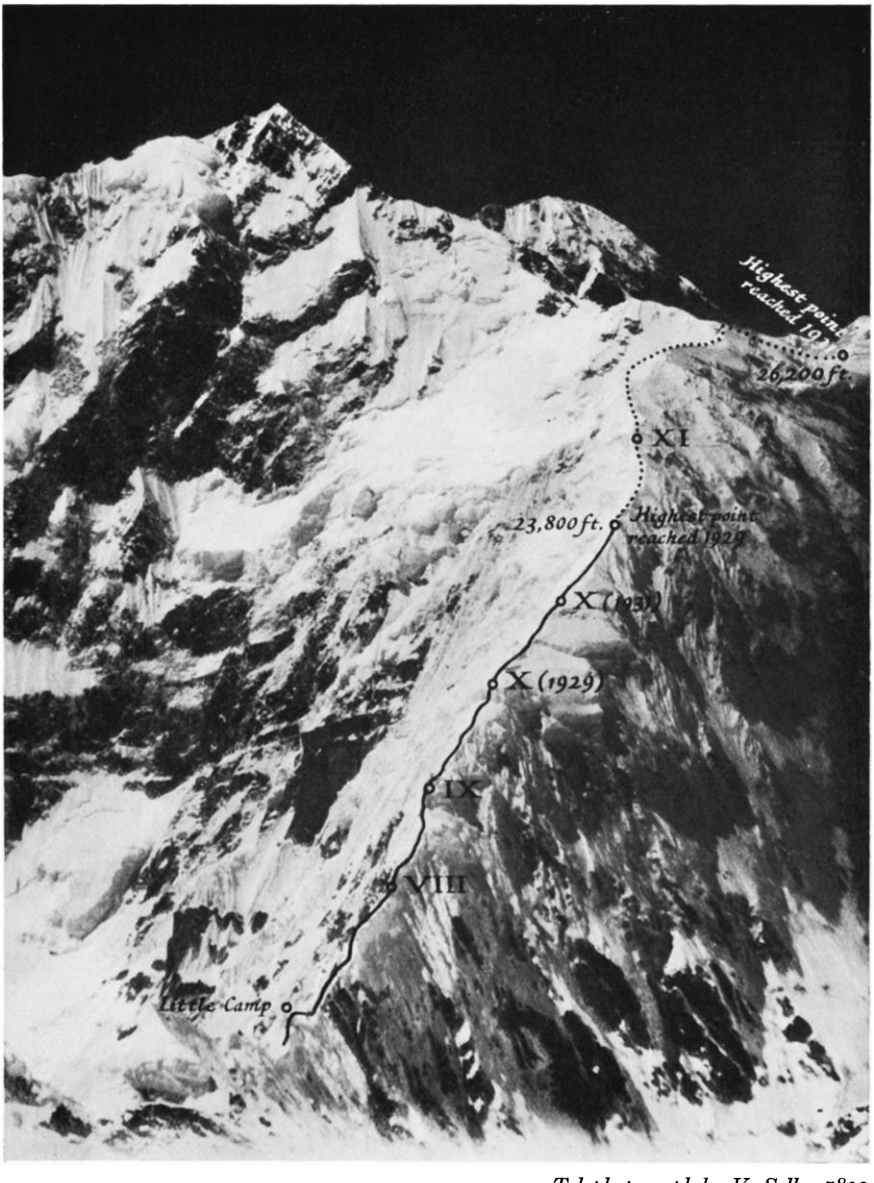
Fifteen days after the accident Camp VIII was definitely established. The weather had become exceptionally warm and much extra care had to be exercised. The porters were, rather naturally, badly shaken by the tragedy, and with three notable exceptions could no longer be relied on beyond Camp VII. The extra carrying that had to be done by the climbers delayed them and must have worn them out. The cave at Camp X, cut higher than the Camp X of the 1929 expedition, at 23,620 feet, was occupied on September 10, the cave at Camp XI at 25,100 feet on the 16th, and on the following day, after plodding over vast slopes of deep powder snow, the highest crest of the North-East Spur, at about 26,200 feet, was reached. Beyond this point the snow was unfavourable and the party returned to Camp XI.

On the 18th three members of the party set out for a further reconnaissance and to excavate Camp XII, but found the slope forming the sole approach to the North Ridge totally unassailable owing to the avalanche condition of the snow. There is little doubt that, however hard it was to make the decision to abandon the climb, the right decision was made. Bauer sums up this decision in these words:

"No doubt the unfavourable state of the snow was only temporary; but unfortunately at such a time there was no prospect of it improving, for every day it snowed for several hours. There was also now the constant menace of a great snow-fall such as had two years before forced upon the expedition a most hazardous retreat demanding the utmost exertions. The issue of a second retreat over deeply snowed-up slopes and ridges from those high altitudes could not be foreseen. Although our leading party had had six weeks to get fully acclimatized to the high altitude and our speed of ascent up to 8000 metres had not sunk below half that customary in our native mountains, yet it must be remembered that we had carried our heavy rucksacks for forty days almost without a single day of rest and had carried out some very trying ice-work which had set a great strain on our reserves of strength. We might have ventured a final assault in which all was staked on a single card, but even so we must have waited; and a long wait at those heights, if it is possible at all, demands fresh forces. In consequence of these considerations, we felt that there was no option but to renounce final success. An immediate attack on the slope would have been senseless and inexcusable."

The Editor of the *Alpine Journal*, in a brief note on Paul Bauer's account of his last expedition, writes: "To comment at length on the great 1931 struggle would be mere presumption. It will be sufficient to state that for skill, endurance, cold-blooded courage and especially for *judgment*, the expedition will stand as the classical model for all time." This comment will be endorsed by all who know the Himalaya.

Thus ended the 1931 attempt to conquer Kangchenjunga. Each of these three attempts, the accounts of which are here summarized, have increased our knowledge of the topography of the mountain, of its difficulties, and of the organization necessary to success. Before further attacks take place the lessons of these three expeditions must be absorbed. It would seem certain that Bauer's route alone is practicable; but it will indeed be a wonderful party that succeeds where he has failed. It would also seem that only a party of men in the fittest possible condition at the start can hope to reach the summit; and this party must be homogeneous, as was Bauer's party. On the first expedition Bauer himself was the oldest member at thirty-two; the average age was twenty-six. The utmost forethought must be exercised before attempting any of the Himalayan giants; personnel must be selected with the utmost care; plans once made should not be altered at the last minute when it is too late to adapt equipment to fresh



Telephotograph by V. Sella, 1899

The North-East Spur of Kangchenjunga from the Lower Zemu Glacier, showing the route of Bauer's expeditions, 1929 and 1931

Telephotograph by V. Sella, 1899

The North-East Spur from Gangtse on the Lhonak Chu

needs; and single-mindedness of purpose must pervade every member of the expedition.

One is tempted to consider again the question of the use of oxygen. Would it have been of any use? After the last Mount Everest expedition the conclusion was reached that for a mountain of considerable altitude a light form of oxygen apparatus might be taken with advantage, but that it should be considered solely as an emergency measure. For success acclimatization must be attained without oxygen. The Bavarians acclimatized, but in the two accounts of the attempt referred to, Bauer has said little of his collapse at Camp X from severe heart strain. He attempted to descend alone, and had to spend a terrible night in the cave at Camp IX without sufficient covering. An emergency supply of oxygen here, even in very small quantity, might have helped him down to Camp VIII and comparatively comfortable quarters.

Little has been said here of the explorations carried out by these expeditions otherwise than on Kangchenjunga. Mention has been made of the climbing accomplished by the international expedition of 1930 north of the mountain, of the fine map by Marcel Kurz which appears in Dyhrenfurth's book, and of Karl Wien's photogrammetric survey in 1931. The whole of the north-west and north-east quadrants of Kangchenjunga and the region of the Upper Lhonak have now been surveyed in some detail. At the end of the expedition some fine pioneering was carried out by two members of Bauer's team. Allwein and Pircher, with three porters, crossed the Simvu Saddle on October 1 for the first time—it had been reached from the north by Dr. Kellas in 1910—and descended in a south-easterly direction down the unknown Passanram valley, which had never before been trodden by any European. This indescribably savage valley, only 25 kilometres long as the crow flies, took the party seven days to traverse. They eventually reached the Talung valley, where the villages of Pangong and Sanven are marked on the map from native sources. There are no villages; the whole valley here is clothed with dense rhododendron jungle. The details of this reconnaissance will be looked forward to with much interest.

KENNETH MASON

THE MOUNT EVEREST EXPEDITION

THE news from the Mount Everest Expedition is contained in reports sent by the leader, Mr. Hugh Ruttledge, to the *Daily Telegraph* and is by them distributed. The following article is based upon the information contained in the reports and therefore bears the above legend.

On February 9 Doctor Raymond Greene and Mr. F. S. Smythe left Victoria Station to join s.s. *Viceroy of India* when she sailed for Bombay on February 10, the date on which Mr. Ruttledge reached India in s.s. *Comorin* with Messrs. Crawford, Brocklebank, Longland, Shipton, Wager, and Wyn-Harris. Both parties went on at once to Darjeeling, where they were joined by Doctor McLean, who had recently come from Palestine, by Major Hugh Boustead, and by Captain Birnie, Mr. Shebbeare, and Mr. Wood-Johnson, who were already in India.

Before leaving England Mr. Ruttledge had intended to keep his whole party at Darjeeling from March 1 to 15. But it would appear that they acclimatized to that altitude and to the other local conditions more quickly than he had expected, and it was decided to start earlier and advance by easy stages over the first part of the march. By March 6 the seventy-two Sherpa porters had been collected and had been blessed by the head Lama of Ghoom; and an advance party consisting of Crawford, Brocklebank, Longland, McLean, Shipton, Wager, and Wyn-Harris started for Kalimpong, where they would spend a short time rearranging the stores. Mr. Ruttledge with the rest of the party left on March 8, seventeen days earlier than the date of the departure of the 1924 Expedition.

At Kalimpong Mr. Ruttledge's party was joined by Lieutenant Thompson and Lieutenant Smijth-Wyndham, of the Royal Corps of Signals, whose duty will be to erect and operate the wireless apparatus which is intended to receive weather reports from the Indian Meteorological Office.

In the *Journal* of February it was stated that the party might follow the direct route from Gangtok to Kampa-Dzong over the Serpo La. We learn however that they chose the longer route by Pedong, Natang, and the Chumbi Valley, probably because it appeared from local reports that it was too early in the year to cross the Serpo La with a heavy baggage train.

About March 18 the second party must have crossed the Jelep La and descended into the Chumbi Valley, for from Yatung Mr. Ruttledge sent a dispatch to the *Daily Telegraph* dated March 22. The two parties must then have been very close together and should have joined forces at Gautsa. Together they would go forward to Phari Dzong on the edge of the Tibetan plateau.

If they left Phari on March 26 they should, judging by the speed of march of the expeditions of 1922 and 1924, have reached Kampa Dzong about March 31: have arrived at Shekar Dzong by April 12 and Base Camp by April 20, about seven weeks before they may expect the monsoon. It is quite possible that since the party is larger than it has been before the march may take longer, but in any case the early start should allow the men to acclimatize themselves slowly to the altitude and save them from the tiring necessity of having to establish the mountain camps without reasonable intervals of rest.

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EXPLORATIONS ON THE BURMA-TIBET FRONTIER: *A paper read at the Evening Meeting of the Society on 25 April 1932, by*

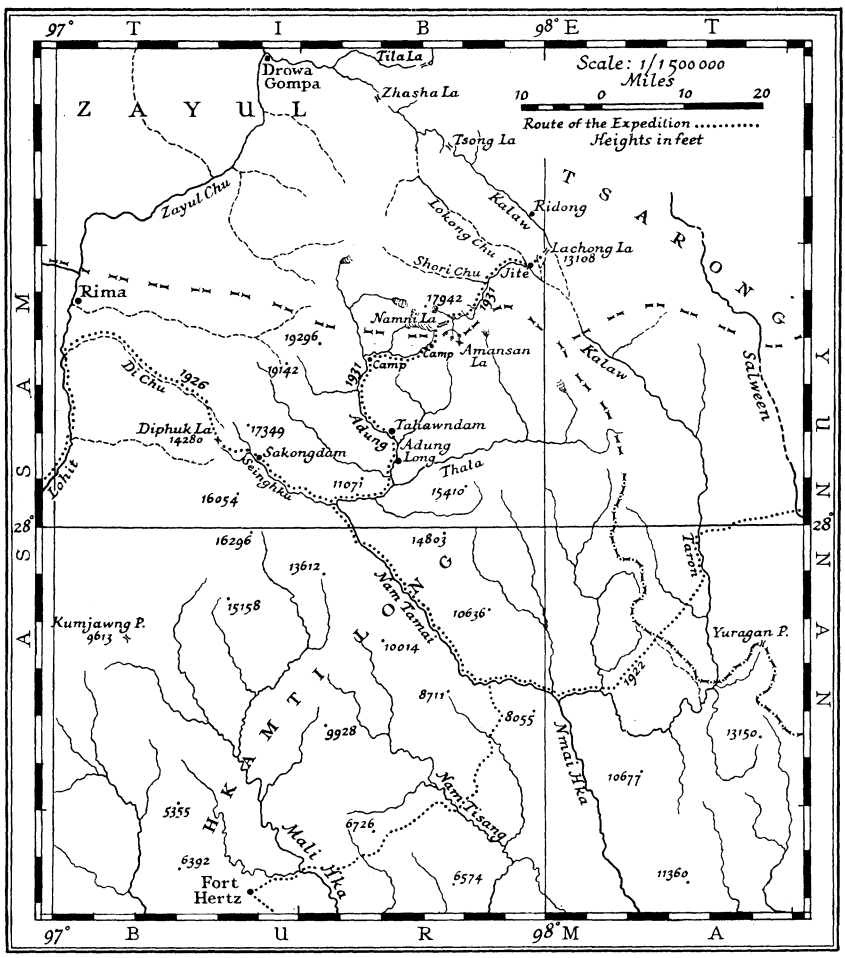
F. KINGDON WARD

IN 1930 Lord Cranbrook and I arranged to make an expedition to the sources of the Irrawaddy. Our objects were: (i) to collect specimens of the fauna and flora, and to introduce into Britain new hardy plants from that area; (ii) to cross the pass at the head of the Nam Tamai valley directly into Tibet, and link up our route, if possible, with that of any other traveller farther north; (iii) to make observations on the glaciers of this region, as to whether they were retreating or advancing, and how far they had formerly extended. I had previously undertaken several journeys at the headwaters of the Irrawaddy, but much remained to be done, especially farther north than I had hitherto penetrated. As in 1926 and 1928 the Trustees of the Percy Sladen Memorial Fund gave a grant towards the expenses of the expedition.

We arrived at Rangoon in November 1930, and proceeded by train to Myitkyina. The expedition finally left Myitkyina on November 26, reaching Fort Hertz on December 16. Here we were held up for several days. We left Fort Hertz on the 27th, and from that date onwards collecting work began in earnest. There is a cold-weather mule path from Fort Hertz to the Tamai river, eight marches in a north-easterly direction, and, when the Tamai bridges are in repair, for six marches up the Tamai, as far as the Seinghku confluence; but owing to the intransigeant attitude of the Yunnan government, Chinese mules working in Burma are not allowed to travel east of the Mali Hka, so after leaving Fort Hertz we had to rely on coolies for transport.

Between the Mali Hka and the Tamai, the mountains reach a height of 6000–8000 feet, and are densely covered with a type of evergreen forest which may be called hill-jungle. This forest extends eastwards from the foothills of Nepal and Sikkim, across Assam and Upper Burma, into Yunnan, in a continuous belt. It is possible now to lay down its limits with some degree of accuracy, and it is surprising how many tree species extend right across, linking up the Himalayan flora with the Chinese flora. On this journey I was able to extend the known distribution of many Himalayan trees eastwards, as well as of several Chinese species westwards, establishing beyond question the continuity of the forest flora in an east-west direction.

We reached the Tamai river a few miles above its confluence with the Taron on January 7. Progress was slow, on account of the shortage of transport, and we did not reach the Seinghku confluence till the 25th. At this point the Seinghku, from the north-west, joins the Adung (as the upper Tamai is called) which flows in from due east, and the combined river swings abruptly through



Sketch-map of part of the Burma–Tibet frontier

135° to flow south-east as the Tamai, continuing the direction of the smaller affluent.

Hitherto we had been on a proper path, even a mule path in the dry weather, but from the Seinghku–Adung confluence there is only a native track up either valley. I had been up the Seinghku valley in 1926; I now proposed to follow the Adung valley to its source, and ascertain whether or no there was a practicable pass into Tibet at its head. In 1926 I had crossed the Diphuk La, at the head of the Seinghku valley, and descended direct to the Lohit river, just

below Rima; this pass therefore straddles the Irrawaddy–Brahmaputra divide. But a pass at the head of the Adung valley, though it would lead directly into Tibet, would not cross the Irrawaddy–Brahmaputra divide. The general direction up this valley being north-east, or north-north-east, it must lead directly into the upper Taron valley, the main source of the Irrawaddy. Therefore, in order to reach the Lohit, it would be necessary either to bear more to the west, or to cross two passes.

The first European to see the Adung valley was the late Captain B. E. A. Pritchard, who in January 1913 ascended about 12 miles to the village of Adung Long, or Lama Ne. He was drowned in the Taron a few months later, during the course of the same journey. A few years later, Mr. P.M. R. Leonard, of the Burma Frontier Service, ascended to the last village, called Tahawndam, and continued a few miles beyond that. So far as I know, they are the only two who preceded us; at any rate no subsequent officer had been beyond the point reached by Mr. Leonard. Native surveyors of the Survey of India had however been up to, or nearly up to, the head of the valley in 1920–22, so that we had a good map of our proposed route. Unfortunately maps show neither political nor climatic obstacles, and having met with no difficulties as far as Tahawndam, the last village in Burma, we became rather too sanguine as regards the rest of the journey. We started up the Adung valley on February 2. At the confluence the river bed stands at 4000 feet above sea, and the mountains on either side, though very precipitous, are thickly forested. The end of the spur in the wide angle between the two rivers however is truncated in a series of escarpments, on which grow scattered trees of *Pinus excelsa*, a Conifer which, from this point onwards, is never far away. At the base of this great cliff, and at an altitude of only 4000 feet, a Tibetan family has settled, the advance guard of a movement southwards down the Irrawaddy ridges. This Tibetan migration wave is moving athwart a westward moving wave of Lisus from the Salween valley; and both are impinging not only against a solid block of Kachin tribes who already occupy the best sites, but also against a definite northward movement from the plains of Upper Burma towards the hill tracts. It will be interesting to see which prevails.

The first day's march lay up the left bank of the Adung, mostly in thick forest, never high above the river, and occasionally in the river bed. Easy as the path was, we made barely 5 miles (measured off the map) in seven hours; nor did we see any huts, though we met a party of Darus. Though we saw no huts—which are widely scattered and well concealed higher up the slopes—there were not lacking, in the rope and suspension bridges, and even in the trail we followed, signs of the presence of man; in the evening we came out on to a cultivated slope. On the following day we had a shorter and more interesting march. It was both more difficult, where we had to climb the cliffs, and cross a precipitous rock face, and at the same time easier, where down below we crossed several cultivated terraces; but as usual the jungle huts were not on the path. We had now changed our direction, and from marching eastwards were again marching northwards towards our goal. On February 4 we had an easy march up and down the cliffs to Adung Long, situated in a wider part of the valley, where the vegetation begins to change

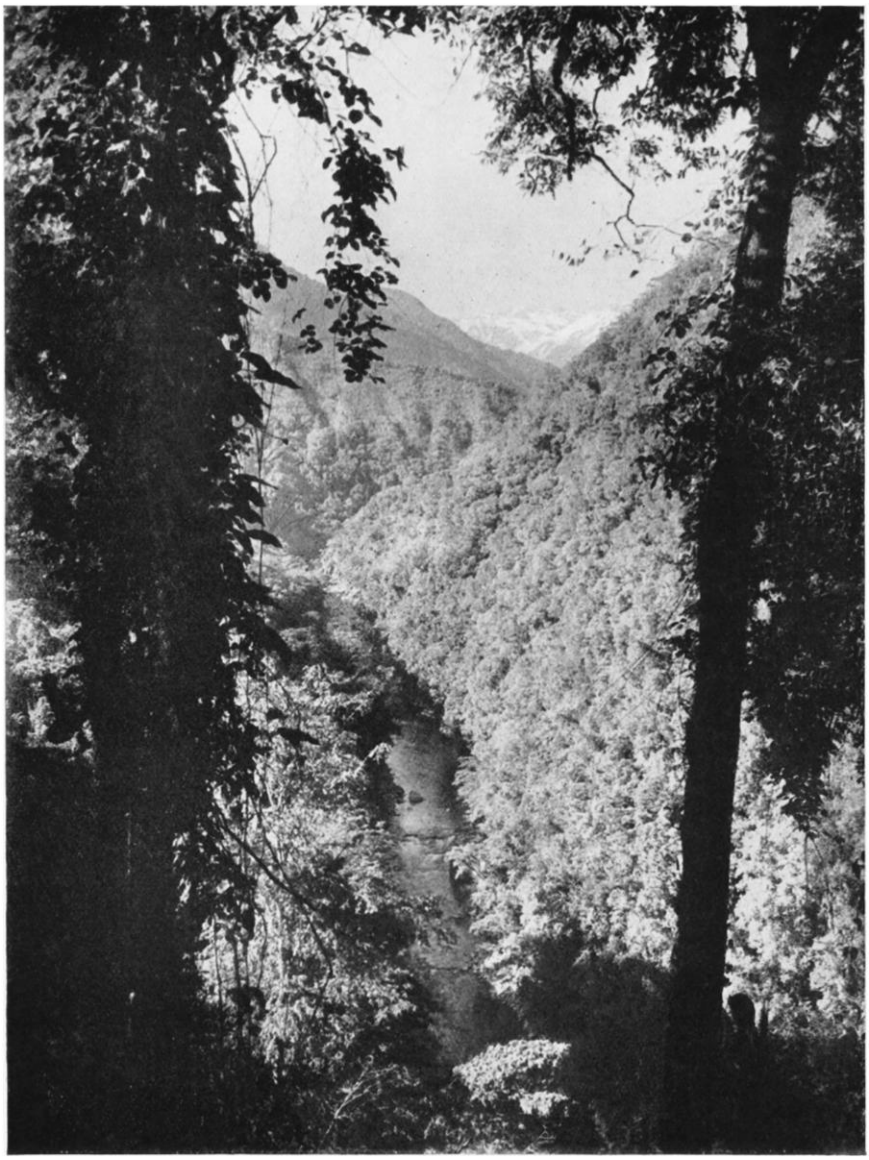
from predominantly hill jungle of Indo-Malayan type to warm temperate, with a considerable admixture of deciduous trees.

From Adung Long to the Seinghku confluence, the river falls about 1000 feet in 13 miles. We had left behind us three big tributaries, two from the east and one from the west; but as these rise amongst the high snow-covered hills of the interior fastness, at this season they bring down very little water, and the Adung river had not shrunk greatly at Adung Long. The steepest gradients in the river bed occurred just below each confluence, which suggests that the river is comparatively young. Indeed, the course of the Adung, as of so many rivers in this region, is altogether odd. The Seinghku appears to have been originally the upper course of the Tamai, no doubt when all the country north of Adung Long was under glacier ice, and very little water was flowing down the Adung valley. At any rate it is significant that the Adung valley, at least as far south as 28° 3′, appears to have been glaciated; the lack of overlap in the spurs—almost, one might say, the absence of spurs—the rounded summits of the hills, the extraordinary levelness of the ridges, no less than the wide profile of the valley and the straight sides of the escarpment often set well back from the present gorge, all point to glacier action. But naturally forest growth has obscured much of the detail, nor has the climate helped to preserve the harsh outline of a thoroughly glaciated region. It was only when we got farther up the valley, and indeed found living glaciers, that the last doubt vanished. The rock is everywhere of igneous origin, mainly granite; and this formed characteristic slab-faced outcrops and escarpments, bare of trees, on all south-facing slopes. At Adung Long there are whole broad slopes clothed with grass and bracken, dotted with widely scattered trees; but these pastures owe their treelessness largely, if not entirely, to fire.

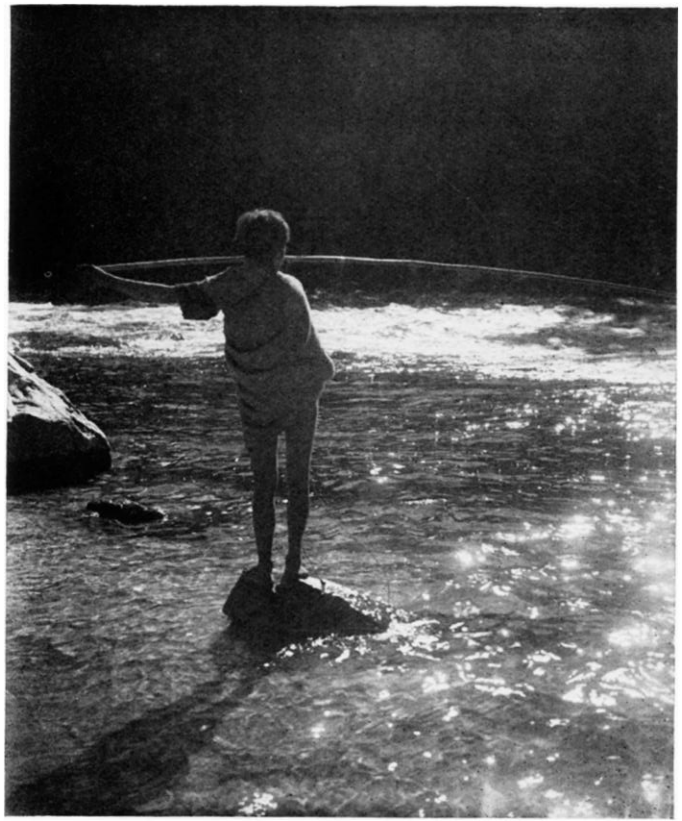
On February 5 a short march by an easy path, ascending however nearly 1000 feet, brought us to Tahawndam, the last village in Burma, on the left bank of the Adung river. About halfway we passed the junction of the last big tributary of the Adung, both below and above which are furious rapids. Here the valley, which lies north-west to south-east, widens out again, before finally contracting to a deep and narrow gorge a few miles farther upstream. By this time the forest is definitely warm temperate, and the Himalayan Pine (*P. excelsa*), together with oaks, maples, rhododendrons, and *Michelia doltsopa* grow along the river bank at the bottom of the gorge.

Tahawndam is the spearhead of the Tibetan irruption into the Irrawaddy basin. The political status of these headwater valleys has long been a subject of controversy, not only between the Indian, Chinese, and Tibetan governments, but between different schools of thought in India. British official opinion appears to be strangely inclined towards geographical frontiers, especially watersheds, irrespective of the implications. At the sources of the Irrawaddy such a frontier is impossible, as well as undesirable. It would imply administering territory on the far side of a great snowy range, inaccessible during six months of the year; territory which has moreover long been administered by Tibet, or at any rate by Tibetans.

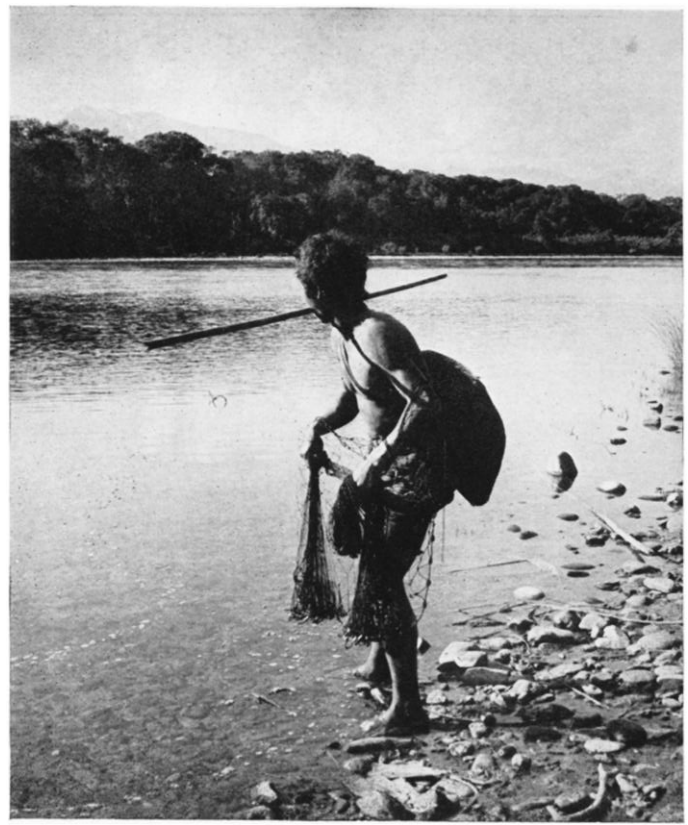
For this reason the Taron valley was definitely and finally excluded from the North-East Frontier of Burma and Tibet's (or China's) claim to it recognized. As the frontier had now to cross the gorge of the Taron somewhere,



Looking north up the Nam Tamai towards the Tibetan frontier range



A Daru harpooning fish in the Tamai



A Nung fishing with casting net in the Tisang

efforts were made to find a suitable line; and one was found based on Pritchard's report on his explorations on the upper Taron, in the course of his last fatal journey.

The second great headwater stream of the eastern Irrawaddy is the Tamai, which, as we have seen, splits into the Seinghku and the Adung; and here government has spoken with two voices. At one time it was proposed to claim only the Seinghku valley, which gave to Burma the Diphuk La, a pass giving direct access over the Irrawaddy–Lohit divide into Assam; the Adung valley was to be presented to Tibet, and is completely excluded from the administered area on Sheet 91 H of the Survey of India, on which no Burma–Tibet international boundary, demarcated or undemarcated, is shown. In 1930 however it was decided to retain the Adung valley as well, although owing to its remoteness its administration presents certain difficulties. The new policy is clearly dictated by the desire to make the watershed the frontier; hence the misgivings and complications when the Tibetans cross the passes and settle on the Burmese side of the frontier.

But obviously a pass of 15,000 feet is nothing to a Tibetan, who habitually lives at 10,000 or 12,000 feet altitude. The Tibetan is not stopped by physical, but by climatic barriers; and no boundary pillars are needed to make him respect these. His frontier is the verge of the grassland, the fringe of the Pine forest, the 50-inch rainfall contour beyond which no salt is[1] (until indeed you come to the sea), or the 75 per cent. saturated atmosphere. The barrier may be invisible; but it is a far more formidable one to a Tibetan than the Great Himalayan range. If he crosses it, he must revolutionize his mode of life. It is just here that the maps of mountainous frontier regions are apt to convey a false impression. These invisible barriers, so thoroughly respected by simpler civilizations than our own, cannot be depicted on an ordinary map, which unconsciously fixes our attention on mighty ramparts of rock.

Tahawndam itself comprises three Tibetan families, whose wooden single-roomed cabins, thatched with grass, stand amidst permanent cultivation in the valley bottom, at an altitude of 6000 feet. These people possess herds of half-bred yak, and goats, which furnish them with milk and butter; sheep, pigs, fowls, and two breeds of dog, the ordinary Tibetan mastiff watch-dog (smaller than those commonly met with in Tibet), and a small smooth-coated prick-eared yellow dog used for hunting. Yak are yoked to the plough. The Tibetans also hunt gooral, serow, and barking deer, and collect wild honey. They cultivate barley, oats, maize, buckwheat, millet, peas, and beans. In fact they live extremely well. Not so the Darus, of whom there are five or six families scattered up the slopes of the valley, where they grow crops on the old river terraces, sometimes nearly 1000 feet above the river. They have no cattle, and subsist precariously on their scanty crops, and on jungle produce. Such meat as they get comprises chiefly small animals—squirrels, flying squirrels, and bandicoots, though they also hunt larger game and snare pheasants. Temminck's tragopan occurs here above 8000 feet, and higher up the valley Geoffroy's blood-pheasant and the crestless monaul (*Lophophorus sclateri*).

One is tempted to think that the Tibetans are gradually ousting the Darus

[1] See 'Diet and Race,' by F. P. Armitage, *Longmans, Green & Co.* 1922.

from these valleys, but this seems unlikely. The Darus may indeed give way before the Tibetan pressure, but the Tibetan will not willingly exterminate the Daru; he finds him much too useful, and might be hard put to it to survive in these sour jungles if he had not the Daru to work for him.

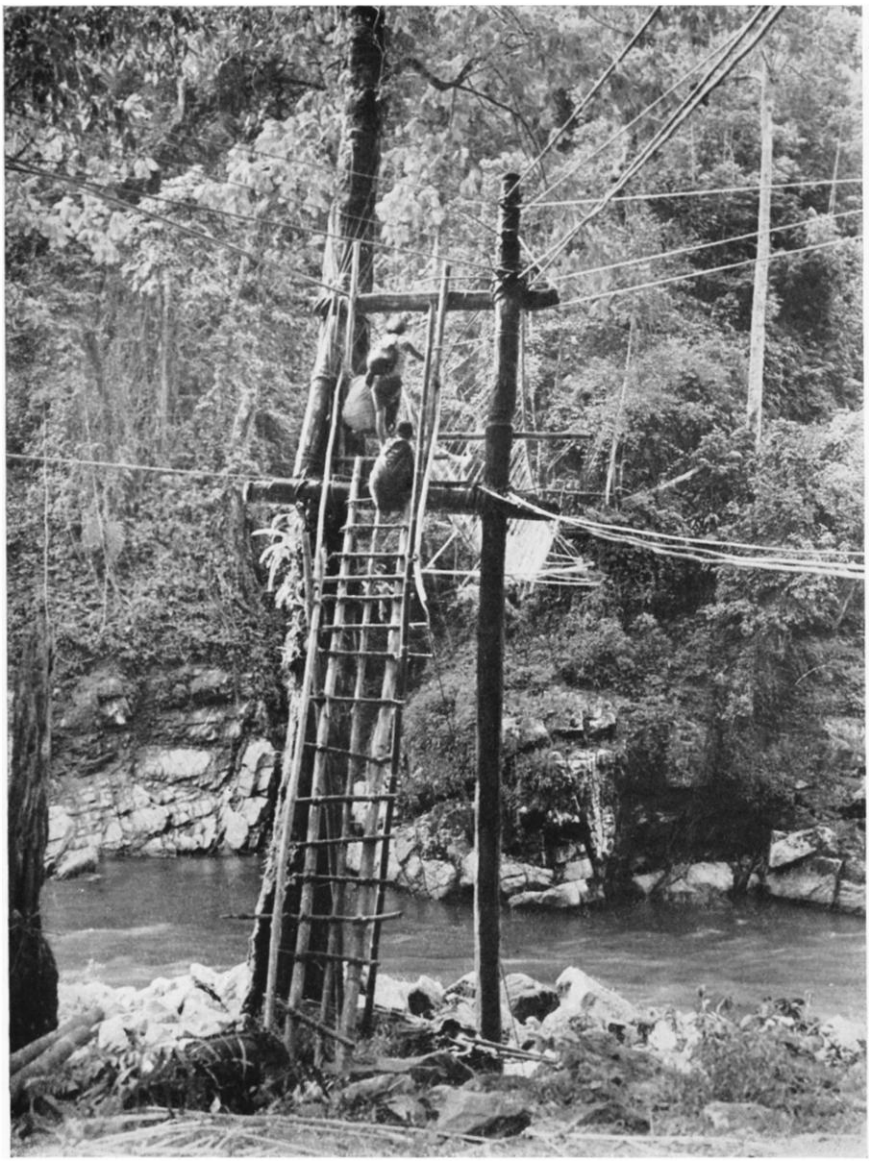
The Daru appear to be the only tribe of the upper Irrawaddy who have no generic name for themselves. The Tibetans call them Dalu or Talu. The English must have added the *r* sound. It is significant that the Mishmi, who live in the Lohit valley to the west, call the Lohit river the Tellu, which is obviously the same word. There is no evidence that the Daru have been pushed up towards the sources of the Irrawaddy from the south, nor is there any argument for such a theory. It seems to me much more probable that they came originally from the north and west, being forced over into the Irrawaddy by Tibetan pressure consequent upon Chinese pressure from the east. In other words, Mishmi and Daru are probably derived from a common ancestry in Zayul province; the Mishmi following the Lohit valley towards Assam, the Daru crossing the great range and lurking in the valleys of the upper Irrawaddy. They were prevented from moving farther south by the Kachins and the Shans, marching and counter-marching across the hill country south of Hkamti Long. Bailey, when he was at Rima, notes that the country over the range to the east of Rima, called Cho—in other words, the valley of the Tamai and its headwaters—is inhabited by a race similar to the Mishmi.[1]

The Daru are the same as the people called Khanung by the Shans of Hkamti Long; the Khanung, or Nung, is simply a more cultivated Daru. The people of the Taron valley, to the east of the Tamai, called Talong or Dalong by the Tibetans, are of the same stock, and speak practically the same language; Talong being obviously the same word as Taron. The Daru, though wild-looking, are very timid folk. They are usually dwarf, not exceeding 5 feet in height, though exceptions are sufficiently common to require explanation; women are shorter than men. Girls often tattoo their faces with blue lines and circles, or crosses; there are several patterns in vogue, and as these are segregated in different localities they presumably indicate clans; but tattooing seems to be optional, and of no real significance other than ornamental.

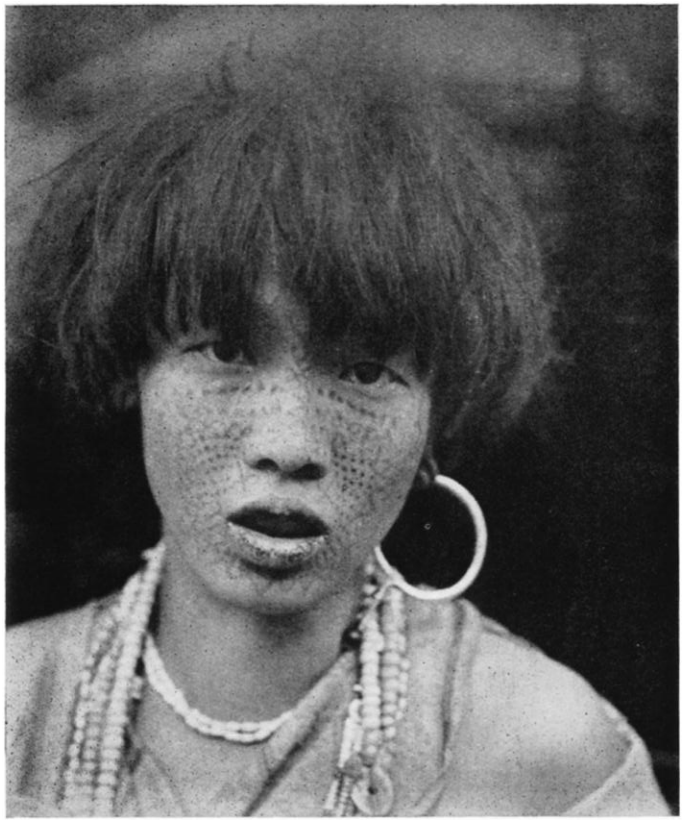
Other peculiarities of the Khanung or Daru are their use of the "necktie" hoe (a short iron implement with a wooden handle, used for scraping weeds), their method of harpooning fish—the harpoon, with four detachable iron hooks fixed loosely into sockets at the end of a bamboo is perhaps more in the nature of a grapple than a harpoon—and their use of thorn-lined bamboo fish traps.

They burn their dead, the ashes often lying in state (in the open) for a considerable time awaiting a favourable, which means a financially favourable, opportunity for interment. It is the burying, not the burning, which is the significant ceremony. A wooden coffin, shaped, and sometimes rudely carved with a face, like an Egyptian sarcophagus, contains the ashes; and during the lying in state the material property of the deceased, together with a few takin or other horns, decorate the bamboo platform. The religion of all these tribes is a primitive animism, nor has contact with the Tibetans substituted even

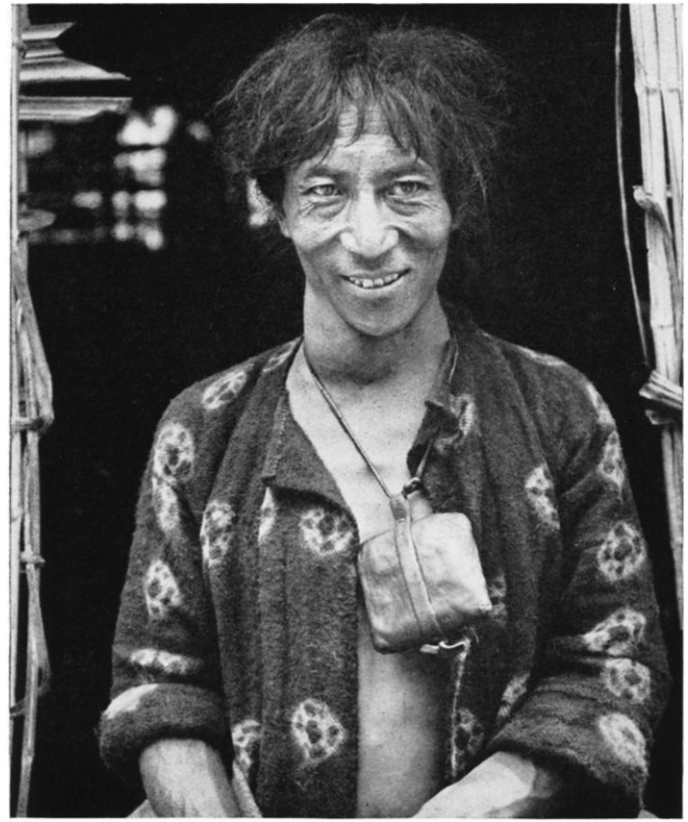
[1] "Journey through a Portion of South-Eastern Tibet and the Mishmi Hills," by Captain F. M. Bailey, *Geogr. J.*, April 1912.



Supports of a cane bridge spanning the Nam Tamai



Tattooed Daru girl



A Tibetan of Tahawndam, Adung valley

the most debauched Buddhist ideas for simple nature-placation; rather have the Tibetans who cross the range become infected with animism. The reason is clear. No Tibetan Buddhist monk considers it financially worth while to spread the gospel in such a country, amongst such a people.

We made Tahawndam our base for the year, and spent the next three months here. To our chagrin we found that the Tibetans do not take their herds up the valley to the foot of the pass, as we expected, in the summer; they take them straight up the mountain side above the village. This made things more difficult for us. Our object was to cross the pass at the head of the Adung valley, but we discovered that the pass is more used by the people on the other side than by the local inhabitants. As the pass was six days' march from the village, and the first village on the far side was another two days' march, everything turned on the transport problem. In the middle of May we moved our camp three days' march up the valley to a point where the river bifurcates. The actual distance was no more than about 15 miles, but the going was hard for the coolies. Lightly laden coolies would do it in two days. The track follows the left bank of the river, through the forest, and for the last few miles is high above the stream, descending again at the point of bifurcation. We camped on the left bank of the eastern branch, here bridged by an enormous tree trunk (often impassable during the rains), at an altitude of 8000 feet. The forest here is temperate mixed forest, about 50 per cent. of the trees being Conifers. These latter, especially *Picea Morinda*, *Pinus excelsa*, and *Tsuga yunnanensis*, attain a great size. Birch, maples, oaks, hollies, and, of course, rhododendrons, comprise the bulk of the broad-leafed trees and shrubs. The rhododendrons, of which there were fifteen or twenty species hereabouts, were in full bloom, and coloured the cliffs. Several species grew socially, and it was these especially which produced such gorgeous colour effects.

The north branch of the Adung rises amongst a group of snow peaks over 19,000 feet high on the main (Irrawaddy-Lohit) divide. It is certainly as big as, probably bigger than, the east branch. The water at this season was milky white, in strong contrast to the clean snow water of the eastern branch, and the gradient of the valley, for the first few miles at any rate, is distinctly less than that of the latter. Unfortunately there is only a hunters' trail up the north branch, and this soon disappeared, though not before I had reached a snow bridge across to the right bank, at a height of less than 9000 feet. A steep snow-filled gulley had thrown the snow across the river, and the bridge lasted into June, though it was wearing very thin when I last crossed it. There is said to be no pass at the head of this valley, which in itself suggests that this is the main branch, since it is unusual to find the pass at the head of the main valley; the northern branch also appears to be slightly longer than the eastern. On May 21 two Tibetans crossed the Namni La, the pass at the head of the eastern branch, for the first time that year. The winter of 1930–31 was a season of unusually heavy snowfall; and nothing could show more clearly the approach to drier Tibetan conditions than the fact of a pass over 15,000 feet high being open so early in the year. The passes to the south and east, 12,000–13,000 feet high, are rarely open before the end of June. In 1926 the Diphuk La, 14,300 feet, was not crossed till June 13. Farther north where the

climate, though severe, is much drier, the highest passes are open all the year round.

On June 6–7 we moved our camp another two marches up the valley, ascending 4000 feet in 10 miles. There was a large open boggy meadow or marsh here, surrounded by a fringe of Silver Fir (*Abies delavayi*), and bush Rhododendron; a short mile up the valley, and at 13,000 feet, more or less, on the sheltered cliff face, tree growth ceased. One may say that the tree line in the Adung valley lies between 12,000 and 13,000 feet, but that woody growth ascends another 1500 or 2000 feet. There is no plant growth above 16,000 feet. The snow-line is about 16,000–17,000 feet. We spent nearly three months in this camp before crossing the Namni La on September 1; thus we had plenty of time to explore the neighbouring valleys, as well as the main valley to its head. This marshy meadow is called Lung Sa—presumably "the valley (open) place or space"—which well describes it.

Perhaps the most surprising thing about the wild mountains we now found ourselves amongst was that there appeared to be no trace of any mammal larger than a cat-bear (*Aelurus fulgens*). Cranbrook hunted every valley assiduously, day after day, but saw nothing; neither did I on my many excursions after plants. At the top of the Seinghku valley I had frequently seen gooral up to 15,000 feet; here we saw none. A few weasels, and numerous Pika-hares in the open, and voles in the forest, represented the mammalian fauna. Blood-pheasants were numerous in one spot only, where there was a dense growth of Arundinaria. Temminck's tragopan was usually present in one high valley, and there was abundant small bird life. There were toads in the ponds, but we saw no snakes as high up as this. The alpine flora was of the usual Sino-Himalayan type, rich in species of Primula, Rhododendron, Pedicularis, Saxifraga, Gentiana, and other genera. There are also vast numbers of a species of Nomocharis (*N. Souliei*), and of *Omphalogramma Souliei*, and of two Gaultherias; while two families, Compositae and Ranunculaceae, together account for an appreciable percentage of the total alpine herbaceous flora.

The lateral valleys are all of the hanging type, and recently contained glaciers. We discovered two glaciers, as opposed to mere snow-beds, one at the extreme top of the valley, coming from a peak marked as 17,942 feet high on the survey sheet, the other in a valley to the south-east of our camp. The snow did not finally disappear from the highest ghylls till October. Thus the eastern branch of the Adung river, like the northern, may be said to rise in a glacier, and the Adung river derives some of its water, though not the bulk, from glaciers. One must however try to picture the whole of this region between the parallels of 28° and 30° N. and the meridians 92°–100° E. as covered at no very remote date, not so much with numbers of great glaciers, as with an almost continuous ice-sheet. In the neighbourhood of the Adung valley the uniform heights of the peaks and the long level ridges point conclusively to a plateau structure. This was clearly visible from our November camp immediately above the village of Tahawndam. Looking across the valley one saw the peaks on the other side sticking up from a uniform level of about 15,000–16,000 feet, which is the height of the highest glacier valleys. The heights of the peaks, which, as already observed, are remarkably uniform, give

the height of the ancient plateau. Out of this plateau a number of glaciers subsequently scooped wide comparatively shallow valleys, to a depth shown by the lips of the hanging valleys, say 13,000–14,000 feet. Lastly, as the glaciers shrank farther and farther, water cut deep V-shaped grooves in the wider ice-worn valleys.

When the ice was at its maximum, this Sino-Himalayan ice-sheet must have covered between 30,000 and 50,000 square miles; and the almost total disappearance of this vast quantity of ice, in the course of many thousands of years, has of course had a great influence on the flora, as well as on the shape of the country and on the climate.[1] In the alpine region it was noticeable how the hanging valleys occurred in tiers. Thus the side valleys overhung the main valley for 500–1000 feet. A tertiary valley overhung the side valley, also for 300–500 feet, and often a still higher valley overhung the tertiary valley. These steps probably mark a series of pauses in the retreat of the ice.

The core of the range is composed of granite, flanked on both sides by gneiss, schists, and slates, which dip steeply (45°–70°) more or less north-north-east on the southern flank of the dividing range, that is to say in the upper Adung valley, and more or less south on the northern flank, that is within the Taron basin. Thus the general strike of the rocks is east and west. Farther west a belt of crystalline limestone cuts right across the country in a general north-westerly direction parallel to the Tamai valley, where it forms the watershed between the Tamai and the Mali Hka[2]; but we diverged from this, and nowhere did we meet with limestone. If this belt continues in the same direction, it should reach the Lohit valley just north of Rima, and presumably the Lohit river cuts across it.

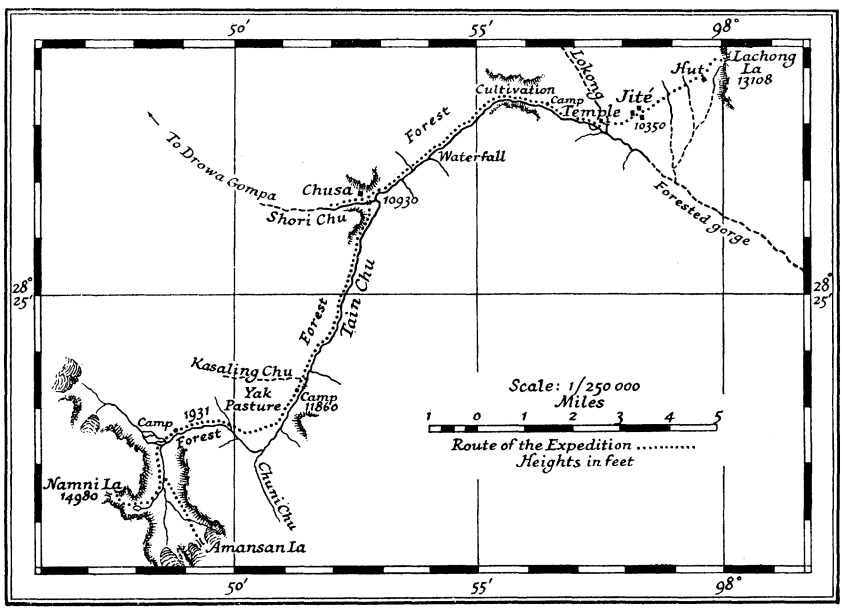
Every summer the Namni La is crossed by numbers of Tibetans, Lisus, Darus, and even Chinese, attracted to these inhospitable mountains by two things: the bulbs of a small alpine Liliaceous plant (*Fritillaria Roylei*) called *pai-mu* by the Chinese, and valued for its medicinal properties, and the skins of such animals as the gooral and serow. People come from as far east as the Mekong. The Darus, in turn, cross the pass to buy salt, clothes, cooking vessels, and cattle from the Tibetans. During July and August a considerable number came over and spent a fortnight in the upper Adung valley and its tributaries digging for bulbs.

Having persuaded ten of these people to carry loads for us on the return journey, we started on September 1 for the first Tibetan village on the other side, called Jité. It was a very wet day, with bad visibility. From near the foot of the glacier at the head of the Adung valley, the path turns due east, ascending precipitously to a hanging valley, whence the Namni Pass is reached over a snow-bed. The height is about 15,300 feet, and there is no view from the summit. Descending a precipitous scree and crossing a snow-bed we reached a beautiful glacier lake about 1500 feet below the pass, the water from which fell over a cliff into a larger valley. Descending steeply again, we saw three

[1]See "A Note on Deglaciation in Tibet," *Geological Magazine*, June 1927, where I estimated the total known glaciated area in the "river gorge region" at a quarter of a million square miles, and the total amount of ice melted at 139 billion cubic feet.

[2]See Murray Stewart: various papers in the *Records of the Geological Survey of India*.

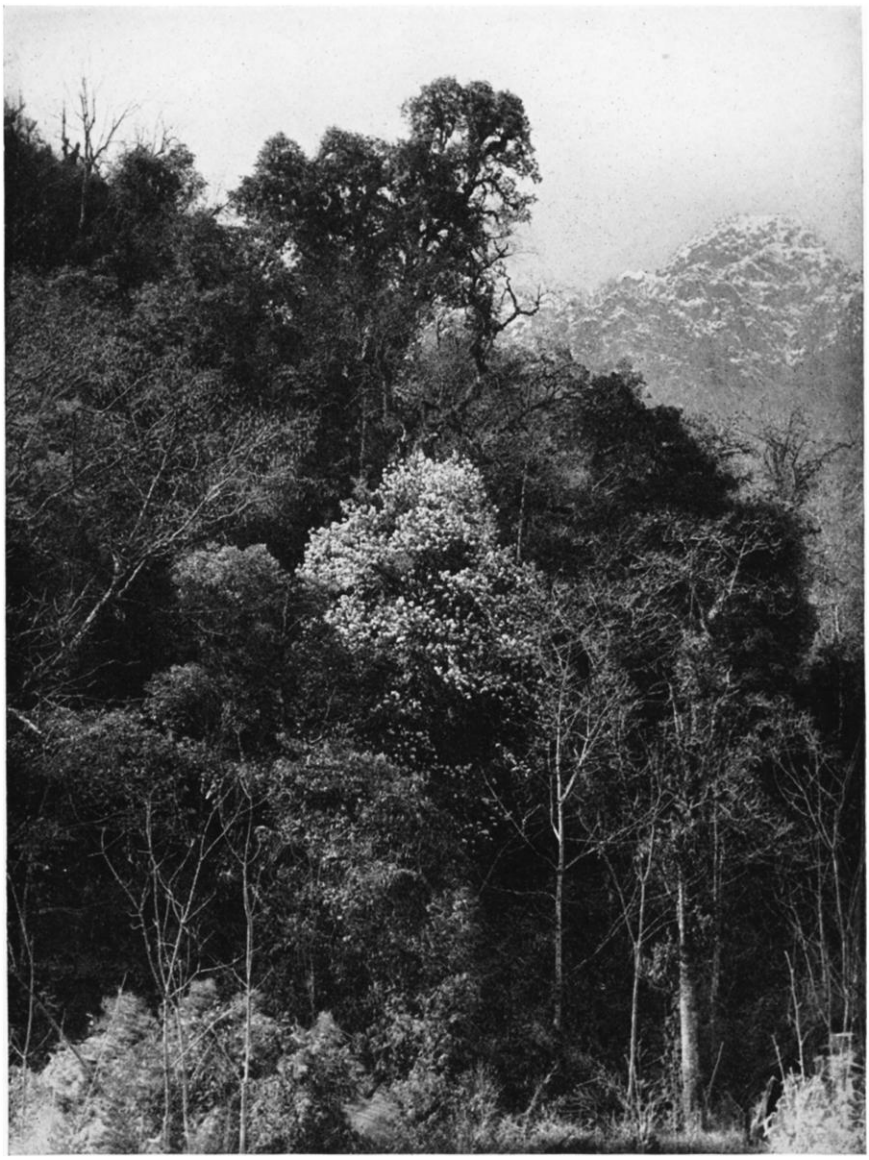
glaciers at the head of this valley, which we followed down to where the trees began, and here we camped. A large stream came in here from the west, and up this valley we noticed a fourth glacier. The alpine country on this side showed much deeper scars of ice work than the Adung valley, and it seems likely that it was more recently under ice. The main river was now flowing about east-south-east, and again it dropped very steeply over ice-smoothed granite rocks into a still larger valley, where it joined a river flowing north-north-east, which also probably rose amongst glaciers. A short march on September 2 brought us into this main valley, and we camped at midday in a huge flat pasture (a silted-up lake basin) over which scores of yak, sheep, and goats grazed. This meadow is known as Kasali; it is about $1\frac{1}{2}$ miles long and $\frac{3}{4}$ mile wide, at an altitude of 12,000 feet. Owing to the weather, survey work was



Route from Namni La to Jité; from a prismatic compass sketch by Lord Cranbrook

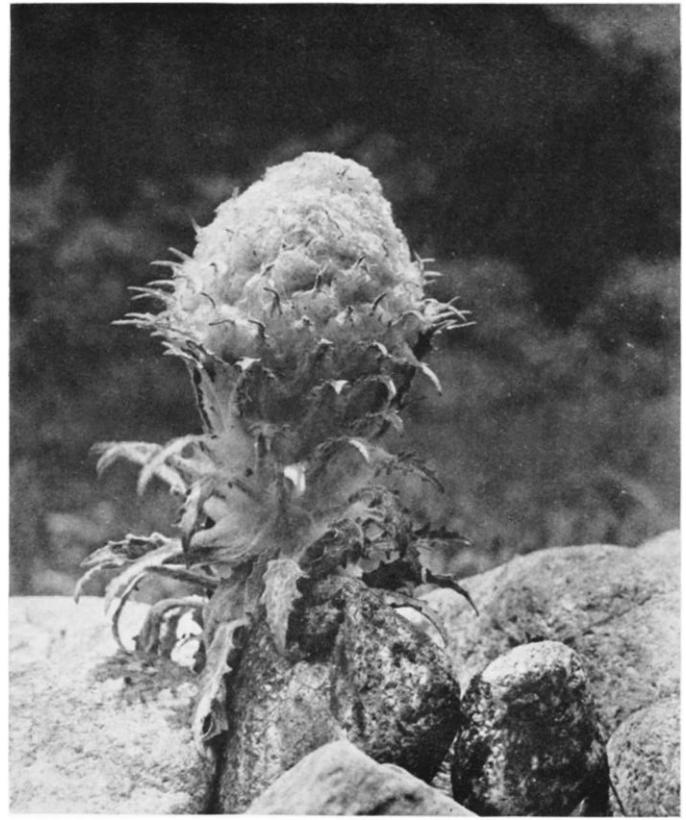
reduced to a compass traverse, faithfully kept by Cranbrook, who also obtained all the topographical information he could.

On September 3 we marched down the valley at first in a direction north-north-east, gradually changing to north-east and finally east. There is a good mule path all the way. After about 2 miles we crossed a large river—Shori river—from the west, by a good wooden bridge. There is a road up this river which leads to Drowa Gompa. It must therefore cross the Irrawaddy–Lohit divide, and probably reaches the Lohit in the neighbourhood of Chikung. This is the direct road from the upper Adung valley to Zayul. After marching some miles we camped in the forest, and next morning, continuing eastwards, we crossed another big river from the north-west, called Lokong Chu. This Lokong river, and the main river below the Shori junction, are about the same



Michelia doltsopa and temperate rain forest in the Adung valley at 6000 feet; March

Aster sp. in the Adung valley at 12,000 feet; August



Saussurea sp. in the Adung valley at 14,000 feet; September

size; the combined river is, or was at this season, a formidable stream, as big as the Adung river at Adung Long. After crossing the Lokong river we ascended 1000 feet or more, to the village of Jité. From Jité the road leaves the river, which turns south of east, and crossing two more tributaries reaches Ridong, on the Kalaw river, in three marches. (See Survey of India, Sheet 91 H.)

I turn now to the question of the source of the Irrawaddy. On his journey from China to Assam in 1911 Bailey crossed two or three of the Irrawaddy headwater streams (*op. cit.*). The first one he reached he describes as 20 yards wide (on June 17 when it would be full of snow water). Bailey calls this an upper branch of the Irrawaddy, and was told that it flowed to a country called Lhoka or Tsong. Lhoka sounds suspiciously like our Lokong. Though he does not mention it, Bailey evidently passed through or close to Ridong. He followed this river (the Kalaw ?) for two days, until it was only about a yard wide, and then crossed the Tsong La. The river he had been following so far rose just north of the pass in some snow-covered hills. For some obscure reason the Survey of India have projected the main branch of this river some 16 miles beyond, east and north of, the Tsong La (Sheet 91 H), though Bailey's statement is explicit. Any one with any knowledge of this country knows that a stream a yard wide in mid-June is likely to have its source closer at hand than that. The map is therefore probably based on that of Bacot. After crossing the Tsong La, Bailey reached a river which flowed due south, "and must be the headwaters of the Tarawan, which passing through Hkamti Long, joins the Irrawaddy." Bailey's Tarawan is obviously the Taron wang; and it is this stream which is our Lokong river. Thus the eastern branch of the Irrawaddy, or Taron river, has four headwater streams—the Kalaw, Lokong, Kasali, and Shori. We do not know which is the largest, but the Kalaw, hitherto regarded as the source stream, is obviously smaller than the combined Kasali, Lokong, and Shori streams, and the ultimate source must be sought amongst the latter. The Lokong river appears to be longer than the Kasali branch; but at the junction I could see little difference in volume, though it is of course impossible to judge. A river like the Irrawaddy has in fact several sources, and we certainly had the satisfaction of discovering one of them.

Jité is a small village of three wooden, slat-roofed houses, and one or two storehouses, standing amidst permanent cultivation on a shoulder of the mountain at an altitude of little under 11,000 feet. It is thus very much higher than Tahawndam. The inhabitants—Tibetans and a few Daru slaves—were rather shy of us at first, and held aloof; but after a few days they plucked up courage and sold us food as required, including turnips and potatoes; but transport to Ridong they refused, and here we stuck. The weather was atrocious throughout the fortnight we remained, and we were never favoured with a view in any direction. One thing was rather remarkable, and that was the difference in the flora on this side of the range; indeed I had noticed it almost as soon as we crossed the pass. We might still be in the Irrawaddy basin, but we were undoubtedly no longer in Burma. Imagine cultivation at nearly 11,000 feet, in Burma, to start with! In view of the far smaller rainfall on this side we hoped that September would be fine, but it rained persistently,

and by the middle of the month many of the trees were flying signals of autumnal distress.

On September 20 we broke camp, and with ponies to carry the baggage started for our Burma camp. The ponies had to be left at Kasali, coolies taking their place; and on September 23 we recrossed the Namni Pass in a deluge of rain, and reached our alpine camp. We had left a certain amount of food here, but not very much, and when our Tibetan coolies had departed, Cranbrook, our cook, and I found ourselves rather stranded. It was five marches to the village, and the headman, who was expected to meet us here, had not arrived, nor had a man we had sent to Fort Hertz with our mail. I had a fortnight's work seed collecting in prospect, and was in no mind to go down the valley, so Cranbrook undertook to return to the village and get help. He left on September 25 and reached the village on the 29th. A few days later coolies reached me with rations, enabling us to remain on in the alpine camp (12,000 feet) till October 19. The weather in October was the best we had had since the beginning of June, and there were quite a number of alpines in flower. On the 19th we started down the valley for the last time, with coolies who had come up to help us, and that evening I rejoined Cranbrook, whom I found in a new camp at 10,000 feet. Here we were marooned for a week, waiting for transport, and the weather breaking again we were far from comfortable. With relays of coolies we finally reached our base camp and the village on November 2. But it was a week later before our cook and the kit, which we had abandoned in the upper camp, arrived. Meanwhile the man we had sent to Fort Hertz with our mail had returned, and by the second week of November we were a reunited party.

On November 20 we broke camp for the last time and started back for Fort Hertz, reaching the Seinghku confluence and a comparatively decent track on the 23rd. Retracing our steps down the Tamai valley, we crossed over into the western Irrawaddy on December 1, and nine days later reached Fort Hertz, after an absence of just under a year. We spent a busy five days here, sorting and packing our collections of plants, seeds, mammals, birds, snakes, and insects, and on the 16th we set out on the last lap of our journey. We reached Myitkyina on New Year's Day, 1932, after an absence of just over thirteen months.

It will be some time yet before our collections are classified and named, but meanwhile it is possible to summarize some of the results of the expedition in a general way. Two problems present themselves when we come to consider the distribution of animals and more particularly plants, in south-eastern Asia. Which of the two great mountain systems—the east-west Sino-Himalayan system, or the north-south Sino-Malayan system—has mainly influenced distribution in south-east Asia: (i) in so far as a mountain system acts as a barrier, (ii) in so far as a mountain system acts as a carrier? (It may be remarked, in passing, that a great mountain system such as either of the above is itself a geographical area with its own endemic flora.) In other words, what are the relationships between the three botanical regions which are divided by, and also traversed by, these two mountain systems? The facts point to a continuous east to west flora, extending from the north-west Himalaya, eastwards through Bhutan, thence across the river system from the Tsangpo to

Rhododendron vesiculiferum in the Adung valley at 8000 feet; May

Gentiana gilvostriata in the Adung valley at 13,000 feet; October

Rhododendron Nuttallii in the Adung valley at 6000 feet; May

the Yangtze, through China to Japan and Formosa, rather than through Burma, the Malay Peninsula, and the East Indies; and this irrespective of any mountain barrier running north and south across the axis of extension. This view is strengthened as a result of our explorations and collections on the upper Irrawaddy. Thus, although the north-south ranges are such a conspicuous feature on an orographical map of south-east Asia, they have proved singularly ineffective in checking the east-to-west movement of the flora, or in advancing its north-to-south movement. We did however observe examples of this last movement, every one of which is striking.

This conclusion is of some importance in view of the much greater age of the Sino-Malayan mountain system. It indicates that the present distribution of animals and plants over south-east Asia is a geologically recent phenomenon, since it must obviously be post-Himalayan. But it is really much more recent than that. It was the advance and retreat of the ice in quite modern times which made for the present distribution, and which further accounts for most of the endemism in the mountain flora. It may be doubted indeed whether we can have any idea of the flora or its distribution here in pre-glacial times. What we see is the ultra-modern; even the recent is obliterated and a matter of conjecture. Our explorations at the sources of the Irrawaddy furnished further proofs of the great ice retreat (and of its one-time vast extension) throughout the mountains between the Brahmaputra bend and the Yangtze. We explored the upper Adung valley, crossed the pass at its head (thus proving a direct route from Burma into Tibet), and found one of the three sources of the Taron, besides disentangling other headwater streams. It may be pointed out here that the Diphuk La, at the head of the Seinghku valley, is the direct route from Burma to Rima and lower Zayul; the Namni La is the direct route to upper Zayul, *via* the Shori river, and to Tsarong and north-west Yunnan, *via* Ridong. The district round Jité and Ridong is neither Zayul nor Tsarong, and appears to be nameless. Finally, we discovered a number of glaciers, two at the source of the Adung river, and at least five at the source of the Jité river, proving how glacier-fed the eastern Irrawaddy really is.

Our collections of plants, animals, and birds are being determined at the Natural History Museum, and full details will no doubt be published later elsewhere.

APPENDIX

NOTES ON THE NATURAL HISTORY COLLECTIONS by members of the Staff of the British Museum (Natural History).

A. MAMMALS. By Guy Dollman.

During their expedition to Upper Burma Lord Cranbrook and Captain Kingdon Ward collected some three hundred mammals, many of which represent very rare genera, and names will have to be found for four new forms contained in the collection. The latter include a new gooral from the Adung valley, with which it is proposed to associate the name of Lord Cranbrook, and a new squirrel, which is to be named after Captain Kingdon Ward. There is also a bat of the genus *Myotis* and a species of the genus *Rattus* which require description. Accounts of these various new forms will appear in the *Annals and Magazine of Natural History* in due course. Two species of monkeys are contained in the collection, namely *Pithecus shortridgei* and *Macaca nemestrina*. *Pithecus shortridgei*

is a grey-coloured langur monkey allied to *Pithecus pileatus*, but entirely lacking the buff tint of that species. It was originally described from Homalin, Upper Chindwin, Burma, by the late Oldfield Thomas and the late R. C. Wroughton. The Pig-tailed Macaque, *Macaca nemestrina*, is represented by two specimens, a young one from the Adung valley and a part of a skin made into a native bag along with a portion of skin from the new species of gooral, from Nam Tamai.

Four species of bats were obtained and no less than ten genera of Insectivora. Amongst the latter are some exceptionally rare forms. Three specimens of the squirrel-like Tupaia, or tree-shrew, were obtained in the Hkamti Plain and Nam Tisang. This is the common Chinese tree-shrew described by Anderson from West Yunnan. The family Talpidae is represented by three genera, namely *Parascaptor*, *Scaptonyx*, and *Rhynchonax*, the latter two being very rare genera hitherto known only from a few specimens. The genus *Scaptonyx* was founded by Milne-Edwards on material from Kokonor and Szechwan, and the specie was described as *Scaptonyx fusicaudata*. Some years later Oldfield Thomas described under the name of *Scaptonyx fusicaudata affinis* a new race of this species from Atungtsi in the drainage area of the Upper Mekong. The only other specimen of *Scaptonyx* in Museum collections is one collected by the late Mr. Forrest from the Mekong–Salwin Divide which has been referred to this subspecies. The present specimens, some three in number, came from the Adung valley, and therefore may be looked upon as identical with *Scaptonyx fusicaudata affinis*. It should be noted however that all three of the new specimens have considerably longer tails than the type of *affinis*, but I do not feel justified in attaching any systematic importance to this character in view of the geographical side of the problem. *Scaptonyx*, like *Rhynchonax*, is one of the members of the family Talpidae which imitate the shrews, being more like a shrew than a mole. *Rhynchonax* was described by Oldfield Thomas as a new genus in the year 1911 on material sent home by Mr. Malcolm Anderson during the Duke of Bedford's exploration of Eastern Asia. Two specimens of this rare genus are included in the collection, both from the Adung valley, so that the distribution of *Rhynchonax* is now known to be considerably more extensive than was formerly thought, the typical series of *andersoni* coming from Omisan, South Szechwan. *Rhynchonax* is closely allied to the genus *Urotrichus*, with which are associated the genera *Uropsilus*, *Nasillus*, *Dymecodon*, and *Neurotrichus*.

Amongst the shrews are fine series of the two Giant Water-shrews belonging to the genera *Nectogale* and *Chimarrogale*, which appear to be referable to the species *Nectogale sikhimensis* and *Chimarrogale styani*. Of the true shrews a large series of the striped shrew-mouse was collected in the Adung Valley and another rare species found in the same locality was the short-tailed *Blarinella wardi*, named after Captain Kingdon Ward by Oldfield Thomas in 1915. The type of *Blarinella wardi* was collected at Hpimaw, Upper Burma, at about 8000 feet, the genus having hitherto only been recorded from Western China. A specimen of the long-tailed shrew-mouse, *Soriculus irene*, was also obtained in the Adung valley district. This latter species has an enormously long tail compared with the length of the head and body; in the type specimen the head and body measure 60 mm. and the tail 90 mm., and in the present specimen the tail is even longer, measuring some 101 mm. The type of this species came from Yuenchingsien, South-west Szechwan, and does not appear to have been recorded from any other locality except some specimens from Mount Omi, referred to this species by Oldfield Thomas.

Two large cats were collected at Nam Tamai, *Profelis temmincki tristis* and *Profelis temmincki dominicanorum;* the latter, which was described from Foochow, Fukien, China, has recently been recorded from Laos by Wilfred H. Osgood.

Two palm-civets (*Paguma grayi*), a leopard cat (*Prionailurus bengalensis*), a martin (*Charronia flavigula*), and a panda (*Ailurus styani*), were collected at Nam Tamai and Nam Tisang. Other members of the carnivora in the collection are a wild dog, two species of weasel, and a linsang.

The collection of rodents contains about sixteen different genera including specimens of the giant flying squirrel (*Petaurista yunnanensis*), the lesser flying squirrel (*Hylopetes alboniger*), the giant squirrel (*Ratufa gigantea*), the long-nosed squirrels (*Dremomys pernyi* and *Dremomys macmillani*), and two species of striped squirrels of the genus *Tamiops*. There is also a large series of the red-bellied squirrel (*Callosciurus erythroeus*) and two specimens apparently representing an undescribed form of the genus *Tomeutes;* these latter came from the Kachin Hills and a description of the characters will be published in due course. Among the rats is an interesting new species and about six other species of the genus *Rattus*.

The ungulates are represented by three Chinese muntjacs, a serow (a subspecies of *Capricornis sumatrensis*), and the new gooral. This latter form, a description of which will be published in due course, is a very handsome animal, and Lord Cranbrook and Captain Kingdon Ward are to be congratulated on securing such a fine new species. The type came from the Adung valley and a fragment of skin apparently belonging to the same species forms part of a native bag obtained at Nam Tamai.

B. REPTILES AND AMPHIBIANS. By Dr. Malcolm Smith.

The collection of Amphibia and Reptiles, although not large, is of considerable value. The region visited is of particular interest in that it is the meeting-place of the true Himalayan and the Trans-Himalayan faunas, the latter being mainly of Chinese origin. Altogether seven species were obtained. Among the Himalayan species, whose range is now extended farther east, are *Rhacophorus maximus*, one of the largest of the Indian tree-frogs, *Scutiger sikkimensis*, an interesting toad that has not hitherto been found below 14,000 feet altitude (this specimen was collected at 12,000 feet), and a Pit Viper, *Trimeresurus jerdoni*.

Two snakes with a wide range in Southern China were obtained, namely, *Natrix nuchalis* and *Elaphe mandarina*. The only lizard collected was an *Agamid* of the genus *Calotes*, and it proves to be new to science. It was caught in camp in the Adung valley, altitude 7000 feet. I have pleasure in naming it after the leader of the expedition. A description of this lizard will appear in the forthcoming volume on Lizards in the Fauna of British India series.

C. BIRDS. By N. B. Kinnear.

The collection of birds consists of some 152 specimens belonging to 92 species, and of these over a dozen are new to the Burmese list. One, a Bar-wing, is a new race of the Hoary Bar-wing of Nepal and Sikkim. Many of the birds are intermediate in character between those found in the Himalaya and Yunnan. Among game birds there is a Temminck's Horned Tragopan, with curious brilliant blue horn-like processes of skin on either side of the head; two young birds of Sclater's Monal; Kusier's Blood Pheasant, and a Black-breasted Kalij Pheasant. Pigeons include two species, the Snow Pigeon, and the large Grey-headed Imperial Pigeon. The only wading bird is a common Sandpiper obtained on migration on November 30 at Trang, near Myitkyina, while a Teal—a winter visitor to the Adung valley—was shot on February 27. A Burmese Barred Owlet is the only bird of prey in the collection, but the Woodpeckers are represented by three kinds of Pied and a beautiful Rufous Piculet, a miniature Woodpecker about the size of a Nuthatch. Of Sunbirds there is the brilliant Yunnan fork-tailed Sunbird, also Dabry's Sunbird with a brilliant scarlet breast and metallic purple

head, and the more sombre coloured Nepal Yellow-necked Sunbird ranging from Sikkim to Yunnan.

Two examples of Hodgson's Wagtail were obtained in May, and probably breed in the district. The Finches include several interesting species, but three examples of the Himalayan Siskin call for special mention, since, before Forrest obtained a single male on the Lichiang Range in 1925, it was only known from six specimens in the British Museum from Sikkim. There are several small Willow Warblers and two kinds of Thrush, one of which, the Black-throated Thrush, is a migrant from the north and has occurred in the British Isles as a straggler. A Wren indistinguishable from that of Nepal is represented by a single specimen, and there are two Brown Dippers similar to our bird but of a uniform brown all over. Among the Timalidae there are two birds of striking colour, the beautiful little Fire-tailed Mixornis, green all over with the outer webs of the tail edged with red, and Hodgson's Grandala, the size of a Thrush and of a deep violet-blue colour; this last was previously known only from the Himalaya and Szechwan. Of the true Babblers, three out of the five species have not previously been recorded outside Yunnan. The Tits include a miniature Long-tailed Tit, a race of our Cole Tit, and a Crested and Green-backed Tit. Among the Corvidae there is a form of the Indian Jungle Crow; a beautiful long-tailed blue-and-white Magpie, with a red bill; and a Green Magpie, or Hunting Crow, in which the yellowish-green colour changes after death to a dull blue.

D. INSECTS. By K. G. Blair.

Mr. N. D. Riley reports of the butterflies, on a preliminary examination, that they are all known species but include some interesting forms and that their affinities are entirely with Western China, not at all with India or Indo-China (*i.e.* Eastern Palaearctic, not Oriental).

The Diptera consisted mainly of Tipulidae, of which Dr. F. W. Edwards finds forty species, almost all undescribed. The identified species are *Tipula hingstoni* Edw. recorded from Mount Everest and *T. wardi* Edw. from Southern Tibet. (The latter is probably identical with *T. splendens* Brun. from Garhwal.) The others show no noticeable affinity to Indian or Indo-Chinese forms, but several of them are allied to species known from northern Yunnan or Szechwan; others are related to European forms.

The Bumble-Bees have been examined by Dr. O. W. Richards, and show affinities with the Himalaya.

DISCUSSION

Before the paper the PRESIDENT (Admiral Sir WILLIAM GOODENOUGH) said: That great river, the Irrawaddy, a free translation of which I believe to be "the container" or "possessor of water," and which forms one of the great highways of Burma, though not, as many people think, part of its irrigation, has its source somewhere about the 28th or 29th parallel of latitude. I say "about," for, unless Mr. Kingdon Ward has discovered its source during his recent journey, the real source of the Irrawaddy is unknown. As the crow flies it is many miles from the mouth of that river, and as the river runs it is 1300 miles, for a thousand of which from its mouth it is navigable by good-sized steamers. I mention this to show how important the source of such a river is. It is the headwaters of that river of which we are to hear to-night, and we are to hear of them from one whose travels and investigations have made him one of the greatest authorities that we could call upon.

Mr. Kingdon Ward was at St. Paul's School, and after that at Christ's College, Cambridge. He started his journeys early, for in 1907, though you might not

think it to look at him, he was in Shanghai. He crossed China in 1909–10, and began plant-hunting in 1911. In 1913–14 he was travelling about Yunnan and the Burmese frontier, and after serving in the war he went back to Burma and made many journeys there. He went to Western China and found new routes back from those parts in 1924, 1926, and 1928. Then he explored certain portions of Assam and the frontiers which approach to those places, and in 1929 he made a very interesting journey through Indo-China across to Hanoi on the Annam border. In 1931 he and his companion, Lord Cranbrook, who is here to-night, were the first Europeans to reach the Tamai pass that leads into Tibet, but just missed joining up with the route followed by Colonel Bailey as he came down towards the south and west in 1911. It is of that journey that I will ask Mr. Kingdon Ward to tell us now.

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

The PRESIDENT: Although I said it in introduction of Mr. Kingdon Ward I think it will bear repetition, that is, that he and Lord Cranbrook were the first two Europeans to look over the Tamai pass into Tibet. Any new expedition of that kind bears the mark of the pioneer which we like to honour so far as we can in this Society. Lord Cranbrook is here this evening. I will ask him to address us.

Lord CRANBROOK: It is extremely embarrassing to follow Mr. Kingdon Ward because he always does things much better than I do. You have seen his photographs, but you have seen none of mine because none of them came out. I was following him the whole time and I am going to do the same now.

As he said, my job on the trip was mainly zoology. I do not know whether you realize what are the trials of a zoologist's life out in Burma. I am devoted to roast duck, and one thing I love more than any other is the nice brown fat skin. When one shot a duck and had to take that skin off for the Museum it almost broke one's heart, and when one brought it home to be told it was a common teal one's heart was completely broken. We got a few birds and a good few mammals, but, as Mr. Kingdon Ward said, most of the mammals are very small. I used to carry a rifle all over the place, a shot-gun, a catapult, and a butterfly-net. I did far more with the butterfly-net than with the rifle. We got one new big-game animal, a new species of gooral. Apart from that the animals were all previously known.

Kingdon Ward showed how four areas meet in the district we traversed: those areas are Tibetan, Chinese, Malayan, and Indian; and he told you also that the flowers are very largely Tibetan and Chinese. In the same way the Chinese forms seem to predominate in both the birds and the animals. It is too soon to say anything definite yet because it has not been possible to work out the animals. We carried an enormous quantity of tackle to collect snakes and frogs and such things but were very unsuccessful. Snakes and frogs hid themselves whenever we approached. We brought back four snakes, one frog, and two of the most delicious and enormous slugs you have ever seen. They were absolute gems, but they are set as hard as rocks and nobody has found out what they are.

The PRESIDENT: You have heard Mr. Kingdon Ward speak of the governors of Burma. We have one here to-night, Sir Harcourt Butler. I will ask him to address us.

Sir HARCOURT BUTLER: I feel that I cannot add anything very important to the delightful addresses that you have already heard, but your President told me, and we all have to obey the President, that he wished me to say something about the lower reaches of the Irrawaddy. Mr. Kingdon Ward told us about the Irrawaddy as far south as Myitkyina.

The Irrawaddy is still the great highway of Burma. Lord Dalhousie, one of the greatest and most far-seeing of the Governors-General of India, added

Lower Burma to the British Empire after the Second Burmese War in 1852. It was one of his main objects to open the Irrawaddy to the commerce of the world. He called it, and it still is, a mighty avenue. The opening of the Suez Canal in 1869 completed the transformation of Burma; a great demand was set up for rice and other grain and raw materials, and the Irrawaddy from that day has been a very great highway of commerce. I swam across it somewhere about 200 miles below Myitkyina, where it was so rapid a stream that I was carried at least three-quarters of a mile down to the bank on the other side before I could land. I should not swim it now! I was told then there were no crocodiles, but towards the end of my time in Burma I did find a crocodile in a tributary of the Irrawaddy. The river is not however infested with crocodiles, as are the rivers of India. There are a few at the mouth. How they get there is not quite known. There is another difference as compared with the Indian rivers, and it is that the porpoise of the Irrawaddy is quite a distinct species from the gangetic porpoise which is found not only in the Brahmaputra and the Ganges, but also in the Indus. Geologists tell us that the whole of Northern India was once a great sea or lake.

The Irrawaddy at Mandalay has become rather a slower stream. Down to this point its course is fairly straight. Then it begins to meander. Mandalay is about 250 feet above sea-level, and the Irrawaddy runs over 700 miles from there before it reaches the sea. There are great variations in the level of the river. Between the lowest watermark and the highest flood-mark at Mandalay I think, speaking from memory, there is about 40 feet. Southern Burma is one vast rice plain through which the Irrawaddy discharges itself in innumerable streams. Hitherto we have not used the Irrawaddy for irrigation. The water is wanted to keep up the steamer service which is an excellent service run by the Irrawaddy Flotilla Company. The area of land to be irrigated between the hills and the river is said by engineers of Indian experience to be insufficient to make it worth while to develop a big irrigation scheme. We are making railways and roads, and in time no doubt the Irrawaddy will cease to be the important highway it is at present, and then perhaps its waters will be used for irrigation and also for water-supply to the towns.

The Irrawaddy is a beautiful river. You see all sorts of craft on it, canoes, sailing-boats, a sort of dhow, what they call sampans, and rafts with which they bring teak wood down to the coast. It takes five years to get a teak tree to the coast. The wood is so heavy that they have to kill it before it will float. A notch is cut round the base of the tree something like 6 inches deep. That lets all the sap out, and after three years the tree is felled and dragged to the nearest stream which flows into the Irrawaddy or other big river. The trees get jammed and they then use elephants and buffaloes to pull them out. Once the logs reach the big rivers they are made up into rafts with bamboos and other lighter woods, and they float slowly down the river to the coast.

The sunsets on the Irrawaddy are famous. Life there is very peaceful. People enjoy life and wear bright garments. They are altogether a most charming race. This is all I have to say about the lower end of the Irrawaddy, of the higher reaches of which we have heard in Mr. Kingdon Ward's and Lord Cranbrook's delightful addresses.

The PRESIDENT: Mr. Kingdon Ward, the size of this audience will have shown you when you began how eagerly we looked forward to your lecture, and I can assure you, both on my own behalf and on behalf of everybody here, that we have not been disappointed in your remarks, nor in any of the very lovely pictures which you have shown us. If we have one further wish, when you go again to that part of the world you will be able to satisfy it, for by then I hope we shall be able to supply you from this country with some plates for coloured photographs.

I know when you went last time you tried to take some and that something went wrong with them.

I was very glad to hear you give such praise to the maps of the Survey of India. There is a member of the Indian Survey here this evening, and he tells me that he would like to tell you how gratified he is to hear that those maps are correct. From time to time there have been criticisms of the maps, I will not say of the main features, but of some of the details of the maps, and it must be a great satisfaction to those concerned to know that you have found them so accurate.

You heard Mr. Kingdon Ward speak of the trials of travel to a middle-aged man. I am told by his companions that that is not the trouble they find. On the contrary, they wish he would take things a little easier sometimes so far as they are concerned. Some one remarked to me to-day: "Oh, Kingdon Ward, by Jove! You know, he really is as hard as nails." I am going to take advantage of my age and my position as President to tell Mr. Kingdon Ward that when he goes again we hope he will look after himself a little more, because we want to get a great deal more out of him yet. We do not want to see him breaking himself up unnecessarily.

I have not been in those parts myself. Very few people have. My business here is, as always, a very delightful one, and that is to convey the thanks of this audience to Mr. Kingdon Ward and Lord Cranbrook for a very charming evening. I did not mention before, and perhaps it is unnecessary to remind you now, that Mr. Kingdon Ward is a Gold Medallist of our Society; and after the way in which he has delivered his lecture, with no mention of hardships, difficulties, and dangers encountered, you may not be surprised. I beg you to accept, therefore, Mr. Kingdon Ward, our most sincere thanks for the admirable work you have done and for the delightful and, may I say, modest way in which you have described it.

did not reach Khava on the east or the Gizarud on the south, but that when he stood on the rolling hills of the Kuh-i-Daud, south of Harsin, which he describes exactly, and asked his guides what the place was called, they waved their hands eastward in the vague Persian way and said, "There is Khava," though as a matter of fact the plain is nearly a day's journey farther east. The fixing of localities is indeed one of the most difficult things in nomad country with no settled villages.

Professor Minorsky has kindly sent me the following comment on the name Dukkan Daud = the Shop of David (p. 499): "There is a more celebrated place of that name south of Saripul. Both are certainly supposed to be David's workshops where he fabricated his famous coats of mail (Quran xxi, 78; xxxiv, 11). The place must certainly be connected with the Ali Ilahi cult."

[*We regret that we have not been able to reproduce for this number the sketch-map which Miss Stark made to illustrate her paper. It is however available for students in the Society's collection, and we hope that it may be reproduced in a later number to accompany a further paper by the author.*—ED. *G.J.*]

THE HABITABILITY OF CHINESE TURKISTAN

LIEUT.-COL. R. C. F. SCHOMBERG, D.S.O.

AT a period when Nature has shown herself so lavish that the world is glutted with foodstuffs, it may be almost perverse to discuss the possibilities of the empty places of the universe; but population continues to increase, and lean years follow fat ones. These empty places must therefore be a subject of speculation, and it is proposed to consider briefly to what extent the province of Sinkiang, which embraces all Central Asia now in Chinese hands, can support future generations.

Politically this province comprises three geographically distinct regions: 1. The so-called Tarim Basin between the Tien Shan and Kunlun ranges, which is at once the most populous and the oldest inhabited of the three. 2. The plain north of the Tien Shan. 3. The Altai area, between the Great Altai range and the Irtish river. The Ili valley and the Turfan depression are isolated tracts which do not call for separate discussion.

The population of the province consists of nomads and settled cultivators. It is the latter who predominate, and the means of subsistence from agriculture are greater than from pastoral pursuits; and as the Tarim Basin is the most promising part of the province, it is well to consider it first. Agriculture in the Tarim Basin or Kashgaria (a more convenient name) depends wholly on irrigation, and I have nowhere seen south of the Tien Shan, either on the plain or in the hills, a single piece of unirrigated ground under crops. The present population of Sinkiang is between 5 and 6 millions, and that south of the Tien Shan certainly well over 4 millions. Professor Penck's estimate (see *G.J.*, vol. 76, p. 484) requires revision. The estimate as now given is based

partly on observation, but chiefly as the considered opinion of the late Governor and the chief officials at Urumchi, and may be regarded as a conservative one.

To enable any clue of the capabilities of the Tarim Basin to support a larger population its irrigation must be considered, for on irrigation depends the life of the people. Unfortunately, Turki methods of irrigation are singularly bad. The season is from May to September, and during the rest of the year, when the water is low, or frozen, the fields are flooded to soften them, though even this is not the universal practice.

Sketch-map of part of Chinese Turkistan

Any one who has observed methods of irrigation in other parts of the world where water is scanty or the congestion great will be unfavourably impressed by even a casual glance at Turki irrigation. To begin with, there is no system at all. It is true that there are local functionaries in charge of the water supply, but there is no co-ordinated arrangement whatever. The original canalization is uneconomical and inadequate, and the distribution of the water is unequal and uncertain; and in addition the cultivator himself wastes his water. Thus, from the moment the supply in the river is tapped, much avoidable loss, apart from sepage, is incurred. The whole irrigation is bad from beginning to end.

The Turki farmer has a perennial grievance on the subject, but he cannot, in face of the supineness of the administration, do much himself. The problem is too great for the individual, and every distinct irrigable area requires overhauling and replanning: not an expensive task at all, but one requiring skill, enterprise, and intelligence, very rare qualities in Turkistan and especially in the yamens. For instance, in the Kashgar area there are five civil districts depending on the Kashgar river and its affluents, and the irrigation, instead of being under one authority with a consolidated system, is all parcelled out with deplorable results, the water reaching some fields in excess, others very much in defect.

Moreover the wasteful habits of the Turki cultivator call for comment. No Turki ever irrigates his fields at night, not even in places where there is a water shortage, and those who know the countries where the tenants spend the nights watering their fields as being the only means of ensuring enough irrigation, will realize then one-half to one-third of all the water runs to waste throughout the irrigable year. The swamps that accumulate round a village, and the failure to save water in tanks or *bunds*, illustrate the lackadaisical ways of the Turki. The reason of this disregard for water will be discussed later, but the point here emphasized is that in the chief settled areas of Turkistan half the canal water is wasted, so that with proper economy double the population could be supported with the existing supply.

The yield of crops in Turkistan is poor. The return for wheat is on an average of 12. At Charkhliq (Lop Nor) it is 15; at Aqsu and Uch Turfan 10 to 12; at Bai (a cold place) 8 to 10. In England the highest yield is 19·9; in Germany 18·8; in Denmark 30·4; and in parts of India, with good seed, nearly that of England and the Continent.[1] The yield of maize, barley, and rice is also very low, and the grains, particularly of maize and rice, small and ill-formed.

These indifferent harvests are due to want of fresh seed and bad husbandry. The same seed is sown year by year on the same ground. The weeding of the fields is perfunctory and slovenly, and often neglected. The rice crop is particularly badly tended, in spite of the fact that there is an unsatisfied demand for rice which is exported to all parts of the province and fetches very good prices. The seed is never sown in nurseries and then transplanted into the fields, and regularly weeded and watered, but it is flung anyhow into the fields and only weeded once.

The slovenliness of the Turki reacts on the soil in such habits as not cutting down the maize but merely taking off the heads and leaving the stalks for winter fodder for animals. Then, again, the young wheat is deliberately twice eaten down by sheep. This is said to increase the yield when the corn is finally allowed to grow, but there is loss caused by the animals trampling down the young shoots. The Turki keeps fewer domestic animals than the native of India, but he does not use all their manure for fuel, although the manure available is inadequate. Horse dung is the most abundant, and it is singular that in Sinkiang it is the most valuable, as it enriches the soil in a way unknown in other countries. The dryness of the climate and the failure to store manure

[1]The amounts for England, Germany, and Denmark are given in cwts. as the highest average yield per acre, from the Ministry of Agriculture's Official Report, 28 February 1924. The yields in Turkistan are in return to the seed sown.

properly prevents a supply of "short" or well-rotted dung. A great deal turns on the manure pit, and the introduction of this manure pit into the Gurgaon district for the Eastern Punjab (see F. L. Brayne, 'Rural Reconstruction in India: The Gurgaon Experiment') was a remarkable success. In one or two places I have seen these pits in Turkistan, but they are very rare. If the available manure were properly collected and stored, the increase in the harvest would be great, and the shortage now complained of would be largely adjusted.

The poverty of the soil is not often a factor in production, as generally speaking the soil in Turkistan varies little and is very good. Sir Aurel Stein records that the whole of the Taklamakan desert is potentially cultivable. There are, of course, throughout the settled areas sandy tracts where cultivation is poor. The usual loess soil benefits by a top dressing of sand which prevents it from setting into a cake of hard clay after irrigation; and so small heaps of sand are commonly seen on the fields before ploughing.

The Turki often over-irrigates, and although he understands the rotation of crops, is very lazy about it. Perhaps he should be described not so much as a bad farmer as an uninterested one, without that keen absorption in the land which is often a pleasing trait of the Indian peasant. The reason for this languidness in farming and the unsatisfactory system of water supply lies in the lack of incentive. Generally speaking the Turki can grow, under the present hugger-mugger agricultural system, more than enough for his personal use and for marketing, so there is no inducement to greater efforts. After all, his attitude is natural enough, and so it is that the farming standard is in all respects low. When it is realized why there is this lack of agricultural enterprise, it will be possible to estimate the agricultural possibilities of the country, for this low standard has nothing whatever to do with bad soil, defective water, or uncertain climate, but solely with the farmer himself.

It is safe to say that proper irrigation will double the yield. Good farming will add 50 per cent. to this double yield, so that the average settled areas should treble their returns. This is a conservative estimate, as the land adjoining these settled areas and not now irrigated would come under the plough by the introduction of a good system, and thus the population of the settled areas of Sinkiang could be increased to 12 millions.

Professor Penck (*op. cit.*, p. 484) gives 5000 square miles as a rough estimate of the cultivated areas of Southern Sinkiang, based on Sir Aurel Stein's maps of the Tarim Basin. But this requires some adjustment. To begin with, much cultivation is unmapped, notably the fertile district north of Aqsu. Then again, the maps are thirty years old, and allowance must be made for the increase of the areas shown, opening of new ground in areas mapped, and for cultivation both new and old on wholly unmapped tracts. It is quite safe to double this estimate. Very little land has gone out of cultivation, whilst in some cases, *e.g.* along the left of the Yarkand river from Yarkand city almost up to Maralbashi, what is shown on the map as a scantily settled tract is now a belt of fertile land with busy bazaars.

Having thus discussed the cultivated parts of the Tarim Basin we must consider how much more of this immense area is available for human settlement.

Professor Penck (*op. cit.*, p. 486) rightly discards the habitable estimate of 75 inhabitants to 1 square mile as being much too low, and would raise it to 225. This estimate approaches that given in M. L. Darling's 'Rusticus loquitur,' p. 84, where a family of five, growing wheat, maize, and sugar-cane, can be supported in comfort on 13 acres of "barani" or non-irrigated land. (It must be remembered that there is agriculturally speaking no rainfall in Southern Sinkiang.) P. 199 (*op. cit.*) gives an estimate of five persons on 9 acres if water were sufficient; except for the sugar-cane, the resemblance of the Punjab to Kashgaria makes this valuable corroborative evidence, and allowing for difference of yield and season 250 persons per square mile is admissible for Turkistan, especially as the Sart has additional food supplies in cheap meat and in the oleaster (Trebizond date), while the lack of ghi is balanced by the linseed oil he consumes.

I confess to being unable to follow Professor Penck's estimate of the amount of cultivated land along the Tarim (p. 486), as it seems to me that this vast river would lend itself to a scientific system of irrigation and that the lagoons, back-waters, swamps, and minor branches would all appropriately disappear when the water is brought under control. Take, for instance, the village of Qaratai (Stein's Map No. 25, D.4), a Loplik village in south-east Sinkiang. In former times before the water from the Tarim flowed into the Yangi Darya this village was conspicuous for its fertility, so much so that 80 lbs. of wheat sold for sixpence. The land about it is irrigable and cultivable, and the same applies throughout the course of the river from Kurla to Charkhliq. Where now exists a shortage of water, scanty crops, dying pasture, and dwindling herds, there could be made by proper canalization a smiling area. I cannot believe that proper canalization of the Tarim together with the Konche Darya is only going to increase the cultivated area by 1000 square miles, which is little more than that irrigated by the comparatively insignificant Keriya river. But perhaps I have misunderstood the figures.

Bearing in mind how the face of the Punjab has been changed by successful canalization I think it difficult to limit the habitable possibilities of Kashgaria if scientific methods accompanied a development caused by pressure of population. In the Lyallpur district of the Punjab the population rose from 30,000 in 1891 to 979,000 in 1921. There is as good soil and abundant rivers in Sinkiang as in the Punjab, but without the irregular climate and ubiquitous pests. In this dry rainless region conditions of life are far better. In the Eastern Punjab the tenant is well enough fed, not badly clothed, but miserably housed. His dwellings are rat-ridden and vermin-infested (Darling, *op. cit.*, p. 346). Contrast this with the roomy comfortable houses of even the poorer Turkis, where flies are seasonal and vermin and rats unknown. These happy conditions materially act in extending settlements and supporting a healthy population.

Professor Penck hazards (*op. cit.*, p. 486) 40 millions as the maximum population for Central Asia, the limits of which he does not define. I should multiply this by four for the Tarim Basin alone. And I cannot agree with his view of the low standard of life in Central Asia. If the standard of life is judged by a full belly, warm clothes, and fat children, then the standard is very high. In India during the cold weather warm clothes are rare, but there is not a Turki

in the land who has not a warm wadded coat. Standards of life are deceptive, for in India the peasant spends his money wildly and wastefully at certain times, whereas the Turki puts food and clothes before family, religion, ambition, education, or whatever sways the desires and opens the purse of mankind. It is comfort, first and last, that appeals to the Sart, and for that reason he will not tolerate conditions under which the Indian peasant lives contentedly, even though he could change them if he wished.

It is not so easy to estimate the potential increase in the pastoral areas of Kashgaria, particularly as southern Sinkiang possesses fewer true nomads than does the North, partly because there is less good pasture, and partly because the settled population send their flocks to the uplands, and encroach on the nomads, who find it difficult to secure fresh grazing grounds. There is however the same lack of system and control in the pastures as in the irrigation of the plains, and if the increasing number of nomads and their flocks is to be maintained, some co-ordination of their grazing is necessary. At present these pastures are divided off definitely but not equitably. For instance, the Qirghiz tribes in the Tekes valley urgently need new ground, while the Alaban Qazaqs close to them have more grass land than they need, but resist any intrusion of other flocks. South of the Tien Shan, particularly near Bai and Uch Turfan, the Qirghiz are harassed by Sarts who strive to drive them away, so that in self-defence the nomads are taking to agriculture in the Taushqan and Qarabagh valleys to increase their means of subsistence and to check the encroachment of the Sarts. No one takes any trouble about the rights of the nomads, who are nevertheless of great economic value, as their horses, cattle, and sheep are a source of wealth to the province.

The damage done to forest and pasture by neglect and waste is great and quite unchecked. Many trees are burnt every year by carelessness or laziness, and many are cut down and abandoned, while good pasture land is trampled on and rendered useless for subsequent use, just as many upland valleys are boycotted as being too remote, too cold, or merely inconvenient. There is no reason why this should be, and a little arrangement would remedy the wastefulness and muddle, but it must be remembered that pasture and forest cannot be increased like arable, and much irreparable damage is done. It is a reasonable estimate to treble the number of animals now existing that could be grazed. It is improbable that the interests of the pastoral races and the preservation of the forests will be considered, although especially near the towns of Ili (Kuldja and Chuguchak) the scarcity of wood is greatly felt. The riverine tracts in the Tarim Basin, and also in other parts of the province, support many sheep, and the toghraq forests (*populus balsamifera*) are damaged by lopping off the boughs to let the animals eat the leaves. Thus in many places there are only pollarded or stunted trees; the lack of new and adult ones means an ultimate decrease in pasture, both arboreal and ground. These stretches of toghraq and scrub grazing however are so immense that it will be years before the harm is felt.

North of the Tien Shan, and especially in Dzungaria and in many places in the Ili valley, many crops are produced in unirrigated land, and the wheat so

grown, especially on the low hills between Urumchi and Guchen, is particularly fine, and the opium, barley, and millet markedly good. There is, of course, extensive irrigation, but as there is also abundant rainfall, advantage is taken of it. In the Ili valley especially this is so much the case that whilst in 1928–29 there was a shortage of wheat and barley, in 1930 by planting every available unirrigated upland the harvest was ample, and flour cost less at Ili than anywhere else in the province, to the chagrin and surprise of the profiteers.

The farmers north of the Tien Shan are largely Tungans and Chinese, and are more industrious and intelligent than the Sart. In places, too, the soil is considerably richer with less loess and more humus. The air, too, is more humid. On the other hand, the climate is most unsettled and the crops are often ruined.

It is very difficult to foresee the future of Dzungaria, that great tract extending from the north of the Tien Shan to the Irtish river. After the fertile mountain slopes have been left, the country is thinly populated and largely desert, and it lacks the great rivers that are the salvation of Kashgaria. But far down the Manass river there are many settlements, and the possibilities of irrigation very great. It is however rash to hazard any estimate until the country is better known and more settled. Political conditions have been very unfavourable hitherto, and the fertile districts occupied near the mountains have been so often plundered and their owners murdered that the possibilities of future settlement can hardly be guessed at.

North of the Irtish up to the Great Altai, the only part of Outer Mongolia now in Chinese hands, the settled population is very small but is increasing. Barley and wheat are being grown, the climate is good but harsh in winter, and the future is favourable to extension. The pastures here and to the west, particularly about Chuguchak, are magnificent, and it is wonderful to see these glorious prairies where the flower-decked grass will hide a mounted man. Fine as are the pastures of the Tien Shan, those of the Altai, Saur, and Maili Bar appear even richer, and should be able to support a thriving dairying industry. The larch of the Altai is better grown than the spruce of the Tien Shan, but being remoter it has been less damaged than the latter forests. The Chinese would seem to have every reason to be angry over the way that the rest of Outer Mongolia has been filched from them.

One must bear in mind in concluding this brief account of the habitability of Chinese Central Asia that the skilful use of modern methods of irrigation and agriculture alone can turn this vast empty province into a smiling and populous area. It is possible that the world's needs may never demand this transformation, but it is a feasible one. Perhaps an awakening China, wondering where to settle its surplus millions of people, may have the good sense to call in the science of the West and to develop Sinkiang. There, secure from the annual dread of floods, the industrious Chinese peasant could dwell in contentment to the infinite benefit of himself as well as of his immediate neighbours and of the world at large.