Sun, Snow and Science on Xixabangma

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While Luke and Stephen were dawdling along their 7000m ridge and admiring the view, there were other members of the expedition who were doing a real job of work: I refer of course to the scientists.

After protracted negotiations with the Chinese Academy of Sciences and the CMA we had agreed on a programme of research on both the present glaciers and the valleys below them, where they once extended far below their present limits. Since one of my main intentions was to give Himalayan experience to young people, the core of the science group consisted of Brian Davison, a glaciologist and high-grade climber, and three of my newly-graduated geography students, Claire Roberts, Marion Evans and Jonathan Cook, all three experienced walkers and campers but not mountaineers. Besides these we had Liu Jie and Liu Changhe (generally known as Liu Two) from the Institute of Geography in Beijing, and Ivan Hui from our sponsors, ICI China, based in Hong Kong. For most of the time we worked closely with the support group consisting of John Blashford-Snell, John Davies, our doctor, and a bevy of beautiful but tough and hardworking young ladies.

Our initial acclimatization trek in Nepal up the ridges on the E side of the Balephi Khola was a painful but invaluable prelude to the generally much easier walking in Tibet. The monsoon had not yet ended, and leeches waged guerilla warfare as we toiled up emerald staircases of rice terraces to the knife-edged forest ridges. At dawn we had glimpses of Dorje Lakpa and other peaks at the head of our valley, with slender waterfalls and bank-full rivers far below us. Incision by the rivers has been so powerful and fast that most traces of former glaciers have been destroyed, but we passed one stretch of huge gneiss boulders on a ridgetop at about 2000m which must have been an old moraine, as the local rocks were all schists and phyllites. Our highest camp was by Bhairab Kund at 4400m, a little lake where local Buddhists and Hindus hold an autumn fair. All that remained were prayer-flags fluttering forlornly by the misty shore. It is one of a string of tarns and cwms near the ridge-crest which mark the positions of former little corrie glaciers and of the contemporary snowline, now 1000m higher.

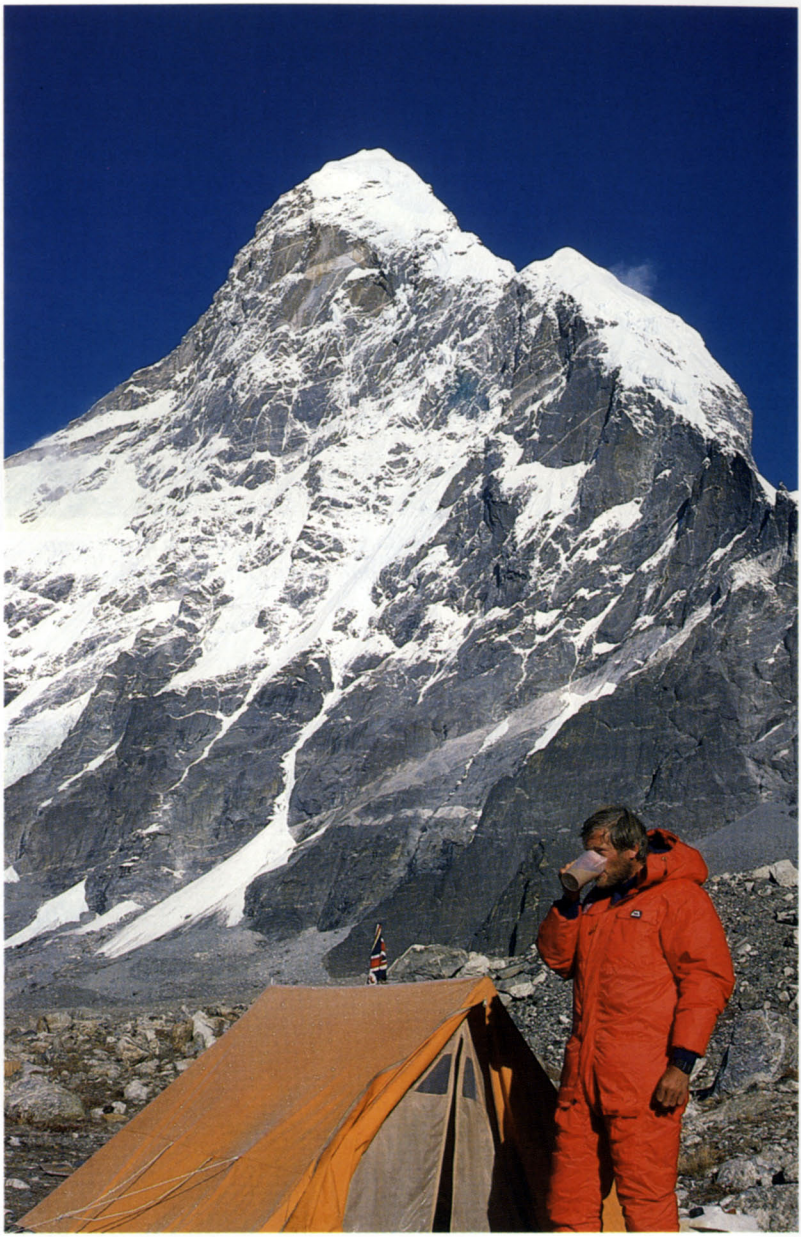
We dropped 3000m to the road again and washed ourselves free of mud and blood in the hot springs of Tatopani. 180 porters took our baggage across Friendship Bridge into Tibet and up the steep hillside to beyond Zhangmu, as landslips have wiped out large sections of the road where it zigzags up a huge unstable talus slope. Our roadhead camp was 30km further up the gorge, by the river at Nyalam, where we sorted baggage and helped the climbers on their way to establish a Base Camp on the E side of the mountain.

We and the support group then went by lorry to the north of the mountain. At the Lalung Ley Pass (5050m) we stopped to admire the view. Southwards stood the ramparts of the main Himalaya, from Everest to Xixabangma. Northwards stretched the immense plains and brown rolling hills of the Tibetan plateau. Beneath our feet lay thick beds of rounded boulders and gravels, once thought to be moraines but now recognized as having been deposited by rivers in intermontane valleys, at the same time as the Siwalik beds were being deposited on the S side of the Himalaya. These beds contain fossil animals and cedar pollen which show that the range was then much lower; in a roadside cutting we found a fossil rib, probably *Hipparion*, a genus of three-toed horses which was widespread in Asia, Europe and North America, 3–10 million years ago.

We camped by Pei Ku Tsho (4580m), a slightly brackish lake, into which drain some of the sparse waters of N Xixabangma. The weather was glorious, with a warm sun blazing from a cloudless sky; we basked on the shore and Jonathan and I even had a quick swim in the sparkling blue water. A flight of former beachlines rises behind the present shore to a height of 100m, showing how much deeper and bigger the lake was in the past. It is not clear how much of this change has been due to tilting of the land, downcutting of the overflow channel or climatic changes, but the old lake sediments lap against the oldest moraines so presumably postdate them.

My three students and I then made a quick foray up the valley which leads to the long-established N Base Camp site. We hired four yaks and two delightful yak-men who had a much bigger and better tent than we had, and a splendid yak-dung brazier which gave out a tremendous heat. We soon decided to cook and eat with them. A long walk brought us to a good campsite at 5600m near the end of the Dasuo (*tag.so*) Glacier. Like other glaciers on this side of the Himalaya and a few in the Karakoram, this has a spectacular array of ice-towers along the lower four kilometres of its tongue, some of them 50m high. These features have nothing to do with the seracs of an ice-fall and indeed only develop on glaciers with a moderate slope, in a high, dry, sunny climate. They are related to *nieves penitentes*, columns of snow a metre or so high which are found on some tropical glaciers in Africa and the Andes. Though little work has been done on them, they both appear to be due to differing responses of clean ice or snow to a high intensity of incoming radiation in different situations. Any initial chance projection from the surface is surrounded by dry air, so the energy it absorbs can be dissipated by sublimation (direct conversion of ice to water-vapour) which only consumes 1/620 gram of ice per calorie. In any chance hollow, however, the absorption of radiation is increased by repeated reflections and the air is stiller and moister, so melting occurs rather than sublimation. This consumes 1/80 gram of ice per calorie, that is, eight times as much. Thus, although the whole surface is being lowered, the hollows are deepened much faster than the crests, and the relative relief increases.

Moraines of different ages lie on either side of and down-valley from the terminus, evidence of a quite recent small retreat, besides older greater extensions. 500m above the valley on both sides lie high banks of moraine-like material, previously interpreted by Chinese geologists as a moraine older than



44. Unclimbed Nyanang Ri (6592m) on the S ridge of Xixabangma, from the Base Camp on the east. Nigel Williams drinking.



45. *Our baggage yaks setting off from Ganji for N Xixabangma Base Camp. In the distance Xixabangma (right) and Phola Ganchen (left).*



46. *Ice towers on the Dasuo glacier, N Xixabangma.*

any others recorded elsewhere in Tibet. I think, however, that they may be huge accumulations of frost-shattered rock, such as form aprons to the lower slopes of most of the mountains and hills in this area. On these banks lie thin plateau glaciers, nearly stationary and probably cold-based, quite different from the active valley glaciers. We climbed up to the one on the E side of the valley, a gently rounded summit at 6176m. Though no technical difficulties were involved, we were quite pleased, as few people reach 6000m on their first mountain, and we knew that the climbing group were still slogging away well below this altitude on the east.

It was a glorious sunny day with superb views in all directions: the main peaks still high above us and the apparently infinite Tibetan plateau stretched out below. However, there was a tearing, biting wind, so the other three did not linger but made off into the valley where we had arranged to meet our yak half-a-day's walk further down. I wandered at a more leisurely pace along the crest, noticing some tracks in the snow which I thought were probably *bharal* (Blue Sheep). Presently, however, I saw a line of tracks which looked quite different, and much more like those left by a large biped. Each print was about 25cm long, and 15cm wide at one end but narrower at the other, with a step of 45cm. The snow was hard and they were only a couple of centimetres or so deep and apparently not greatly affected by sun-melt. I have an open but somewhat sceptical mind about yeti and, at the time, I assumed that the prints were those of a bear which was carefully putting its hindfeet in exactly the same places as its forefeet; many animals of course do this at certain gaits. However, I was sufficiently intrigued to photograph them and I do not now think that they closely resemble bear prints. For one thing they are only very slightly set off alternately from a straight line. Professor Michael Day, who is an authority on fossil human footprints, sees no reason why they could not have been made by a manlike biped but, being a sceptic, he prefers to attribute them to snow leopard or some other known animal. Miss Hills of the British Museum's Mammal Department is similarly sceptical. Thus my photos contribute little towards solving the yeti controversy, though they do, I think, represent the highest level (c6000m) at which 'yeti-type' tracks have been recorded, or for that matter those of any large animal.

We met the others and returned to Nyalam. Despite yak problems the climbers and their baggage were now nearly all at Base Camp or higher, whither we followed them. The whole valley is lined with huge moraine ridges which extend several kilometres below Nyalam to about 3500m. Brian had been with the climbers while we were round to the north, and was busy taking snow samples from high on the glacier up which they were climbing. These were for chemical analysis in England for traces of contaminants of natural (e.g. salt) or human (e.g. Chernobyl) origin, which are deposited even in these remote places; not enough to cause harm but enough to provide useful information for modelling the atmospheric circulation. Originally we had intended to do all our glaciological work there with substantial help from the climbers, but the dangerous access down an unstable moraine, the moraine cover on the tongue, the difficult ice-fall above, and the preoccupation of the climbers with climbing, all dictated another choice. We planned to measure the rate of flow of the glacier

using stakes surveyed by theodolite, and to measure the temperature profiles in the top 20m of ice at various altitudes. For the latter we had a steam boiler, specially made for us by British Aerospace in Bristol, with a lance with which we hoped to melt a hole down which we could lower a string of thermistors. These would be allowed to freeze in and after a few days the temperature would restabilize.

Brian had reconnoitred a small and suitable alternative glacier, so we established a high camp just below it and dumped our heavy equipment up on the glacier. Now came the blizzard which was to plaster most of the Himalaya with more snow than in living memory. I was lying happily in my tent looking forward to a day spent reading *Brighton Rock* when Brian persuaded us that we should go down rather than idly consume our limited stock of food: 'No need to take any food; we'll be in Base Camp by lunchtime.' We ploughed down through deepening snow and poor visibility. Lunchtime came and went. Brian broke the trail, swearing each time he stumbled thigh-deep over some buried boulder. Jonathan and I dumped some of our loads in a dustbin bag on a boulder. Claire, only a lightweight, somehow carried on with a rucksack almost as big as herself. By dusk we were crossing a steep moraine ridge and I decided that it was time to bivouac. We dug a small ledge in the snow, partly sheltered by a big boulder, and settled down for the night. At midnight the sky cleared, and we found that we had in fact just passed the trail to Base Camp and were looking out over a part-frozen lake at the steep face of Nyanang Ri, soaring black and forbidding in the starlight. The wind, however, freshened, and the drifting snow continually threatened to bury us as we huddled together in our bags. Orion crept at a snail's pace up the eastern sky, but eventually the sun struck the top of Nyanang Ri, a memorable dawn to my 65th birthday.

We rose stiffly and repacked. Following the crests of the ridges which had been swept nearly bare of snow, we slowly made for Base Camp, and were soon cheered by the sight of Brian's fresh footprints. The previous evening, stronger and more lightly equipped than us, he had decided to press on to try to reach Base Camp and avoid a bivouac. The lake-shore was an unwelcome surprise to him, and after scrambling back up the moraine he had to hole-up between two boulders, whence he had to burrow out through several feet of snow next morning. Reaching Base Camp he sent out a rescue party to look for us, expressing doubts about our survival. They met us with a welcome flask of coffee, but then pressed on to find a group of climbers similarly benighted on their way down from Advanced Base Camp.

Those at Base Camp had spent most of the previous 24 hours digging to prevent their tents being buried and crushed, so for a few days we relaxed in the sun while the snow settled; nursed frosted toes or fingers; planned a further attempt on the summit; and debated the problems of getting ourselves and our baggage out without help from yak which could not get through the snow. JBS and Jonathan used packing cases to make sledges which went splendidly on the well-trodden paths round camp but were quite impossible off the piste.

Brian and I, with generous help from Lindsay Griffin, decided to return to our glacier. The other two each had a pair of the expedition's limited supply of snowshoes, and they dashed ahead. I slowly floundered along behind and

decided to bivouac part-way at a prominent rocky bluff on the shore of Kung Tsho. There were several small caves in it and we optimistically called it Snow Leopard Rock, although the only evidence we ever found were some droppings that were clearly from a large cat and in which Miss Hills later found marmot hairs. This was a superb bivouac site on a ledge only a few feet above the clear blue lake, reflecting the snow-covered mountains.

Next day I rejoined the others who had spent the entire day trying fruitlessly to find the boiler and other gear, now completely buried beneath a smooth snow surface. We tried again the following day. Luckily we had previously surveyed the positions of two nearby stakes from a fixed rock that was still exposed. We resurveyed and dug for these in their recorded positions and eventually found them, about two metres down-glacier because of flow in the meantime. Then we probed around and soon found our boiler. Its design had been taken from one already well-tried in Canada, and we had tested ours both in the cold chamber at British Aerospace and at Base Camp. However, we found that we could not raise a sufficient head of steam to drill, even using a petrol cooking-stove to supplement the gas burner. This seemed to be due to the combination of low oxygen pressure and a tearing cold wind. Sadly we packed up and returned to Base Camp.

A final attempt on the summit by Luke and Stephen had meanwhile been driven back, and two groups had already left Base Camp for Nyalam. The first, including all the Chinese, had a hard time breaking the trail, and took three days over what could be done in one before the snow. We all followed in dribs and drabs, feeling rather like Napoleon's retreat from Moscow. At Nyalam we reorganized, faced with new landslides blocking the road to Nepal and snowdrifts blocking that to Lhasa, but by walking or by waiting patiently we finally all got out in one direction or the other. I ended up in Beijing where I had protracted and frustrating negotiations with some of the scientific authorities.

Apart from the glaciological work, we carried out various other scientific studies. Claire made a plant collection, to be divided between Kew and the Chinese Institute of Botany; Marion (who also did some filming) and Liu Two did ecological work and collected soil and water samples; and Jonathan studied the geology. The climbers had at one time planned to ferry all their stores across the lake above Base Camp, to avoid the laborious and dangerous traverse of the glacier tongue. Once there it was clear that this naval exercise would be even more hazardous, not least because the lake was partially ice-covered. However, the inflatable boat had another potential use for sounding and measuring the turbidity of the other numerous lakes near Base Camp, most of which were warmer and unfrozen as no glacier calved into them. The Support Group launched it on the Kung Tsho and took several photos and one observation. Faced with a stiffening breeze, they prudently adjourned till the morrow. That night the blizzard broke, and so far as is known the boat still rests under a blanket of snow on the lake-shore; resting too on its laurels in the *Guinness Book of Records* where John Two now holds the altitude record for rowing (4580m). We all, especially JBS who occasionally lay out at night with a 'sniperscope', took an interest in the wildlife. Blue Sheep were the commonest large animal and were often seen near Base Camp. Wolves, Tibetan antelope

and wild ass (*kiang*) were rarely seen. In the India Office Library there is a beautiful old pictorial map (the 'Wise Map') of this area drawn in about 1850 showing abundant *kiang* on the plateau north of Xixabangma. There were surprisingly few colonies of marmots, possibly because of a reported campaign against them by the Chinese on the grounds of the damage done by them to the grazing. Pika (like guinea-pigs) were very abundant; after the snow, scores could be seen sitting out on the sides of the road, scampering for their holes as one drove by, or as large hawks skimmed a foot or two above the ground in close pursuit.

We owe thanks to many people and organizations for their help. Besides those mentioned by Luke Hughes, the scientists owe special thanks to British Aerospace, Avon Boats, Bristol University and the Chinese Academy of Sciences.

NOTE

The Chinese have produced a beautiful map of Xixabangma at a scale of 1:50,000 and contoured at 20m vertical intervals. It has evidently been done from air photos with close ground control, and I found it very accurate. The only errors were in the interpretation of some small lakes, probably covered with ice and snow in winter.