

The Course of the Upper Irawadi

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"Halls of the Thousand Buddhas," they revealed a great series of fine frescoes and stucco sculptures, going back mainly to the eighth and tenth centuries of our era. Together with abundant other remains, they attest the highly flourishing condition which Buddhist art and studies, imported from India, both through Central Asian and Tibetan channels, had, from an early date, attained here on purely Chinese soil. The materials collected are so ample and varied, that they will require prolonged labour on the part of several specialists.

Everywhere about the oasis I was able to observe the far-reaching effects which the devastation and loss of population attending the last great Mohammedan rebellion have had on the cultivated area. Taking into account the prevailing physical conditions, it appears improbable that the lands then abandoned to the desert on the outskirts of the oasis, will ever fully be recovered again for human occupation. Again and again I came upon such ruins of recent date which drift-sand is steadily invading. There is more than one "old site" in formation here which might well be ear-marked—for the archæologist, say, of 4000 A.D.

I am now starting along the foot of the mountains towards Su-chou, from where I hope, if time and local conditions permit, to effect surveys, both along the Great Wall north of this corner of Kan-su and in the Nan-shan range southwards during the summer and early autumn.

[In a later letter, dated July 10, Dr. Stein writes—]

Since sending you the last account of my doings, I have been able to carry on interesting survey work in the Nan-shan ranges south of the An-shi and Yü-mên-hsien. It was very pleasant to get near the snows again. They are plentiful on the main range, which has peaks rising to 21,000 feet and more. We have taken many heights by mercurial barometer and clinometer, and I hope the mapping done will be of geographical value even after the labours of the Russians. The physical conditions prevailing on the successive plateaus by which the Nan-shan rises from the Su-le-ho basin offer many curious features explaining formations in the desert below. Near Chiao-tzü I surveyed an extensive old site deserted six or seven hundred years, which reproduces most strikingly the changes undergone by the ground about the ancient sites north of Lop-nor. The same powerfully erosive east wind has been and is still at work at these widely distant places.

THE COURSE OF THE UPPER IRAWADI.

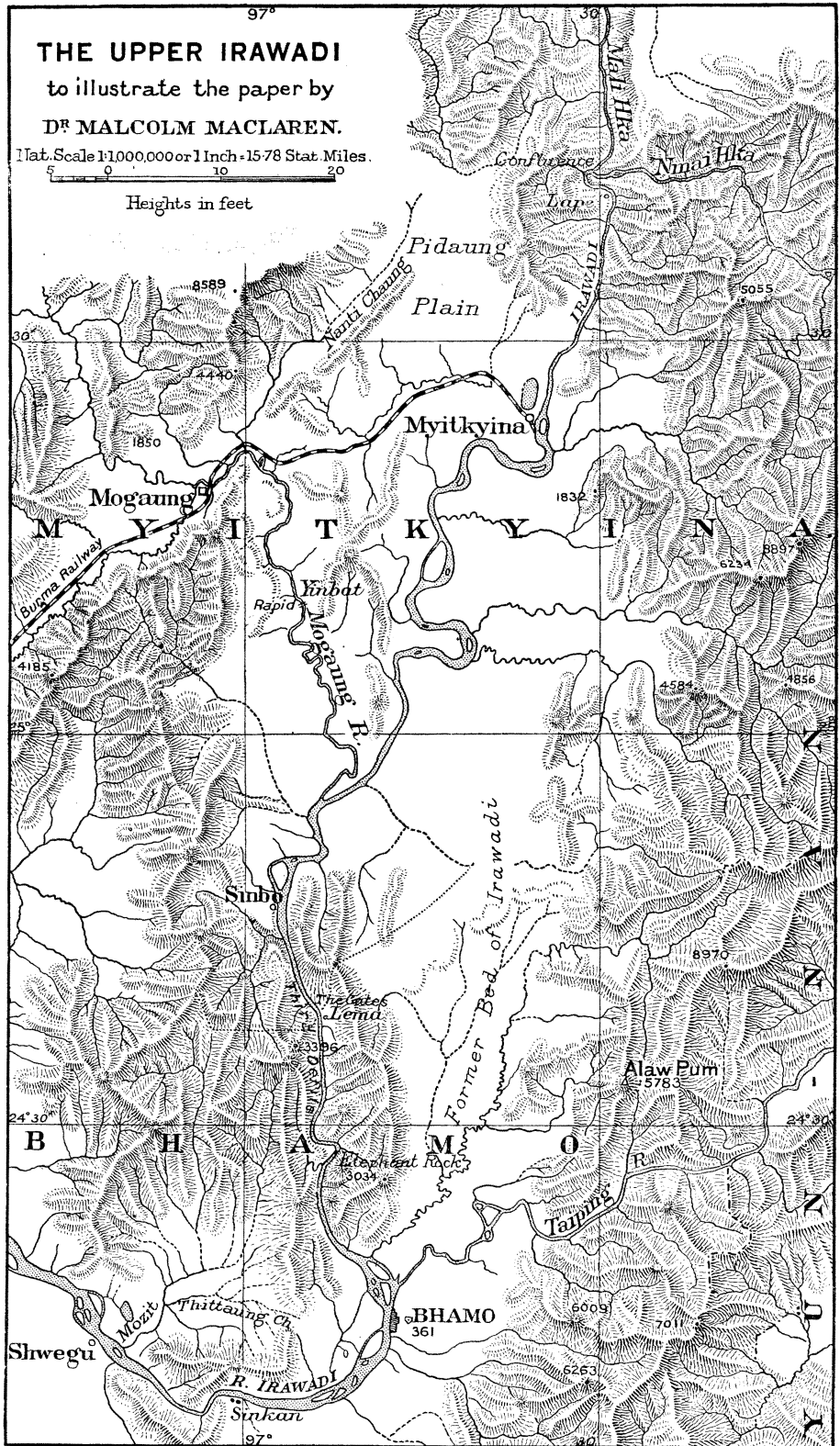
By MALCOLM MACLAREN, D.Sc., F.G.S.

THE present note deals with changes of recent date, geologically speaking, in the course of that portion of the upper Irawadi that lies between the Confluence, marking the northern limit of British "administered

territory," and the village of Shwegu, some distance below Bhamo. This portion of the Irawadi, together with the lower reaches of its two great affluents, the Mali Hka and the 'Nmai Hka, uniting at the Confluence, were traversed during the cold season of 1905-6 by the present writer in the course of an examination of the auriferous alluvial deposits of Burma. The upper waters of the affluents in Hkamti Lông have been seen by two or three travellers, and have been crossed only by Prince Henri d'Orleans on his arduous journey from Tongking to Assam, and more recently by E. C. Young. To visit their lower reaches, even in the vicinity of the Confluence, necessitates the employment of a strongly armed escort, and no explorer has yet succeeded in reaching the Hkamti valley by way of these streams. So far as they were ascended on the present occasion they lie in a deeply dissected mountainous region, the stronghold of the truculent Kachins. The old river-terrace on the flat tongue formed by the junction of the two rivers at the Confluence, the deep, narrow valleys, and the numerous rapids, all indicate streams still engaged in deepening their beds, and at this stage full of virility. On the Mali Hka, the western affluent, long shallow reaches with fast-flowing waters alternate with pebbly rapids. This branch, therefore, presents no insurmountable obstacle to canoe traffic. The 'Nmai Hka, on the other hand, as indeed its Kachin name would indicate ('*Nmai*, "bad;" *Hka*, "water"), offers serious impediments. It flows over Miocene ash-beds, whose strata of unequal hardness, yielding most irregularly to corrosion, have produced dangerous bars with narrow and tortuous rock-bound channels, through which the whole volume of the river rushes.

From the Confluence, and after a preliminary bend near Lapé, the river flows south in a fairly straight line to Myitkyina. Its current is still too rapid to permit of the deposition of anything but coarse gravel, and since the valley is narrow a natural sluice is formed here. It is, therefore, in the heads of the long reaches and on the bars in this portion of the river that gold has been deposited and concentrated in sufficient quantities to warrant gold-dredging, an industry now being vigorously developed. At Myitkyina, the British administrative post farthest up the Irawadi, the river may be fairly said to have left the Kachin hills. Its channel immediately widens to some 800 yards, and from Myitkyina to Sinbo, 72 miles by river and only 48 in a straight line, the Irawadi has almost reached a temporary base-level, as, indeed, the figures themselves would indicate. Its valley bottom, only half a mile to a mile wide above Myitkyina, has broadened to 16 miles. Its deposits are no longer gravel, but fine sand and mud.

To the north-west of Myitkyina lies the Pidaung plain, a broad savannah covered with tall *kaing* grass, the haunt of gaur (*Bos gaurus*) and tsine (*Bos sondaicus*). Its origin is obscure, for there is now no stream running through it capable of cutting it out, or of



filling it when cut out, nor is it a filled oxbow of the Irawadi. It seems possible, however, that the Nanti Chaung, which now flows south-west to Mogaung and thence to the Irawadi, cut out the plain, possibly also assisted by the waters of the Mogaung Chaung itself, before their "capture" by a small stream at a point a couple of miles north-east of Mogaung station. The gorge-like character of the Mogaung Chaung at this place and its rapids near Yinbat lend some support to the view. The suggestion implies a partial reversal of the slope of the Nanti valley, but as the present divide between the head of the Nanti Chaung and the Pidaung plain is very low, and as the rock is an easily eroded sandstone, no great modification of present conditions is thereby demanded.

Turning again to the great river, a remarkable change in the nature of its valley takes place at Sinbo. It has all the way from Myitkyina been quietly meandering between low banks along a broad jungle-clad plain. A mile below Sinbo it plunges into the heart of the mountains, everything at this point, except the course of the waters, giving the impression of ascending rather than descending a valley. Half a mile wide in the plain, the river is now confined at the entrance to a channel no more than 50 yards wide. In the great floods of the "rains," the turmoil of the waters in the basin above the entrance is indescribable. Even at Sinbo, a mile back, the waters rise 80 and 100 feet above the low-water mark. It is related at Sinbo that they have been known to rise the former height in a single night. Once within the defile the channel broadens a little, and its average width for its length of 30 miles in the Third Defile may be taken at 150 yards. The "Gates" and the Elephant Rock are narrows, in the former case the width being only 50 yards. The general course of the channel is straight, but the valley ridges coming down to the water's edge with the *en échelon* disposition characteristic of the lateral valleys of virile streams, its course in detail is most tortuous, and sharp right-angled turns, yielding most exciting moments to the navigator, are by no means uncommon. The channel is rock-bound throughout the whole length of the defile, and is practicable for steamers only from November to April, the season of low water.

Twelve miles east of the great defile, and parallel with it for its total distance, is an open flat valley, 10 to 12 miles wide near Bhamo, and untenanted by any stream of consequence. East of Sinbo it is nearly as wide, and is there open to the broad Irawadi valley. Its levels are unknown, but there is no visible ridge at the head, and the divide, if one exists, can be only a few feet above the Irawadi level. From Alaw Pum (5783 feet), on the Yunnan frontier, and 28 miles north-east of Bhamo, the whole valley plain from Bhamo to Myitkyina appears absolutely level and unbroken. From that height the Irawadi may be seen to disappear near Sinbo, and instinctively but vainly the eye looks for its silver thread in the broad valley on the hither side of the Sinbo hills.

Yet it has obviously flowed along that valley at no very distant time. Why, then, has it deserted it to flow through mountains 2500 to 3500 feet high, and mountains composed, not of soft rocks, but of metamorphic schists? The answer is that the Irawadi waters have been "captured" by one of its own tributaries—a case, indeed, of "domestic piracy," to use the confused, but generally accepted, American phraseology.

An examination of the topographical features of the country of the Third Defile reveals the history of the capture. When the Irawadi in former days meandered peacefully beneath the Yunnan frontier hills, a tributary stretched from near Bhamo northward into the hills for a distance of some 30 miles. Beyond its head a stream flowed northward to join the Irawadi near Sinbo, as is shown by the general northerly direction of the tributary valleys. Near the Kachin village of Lema was the col. As both streams cut back their heads, the col was lowered until the waters of the Irawadi at high flood burst over it, and, hampered by the lack of grade due to the meanderings on its old flood-plain, gladly seized and deepened its new channel. It became, indeed, locally rejuvenated.

Below Bhamo also there have been changes, though none so striking as the foregoing, probably the most notable case of "domestic piracy" that modern rivers may show. Nine miles west of Bhamo is a broad gap in the hills, through which the Irawadi formerly flowed. It was at that time that the coarse gravels of the Mozit Chaung and Shwegu were deposited. The course of the old river-bed is now occupied by the Thittaung Chaung. Here again there appears to have been domestic piracy, though the evidence is far from being as conclusive as in the Third Defile. The waters of the broad Irawadi valley seem to have been tapped near Sinkan by a small tributary, and there resulted the Second Defile, neither so long, so grand, nor so dangerous as the Third, but infinitely more beautiful.

The movement of the Irawadi channel at the Third Defile has been westward. Seeing that Chindwin river, also meridional in its course, closely hugs the western edge of its valley and leaves a plain on the east, some support might here be obtained for Ferrell's theory of the westward tendency of river channels in the northern hemisphere, a tendency supposed to arise from the retardation of the waters due to the Earth's west-to-east rotation. That the movement of both should be in the same direction is merely a coincidence, for the Chindwin is certainly moving west with the dip of the Miocene sandstones, along the strike of which it flows. It affords, therefore, an example of "monoclinal shifting." In any case, either on the Chindwin or on the upper or lower courses of the Irawadi, lateral movement due to retardation cannot, as Gilbert long ago showed for another region, take place so long as the rivers are silt-laden, and of the rivers of the world the Irawadi is at the present time the second greatest silt-bearer.