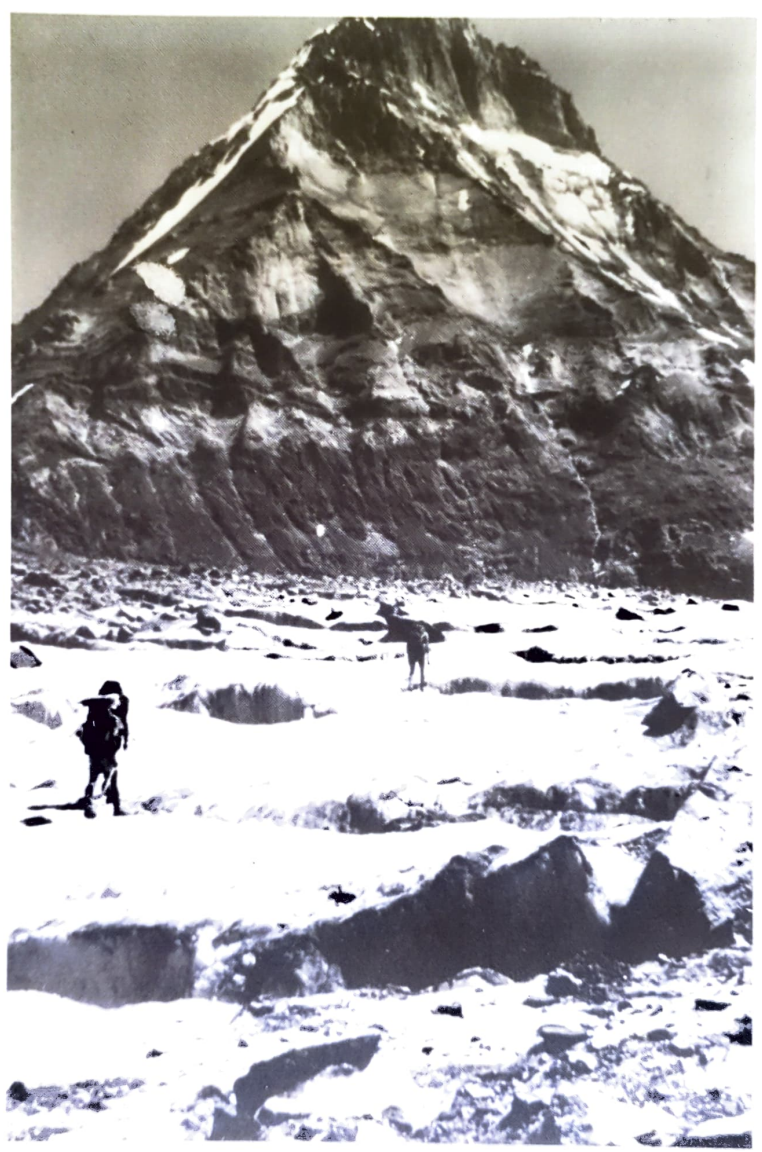


1424

1424

ST. JOHN'S COLLEGE, CAMBRIDGE

ECOLOGICAL EXPEDITION
TO KASHMIR 1983



FINAL REPORT

1424

1424

ST. JOHN'S COLLEGE



Cambridge



ECOLOGICAL EXPEDITION TO KASHMIR 1983

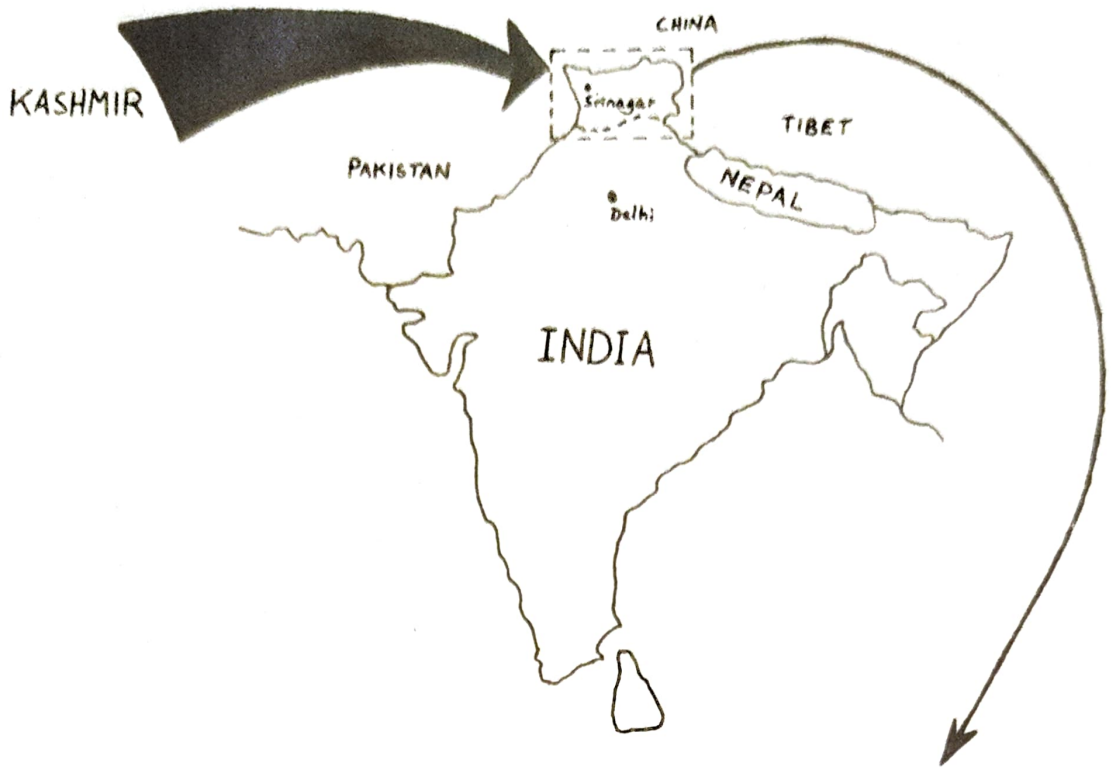
Members:

Mark Rothera
John Zealley
James Mayers
Graham Radford-Smith
Robert Holmes

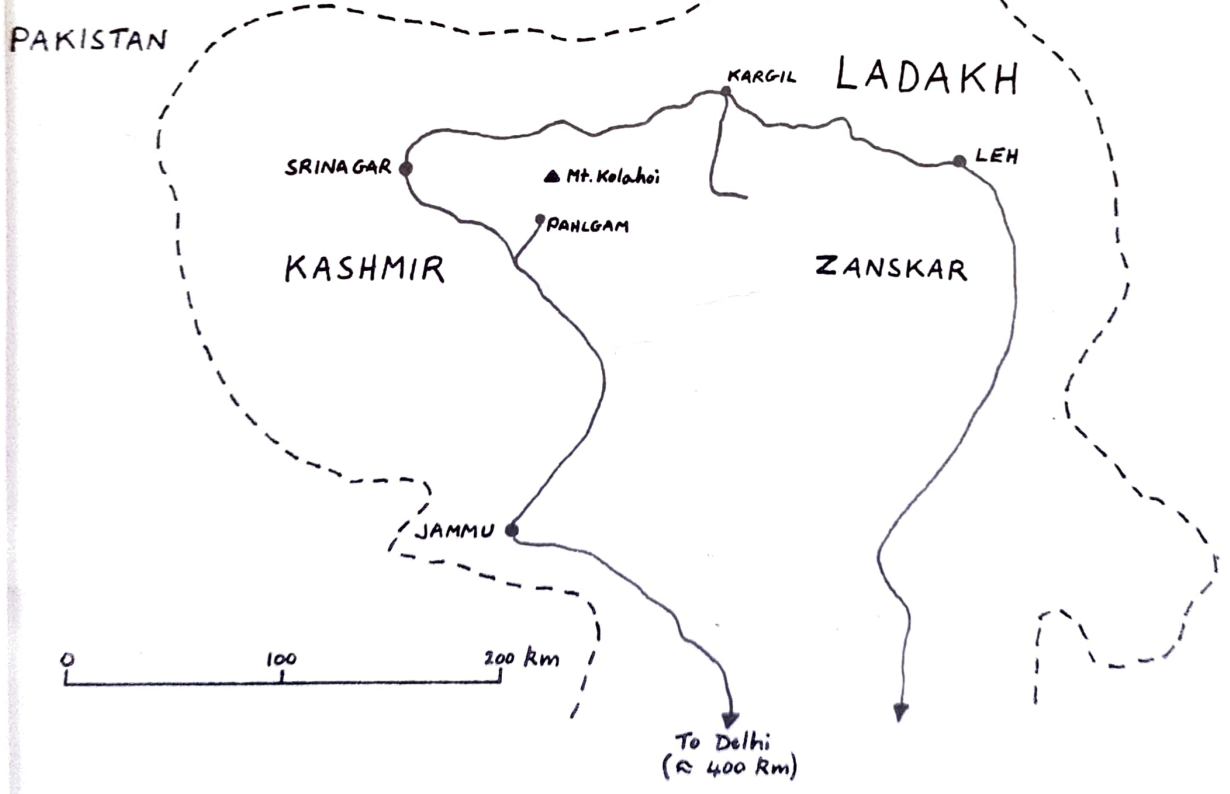
Patrons:

Prof. F. Hinsley OBE
Prof. D. Bryce-Smith
Dr. I. Woodward

Master of St John's College, Cambridge
Dept of Organic Chemistry, Reading University
Dept of Botany, Cambridge



JAMMU AND KASHMIR STATE



FOREWORD

It gives me great pleasure to introduce this report by the St John's College Ecological Expedition to Kashmir in 1983. The members of the Expedition displayed great enterprise in obtaining funds to make their work possible, and in organising the expedition, and the same spirit of enterprise is shown throughout their most interesting report.

F. H. Hinsley

F.H. Hinsley
Master
St John's College

CONTENTS

	<u>Page</u>
INTRODUCTION	1
THE EXPEDITION	
(i) Preparations	5
(ii) Delhi to Srinagar	7
(iii) Fieldwork at Mounq Kolahoi	9
(iv) The Trek, Part I	10
(v) The Trek, Part II	17
(vi) Leh to England	22
ORNITHOLOGICAL PROJECT	24
BOTANICAL PROJECT	38
LEAD PROJECT	52
APPENDICES	
(i) Finance Report	56
(ii) Food Report	59
(iii) Equipment Report	61
(iv) Medical Report	62
(v) Transport Report	63
(vi) Photographic Report	65
(vii) Bibliography	66
(viii) Useful Addresses	67
(ix) Diplomatic Report	68
(x) Itinerary	69
ACKNOWLEDGEMENTS	72

THE PLATES

1. The Expedition Members
2. Srinagar; the Old City
The Lidder Valley, below Lidderwat
The Team?
Sainsburys; Pahlgam
3. Mount Kolahoi (17,799 ft.)
The Botany Project
The Kitchen
Mark tells a joke to the locals
4. Putting a brave face on it
And the Kashmiri's response
5. Gulol Gali (14,350 ft.)
Camp at the foot of the pass
6. Bobang Glacier
Bobang Gali (14,750 ft.)
7. Ice Bridge
Chortens at Yuldo; Suru Valley
Kangi-La (17,200 ft.)
8. Rangdom Gompa
Camp at Rangdom with Tassi Tonga beyond
The Ladakhi Himalaya, from 18,000 ft.
9. Kangi Village
Karma Tsering - village amtchi
Two Ladakhi women
10. Srinagar-Leh road; Hangla-Loops
Lamayuru Gompa
Lamayuru Village
Inside the dukhang; Lamayuru Gompa
11. Leh - the High Street
The Old Palace and Gompa
Tikse Gompa
Self-effacing antique seller in Leh
12. Rangdom at dawn
The Zaskar Range through Chortens

INTRODUCTION

WHAT?

What follows is an account of the St John's College Cambridge Ecological Expedition to Kashmir which took place during the summer of 1983. Five slightly fearless undergraduates undertook three altitude-related projects in the Himalayas of this northern-most area of India.

The venture was conceived in October 1982 and united by a common urge to see this magnificent area; the five of us soon put together the three scientific projects, largely related to our fields of study, and could best be carried out by forming an expedition. It could be said that the reason for choosing Kashmir was that it represented the only possible area in which to attempt the projects, and although this is largely true, we make no bones about the fact that we were all primarily mad keen to go there.

The first of our projects was concerned with the morphological and physiological adaptations of certain plants to high altitude. We looked at several plants over a range of altitudes (from about 13,000 feet down to about 8,500 feet) and measured physical parameters such as temperature, solar radiation, wind speed, relative humidity etc., together with our physiological measures of leaf temperature, stomatal resistance, leaf areas and plant growth rates. Our aim was to provide information on leaf energy balances at high altitude thus reducing the paucity of data in this field.

The ornithological project was concerned with Parus species (titmice) which occur in large concentrations and in the greatest variety in Kashmir. The woods of Kashmir thus possess a unique combination of these titmice. Some of these species are morphologically very similar and to a large extent they are segregated from each other by the different altitude ranges which they occupy. However, in many areas these titmice co-exist in the same habitat where their altitude ranges overlap and in these circumstances it is not accurately known how such morphologically similar species can co-exist without great competition. Our aim was to study the feeding behaviour of these birds to try and quantify any differences between the species over a range of altitudes and the corresponding vegetation types.

Our third project aimed to assess the levels of lead in this part of the Himalayan environment to try to determine how much of it is representative of the global effect of atmospheric lead pollution. We were thus collecting various plant and crop samples which could be assessed for their relative concentrations of indigenous and atmospheric lead. In addition we hoped to be able to assess the lead levels in the population of this area and make estimates of all potential lead sources to these people. We hoped to take hair and possibly blood samples, although this proved impossible in the time available to us.

The lead project provided us with a good excuse to make a trek over the Himalayas into Ladakh since we required a remote village to take our crop samples; this we were able to do having finished our botanical and ornithological projects in the Mt. Kolahoi area in Kashmir.

WHERE?

The work of the expedition was done in the Indian State of Jammu and Kashmir, which lies in the Northwest corner of the Indian nation. This area is not only physically remote in terms of distance, but also because of its separation from the main part of the country by a range of mountains forming part of the Himalayan foothills. Thus, the area is very different from India as a whole, and these differences may be seen both in the physical environment and in the lives of the people.

The first factor that sets the state apart is its overall altitude; lying at above 7,000 feet, and in many places considerably above this level, the temperatures are cooler and the humidity is lower. The less enervating climate appears to have a beneficial effect upon the lives of the people, being more physically active.

It is, however, dangerous to generalise and I shall briefly deal with three sub-regions through which the expedition moved. The first of these is the Vale of Kashmir itself; this is a highly fertile agricultural area supporting a population at far lower densities than much of India. The result is an impression of general prosperity, although that is not to escape the fact that by western standards the living conditions are primitive away from the towns.

There are few large towns, and these are dominated by Srinagar, a city of 350,000 people which is the state capital. The City is itself divided between the old Moghul settlement centred on the fort and Nagin lake, and the Imperial City of the Raj which is of western style. Srinagar is essentially an active trading centre, forming the economic trading base of the area. In the vale the people are largely Muslim in religion, a major bone of contention with neighbouring Pakistan, and the culture is of a different style to that of the Hindus, being far more commercially orientated and less fatalistic.

Beyond the Vale are many narrow bottomed glaciated valleys stretching into the mountains; it was in such a valley, to the south east of Srinagar that the expedition started its work. Here the higher altitude, in excess of 11,000 feet, gave rise to high temperatures and rarified air. This difference in climate requires some acclimatisation for visitors, but supports a thriving man-nature complex.

The slopes are covered, in summer, with lush grass and 'Alpine meadows' of flowers, which make good feeding for the animals of the transhumanic peasants who live here in the summer, and then retreat back to the lower valleys when the winter snows arrive. The mixture of food, space, warmth, ample water and the mountains made the area a 'shangri-la' for hardworking botanists and bird watchers.

The third zone is that lying beyond the Himalayas through which we walked and where we attempted to carry out the lead pollution project. This is in sharp contrast to the rest of the state, being arid and Bhuddist, (the two are not causally related). This area to the north east of the Himalayas looks east to Tibet for its culture. The villages are separated by large tracts of uninhabited land, the villages themselves being totally reliant upon irrigation for survival.

The culmination of this culture is at Leh, a mini Lhasa towards the borders of Tibet. Here the Bhuddist peoples mix with Muslim merchants and the Hindu soldiers. In fact, the military presence is high owing to the tension on the border with China. However, from the visitors' viewpoint the military have made Leh far more accessible through the building of a military road linking the town of Srinagar, 255 miles to the west; the difficulty of travel is indicated by the fact that this relatively short journey takes about two days by bus.

Thus the area is highly varied in its climate, from lush valleys to arid high peaks, and in the nature of its peoples, this diversity made the area highly suitable for an expedition of this nature.

WHO?

Mark Rothera 20/21 years old
Expedition leader
2nd year studying chemistry
1982 Cambridge High Altitude Expedition to Nepal
1981 Mt. Kenya Expedition

As the above shows, Mark is an experienced hiker and weathered expeditioner born with a sparkle in his eye and a pith helmet. A very capable organiser and leader of men, he is renowned for bringing calm and serenity out of total chaos, and vice versa! He is rumoured to have a neat trick, with the Red Sea as props. Anyone seeking a benevolent dictator need look no further.

John Zealley 21 years old
Finance officer
2nd year studying geography
1981 Geographical study in Malaysia

The financial stability of the expedition owes a great deal to John, capable as he is of conjuring money from highly unlikely sources when it is most desperately needed and of having up-to-the-picosecond accounts, interest adjusted, at his finger tips, day or night. In India he made the transition from ruthless treasurer to keen-eyed ornithologist in a day. He also has an eye for a well-tailored pair of shorts. The combination lock on the Zealley money belt has yet to be cracked.

Graham Radford-Smith 20/21 years old
Food officer
2nd year studying medicine
Ten years in Bangladesh

More experience heaving oars than lugging rucksacs, Graham soon proved his worth in terrorising Kashmiris into action, good colonial skills the rest of the team found hard to acquire. Our very grateful thanks go to our good supreme for amassing morale-lifting provisions but his restraint and self-control in hoarding his own chocolate supplies proved a source of continued frustration for the cocoa addicts amongst us.

James Mayers 20 years old

Project leader

2nd year studying animal behaviour and experimental psychology

19 years walking experience

As project leader, James drove us hard yet ensuring that regular statutory rest days were taken by even the most botany-crazed members of the team. All religious festivals and days containing the letter 's' were respectfully observed. Our bird man had a healthy preoccupation with food throughout the trip thus ensuring that our stomachs were fully abused at least five times daily; he has yet to recover from the loss of a 2 litres tub of honey. A staunch advocate of "hugger" designer undies.

Robert Holmes 20/21 years old

Medical officer

2nd year studying medicine

21 years experience sleeping under the stars

As an over zealous and dedicated medicine man, Bob clearly displayed his understanding of preventative medicine, preventing illness amongst his patients by catching most diseases on their behalf! Besides from pestering the team to take prescribed medication and fighting off a pandemic of Kashmiri headaches, he will be remembered for his liking for home-cooking, heavy rucksacs, hideous head gear and an obscene predilection for washing at any time (and temperature) of day and night.

HOW?

From October 1982 to June 1983, the expedition raised the £5,000 it needed to maintain itself for 9 weeks in Kashmir with innovations such as 'Himalayan Bop' and perseverance at writing to companies and trusts the money came in right up to the last week before departure. We left England knowing that we had reached our target.

The team flew to Delhi on 24 July 1983 and travelled from there to Srinagar, the capital of Kashmir, by train and coach. Stores, maps and labour were arranged in Srinagar and then final arrangements made at Pahalgam the last stop at the foot of the Lidder Valley, our research location. With mules and pony-men hired at Pahalgam we transported our equipment and food to three different altitude differentiated sites up the valley, in order to allow us to complete the Botanical and Ornithological Projects.

The second phase of the expedition also began at Pahalgam; this time with a new guide and pony-men. The team trekked eastwards into Zaskar for 17 days in order to carry out the Lead Pollution Survey. The trek terminated at the Srinagar-Leh road where we waited for passing vehicles to give us a lift into Leh. After a brief stay in Leh it was back to Srinagar, down to Delhi and the smooth as silk return flight to Heathrow.



Mark Rothera

John Zealley

Graham Radford-Smith

James Mayers

Robert Holmes

THE EXPEDITION

(i) Preparations

Mark writes:

The expedition took its final shape in late October 1982 after a major change in personnel. For ease of administration and an extra sense of identity, the team was primarily from St John's College. The projects were necessarily in an embryonic state and during the next two months as the need to communicate our intentions increased so thoughts gelled into concrete proposals. The Cambridge Expedition Committee approved the expedition in late November and so we had the starting pistol's clang to spur us on in our quest.

The prospectus outlining our projects, budget, location and itinerary came out in early December and from then on the money raising, the most immediate goal for the team, started in earnest. Needless to say this was a slow and often frustrating process. A mere £200.00 had been raised by the end of March which didn't seem to be justified considering the effort put in, but we were not to be disappointed. Spring brought new hope, particularly a blessing from Donald Coggan the former Archbishop of Canterbury in the form of a cheque, and then welcome gifts from the Royal Geographical Society, Mount Everest Foundation and British Ecological Society.

Food and equipment were also sought after to alleviate our budget. Chocolate bars, dried meats and vegetables, chewing gum, hot drinks, spreads and many other delicacies emerged during the periods of financial gloom thanks to Graham's efforts. The equipment firms were not as generous as was hoped presumably because we were the type of organisation the firms wanted to sell to but Bob still managed to obtain a rucksack, tilley lamps and other items to partially meet our needs.

By the summer term we were confident of our departure, only requiring the last pennies to meet our targeted budget. An innovative 'Himalayan Bop' conceived during the dark despondent days went forward as planned, ten days before most people's exams and still managed to raise the vast sum of £20.00 after the outlay of £320 had been subtracted!

The 'team' was very much an unknown quantity at this stage. We had been unable to have a trial camp together and had only gathered as a group to do business. The start of the Summer Vacation saw us departing to our respective parts of Britain to see family, attend courses and make our personal preparations. When we finally regrouped on 22 July to pack up the 200kg of equipment and food to be taken we saw each other in a new light. We were preparing to spend nine weeks with each other like it or not.

Our last day in England was a memorable one. Crates of food were unpacked in the cloisters of St John's and then sorted into weeks rations and repacked into plastic bags to keep the weight down to a minimum. A 100 kilogram excess luggage allowance granted by Thai Airways had to be adhered to.

With the willing co-operation and kind assistance of Bob's father (and caravanomobile) the luggage and team were transported to Heathrow on the

evening of Wednesday 27 July. Here, another in a stream of short nights was spent playing frisby amongst dormant forms in a surprisingly empty waiting lounge and attempting to sleep while cleaners swept and hoovered around us. At 5.00 a.m., more than exhausted we cleared up and wheeled our cumbersome gear to check in.

What a relief. At 10.50 a.m. our Jumbo, promising of 'Orchid service' rose gracefully into the air. Free booze and a tempting little four-course meal:

Smoked Trout and Vegetable Salad
Seafood Newburg
Cheese and Biscuits
Gooseberry Cream Cake
Coffee, Brandy and chocolates.

lulled us into the belief that this was what nine weeks in Kashmir was to be like.

Sweat, heat, dust, buzzing. As we stepped out of the airplane we were hit by a wall of humidity. By the time we had reached the bottom of the stairs, the sweat was pouring off our bodies. This was Delhi Airport. We approached customs with the hope that there wouldn't be any delays in clearing our large quantity of luggage and were pleasantly surprised. (It's always advisable to carry a couple of copies of the expedition prospectus at this stage of the proceedings. Customs officials stop you at random and ask you about your luggage and contents. To avoid opening 200kg of packed equipment, one flash of the brochure is enough.)

We emerged from the airport buildings. The humidity combined with the noise and novel smells had the team's senses on full alert. Mark, being familiar with the situation set-to lining up a couple of taxis to transfer the luggage to a cheap hotel in old Delhi. Although we had had very little sleep in the last three nights, it was difficult to settle down at 3.30 a.m. with the excitement of our arrival in India.

Our first day was spent arranging a coach trip to Agra to see the Taj Mahal and other well known Moghul structures to help us acclimatise. Most importantly we booked our train tickets for the twelve hour journey from Delhi to Jammu on our way to Srinagar, Kashmir. This was readily done at the Northern Railway Office in New Delhi.

The hiking boots, long trousers, sweaters, ropes and other heavy items of clothing worn on the aeroplane for obvious reasons soon gave way to shorts, shirts and shades. The humidity of the monsoon season forced a 'laid back' existence. To most of the team this was the first experience of India. Bob and John who had a typically reserved English palate (meat and two veg) encountered chilli and curry powder in a big way and countered this with their antidote, chilled soft drinks. Then there was the noise and the perpetual motion of the place. Our back street hotel in Old Delhi looked out onto a maze of auto-rickshaws, people, cows, street vendors, dangerously crossed electricity and telephone wires, pigeons, stray dogs and the all pervading dust. Only at night after the 'Imperial Cinema' down the road had spewed out its last full house and the small shops had ceased selling their wares and the monsoon humidity had subsided, did a semblance of calm exist. By then we were asleep.

The day after our trip to Agra we were packing for our real destination. A morning spent buying supplies in Delhi gave way to the assembly of the ever increasing stack of expedition equipment. A cavalcade of auto-rickshaws, bulging at the seams deposited us outside Delhi Station.

(ii) Delhi to Srinagar

John writes:

Fortunately the hotel was quite close to New Delhi Railway station, since the over-filled auto-rickshaws looked very vulnerable on the crowded streets, with the baggage precariously balanced and the expedition members being stuffed into any available space. Once at the station it was a battle to defend the boxes and tins from the attentions of the massed armies of porters and whilst a couple of us went to see which platform the Shalimar Express was at and to find our reserved compartment the rest surveyed a scene, somewhat worse than a mainline London station at rush hour.

Despite the apparent extravagance the first class sleeper fare was only twelve pounds each and allowed us a far higher level of security for the equipment. The train left at four in the afternoon and travelled out through the "suburbs" of Delhi, where squatters huts came right up to the railway track and out onto the flat plains, with rice fields stretching-out to every horizon.

The train itself was moderately comfortable, but with the intense monsoon heat and humidity the fans were all but ineffectual, and the bars at the window prevented one sticking one's head out. Occasionally the train would stop at some signals and everyone piled out to stretch their legs, whilst some passengers could be seen taking the opportunity to squat in the fields. At stations we were encouraged to buy food and drink from hawkers who came to the carriage window, proffering their wares in disposable rough clay pots.

The night was somewhat interrupted and it was with great relief that we pulled into Jammu Tawi station at 6.30 the following morning; again we doggedly refused to pay the porters to carry our load out to the waiting buses; in hindsight this was, I felt, unnecessarily tight-fisted of us. The express connects with buses that carry passengers over the foothills and into the Vale of Kashmir and so it was easy to find a suitable A Class bus.

Despite the fact that the bus journey takes about twelve hours the contrast with the train journey was complete. The temperature rapidly dropped as we climbed, and the humidity fell as we left the plains behind us. Physical aspects aside, the view was for ever changing as we wound our way around hairpin bends with cameras at the ready to catch a particularly good vista. The Indian Road Authorities have a somewhat avuncular attitude to their drivers and the verge; the corners boasted various maxims, for instance; "Keep your nerves on the sharp curves", "If married to speed, divorce her!" and "Liquor licks the driver". Whether they achieve their purpose or not they certainly provided us with welcome entertainment.

Although we were delayed for an hour by a puncture we arrived in Srinagar at seven o'clock and were met at the bus station by our house boat owner. The whole atmosphere was completely different from that we had left

on the plains, both literally and metaphorically. For a start the higher altitude, six thousand feet, meant that it was substantially cooler and because the mountains were effectively shielding the Vale from the monsoonal airstream it was also far less humid.

In addition the people looked far more healthy, and instead of crowded little mud huts all over the place there were a substantial number of two storey wood and brick houses. Srinagar is a busselling town that has a long history based on Moghul princes long before the British arrived. The British feel in love with the place, for its temperate climate and close resemblance to northern Europe. As a result they established a thriving community there.

A particular part of Srinagar's character is derived from its site on the shore of a large lake. On this lake the British established large floating houseboats, ranging from mansions to villas in size. These have since been taken over by the locals and are now run as extremely attractive hotels.

After the discomforts of the journey the house boat was sheer bliss; furnished in the western style and looking like a victorian parlour, all chintz and curios. More importantly for Bob and myself was the non-curried food they served for supper. The charge for full board for all five of us was only thirteen pounds a day, for which it was easy to accept the rain pouring in during the awe inspiring thunderstorm that flashed around the mountains that night.

The next day we began to organise our own particular aspects of the expedition; Mark and James made contact with Dr Uppeandra Dhar, head of the Medicinal Plants unit at the University of Kashmir, who not only gave them valuable help in determining the exact location for our work, but also gave permission for Virjee, one of his research students, to join us. At the same time we used the Kashmir Himilayan Trekking Company to give us advice about how best to carry out our research in Zanskar.

As the man with the money, of which four hundred pounds was in denominations of about twenty pence, I accompanied our house boat owner to go and buy the various essentials of life from the local market. These ranged from 40kgs of rice to cooking pots and tin mugs. Furthermore, we also needed sufficient curry and chilli powder to keep "hot lips" Mark Rothera happy for two months.

An important part of the purpose of our short time in Srinagar was to get somewhat better acclimatised to the altitude; the rapid rise from sea level to 6000 feet had caused no problems, however, it would have been unwise to proceed higher too rapidly. Hence we also indulged in some blatant tourism; this included a shikara ride (the Kashmiri equivalent of punting) to a large fresh water lake where swimming and water skiing were in order and also an early morning jaunt to see the floating market, where the produce is displayed in small skiffs and the buyers move from one to another in their own craft.

We also had our first casualty, James contracted a very nasty intestinal bug, which was the pre-cursor of at least one dose of the squits for all of us during the journey. At last, however, all was ready and we left, with our houseboat owner, Bashir, in tow as cook-cum-guide, for Pahalgam, our starting point.



As if on cue the previously idyllic weather chose that moment to break and the rain poured down. The bus was crowded out with steaming, and exotic smelling bodies not to mention the animals. The intrepid explorers made a rapid assessment of the weather upon arrival and made a dash for the nearest hotel, where we spent the afternoon drying everything out. The next morning was set fair and having engaged the services of six "mules" and their drivers we set forth.

(iii) Fieldwork at Mount Kolahoi

Graham writes:

Pahalgam is a typical trekking outpost dominated by rolling hills and the roaring Lidder river. We picked up ponies here and final supplies required for the next four weeks in the field. Our destination, near Mount Kolahoi, was about 20 miles away. The route followed the river northwards.

It was not long before we came up against our first major obstacle. The heavy rain over the past four days had washed away part of the track and the ponymen insisted that it was too treacherous for their animals to cross fully loaded. So, we carried everything across ourselves. Only 10 minutes after restarting we came up against a similar problem but this time had to wade through the mud, which came up to our thighs. One felt rather vulnerable carrying a 60lb box and sinking deeper and deeper into the quagmire. However, we eventually got going again and reached the next outpost, called Aru, where we cleared up and sampled the local chi (tea).

A steep climb out of Aru led us into a thick wood which sheltered us from the rain. Three hours later we reached Lidderwatt, a tiny hillside outpost surrounded by thick woods and snow-peaked mountains. The group decided to stop here for the night. We made an early start the next morning and by the afternoon found a suitable camp site. The tents were put up in the pouring rain. We tried to huddle under the kitchen shelter while our guide, Bashir, prepared some food. It was a little disillusioning being faced with such appalling weather right from the start. However, the storm clouds made the mountain scenery very dramatic.

The altitude of our first camp site was 11,000 feet. We spent the first couple of days establishing ourselves and made good friends with the local shepherd and his family. Most of the botanical work was done on a nearby slope, facing southeast. The ornithologists disappeared every morning and crossed the nearby Lidder river to reach the nearest wood. Each project soon developed its own routine.

During the two weeks at site one, we managed to do two hikes. One took us up a neighbouring mountainside, while the other was up to the Dud-Nag lake which lies in the shadow of Mount Kolahoi. The latter provided us with a stunning view of the Kolahoi glacier on one side and the Lidder valley on the other. We could not resist the temptation of having a dip at 12,500 feet, but found the water just a little cold.

Robert had problems adjusting to the high altitude and did not have a very enjoyable twenty-first birthday. However, it was not long before we were all fighting fit and enjoying better weather.

We were lucky enough to be entertained by the local shepherd, Gulam Mohammed, who opened his house to us and gave us some typical Kashmiri food,

of rice, vegetables, and curd. He and his family spent the summer in the valley looking after his sheep, but returned to Pahalgam for the harsh winter months.

We were also joined by a research scholar of the University of Srinagar, whose knowledge of the botany of the Kashmir Valley was of great help to us.

We left site one on Friday 19 August and followed the same route back through Lidderwatt to a new site, just below this settlement. The altitude was 9,000 feet and we had the shelter of a small copse. There was a small group of huts near us, but we never struck up a friendship with any of these villagers. We continued our studies on the species. However, the ornithologists had to travel further afield to find adequate numbers of titmice.

It was not long before we decided to explore the area around us and we were amazed to find tiny settlements at the top of the surrounding hills. I came to the conclusion that the local people must be exceptionally fit to cope with all the climbing involved in living at such an altitude. The weather was kind to us for the most part and we were able to complete our work here within 10 days. However, on the weekend before our departure we decided to make a trip to Lake Tarsar (13,500 feet). The scenery was breathtaking - the lake was perfectly still. On the following day, we collected plant samples and explored the high ridge that surrounded the lake. We managed to get a magnificent view of Mount Kalahoi from the west.

We left site two on Tuesday 30 August and followed the same route back through Aru, to Pahalgam.

(iv) The Trek, Part I

Robert writes:

On 1 September we met up with our guide and cook, Raschid, and his helper, Latif, whose services we had sought from the Kashmir Himalayan Trekking Agency in Srinagar. Raschid was a quiet, shy and thoughtful man whom we found very difficult at first but who gradually became less reserved. By the time we separated, 17 days later, we all liked and respected him. The love for his family was clearly apparent as was illustrated by his sadness that his job kept him away from them for the summer. Latif was the antithesis of his boss, talkative, boisterous and all smiles. However, they were both keen to please in their different ways, Latif excessively so because he hoped to get a fine reference from us to further his ambition of becoming a guide.

All was set for an early start the following morning after the arrival of our beasts of burden and their minders. We gave Bashir a big send off, taking him for a meal and giving him a Tilley lamp, which he had hinted he would like for three subtle weeks, and a generous tip.

A dawn departure was in retrospect rather too optimistic. A night of severe storms had subsided into severe rain by the morning and motivation for the great adventure ahead was at a low ebb, especially in Graham and John's case, their tent having been all but washed away during the night. A healthy (i.e. huge) breakfast was eaten at a leisurely pace in reverence to the Mayers axiom "You've got to eat, haven't you?" and last minute postcards



and aerogrammes written. Enlightening contrasts in the description of our destinations were to be found in these letters. From the creative imagination of our leader, "... across lush, alpine Kashmir to the mysterious hidden kingdom of Zaskar and the remote, barren moonscape of Ladakh", to the information style of the medical officer "from moslem Kashmir across the Gt. Himalayan range to the buddhist kingdoms of Zaskar and moon-like Ladakh"; and the impatient "... across the Himi's to Ladakh" of Project leader Mayers.

Departure was further delayed by the obstreperous ponymen who, like most Kashmiris were imaginatively named Bashir and Bashir. Despite all personal equipment being carried by individuals, the gear was considered too heavy for three ponies and two more had to be obtained, each now carrying 35kg despite guarantees that each would carry 60kg. Admittedly, we did underestimate our requirements and 60kg did seem an awful lot for such world-weary beasts. After extensive noisy and ill-humoured negotiations it was agreed that the cost of the trip as laid down in the contracts in Srinagar would be honoured with the company paying for the extra ponies. Not a good way to start and already the head ponyman had been appropriately re-christened. Whilst waiting, final ounces were shed from our packs, Graham winning by a clear head, total kit being toothbrush and spare undies with Mark a poor last, such are the temptations of a 100 litre sac.

Our first day's walk was an eventful and disturbing one. Less than an hour out of Pahalgam, the sight of a palid, contorted body being dragged out from amongst the rocks of an angry, mud-laden river in full spate was a sobering one which was to leave us quiet and thoughtful for the rest of the day. The night's storm we were informed, claimed the lives of six cowmen whilst trying to protect their valuable livestock. The experience certainly taught us to respect our vulnerability and show extreme caution when negotiating the fast rivers we would inevitably meet on the trek.

Heavy rain had flooded out the trail a couple of miles further on and we had a long, frustrating wait for our ponies, fearing that the torrent might prove impassable. Our fears were unfounded and we struck out for our destination, Chandanwari. As we arrived we were shocked by its appearance; that of a recently deserted shanty town, tents semi-erect, tin huts with corrugated iron rooves awry and signs of recent human inhabitation - fires smouldering, levelled ground and the fragrance of "sanitation au naturel". Despite this, our arrival was accompanied by feelings of great relief for we were all cold, tired, irritable and very wet. Fortunately, shelter and chi in large quantities in front of a clay fire could be found amongst the extensive remains of this Armanath pilgrimage campsite. Only two weeks previously it had been host to thirty thousand hindu pilgrims and attendant entourage en route for Armanath cave, 13,500 feet up in the mountains, in whose depths is their goal, a stalagmite, Shivling, the ice-phallic representation of Shiva, the Creator. We had all wished to join the pilgrimage for part, if not all of its thirty miles, but unfortunately Sawan (July - August), full-moon day fell rather too early and the fulfilled worshippers were now returning to all corners of the hindu world.

A cold uncomfortable night was spent in a concrete labour Serai, a poor substitute for our tents.

Day two was one of mixed emotions. On the one hand the group had to contend with illness, thoughts of a sadly missed sister's wedding at home and the mysterious disappearance of a pair of canvas boots and a bottle of

brandy, a grave loss to the medical kit. Conversely, the scenery was exhilarating, especially the sight of the Sheshnag glacier plunging into the emerald green waters of the Sheshnag lake, so named as the home of the Kashmiri Loch Ness Monster, the serpent Nag. As elusive as its Scottish counterpart, the beast has enjoyed relative peace (no American research stations here) having only to contend with pilgrims combing the shores during the period of the Armanath trek. Another memorable moment was the walk through a narrow gully with crags towering skywards on all sides where we were to spot two Lammergeier huge and rare Bearded Vultures, characteristically hugging the hillsides and contouring only yards above us with swift and effortless precision.

Far more prominent were Griffon Vultures. Almost omnipresent in the mountains of Kashmir, this bird soars high above the valley floor and well clear of the hillsides.

Gulol Gali at 14,350 feet was our first experience of Himalayan passes and we were not to be disappointed. The pass was as all passes should be; a narrow col with ridges sweeping upwards to the peaks either side of us and expansive views plunging downwards in front and behind us. To complete the effect it was cold, windy and the ice-reflected sun fierce. Time for a Yorkie. To what extent the exhilaration was distorted by the sheer relief that the pain of hauling rucksack and self (albeit Indian slimline versions) up steep, winding and vague tracks on semi scree and then on ice, was coming to an end is hard to judge. "It's all part of the experience". Our admiration for Graham who struggled gamely ever upwards through the rarified air despite a painful and energy sapping illness, knows no bounds. So too for Raschid who gallantly offered to porter his rucksack, light on clothes but now weighed down by Grahams little nest egg of five week Yorkie and Crunchie bar supplies. Not a man to indulge himself is Graham. For some members of the party, adhering to rations as laid down by our Food supremo (the afore mentioned) was to be a severe test of character throughout the trip and for some, Indian supplements proved invaluable.

The panorama before us, stretching eastwards across the expanse of the Kashmiri Himalaya to the peaks of Nun and Kun on the horizon, our destination eight days hence, gave us a vivid picture of what lay in store for us. Only pre-ground images spoil the entire effect; Mark and James modelling the leggy remains of M & S's pyjama bottoms on their fair english crowns and Mark resplendant in pyjama hotpants. The eerie reverberating sounds of Marmot's screeching and Graham's stomach accompanied our drop in altitude and a relaxing lunch was spent on a sun-drenched, flower-clad slope.

This was followed by the hurling of abuse at a recently departed Guja shepherd who had taken a fancy to Mark's mirrored shades, a loss which was to severely cramp his style on future summit attempts.

At this stage in the trek we periodically came across isolated shepherd huts and occasionally entire communities in remote valleys, several days hard trek from any form of western 'civilisation'. Initial thoughts that such shepherds would be suitable subjects for the lead project proved impossible because such people are nomadic, spending the harsh winter in Pahalgam and Srinagar living off their summers labours. Tough and resilient though these people are their life style and culture are more pragmatic than the people of buddhist origin we were to meet later. For the latter, life is entirely overshadowed by the preparation for and the survival of the



harsh Himalayan winter. In Kashmir the summer is far more conducive to the growing of plentiful crops for the eight month winter than the arid desert of Ladakh where vegetation of any kind has to be irrigated and carefully nurtured. Yet it is the Ladhakis who live the year round in their barren mountain environment and the Kashmiris that migrate. Our plans for the lead project were now directed, therefore, towards two remote Ladakhi villages where we knew the people lived all year and we returned our attentions to the business of trekking through the alpine scenery of Kashmir.

The night beyond Ranmarg at the foot of Gulol Gali was spent on a delightful exposed spur with precipitous views of a long deep curving valley where river floor was extensively draped in a year round snow-bridge, the solitary life-line between communities in such uncompromising terrain. Adjacent to a small village we were to be greatly entertained that evening by the incessant howling of chained dogs, the friendly and inquisitive visits of little children (with the delightful yet common sight of a small child mothering an even younger one), the evening surgery to fight off all the headaches and stomachaches which reached epidemic proportion on our arrival, and a village feud which resulted in a fight and the ostracism of one of their saffron-bearded brethren. Mark bravely entered the fray in an attempt to barter for a pair of metal and leather, severely curved and pointed, 'court-jester' shoes modelled by one of our headache victims. Comfortable, hard-wearing and visually appealing though they undoubtedly were, the price was grossly inflated even bearing in mind the kudos afforded a CUETC President modelling such items down Kings Parade.

A major blow came that evening with the sad loss of the official expedition frisbee, last seen soaring over James' head and into the ravine hundreds of feet below, loedged in the depths of the snow bridge.

Looking at and visiting the summer dwellings of these people we were struck by their strength and permanence. Not hacked together at the beginning of the short summer as a makeshift shelter, they were permanent wood structures constructed in such a way as to afford maximum protection from the elements yet remain ventilated - an important consideration when the contents are a very large family and a clay stove primarily used for cooking since with wood scarce at such altitudes heating is a luxury which precious resources cannot meet. Rough blankets have to suffice, such items being essentially multi-purpose; bedding, overcoat, sun shade and suitcase. The major building materials are large logs that have to be imported over high passes from tree clad-areas below 10,000 feet. The roof is completed by interwoven juniper twigs and earth. Grass adorns the roof - a well camouflaged structure. Inside, the floor is a soft and springy mat of vegetation and there is not furniture, just a few cooking utensils and the ever-present hooka pipe, (Jegeer) the spiritual guidance of the male Kashmiri.

The next two days were characterised by immensely relaxing alpine walking along fast bubbling rivers, over imposing snow bridges and alongside herded goats, with towering snow-clad peaks wherever one looked. Somehow not quite Himalayan expedition stuff - not quite enough suffering. That was to come later with the discovery that a cherished two-litre tub of honey had dispensed itself over an entire pony and its load. The concern was not for the gear but for our "chappatti-enlivener". Lunches were not quite the same again. To make matters worse, our ponymen were revolting, refusing to work according to our itinerary and wishing for a rest day with the subsequent loss of a small extra route at the end of the trek. It was appreciated that

their concern was for good grazing ground and rest for the ponies, but it was a frustrating reversal of our agreement. Raschid fortunately wielded his quiet yet forceful authority and after a heated exchange of words our original plans were upheld.

It was about day five or six into the trek that the concept of "vista scale" was born. Whilst writing diaries and enthusing about spectacles before us it became painfully obvious that, due to abuse of the English language we were impotent to adequately express ourselves. After years of soap powder commercials and football commentaries superlatives have lost much of their meaning and the limited vocabulary of the average Cambridge scientist is left shamefully wanting. One can wonder and marvel but where is the imagery in 'wonderful' and 'marvellous'? We tried a reappraisal of these words but the regular use of "brilliant" and the like when confronted by a supper of rehydrated meat and rice emphasised the futility of our task. Hence the vista scale (0-7) with the view from Gulol Gali being designated V.A.3 - plenty of room for untold beauty yet to come.

Day six was to prove one of the most tiring yet exhilarating of the entire expedition, the ascent of Bobang glacier. Everybody was fully fit and an early start was anticipated only to be thwarted by a two hour search for ponies who had wandered miles despite front legs tied together. It was the first day that our guide Raschid was essential, nimbly picking a path through first the zone of ablation and then across and up 2,000 feet of glacier. The moraine, from within its depths was immense, a huge natural building site. The treacherous terrain was unable to get the better of our remarkably agile and heavily laden ponies. Yet again they had acted in contradiction to their pitifully inadequate looks. Raschid, too, appeared unconcerned by the sharp pinnacles of rocks separated from his Kashmir-hardened soles only by thin plastic shoes. Despite sufficient wealth for walking shoes, he preferred his 'beach sandals'.

The route up the glacier was a tortuous one, winding round the ends of the larger crevasses and across the little ones. Respect for these black gaping rifts grew as we calculated their known depth to be at least 250 feet in stone dropping experiments. The glare from the ice as the sun struck the thousands of rivulets of water running along its surface was intense as was the cold buffeting our bare legs from such a huge body of ice. The glacier was an awesome sight, its scale only appreciated by reference to the ponies far below us. To our sides were peaks of 17,000 feet and ahead a range close to 20,000 feet. As we approached sheer cliffs of ice, hundreds of feet high, we veered left and off the glacier. From a grassy sun-trapped promontory at 13,500 feet we looked down over the Bobang glacier. Time for a Yorkie. Even lunch tasted good.

The final ascent to the pass (14,750 feet) was a gruelling one on steep ice. There were no panoramic views in a classical Gulol Gali sense, just ice and more ice, clinging precariously to rock faces and with glaciers sweeping down towards us. The cold was severe but it served only to heighten the exhilaration felt.

The descent was rapid and tiring, initially over ice and then over a wasteland of boulders and rubble. Our path was a carefully chosen one, well clear of frequent rock falls to our right. A long afternoons trail bashing brought us to flat ground and water, welcome signals that our destination had been reached. Here more than anywhere else we were very thankful for Raschid and Latif. At the end of a hard day in which they had not had the



thrill and novelty we had felt to drive them on, they now had to apply themselves to the demanding task of satisfying our impatient stomachs. Inevitably yours truly rounded off the day with his ritual masochistic obsession - the 'you've got to go for it properly' total emersion in the icy waters. James, having long since given up explaining that such practices were not in the pioneering spirit, simply looked on in exasperation and braced himself for the hygiene lecture that would be forthcoming before the nights end.

The contrast in terrain was dramatic. In a single days walk we had crossed the Gt. Himalayan Range and had entered its massive rain shadow. The barren, arid, moonscape of Ladakh had been reached. Hard to believe we were only hours from lush Kashmir. A very, hot dusty and rather unpleasant walk (this is what following a mule train should be like) brought us to the wide expanse of the Suru Valley and to Pannikar. The morning was further marred by our leader's total loss of credibility, bringing shame upon the exalted post of CUETC President. Explorers are hardy, never say die romantics, for whom forging the raging torrents of white water is all in a days work. Mark settled instead for a piggy-back on one of the natives.

In Pannikar the contrast became more marked with rounded Tibetan-Mongoloid features replacing the long angled visage of the predominantly moslem Kashmiris. A large golden Mosque glistening in the sun reminded us of these peoples confused origins. The dwellings were now all stone-built and typically Ladakhi, with two rectangular floors, the first semi underground and with no windows, the second lighter and more airy, the winter and summer rooms respectively. Alternatively the ground floor was winter shelter for livestock, the first floor the dwelling all year, the animals below providing the underfloor central heating. We were struck by the pride the people had in their village, the houses immaculate, the winding alleyways clean (for the first time in India) and the ordered arrangement of the irrigation channels permeating throughout the village. The entire community, young and old, was bringing in the harvest.

. A sad consequence of a metalled road to Pannikar was a number of 'hotels' and the presence of young western travellers who appeared to have no respect for the people, culture and environment that they had travelled continents to see. Evidently, the inhabitants must act according to custom in Sydney or Manchester. On a more positive note, dwindling supplies were replenished.

The three days trek to Rangdom Gomba was hot and arid, and the mountains now having a sharp jagged outline against the cloudless sky and stratified multi-coloured rock formations clearly prominent; no snow was to be found here much less than 18,000 feet, said to be the highest snowline in the world. For all of us, a 'waterless' world was unnerving and novel. A ridge at 13,800 feet afforded memorable views of the imposing and notorious twin mountains of Nun and Kun (> 23,000 feet) overshadowing the wide Suru Valley which we could see climbing inexorably up towards Rangdom, 50km eastwards. Dropping down from the ridge towards the valley we stumbled into Parkachik, a small village nestled among rocks hugging the steep hillside high above the valley floor. Strange though its site was, it was plainly obvious that flat, potentially cultivatable land in the valley floor should be reserved for their precious crops of barley and peas. The rough stone houses clung to the rocks in apparent total disarray and with no respect for the impossible terrain upon which these people had chosen to live. And impossible was the word that kept emerging. How and why do people live

here? When one appreciates these people's Tibetan ancestry the answer is clear, their entire culture mirrors the year long struggle with the inhospitable environment and, as we left with an impression of the apparent happiness and resilience of these Ladakhis, we could understand better how and why they survive here.

Breakfast was had with a delightful couple, eager to show us their house and they were all smiles as we appreciatively drank chi and formed Tsampa balls (roasted ground millet) to eat with it. The room was small and dark with small glass-less windows, timber and earth roof, mud walls and a central clay stove with flue. In one corner a large stone slab container for Tsampa, in another small buddhist trinkets on shelves dug out from the walls. Below was the underground windowless cave for the long winter. An incongruous tiny mosque in the centre of the village emphasised the peaceful co-existence of two religions.

Yuldo was reached by day ten after two long level walks up a rough yet truck-worthy track, passing the ruined village of Shakar wiped out several years ago by smallpox and with the Gangri glacier extending directly from the Nun and Kun saddle to the green-tinted Suru river below us, its colour due to a high copper content in the subsoil (Zan-skar: copper valley). A threatening storm never materialised and the sun shone relentlessly.

Yuldo was the first village we met with a Zanskian population and we were welcomed into a large rectangular house bedecked with prayer flags for buttered chi (revolting), cheese, Tsampa and zul, a delightful local yoghurt. From the ground floor stables we ascended, bent double, a tiny darkened staircase up to a large living room, kitchen, bedroom and three storerooms. Our host eagerly showed us a photograph of the Dalai Lama who visited Rangdom in 1976, a major moment in his life, an old Buddhist manuscript and his wife's stunning jewel-adorned necklace, mainly of turquoise. In remote parts of this region such jewelry is worn whilst working in the fields; their wealth is therefore always with them in case of danger. A time to contemplate, sitting crosslegged on a springy mud covered floor with colourful fabrics draped overhead, chickens dozing in a corner and benign smiles all round.

Fate was not on our side for the lead project. Tassi Tonga, the village near Rangdom, seemed ideal being remote and having its own amchi (local doctor of ayurvedic medicine), but negotiations with him proved tricky since Raschid was unable to communicate with him. Eventually we ascertained that he was not willing to allow blood collection but he would happily assist us in collecting hair samples from the children. The evening came to a happy conclusion with great hospitality and freely flowing chang. This is a milky, home-brewed beer made from barley and millet, partially seasoned with pepper and sugar. An acquired taste but well worth acquiring. Its spirit relative, arak, is like vodka and very rough.

A day was spent collecting crop, soil and dust samples and noting potential lead sources but all attempts by the amchi to persuade parents to allow their children to be coiffeured failed. He was confident of success the following day and so we turned once again to the bottle, this time Mark's twenty-first rather than diplomacy being the excuse. Sadly Mark succumbed to "the bug" and celebrations were muted. An intermediary was found to overcome the language barrier and much useful information for the project was obtained from the amchi.



The following morning brought no further success, the parents fearing the consequences of outsiders taking 'extensions' of their children's bodies. More time and a building up of confidence may have helped, but time was short and we had to move on. A story related to us at Tassi Tonga emphasised our remoteness which we were prone to forget. In the early 1970s when for the first time a rough army track reached Rangdom, the locals generously offered grazing for the first truck and for its baby, a jeep following closely behind. My hope is that somewhere in the world such delightful gestures are still being made.

(v) The Trek, Part II

James writes:

An incongruous little quartz clock emits an alarming noise waking two of the five slumbering forms. Mark and I decided to load up with the stars still shining and try to get over to Rangdom Gomba to see what happens at a Ladhaki Buddhist monastery at sunrise.

Dawn lit up the peaks all around us in spectacular shades of pink. Feet though, were cold and wet by the time we plodded up to the gomba and found ourselves in the main courtyard. All seemed silence and desertion until one or two old, maroon-clad monks emerged from their tiny cells and went about their morning ablutions. Before long there were quite a number of monks of assorted size and age bustling about, creeping out of one small doorway and disappearing into another. We were glad only to create a minor stir by our presence; travellers aren't really strangers it seemed.

A pile of sacking on one exposed ledge started to move, and soon three children emerged - monastic folk of smaller variety. Many of the monks were by now heading for a particularly well-used doorway; we were invited to follow. It was the kitchen, and therefore seemed like a good idea. There were many forms huddled around the huge copper tea urns on the stove. Tea was tipped into long hollow wooden vessels; lumps of yak butter added, and a large plunger inserted to mix the brew. Tsampa, or roasted barley flour, the staple of these parts, was passed around and taken in large handfuls by Mark and myself since it partly hid the taste of the butter-tea which came dangerously close to eliciting an embarrassing presentation of last night's supper on the monastic floor.

Thus narrowly avoiding discourtesy, we were then shown around the main prayer-hall, (the dukhang). A mass of coloured finery; five-coloured Buddhist flags draped from every surface; prayer-drums, cymbals and horns. A row of god figures on either side of the head lama's seat included a figure of the Bodhisattva Avalokiteshvara with a thousand eyes and arms; one of three gods in the divine trinity of the Lamaist pantheon. (The Dalai Lama is believed to be a reincarnation of Avalokiteshvara). A lone monk in a back room was engrossed in deep voiced prayer. We left the gomba as the sunlight crept over the plain, completing the transition from an ice-cold morning to a burning hot day.

After a night at the nearby village Tassi Tonga, we were once again chasing our mule train up the gorge. Amidst stripy mountains of multi-coloured raggedness (inspiring flowery lingo), we came close to losing one of our trusty steeds into the raging torrent below, and were confronted with the news that we had to cross the mighty river ourselves. A rope was taken over by our fearless guide Raschid, and, with boots on to avoid loss of toes

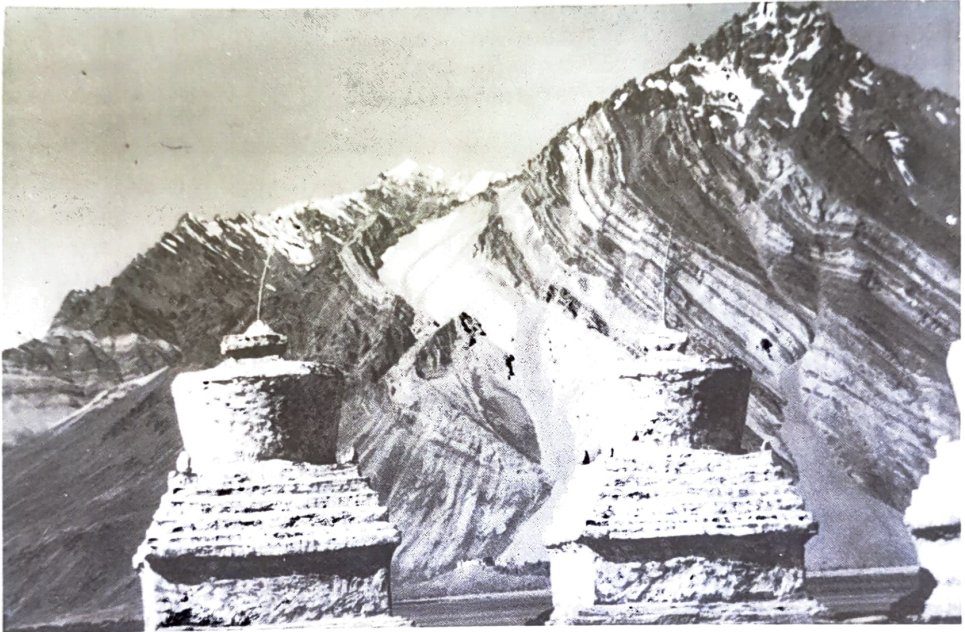
from sharp rocks we all made it across; rather embarrassingly easily considering we'd been dreading it for hours. Quizzical looks were exchanged when Raschid told us we should make camp immediately on the other bank of the river on top of a pile of crumbly rock, though by now we weren't surprised by anything much. However, we were soon cursing Raschid, the mules, each other and the world in general because we seemed to have run out of food. Having eaten incredibly well for the last six weeks this came as quite a blow and we took to our beds. The river rose substantially that evening as the day's meltwater from a glacier way upstream made it more like the mighty torrent we'd expected.

There was a definite 'Last Supper' feel to breakfast in the cold wind the next morning, as we sucked down the last of our porridge supply and mused on the 17,000 feet pass we were about to tackle. (We were soon to find that the food shortage wasn't quite as desperate as we'd imagined but at that time the world seemed distinctly less of a wonderful place). The climb began and an hour later when the sun hit us, the bit was between the teeth, so knowing that all great adventurers casually brush off minor problems like running out of food, we pushed on regardless and within two hours we had climbed the 5,000 foot ice and scree gully to stand atop the Kanji-La, our highest pass at 17,200 feet. As mutual congratulations for being so fit and hearty subsided we began to feel the nip in the high-altitude air, and, since the mountaineering egos were flying high, we veered across the col and up the side to get up onto a peak just under 18,000 feet with a 360 degree view which seemed to make us much higher than the rest of the world. Our route ahead looked an even bigger jumble of peaks than the way we had come - a paradoxical surfeit of ponderous landmarks making orientation difficult, (and words of one syllable impossible). We came down before freezing too many parts, and on looking back saw a precarious ice cornice hanging from the top which we had been very close to standing on minutes before.

A long tortuous descent, through increasingly 'Lord of the Rings' style landscape, to a camp at a three-river intersection. I fell asleep around a scrub-wood fire to the sounds of Mark's snores, as Orion came up from behind a spikey peak into the night sky.

Down the gorge, a rocky outcrop, visible through the gap between the two sheer sides, was bathed in sunlight. Encrusted on this outcrop was the village of Kanji. Small barley fields carefully irrigated (otherwise they would not exist in this arid area), were ripe for harvest as we approached Kanji. A jumble of low square houses and chortens in various states of repair and disrepair, which seemed to beg the question 'why here?' Newly harvested Ladakhi peas were heaped, plant and all, on the roofs of many of the squat white-painted houses. Mini walls following all the routes in and out of town were covered in carved prayer stones with 'Om mani padme hum' written in Sanskrit or Tibetan script. The houses of Kanji are each perched on slopes to keep the small amount of flat land purely for the hardy crops. Each has a couple of tiny doors and windows; often there are small rooms underneath for the beasts in winter, and equally small rooms above for the family; the whole building designed for maximal insulation against the harsh winters. Some of the villagers looked as well weathered as their surroundings.

One of the houses here is the home of Karma Tsering the local amchi. Karma Tsering and his father fled Tibet when the Chinese invaded and transferred their practicing of Tibetan ayurvedic medicine to Kanji. They



collect the plants required up in the Ladakh mountains; each representing one or a variety of cures. Sixty or seventy gauze bags were hanging from the ceiling in the house, and on the floor were a similar number of the books which make up the ayurvedic text; the Rgyud Bzi, printed in beautiful Tibetan script. Karma often takes his medicinal plants to Dharamsala in winter. In the foothills of the Himalayas, in Himachal Pradesh, Dharamsala is the home of the Dalai Lama since the Chinese threw him out of Lhasa in Tibet.

We had chats with Karma and his family during our short stay in Kanji and I think we both managed to convey a bit about our respective lives; our conversations punctuated by tongue-in-cheek requests from father, like 'are you sure you need those socks'. We all became interested in this 'Amchi' medicine, largely because of Karma Tsering's confidence in it. Herbal cures for every ailment; from 'noseworms', to 'lung cancer' were shown to us with proud, wide-eyed glee.

Some work was done in Kanji; we collected some more peas and barley heads, but most of our time was spent, in wandering around the crumbling rock slopes of the village, amongst the passages between the squat, flat-roofed houses, trying to get a feel of what living here must be like. We had been doing something pretty different for the last twenty years. We wanted to come back to Kanji.

To meet the Srinagar-Leh road and thus end our trek meant heading north and descending the chasm. This was the main route in and out of Kanji; but any path that might once have been glued to the rock was nowhere to be seen in many places. Mark nearly killed me and I could have seriously damaged John as we dislodged rocks on top of each other in our more careless scramblings. We had to wade through the river some six or eight times where the gorge was too narrow for any path. Again, the dogged stability of those knackers'-yard rejects, our mules, was a constant inspiration.

Towards the end of the afternoon we passed a pair of delapidated chortens and emerged from the gorge. Knocked suddenly out of the dream-like world we had been in; 52 Indian army trucks growled past on the road, leaving a trail of rising dust clearly pointing the way to Leh. Tramping along the roadside brought to mind the many hours of a mispent youth, trying fruitlessly to hitch-hike from one corner of Britain to another. Soon this vision was improved upon by our arrival in Huns Kot and its tea-shop. After buying up the bemused proprietors' entire tea and biscuit supply, we decided to camp on a patch of earth on the other side of the road.

It is time for slightly less-than-tearful farewells to our mule-men; the two Bashirs. Godfrey Vigne, a very English Himalayan explorer in the 1830s, appreciated in the Kashmiris what few others would admit, namely that 'when detected in a fault their excuses are so ready and profuse, and so often abound in humour, that it is impossible to abstain from laughing and to attempt an exhibition of anger becomes a farce'. Such were our mule-men. These two had caused much hassle, anger and annoyance yet it was hard to rouse genuine anger against them, although they were frequently threatened with having Graham set on them. The parting was thus nothing if not melodramatic. Much arm flailing and exaggerated expressions of horror, grief and woe at the payment bestowed on them. Bakshish consisted less of rupees than of a broken plastic bucket and a ripped tarpaulin, both of which they had the audacity to reject. with a few mutual shouts of friendly abuse

they left us, and I'm sure I detected a slight smirk on Bashir's face as he rode off with his knackered mules, protesting, into the sunset.

We were genuinely sadder to lose our cook-cum-guide Raschid the next morning and on top of his earnings he was pleased to be given our pressure cooker, whilst we pretended not to be glad of getting rid of some of this surplus junk.

We hitched a lift in a jeep to Lamayuru, a very impressive monastery on top of a spur in the Drogpo Valley below the Leh road. Lamayuru had seen many more travellers than Rangdom. There was a wizened old man selling Ladakhi gomba souvenirs (monastic bells, cymbals, prayer-wheels etc., and a Ladakhi speciality, intricate padlocks made from many sliding pieces of metal). Quite a large village clings to the slopes around the Gomba, many of the houses belonging to the monks themselves. Below the houses the ripened barley was still being gathered in; the small terraced fields drawing the attention since the rest of the landscape is brown and lifeless, with sharp peaks apparently stretching for ever in every direction.

Lamayuru was built in the tenth century under orders from the King of Ladakh. It once had up to 400 monks but today there are about 40, some of whom are out teaching in other parts of Ladakh. The monks are of the Gelugpa school - the 'yellow hats' (the Ladakhis are big on hats), the branch of Tibetan Buddhism to which the Dalai Lama belongs. The Gelugpa is one of four schools of the Vajrayana or 'Diamond Vehicle' of Tibetan Buddhism, the others being: the Nyingmapa, Sakyapa and Kagyupa. All Himalayan monasteries belong to one of these, the Kagyupa (the 'red hat' sect) and the Gelugpa controlling all but two in central Ladakh. Like all the monasteries Lamayuru is dependent on the donations of believers. Small daughter-gompas, over which the Head Lama at Lamayuru holds allegiance, channel donations from the outlying villages. The gomba certainly looked in good health but I suspect that this was at least in part due to a healthy influx of tourists. Wall paintings inside the Dukhang portray myths of the Gelugpa order. Shelves of the books of the Kanjur and Tanjur (the Tibetan canon and commentary), drums, chenoi (like shawms), tankhas on the pillars, five-coloured Buddhist flags draped all around, and the low tables or 'chogtse' beneath, where the monks sit at prayer. A vivid vision remains of a dark image of the 11-headed, 1000-eyed Chanrazik.

A truck was flagged down which turned out to be a group of Australians being whipped along from Kathmandu to London with the company Encounter Overland. They had decided to make a (pretty drastic) detour via Leh. We were surprised to be in a truck with our sweaty antipodeal brothers and sisters although we had somehow begun to expect the unexpected.

We spent a night near the village of Alchi. The village was surrounded in apricot trees and many chortens were dotted around the gomba near the centre. There was the sound of running water throughout the village, the little channels leading to each house gave the place an oasis feel. The gomba here was unusual in being not on a hill but in the middle of the village. Thousands of miniature Buddha paintings covered the walls of the gomba and a mandala in the gloom remains a powerful and haunting image.

A long ride and a billion hairpin bends brought us along the Indus Valley to the approaches of Leh. Quite a military presence here, about 8 kilometers of build-up along the road. Indians are very edgy about Ladakh; the Chinese are only just over the hill, and in 1962 it was a severe



embarrassment to find the Chinese occupying the Changchenmo Valley which is part of Ladakh, and war was fought over it.

The military camps eventually gave way to the 'suburbs' of Leh: an Animal Husbandry centre, Leh Radio Station and some large adverts urging us to buy 'Thrill Cola' and dubious sounding cigarettes. Beneath one advert, a woman selling grapes sat next to a man selling sandals made from the rubber of truck tyres. The main street bustled: Ladakhis in black or maroon wool robes, the women often with striped shawls, and the ensemble topped with the yak-wool top hat over a wrinkled brown face which is liable to break into a toothy grin. There are many Moslems too, there is in fact a Moslem majority in Ladakh. A lot of the shops are Moslem run and the town is a lively and interesting place because of this love-hate coexistence of the two cultures. It is possible to find families in Leh whose members are Moslems, Christians and Buddhists since the Ladakhis are characteristically tolerant of other beliefs.

The town is dominated by the old palace on the Tsenmo hill which has most of the old town at its base. The palace was built in the 16th century about the same time as the famed Potala in Lhasa - which it resembles. It is now damaged and deserted due to the Kashmiri invasions of the last century and the Royal Family now live in the Palace at Stok, on the other side of the valley. High above the palace, on top of the hill, is Leh Gompa. Surrounded by thousands of prayer flags and painted bright maroon, the Gompa commands a spectacular view, down onto the town and across the Indus Valley plain to the mountains of the Zanskar Range. Looking north beyond another distant gompa, Sankar, we could see the Nubra road, the 'Beacon Highway' leading up into the mountains. Closed to foreigners the road goes over an 18,380 foot pass to reach the Nubra Valley, making it probably the highest road in the world. The signpost to it says, 'you can have dialogue with God'.

We camped on a rare Ladakhi patch of grass, in the grounds of the 'Himalayan Hotel' under some short, but nicely shady trees. Exploration of the intriguing back streets of Old Leh was regularly punctuated with cups of tea and rice pudding in the 'Tibetan Restaurant'. (We later discovered that this was one of the more notorious hepatitis spots in a town where it was generally rife). There were many interesting little shops, often selling trinkets for us visitors. One shop boasted 'Genuine Tibetan antiques of copper and silver'; the proprietors name was written below and he claimed to be one 'Useless Wali'. I met the gazes of snotty-faced children, chickens and sheep in the old town, the cackle of a couple of Ladakhis merry on chang in a back room. Three young Kashmiris over on a visit, met me in a back alley and after a few banalities they got down to the serious business and commanded me 'you do disco dancing'. It looked like I had no choice so I started strutting around on the cobbles and before long the four of us are jiggling along the alley grunting old Abba songs and laughing at each other. We had some great meals in Leh, the Dreamland Restaurant being the best place, with friendly service, 'best quality prices', electricity (from 8 until 10 p.m. as long as the town's generator is working), and chowmein noodles and lemon tea keeping up our rule of plenty of eating.

Bob, John and I travelled out to Tikse and Shey gompas. Tikse is a huge monastery on a mound with many houses below where the hundred-odd yellow-cap (Gelugpa) monks live. Inside the courtyard we are drawn into the Dukhang by the sounds of drums and cymbals. We are allowed in and find about 50 monks, including many young boys, seated at prayer in a

spectacularly decorated interior. There is a steady drum beat accompanying the low chanting and the occasional clash of cymbals.

Without any obvious signal the prayers stop and all the maroon-clad monks pick up their food bowls which had all been niftily filled from big tubs by a couple of boys during the chanting. There is no other sound but cacophonous slurping of 50 monks at their veg-soup. I don't think I have ever heard so many people eating in silence before, one very small monk seems to have his whole head inside the bowl, hoovering up his lunch. Gradually the eating is punctuated by the odd belch and soon the monks are chatting as other small monks rush around refilling bowls with the lumpy green juice. After lunch the prayers go on in similar vein with the addition of regular blasts on huge horns, and twiddles on the chenoi. A few of the older monks drift off to sleep, a younger one hits an even younger one with a drumstick, and a couple remind each other of the words of the prayer. After half an hour or so of this quite energetic stuff, the chanting subsides into very deep voiced prayers which seem to come from somewhere far removed from the old monk's bodies. I drift off as I sit at the end of one of the rows, the old monk beside me had done likewise.

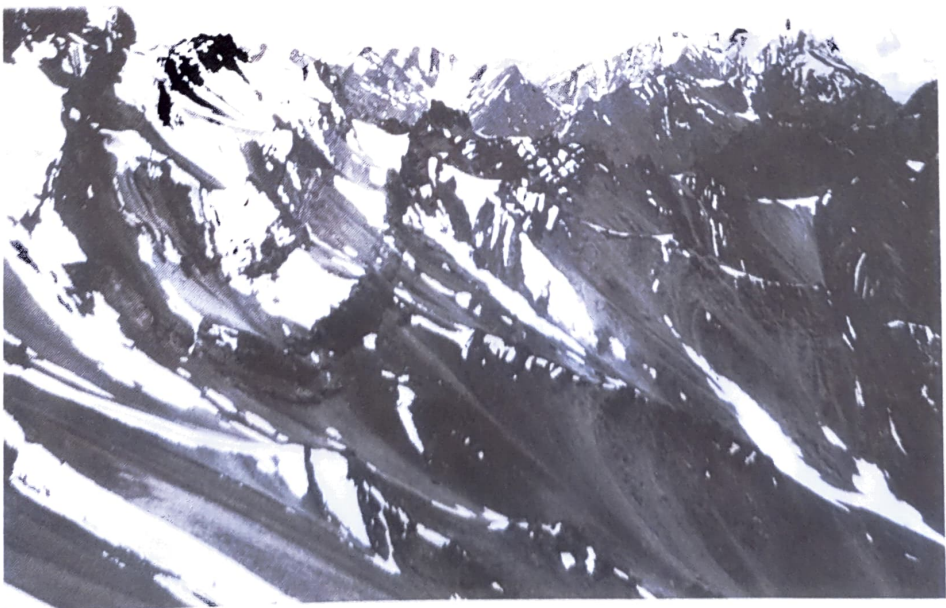
(vi) Leh to England

Mark writes:

It was decision time. The equipment given to the expedition needed to be sold and our finances sorted out carefully before we made our ways back to Delhi for the flight home. An afternoon of juggling of figures and auctioneering to any in the team wanting to buy a particular item went past without great trauma and disagreement as our minds had become quite educated by all the culture.

Graham took the daily bus from Leh to Srinaga first with the intention of flying from there to Dehra Dhun to see friends. James and I were able to take the Encounter Overland truck once more a day later and Bob and John took the daily bus the day after us. Hearing the descriptions of the local buses tearing around the corners of this most precarious of roads made James and I realise how fortunate we were to have had the skill of an E.O. driver who had done the London-Kathmandu route six times on our side.

Before leaving Leh I had an opportunity to visit one of the Amchis (local doctors) recommended to me, to make a preliminary survey of the uses of the medicinal plants collected at Kanji. Taru Amchi lived down one of Leh's back streets, by the Potala restaurant. His small room from which he tended to a large population of Ladakhis was full of packets of dried plant material, bottles of oils and noxious ointments and as a whole exuded an aroma of musty clothes. Two students who had shown me to the room decided to stay and help with the interview as Taru spoke no English. Each bag of plant material I showed him had been written on in Tibetan Script and Taru's job was to offer a translation of the name and if possible to explain its use. He would pick up a packet, carefully scrutinise it, umm in a deep guttural manner and then utter a few words which were picked up by the students. They in turn did their best to explain these to me. At one point the students came to an embarrassed halt, staring at each other, then giggling then gesticulating in a dubious manner. Eventually it became clear that they were at a loss to describe the cure for premature ejaculation! The session came to an end after a couple of hours with the most useful work



being the translation of the names of the herbs into English. I said goodbye, taking a few requested photos as I left and resolved to return and undertake a study of Amchi medicine.

At 5.00 a.m. James and I were ready to leave Leh with the Encounter Overland crew. John had been suffering from a bout of the bug that had struck us all at one time or another and we left him in the capable hands of our Doc. Bob who had caught every bug/ailment going in order to ensure that we could handle it! Another two day journey surrounded by Bruce's and Sheila's followed. The first night was spent in some disused military bunkers at the side of the road where we sat around a fire fuelled by some bush branches and heaps of dried dung. On the second day we were dropped off at Saramarg for lunch, a place known to us for the large number of people who had disappeared from it in the last few years. We had been in touch with one English family concerning this before our departure, but were helpless to unravel the mystery surrounding their daughter's disappearance.

Our aim was to get to Srinagar that day. At first James and I tried to hitch a lift with one of the large number of lorries going that way, but it was in vain as the police were clamping down on the lorry drivers offering tourists lifts. Only a few weeks beforehand tourists had been killed by an accident on the treacherous road. Eventually we persuaded a taxi driver to take us into Srinagar for a mere 30Rp. The first sight of the peaceful lakes and the comfort of the houseboats lifted our spirits and refreshed us. The first duty on arrival was to have bath. Yes, a bath. We hadn't had such a luxury for seven weeks and we needed it. It was a glorious moment. While soaking in the warm water my mind drifted homewards as I read letters from family and friends, and heard about the marvelous summer England was experiencing. (Typical Ed.)

Meanwhile, Bashir our House Boat owner, prepared a large dish of Kashmir food for us. We sat in the lap of luxury for a day awaiting the arrival of the other two.

When Bob and John arrived they too fell for the comfort. A relaxing couple of days was had by all being wafted from lake to lake by 'Shikara' (gondola-like affairs paddled with heart-shaped oars). Eventually we had to say farewell to the region of India we had come to know reasonably well over our nine week stay and we took a coach then the second class train journey from Kashmir back to Delhi. In Delhi we met Graham again and did a final repack of all the gear and presents brought. A word of advice to those who spend a day or so waiting for a plane in Delhi; make sure you go to Nirulais Potpourri salad bar. We spent four hours there before departure refilling our plates after paying the fixed charge for as much as you can eat.

The return was as expected, smooth as silk with Thai. Heathrow airport appeared through the mist as we landed back on 'Terra Firma', home sweet home. Despite Bob managing yet again to catch some foreign disease (malaria), we were safe and all the wiser and more edified for the experience. Thank you to all of you who helped make the trip succeed.

PROJECT REPORTS

DIFFERENTIATION OF FORAGING NICHE AMONG TITS (PARUS SPP) IN KASHMIR

SUMMARY

In the summer of 1983, the foraging behaviour of the morphologically similar Simla Black Tit Parus rubidiventris and Crested Black Tit Parus melanolophus were studied in a birch-dominated wood, and these two species were also studied in coniferous forest areas together with the Greenbacked Tit Parus monticolus. All the study areas were at high altitude in Kashmir. In both types of tree the Crested Black Tit foraged significantly more on the outer parts of the branches than on the parts closer to the trunk. This effect was less evident in birch though where specialisation was of a lesser degree, possibly because there is a lower level of competition, owing to greater food availability, with the Simla Black Tit. The feeding niche of the Crested Black Tit could thus be expanding in birch as a result of ecological release, due to a reduction in the degree of interspecific competition. An interspecific social hierarchy is suggested to explain the apparent dominance of the Simla Black Tit over the Crested Black Tit.

INTRODUCTION

A large number of Parus species are found in the Himalayas. They are largely segregated by the different altitude ranges they occupy. When the ranges of these tits do coincide in the same habitat however, it is not known exactly how they segregate to be able to co-exist over a range of altitudes and their related vegetation types.

The ecological segregation of sympatric European tits is well documented (Lack 1971). Separated by a high degree of ecological isolation, it has even been suggested that the species are now so specialised that they are no longer competitors.

The aim of this study was to test the above suggestion and elucidate the nature of the segregation of foraging niches, over a range of altitudes, in the Parus species unique to Kashmir. Differences in foraging niche were sought by comparing the distributions of the tits in foraging zones in the trees of different study areas.

METHOD

Near the Mt. Kolahoi Glacier we were able to utilise a north-facing birch wood as study Area I at 3,350 metres rising to 3550m - the treeline. Area II was a west-facing pine and spruce wood near Lidderwat at 2870m; and Area III a pine and spruce forest above Arau at 2740m.

It should thus be noted that although differences between tit foraging niche in Area I and Areas I and II may be argued to be due to the altitude difference, the transition of the dominant vegetation type from birch in

Area I to spruce and pine in the lower Area II and Area III is also of much importance. The dominant tree species rather than the altitude could be said to be the major difference.

The three Parus species which we encountered in the study areas were:

Crested Black Tit. Parus melanolophus.

Size: Sparrow - ; length about 11cm.

Field Characters: A small, slaty black-crested tit. Above: crown, crest and sides of neck black; cheeks and nuchal patch white. Rest of upperparts slaty. Two rusty white wing-bars (rows of spots in this case). Below: throat and breast black; belly slaty, a rufous patch on flanks. Under tail-coverts rufous. Sexes alike.

The double wing-bar distinguishes it from the very similar Simla Black Tit which, moreover, has the black on underparts more extensive.

Simla Black Tit. Parus rubidiventris rufonuchalis.

Size: Sparrow + ; length about 13 cm.

Field Characters: Above; crown, crest and sides of neck black; cheeks white; nuchal patch white tinged rufous near back. Rest of upperparts grey. No wing-bars. Below: throat, breast and upper belly black; lower belly grey. Under tail-coverts and a patch on flanks rufous. Sexes alike.

Greenbacked Tit. Parus monticolus monticolus.

Size: Sparrow + ; length about 13cm.

Field Characters: Above: crown and sides of neck black; nuchal patch and cheeks white. Back yellowish olive; rump grey. Wing bluish with two white wing-bars and white tips to tertials. Tail bluish, tip of outer retrices and outer web of outermost rectrix white. Below: throat and a broad band down the middle of belly black. Rest yellow. Sexes alike.

Very similar in pattern to the Kashmir Grey Tit but distinguished by olive back, yellow underparts and double wing-bar.

In addition, a fourth species, the Kashmir Grey Tit. Parus major cashmirensis was observed but at lower altitudes than our study areas. We did not therefore make an accurate quantitative study of this bird. A short description, however, should be added, and the species is included in our estimates of relative abundance of the members of the group shown below.

Size: Sparrow + ; length about 13cm.

Field Characters: Above: crown black; cheeks white; back grey; a whitish patch on nape. wings dark brown, tertials broadly edged with pale ashy; a white wing-bar. Tail blackish with white outer retrices. Below: throat black continued in a broad black band running down the middle of underparts; flanks ashy. Sexes alike.

Altitude Range and Relative Abundance in Kashmir

Crested Black Tit. Found between 2,000-3,350m (6,600-11,000 ft) in the breeding season. It has been found as low as 1,500m (5,000 ft) and it is a frequent visitor to the main Vale of Kashmir. we were studying the bird at the top of its altitudinal range in Area I.

Common in its habitat. Found mostly in thicker woodland and forest but was observed in the comparatively open wooded glades at Pahalgam.

Simla Black Tit. Found between 2,700-3,600m (8,900-11,800 ft) in breeding season, descending as low as 1,500m (5,000 ft) in winter in similar circumstances as the Crested Black Tit, though less commonly. We were studying this tit throughout its altitudinal range.

More common than the Crested Black Tit in dense pine/spruce forest although always in smaller numbers when in groups. Slightly less common than the Crested Black tit in the higher birch woodland (41% Simla, 59% Crested Black Tit).

Greenbacked Tit. Found between 1,800-2850m (5,900-9,200 ft) in summer and the breeding season. Descends to the foothills in winter. We were thus observing it at the top of its range in the Lidder Valley in Area II and Area III. Rather uncommon in most areas. Locally common in open forest. Least common of the tits in our study areas. (About 8% of the total tits observed in Area III).

Kashmir Grey Tit. Found between 1,000-1,800m (3,300-5,900 ft) in the breeding season, and ascends some valleys up to about 2,400m (7,900 ft). In Ladakh it goes up to 3,600m (11,800 ft) in places wherever there are a few trees in irrigated valleys. (We observed them in the small trees in the gardens of Leh at 3,543m.) It is quite common in the more open parts of Kashmir and in the lower, lighter forests. It was reasonably common around Pahalgam, 2,175m (7,000 ft), at the lower end of the Lidder Valley.

The basis of our study was to take standard observations of the tits, along a horizontal transect of known altitude. Clear, sunny mornings were chosen with as light a breeze as possible. This was because these were the conditions in which most observations were possible and also because observations could thus be made in standardised conditions, this being important especially because we could not work in the different areas on the same day and therefore fluctuations in weather conditions would not be the same for all areas. (Two sites were never observed in the same day.) Cloud cover usually formed by mid-day and the breeze generally rose at about this time. For this reason, we worked mostly in the mornings.

The observer took the following standard observation:

1. Species of bird.
2. Vegetation type in which situated.
3. Height of tree or whether in shrub or on the ground.
4. Height of bird in the tree. (Heights calculated by clinometer).
5. Horizontal position of bird.
6. Neighbouring birds, those in the same tree or one tree away in any direction. Occasionally, birds further away were noted if

they were obviously influencing the behaviour of the tit being observed.

7. The nature of the birds activity and its relative intensity ("high" or "low") over five seconds observation.

The observer moved reasonably quickly from one point to the next, recording all birds in range (about 20m radius). If the tits were in a group, either intra- or interspecific, then usually only one or two members of the flock were observed in the way outlined above, although the composition of the flock was always noted. Precautions were taken to try to avoid recording the same birds repeatedly, although the same birds may well be recorded twice in a day - once in each direction of the transect. Single or calling birds were not especially sought and any bird whose behaviour was obviously influenced by the observer was not recorded.

In addition a series of longer observations of single birds was made, following the birds for up to eight minutes.

The results for vertical and horizontal position of each tit observation were subsequently allocated one of nine positions. Three vertical stations; Top, Centre, Bottom; and three horizontal stations: Inner, Middle, Outer. Of the horizontal stations the Inner was comprised by the trunk and first section of any major limbs in any direction; intermediate limbs and branches comprised the Middle zone; and the twigs, buds and leaves comprised the Outer zone.

Indices of foraging diversity of the different species were calculated using the Shannon-Weaver function:

$$H' = -\sum p_i \log p_i$$

in which p_i represents the proportion of individuals observed in foraging category i , (one of the nine foraging stations). The values appear as the ratio,

$$J' = H'/H'_{\max}$$

in which H'_{\max} is the maximum possible value for H' and represents equal utilization of all foraging categories.

The degree of interspecific overlap in utilization of foraging stations was quantitatively determined by Horn's (1966) equation, in which:

$$R_o = \frac{(x_i + y_i) \log (x_i + y_i) - \sum x_i \log x_i - \sum y_i \log y_i}{(X + Y) \log (X + Y) - X \log X - Y \log Y}$$

where X and Y represent the total number of records of the respective species X and Y in the sample, and x_i and y_i represent the number of records made in the i th category in samples X and Y respectively.

RESULTS

(A) Distribution of foraging tits.

The composition of trees and shrubs in the three study areas was roughly as follows:

Area I: 80% Birch Betula edulis, 10% Spruce Picea smithiana; 10% Willow Salix daphnoides; Juniper Juniperus communis and other shrubs.

Area II: 85% Spruce; 5% Pine Pinus wallichiana; 5% Walnut Juglans regia; 5% Heracleum candicans shrub; Sycamore Acer acuminatum and others.

Area III: 60% Spruce; 30% Pine; 5% Walnut; 5% H.candicans and others.

All tits were encountered in the dominant tree species in the majority of cases, except for the Greenbacked Tit which was found more often in the low shrubbery. (See Tabel 1).

In studying foraging station, the most commonly visited tree type was used. Thus, in Area I the results below apply to birch. In Area II and Area III the Morinda spruce and Bhutan pine were the most commonly visited by the Crested Black Tits and Simla Black Tits. Results from both tree types are used in the foraging station study since the trees were found together in the two study areas, they are the same average height (about 30m), and the tits were observed to behave very similarly in both tree types. In Area II there was quite a high frequency of Simla Black Tits in Walnut, these results are not used in the feeding station study however, since although the trees were often compatible in height with the conifers the feeding behaviour of the tits in these trees was obviously different. Likewise only the data from conifers for the Greenbacked Tit was used.

The percentage distributions of observations of foraging tits within the nine arbitrary zones in birch and conifers in areas I-III are shown in Figure 1. The data is broken down into separate figures for horizontal and vertical distributions to display the salient trends in the foraging stations occupied in Figure 2.

The Simla Black Tit was observed foraging in all nine zones in both birch (Area I) and in Spruce/Pine (Area III). The Crested Black Tit chiefly foraged in the outer parts of the branches in the centre and bottom zones of both birch and conifers.

A variety of significance tests were performed on the data and they revealed the following differences between Simla Black Tits and Crested Black Tits in the utilisation of the foraging zones.

1. Differences between the distributions of the two tit species.

(a) Horizontal Distribution. The patterns of horizontal distribution of the two species differed significantly in Area I ($X^2=26.9$, $P<0.001$, i.e. if there were no differences between the species the probability of such a correlation would be less than 0.001).

In Area III also the two species differed significantly in horizontal distribution ($X^2=11.26$, $P<0.01$).

Examination of the sign and magnitude of the differences between the observed results and the expected for the individual cells of the X^2 table revealed that:

(I) Crested Black Tits show a strong tendency to forage in the outer twigs and leaves in both areas (Area I = +16.2, Area III = +7.7).

(II) Simla Black Tits were observed in the inner and middle zones more than expected in both areas (less so in Area III), (Area I: Inner = +8.2, Middle = +8; Area III* Inner = +5.7, Middle = +0.7). Fewer of this species were thus observed than expected in the outer zones.

(b) Vertical Distribution. The patterns did not differ significantly in either area, (Area I: $X^2=1.36$, $P>0.2$; Area III: $X^2=2.27$, $0.2>P>0.05$). In Area III, however, the test proved only narrowly insignificant, it is therefore, worth noting the trends revealed which are:

(I) Crested Black Tits were observed in the top and centre zones more than expected (+3.6, these two categories were added to raise the expected frequency above 5 - the conventional lower limit for X^2 tests).

(II) Simla Black Tits were observed in the bottom zone more than expected. (+3.6).

2. Differences between the distributions of the Simla Black Tit and random.

From Fig. 1 and Fig. 2 it appears that the Simla Black Tit was observed more frequently in the Middle zones in the birches of Area I than a random distribution would suggest. This was indeed a significant difference ($X^2=6.56$, $P<0.05$), with the Middle zones utilised more than expected (+6.8). The horizontal distributions of Simla Black Tits in Area II and Area III did not depart significantly from random (Area II: $X^2=1.86$, $P>0.2$; Area III: $X^2=2$, $P>0.2$).

3. Differences between the distributions of the tit species in the three Areas.

(a) Comparison Between Area I and Area III. The pattern of horizontal distribution of Simla Black Tits in the birch trees of Area I, where Crested Black Tits were present, was different with a high level of significance to that of Area III where both Crested and Greenbacked Tits occupy the spruces and pines together with the Simlas. ($X^2=15.4$, $P<0.001$). The vertical distribution of Simla Black Tits in Area I did not differ significantly from that in Area III, the differences were almost negligible ($X^2=0.42$, $P>0.2$).

The distributions of Crested Black Tits in the foraging zones in Area I and Area III were also compared. The horizontal distribution in the two areas did not differ significantly (the Inner and Middle categories were added to make the data conform; $X^2=1.93$, $0.2>P>0.05$). There were more observations than expected in the outer zones in Area III (+3.3). The vertical distribution in the two areas did not differ significantly ($X^2=1.21$, $P>0.2$). The most notable trend here was the lower than expected frequency of Crested Black Tits in the bottom zones in Area III (-2.7).

(b) Comparison Between Area II and Areas I and III. The difference between the horizontal distribution patterns of the Simla Black Tit in Area I and Area II were almost negligible, ($X^2=0.98$, where for $P=0.2$, X^2 must be 3.22). The difference between horizontal patterns in Area II, the coniferous area where the Simla Black Tit was the only tit, and the coniferous Area III where all three tits were observed was nearly significant ($X^2=5.37$, $0.1>P>0.05$) with more than expected in the Middle zones of Area II: (+4.3),

and less than expected in the Middle zones of Area III (-4.3) where more were found in the inner and outer zones.

4. Indices of Foraging Diversity for the three species in Areas I - III.

The distributions of foraging records shown in Fig. 1 were quantified by calculating the foraging diversity indices of the three tit species. (Table 2).

As already mentioned, these values appear as the ratio $J' = H'/H'_{max}$ where H'_{max} is the maximum possible value for H' and represents equal utilisation of all foraging categories. Thus, low values of J' represent a relatively strong tendency to specialisation in foraging behaviour.

Table 2. Indices of Foraging Diversity

	Area I (Birch)	Area II (Spruce/Pine)	Area III (Spruce/Pine)
Simla Black Tit	0.91	0.81	0.94
Crested Black Tit	0.85		0.76
Greenbacked Tit			0.74

The Crested Black Tit thus shows a marked increase in specialisation in the spruce and pine trees of Area III, where it is found with both Simla Black Tits and Greenbacked Tits, compared with Area I where it is found with Simla Black Tits in birch. The Simla Black Tit appears to show a very slight opposite trend i.e. more specialised on its own in Area II than in Area I, and even more of a generalist in Area III, where both other species were present.

5. Indices of Foraging Overlap for the species in Area II and Area III.

Table 3. Indices of Foraging

	Area I Birch	Area III Spruce/Pine	
	Crested Black Tit	Crested Black Tit	Greenbacked Tit
Simla Black Tit	0.86	0.75	0.87
Crested Black Tit			0.58

Between Crested Black Tit and Simla Black Tit the higher score in Area I compared to Area III is the result of the greater frequency of foraging by the Crested Black Tits in the outer parts of the branches in Area III.

The Greenbacked Tit bears a similar relationship to the Simla Black Tit in Area III as the Crested Black Tit did to the Simla in Area I, i.e. quite a high degree of foraging overlap. In both cases though the vertical distribution was much more alike than the horizontal, each tit favouring the centre and bottom zones in both cases.

The Crested Black Tits and Greenbacked Tits in Area III have a low score for foraging overlap, the Crested Tits "preferred" the centre and outer zones whilst the Greenbacked Tits were found most frequently in the Bottom and Middle zones.

(B) Feeding method

In addition to the study of the foraging zones, a brief analysis of feeding method of the tit species was undertaken.

Following observations on the same tits that were used in the foraging zones study, feeding methods were divided into four broad types:

- (i) Hanging - The tit upside down beneath either leaves, needles, twigs or branches. Found in both birch and conifers.
- (ii) Hovering - The tit feeding off either leaves or twigs whilst in hovering flight. Observed only in birch.
- (iii) Upright leaf turning - The tit in an upright position, turning over or pulling at leaves or needles to feed.
- (iv) Hopping and pecking - The tit hopping along or up the trunk, branches, dead parts, twigs, needles or leaves, or on the ground, making regular pecking movements. Found in both birch and conifers.

The greatest proportion of Simla Black Tits were observed hopping and pecking on twigs and branches in both areas. The greatest proportion by far of Crested Black Tits were observed hanging from leaves or needles in both areas. In Area I as the results of foraging diversity suggested, the Crested Black Tit is much less specialised in its feeding methods, it was observed in many different parts of the tree using all four types of feeding method. In Area III, however, the evidence for a marked specialisation of feeding method is augmented by the fact that 60% of the tits were observed hanging from the needle tips; another 27% were observed pulling at them in an upright position and the remainder were all observed hopping and pecking on the twigs.

(C) Activity intensity

A rather crude analysis of activity intensity of the tit species was also carried out. All activity was included but the majority of observations were of the tits feeding. The measure of intensity was a simple two-state division "high" or "low". Each tit activity observation was classed one of these two states on the basis of its feeding "rate" or speed of movements. Thus, the observations are likely to be affected to

some degree by subjective interpretation and only broad conclusions should be based on them.

The results for high and low activity intensity were subdivided into two categories; alone, or with neighbours (one or more, see below).

The results are shown in Table 4 below.

Table 4. Proportions of tit activity at high or low intensity when alone and when with neighbours (%)

	High Intensity		Low Intensity		Total
	Alone	Neighbours	Alone	Neighbours	
Area I					
Simla Black Tit (n=77)	8	43	29	21	100
Crested Black Tit (n=109)	4	53	14	29	100
Area III					
Simla Black Tit (n=123)	2	55	5	38	100
Crested Black Tit (n=20)	10	80	5	5	100

All four groups of data show significant differences in activity intensity when alone and when with neighbours (χ^2 gives $P < 0.001$ in all cases). In all cases the greatest proportion of results for high intensity activity occurred when the tit had neighbours. When alone the majority of observations were of low intensity of activity in all groups except for Crested Black Tits in Area III.

The species of these neighbouring birds and composition of flocks were also recorded. Neighbouring birds were often members of the same tit species or other tit species. Many other species were also recorded on different occasions in the near locality of the tit under observation. The three most common neighbouring birds other than conspecifics were: Leaf Warblers (Phyllocopus spp.), Sooty Flycatcher (Muscipapa sibirica), Himalayan Treecreeper (Certhis himalayana). Other neighbours were: Common Rosefinch (Carpodacus erythrinus), Kashmir Red-Flanked Bush Robin (Ianthia cyanura), Himalayan Goldfinch (Carduelis caniceps), Crow (Corvus corone), Kashmir Nuthatch (Sitta kashmiriensis), Himalayan Pied Woodpecker (Dryobates himalayensis), Meadow Bunting (Emberiza cia), Common Tree Sparrow (Passer rutilans), Wren (Troglodytes-troglodytes).

It appeared that the tits were more often observed in inter-specific flocks in Areas II and III, i.e. in the coniferous sites.

DISCUSSION

It seems that the morphologically similar Simla Black Tit and Crested Black Tit, and the Greenbacked Tit are partially ecologically segregated by differences in altitude range, but that when they occur together in a wooded area they are segregated to a large extent by feeding position and method (and thus by food), this segregation apparently being the result of variable responses to factors in the immediate environment.

There are many similarities between the ecological situation of the Kashmir tits and that of the European Parus species. Gibbs' (1954) survey of the three main European species in broadleaved woods; the Blue Tit (Parus caeruleus), Great Tit (Parus major), and Marsh Tit (Parus palustris), showed that they are clearly separated from each other at most times of the year, by their feeding stations, size of insect prey, and hardness of seeds taken. The same holds for the Willow Tit (Parus montanus), where it co-exists with them (it is partly separated from the Marsh Tit by habitat differences), and for the Coal Tit (Parus ater), where it joins them in England. The differences in overall size between these species are adapted to their feeding stations. The Blue Tit, correlated with its small size, feeds high up on the twigs, buds and leaves where it is more agile than the other species, freely turning upside down. Being large and heavy the Great Tit feeds mainly on the ground and is only ever common in the leaf canopy when taking caterpillars for its young. The third common species, the Marsh Tit is intermediate in size and feeds either in the shrub layer or, when in large trees it hunts especially on the twigs and branches below 7 metres.

Feeding stations of tits in conifers have been studied in Norway (Hogstad 1976). Here, the Coal Tit, Willow Tit, and Crested Tit display less obvious but similar differences in foraging stations. The tiny Coal Tit spends most of its time high in the trees among the needles, the Willow Tit occurs most frequently on the lower branches when in conifers, and the Crested Tit (Parus cristatus) occupies more intermediate stations.

It is widely agreed (see: Lack 1971 for discussion), that competitive exclusion holds in all six of the common Parus species in Europe, a fact that is not at all obvious at first sight. Further each of these has evolved adaptations in overall size and bill to its particular habitat, feeding stations and size of prey.

The differentiation of spatial utilization of the tit species studied does not appear to be determined by genetically fixed patterns but by an adaptable response. Although the distribution patterns and the indices of foraging diversity of the Crested Black Tits were different in Areas I and III (not significantly in the former case), this could be explained as being evidence of two fixed foraging patterns, one for birch and the other for conifers. The data for the Simla Black Tit however, show marked differences in foraging patterns and foraging diversity between the two coniferous study areas II and III, coinciding with the presence or absence of the other two tit species. This suggests that the niche differentiation of tits is a variable response to external factors. The increased foraging specialisation of Crested Black Tits in the presence of the two other tit species in Area III suggests that these external factors could be the prevailing extent of interspecific competitions.

The results from coniferous areas then, may show evidence of an interspecific social hierarchy with the Simla Black Tit dominating the Crested

Black Tit and possibly the Greenbacked Tit also. As with the foraging niche hypothesis more data is required relating to behaviour when in mixed flocks of tit species.

Several examples of an interspecific hierarchy have been found among European Tits (e.g. Morse 1970). This hierarchy is usually correlated with body size, the larger species being dominant. Average weights in grammes of Kashmir specimens of the three tit species studies are as follows: Simla Black Tit 13.5, 11.9; Crested Black Tit 8.9, 8.25; Greenbacked Tit 14.4, 13.8, (Ali and Ripley 1974). Thus, either the larger Greenbacked Tit is dominant to the Simla Black Tit, supporting the usual correlation, or if the Greenbacked Tit is subordinate then this must be attributable to factors other than mass.

The possibility of an interspecific hierarchy is also supported by a somewhat accidental finding. In our records of the activities of tits in the study areas very few conflict situations or supplanting attacks were observed between the tit species. Since competing physically for favoured foraging sites would be detrimental in terms of energy expended and foraging time lost, adoption of a system of dominance relations where subordinate birds will not fight with higher ranking individuals, would be likely to benefit the various tit species.

In Kashmir, a small but not significant difference was found between the spatial utilisation of conifers by Crested Black Tits when Simla Black Tits and Greenbacked Tits were present, and the utilisation of birch when Simla Black Tits only were present. This might be taken to indicate that the Crested Black Tit is a specialist with little flexibility in its feeding pattern or that this species is dominated by the larger and less specialised Simla Black Tit. More data is required to elucidate the case where the Crested Black Tit occurs alone in both birch and coniferous areas. If, in the absence of other tits, the Crested Black Tit is observed with a greater index of foraging diversity, then the suggestion that its foraging behaviour is affected by the presence of Simla Black Tits, would be supported. Removal experiments would provide useful data on this subject.

In terms of foraging behaviour it seems that the Simla Black Tits and Crested Black Tits were less affected by the presence of each other in birch, compared with that in conifers. There is a negligible difference between foraging distributions of the Simla Black Tit when alone in Area II and when with the Crested Black Tit in birch - Area I, (implying that the Simla Black Tit is unaffected by the presence of the Crested Black Tit in birch). The differences between the Simla Black Tits' distributions in the two coniferous areas II and III are almost significant though and this together with the fact that the Area I and III differences are slightly significant implies that the Simla Black Tit is more affected by Crested Black Tits (and Greenbacked Tits) in conifers, than in birch. There is a greater foraging overlap between the two species in birch than in conifers suggesting that resources are more plentiful and that perhaps dominance relations are less important.

When the Simla Black Tit was alone in the conifers of Area II it had a lower index of foraging diversity than when in the conifers of Area III where Crested Black Tits and Greenbacked Tits were also present, hinting that the tit has to de-specialise because of competition for a resource, probably in the Bottom Inner zones of the tree. Whether this competition is from the Crested Black Tits or Greenbacked Tits (more likely from the

distribution patterns) or from other bird species is not clear from the data. It seems more likely though that the data from Area II is insufficient and more observations are required to elucidate more fully the foraging behaviour at this intermediate altitude, Crested Black Tits could well be present in small numbers in the area.

CONCLUSION

The morphologically similar Parus species studied are ecologically segregated by differential occupation of feeding stations when in trees where food is limited. The food may be less limited in birch trees and thus, Crested Black Tits can occupy a larger feeding niche than when in conifers where there is greater competition for food and so a higher level of specialisation is required. (It is very difficult to estimate the degree of competition without knowledge of what is actually eaten by the relevant species).

An interspecific social hierarchy hypothesizes the dominance relations of the tits. More data is required, especially from situations in which Crested Black Tits and Simla Black Tits occur alone, (probably at lower altitude for the former, higher for the latter), to establish these relations.

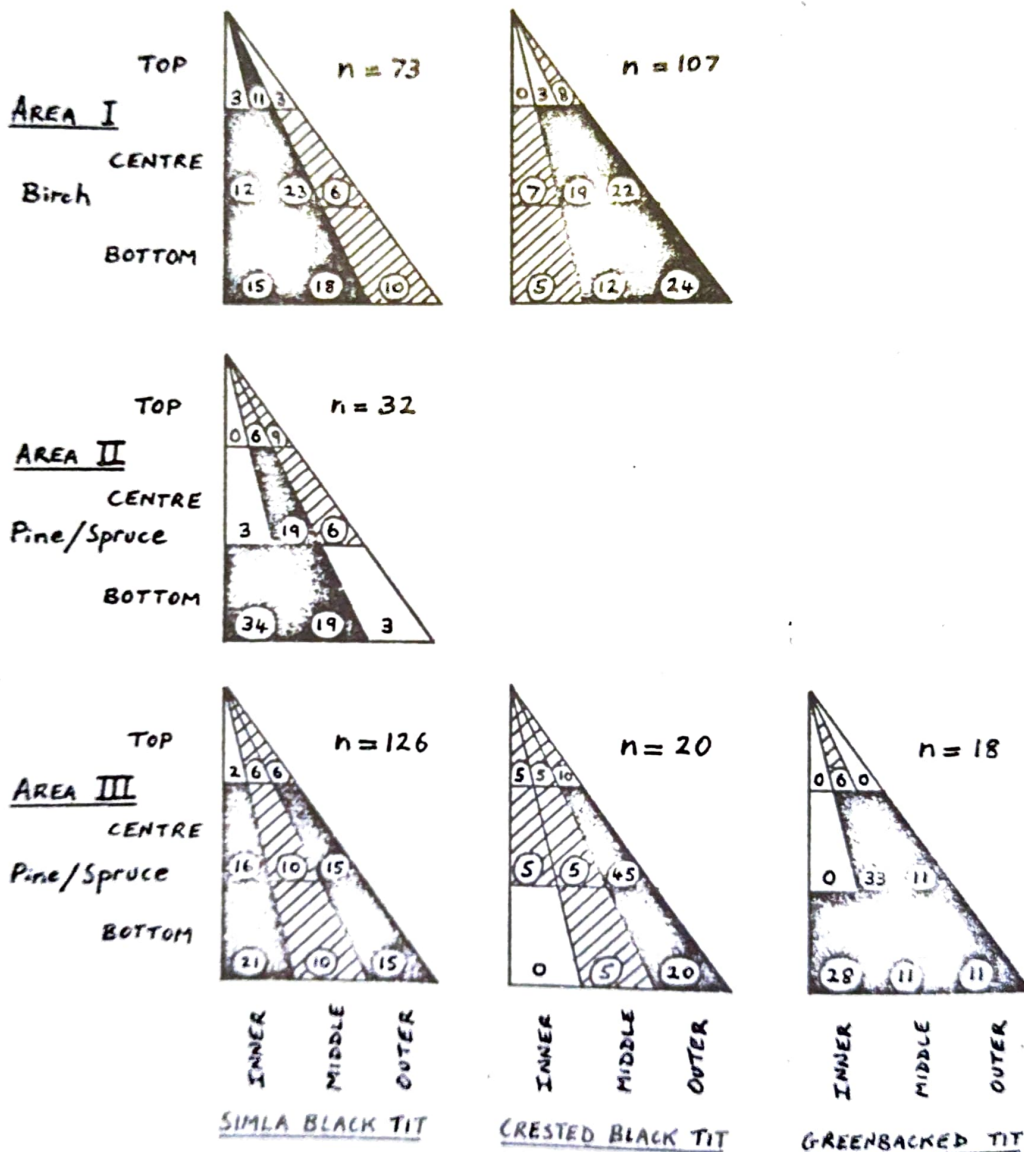
ACKNOWLEDGEMENTS

John Zealley was my co-worker throughout this project and many thanks are due to him. Dr Nick Davies is also thanked for his advice.

REFERENCES

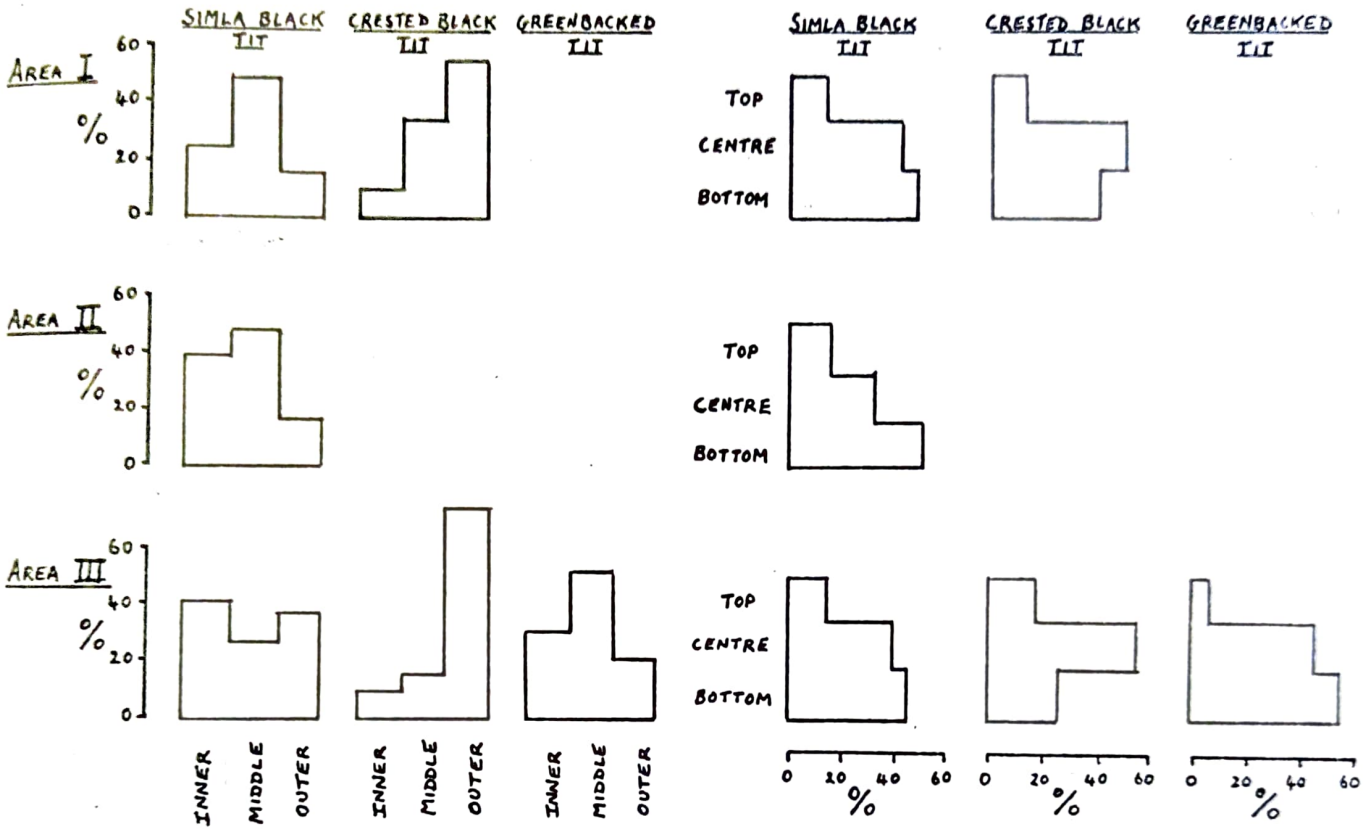
- Ali, S. (1979): Indian Hill Birds, O.U.P., Delhi.
- Ali, S. and Ripley, S.D. (1974): Handbook Of The Birds of India and Pakistan.
- Fleming, R.L., Flaming, R.L. and Bangdel, L.S. (1979): Birds Of Nepal With Reference To Kashmir And Sikkim. Avalok - Katmandu.
- Gibb, J.A. (1954): Feeding Ecology of Tits, With Notes on Treecreeper and Goldcrest. Ibis 96: 513-544.
- Hogstad, O. (1978): Differentiation of Foraging Niche Among Tits, Parus spp., in Norway During Winter. Ibis 120: 139-146.
- Lack, D. (1971): Ecological Isolation in Birds. Blackwell.
- Morse, D.H. (1970): Ecological Aspects of Some Mixed-Species Foraging Flocks of Birds. Ecol. Monogr. 40: 119-168.

Fig 1. Percentage Distributions in the Foraging Zones of The Tits in Areas I-III



n = number of observations. \square $< 5\%$; diagonal lines 5-10%; \blacksquare $> 10\%$

Fig 2. Horizontal and Vertical Distributions of the Three Tit Species in the Three Study Areas.



THE BOTANICAL PROJECT

Introduction

The botanical project was set up to investigate plant adaptation to high altitude. Two species native to the Himalayas were chosen for study:

Phlomis spectabilis, referred to as Plant A

Plantago major, referred to as Plant B.

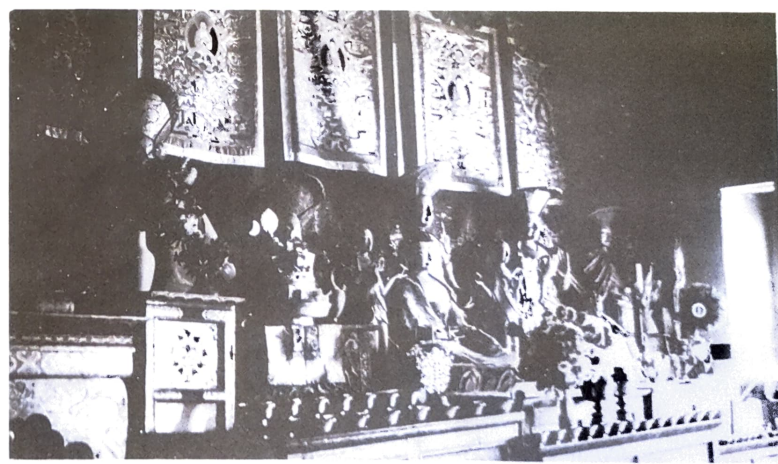
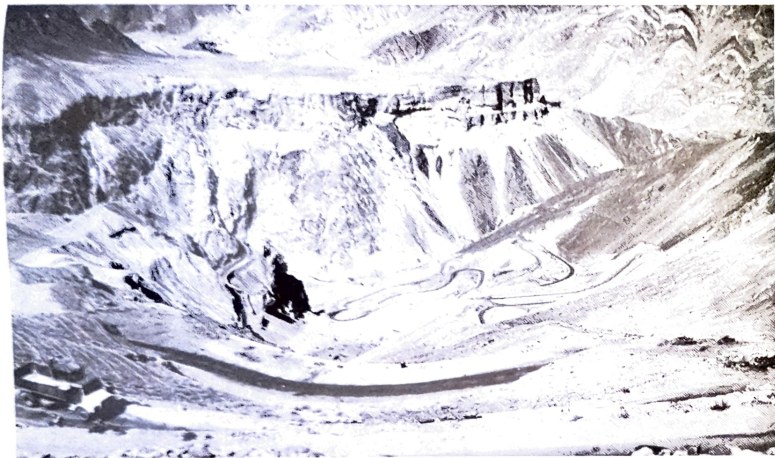
Much work has been carried out on the changes in climatic conditions with increasing altitude. The major factors which determine the microclimate of a plant, and which are thought to change with altitude are as follows:

Solar radiation;
temperature;
wind;
humidity and evaporation;
precipitation;
snowfall.

The following is a brief account of the way in which these climatic factors are expected to change with altitude:

- (1) Solar radiation increases with increasing elevation, since the turbid, scattering, and absorbing atmosphere decreases in mass. The highest radiation intensities are not reached under clear skies but when bright, highly reflecting clouds occur high up.
- (2) Air temperature decreases with increasing elevation, at about $0.5^{\circ}\text{C}/100\text{metres}$. This temperature decrease with altitude further results in less available heat for the plants during the short summer, thereby inhibiting rates of many temperature-dependent life functions.
- (3) Wind velocity generally increases with increasing altitude. However, plant temperatures as well as transpiration and photosynthesis are directly influenced by the wind only up to relatively low velocities and remain constant as the velocity further increases.
- (4) With increasing elevation the vapour pressure (absolute humidity) of the air decreases; however, since air temperature also drops, the saturation pressure of water vapour decreases sharply. Thus, although absolute humidity decreases, relative humidity increases and the saturation deficit decreases with elevation.
- (5) Precipitation and snowfall both increase with increasing altitude; however, these factors were not considered on this study.

The experiments carried out in this project attempted to analyse the water balance of the two plants named above, relating these to the morphological features associated with each species. The climatic factors listed above had to be measured in order to determine the extent to which each plant compensated for diurnal changes.



Methods

The following measurements were made:

- (1) Leaf temperature was determined by using a 42-gauge copper-constantan thermocouple. The thermocouple was inserted into the midrib of the leaf and measured by direct comparison with ambient temperature, to which the second junction of the thermocouple was attached.
- (2) Solar radiation measured using a solarimeter, in units of watts/m²/mV.
- (3) Leaf thickness determined using a micrometer screw gauge, taking values of the leaf edge at six discrete points.
- (4) Soil temperature measured with a mercury thermometer inserted 2cm below the soil surface.
- (5) Specific leaf area, which relates transpiring surface to water stored in the tissues, and this is expressed as:
$$\frac{\text{surface area (cm}^2\text{)}}{\text{fresh weight of leaf (g)}}$$

Measurements were made at two sites for Plant A, and at three sites for Plant B. Site one was at 11,000 feet, site two at 9,000 feet, and site three (Lake Tarsar) at 13,000 feet. The plants used at each site were all found on exposed ground (unless stated), and measurements were taken at one minute, five minute or ten minute intervals.

Results and Discussion

Excess leaf temperature and solar radiation

Results were obtained for both plant species at site one and site two. The excess leaf temperature was determined as that value above the ambient temperature (in °C).

The graphs of excess leaf temperature versus solar radiation, shown in Figures 1 and 2, indicate that increasing solar radiation produces an increased leaf temperature. Plant B shows a greater excess leaf temperature at site one compared to plant A, while the two species show very similar values at site two. The expected increase in leaf temperature in Plant A at site one compared to site two is not apparent.

There are certain morphological features of Plant B (*Phlomis spectabilis*) which may promote a higher leaf temperature compared to Plant A (*Plantago major*). The leaves are darker and thicker, allowing less transmission of radiation, but greater absorption. The thin leaves of Plant A may allow a greater degree of transmission of radiation. These features may explain the increase in leaf temperature with altitude for Plant B, but not for Plant A. A greater altitude range may be necessary in order to demonstrate differences in leaf temperature for this species.

Further analysis of the points distribution on the graphs suggests that results may be influenced by the prevailing wind conditions. Therefore, at a given solar radiation, there may be several different values for leaf temperature depending upon the wind speed.

Figure 3 indicates the solar radiation, leaf temperature and ambient temperature between 9.00 and 17.00. There is a good correlation between solar radiation and leaf temperature once again, and supports the data for excess leaf temperature.

Leaf thickness and solar radiation

Measurements of leaf thickness versus solar radiation at site one for both plant species shows a downward trend (see Figure 4). In addition, an experiment carried out during the first half of the day (Figure 5) shows that leaf thickness follows a diurnal rhythm, correlating with solar radiation and temperature. Therefore, the leaf is thickest during the early morning but reduces as it becomes exposed to solar radiation. However, the leaves are always exposed to the wind factor, suggesting that the frequency of stomatal opening increases as the plant is exposed to sunlight during the early part of the day. This results in increased transpiration and a corresponding decrease in thickness. Further examination of Plant B shows that it is covered by a layer of dead hairs which may reduce evaporation from the leaf surface, and therefore reduce the rate of decrease in leaf thickness. This may be another important adaptation to the high rate of evaporation that occurs at higher altitude, due to high winds and solar radiation.

Measurements of leaf thickness are complicated by a number of problems, for example:

- (i) damage to the leaf structure. This may lead to an increased loss of water, and a decreased transfer of water through the leaf, producing a false decrease in thickness
- (ii) factors not measured. At least three factors not measured might be expected to influence leaf thickness: plant transpiration, humidity and wind speed. Even those factors that are being measured may change dramatically over time intervals (lag factors).

The results shown in Figure 6 for Plant B over an entire day indicate once again that leaf thickness shows a downward trend during the morning sunlight. During the afternoon, the plant appears to remain at a low thickness value and does not begin to show any increase up to 6.00 p.m. This suggests that the recovery stage is during the night when stomata are closed and the plant stops transpiring. It is possible that the leaves are able to reach an equilibrium after several hours of the morning such that the vapour pressure gradient is reduced. This may be due to a build up of moisture around the leaf itself. Only an increase in wind speed would disturb this equilibrium, and increase the rate of water loss from the leaf once again. The conclusion from these data is that measurement of wind speed would have been an extremely useful additional variable.

Specific leaf area studies

As indicated above, specific leaf area relates transpiring surface to water storage within internal tissues. Therefore, plants found under hot, dry conditions should be expected to have a reduced specific leaf area in order to help conserve as much water as is needed (e.g. xerophytic species).

However, Korner and Mayr (1981) suggest that the importance of leaf water potential as a rate limiting factor decreases with altitude. So, the xeromorphy commonly found in plants at high altitude is not primarily related to the aerial environment.

More recent studies of specific leaf area of both lowland and upland species in Scotland (Woodward, 1983) suggest that there is a significant decrease in specific leaf area with altitude for the two species, *Festica ovina* and *Cavex bigelonii*.

The studies on specific leaf area carried out in this project support the above theory. In particular, results for plant A (Figure 7) show a decrease in specific leaf area at 11,000 feet compared to figures obtained at 9,000 feet. Values for plant B (Figure 8) were unfortunately less convincing. Those obtained at 10,000 feet, 11,000 feet, and 13,000 feet did not show a downward change, and were not (statistically) significantly different. It is possible that the range of altitudes chosen was not sufficiently great to detect a change in the specific leaf area of Plant B. The adaptations, outlined above, may be more than adequate to compensate for increased water loss.

Experiments under controlled environmental conditions have also indicated that leaves with a lower specific leaf area are more resistant to an increase in wind speed, when compared to leaves of high specific leaf area.

Further experiments to investigate the role of specific leaf area involved sun transects. Plants of either species were studied for specific leaf area and for shelter against wind and solar radiation. Shelter was defined as the perpendicular distance from a chosen rock. It was discovered that those plants furthest away from the shelter showed a decrease in specific leaf area. The graph for *Plantago major* (see Figure 9) indicates a fall in specific leaf area followed by a small rise, as the distance from shelter increases. The rise in specific leaf area indicates that other factors may play a part in determining this variable, apart from degree of shelter. This may include a positive response by the plant to greater exposure to solar radiation.

Leaf thickness measurements were taken together with specific leaf area for *Phlomis spectabilis* (Figure 10). These two variables are inversely related as indicated by the graph.

The results obtained from the specific leaf area studies suggest that an important adaptation to the increased solar radiation and wind speeds found at high altitudes is a decrease in specific leaf area. This gives rise to a smaller, thicker leaf which is capable of controlling water loss from its surface more efficiently.

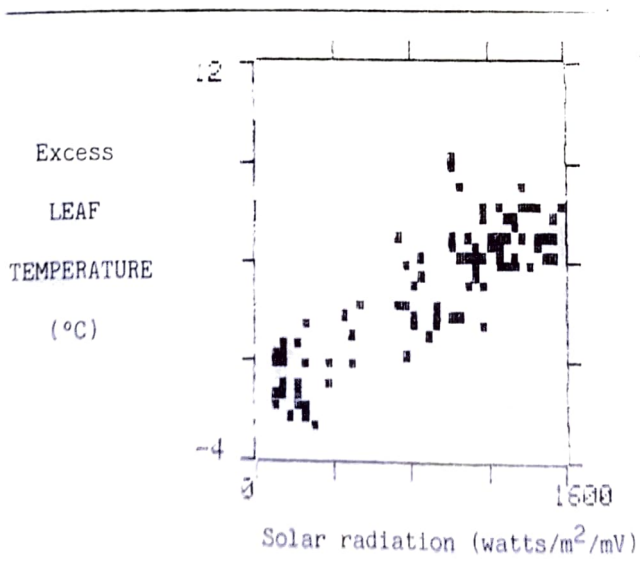
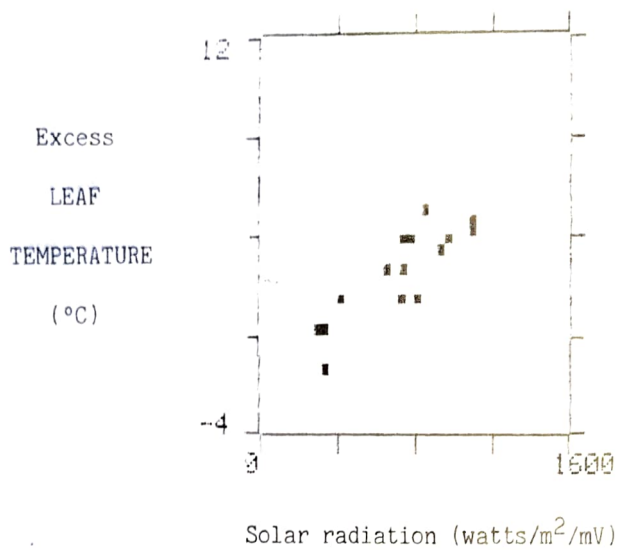


FIGURE 1. The following graphs indicate the variation in excess leaf temperature with increasing solar radiation for Plant A at (a) site one, and (b) site two.

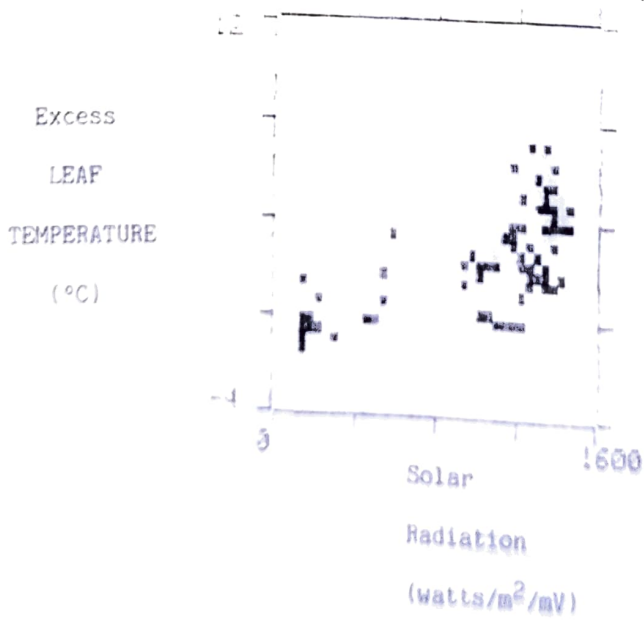
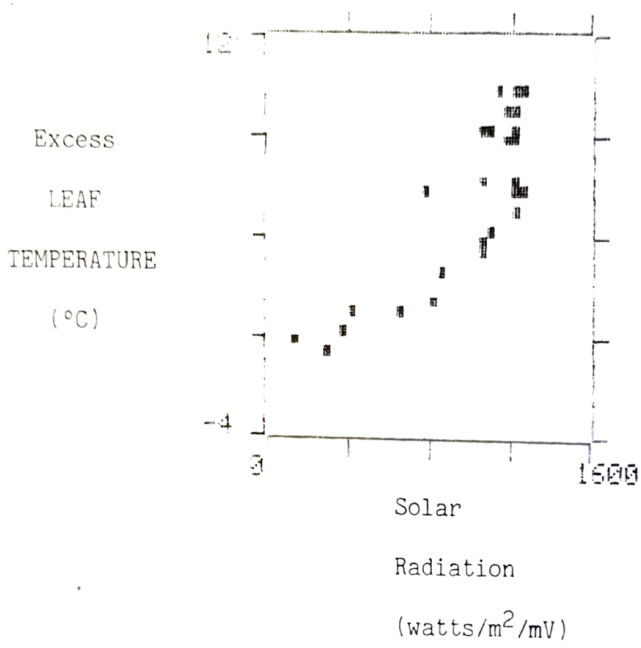


FIGURE 2. The following graphs indicate the variation in excess leaf temperature with increasing solar radiation for Plant B at (a) site one and (b) site two.

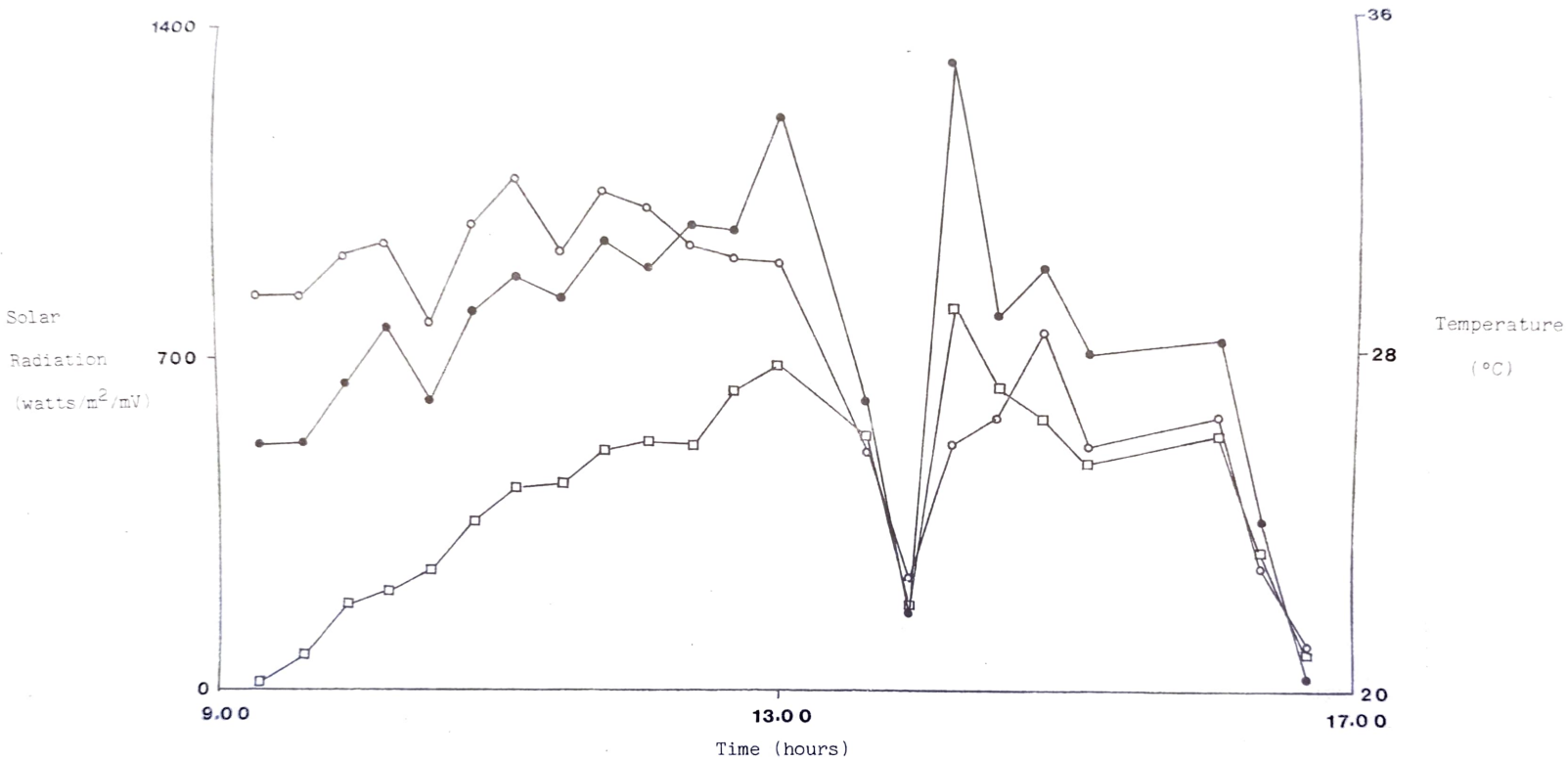
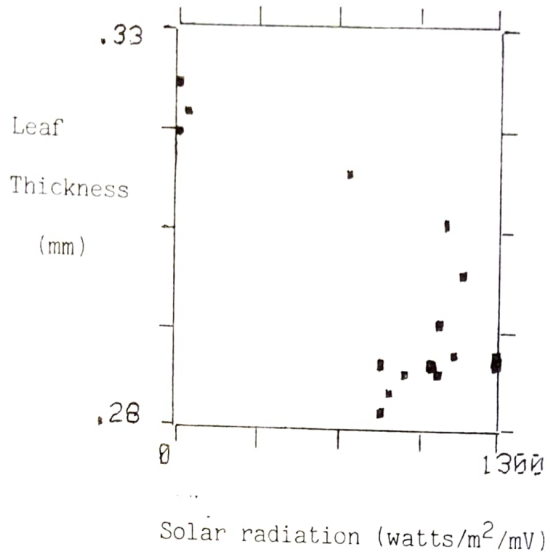


FIGURE 3. The following graph gives values for solar radiation (○), leaf temperature (●), and ambient temperature during a typical sunny day at site two.

(a)



(b)

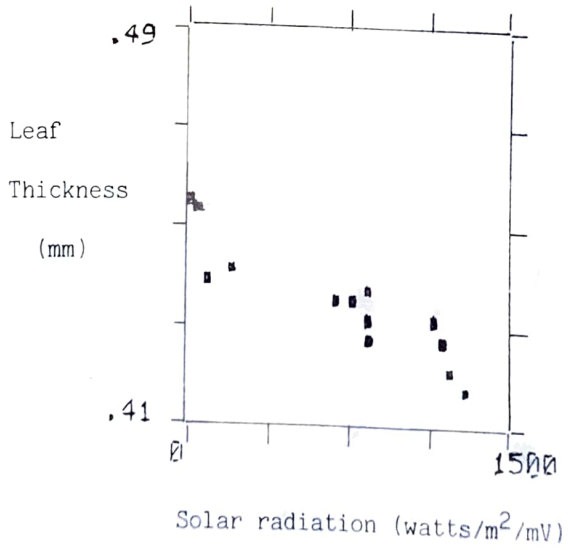


FIGURE 4. The following graphs show the variation in leaf thickness for (a) Plant A, and (b) Plant B, with increasing solar radiation.

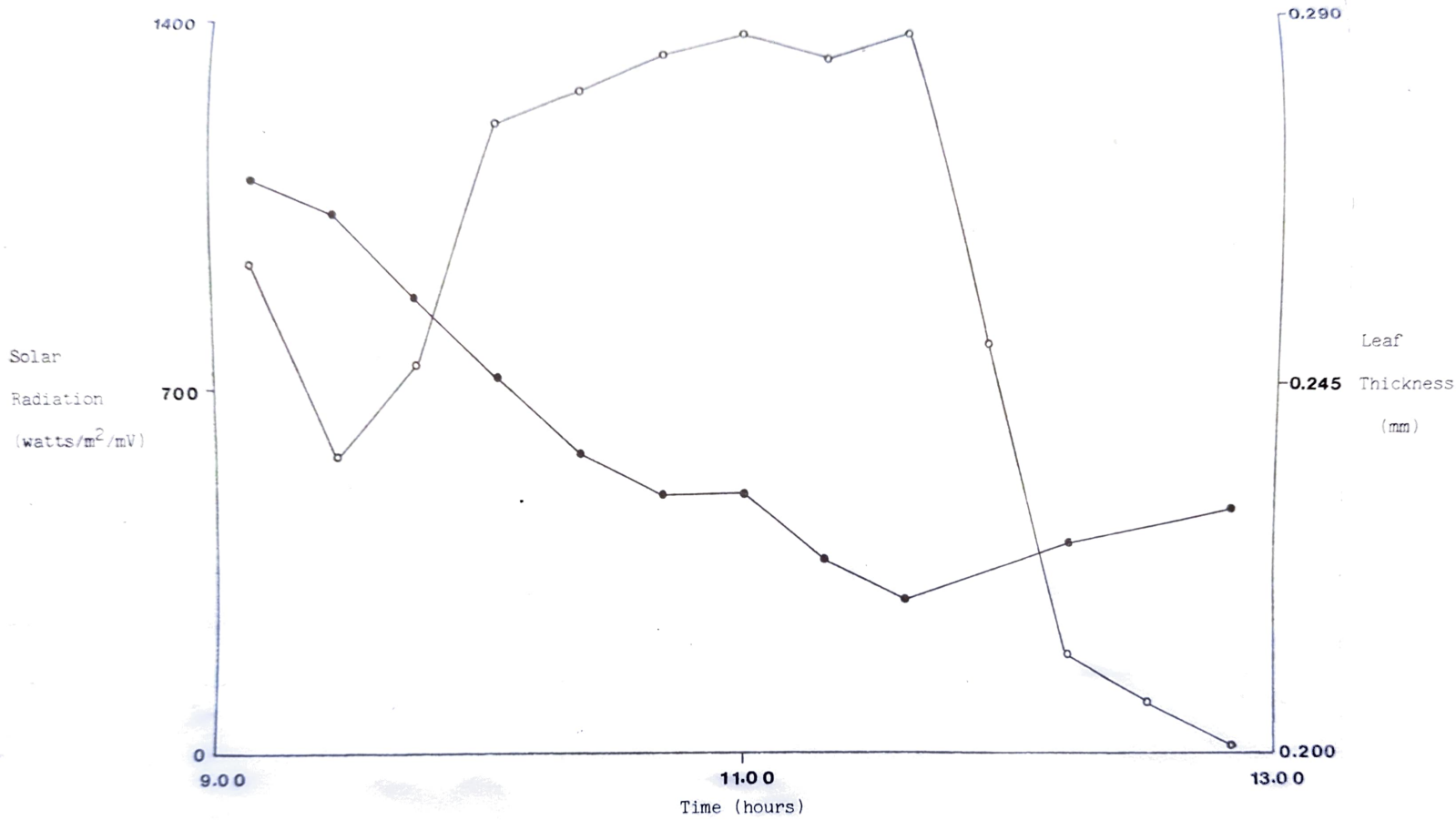


FIGURE 5. The following graph indicates the variation in leaf thickness () and solar radiation for Plant B between 9.00 and 12.00.

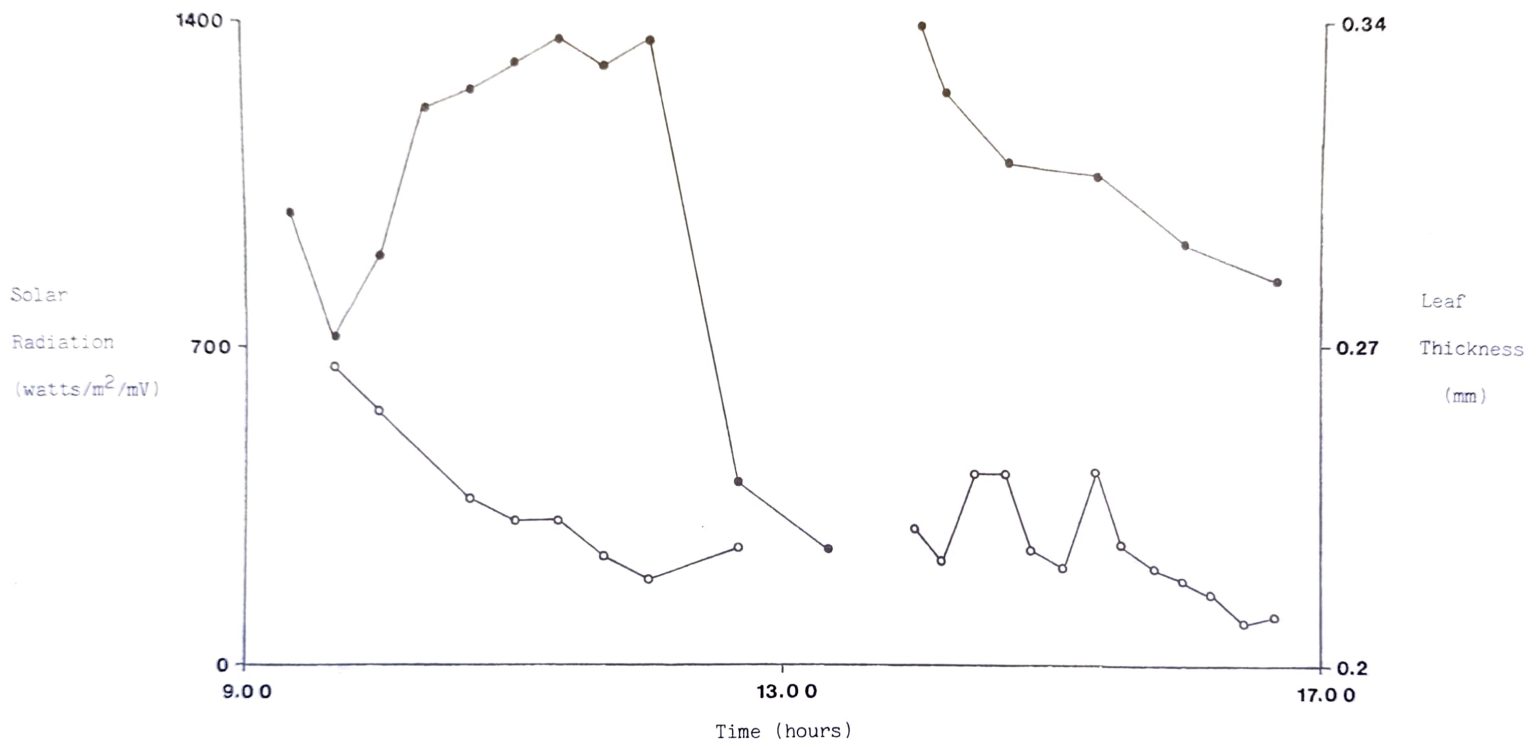
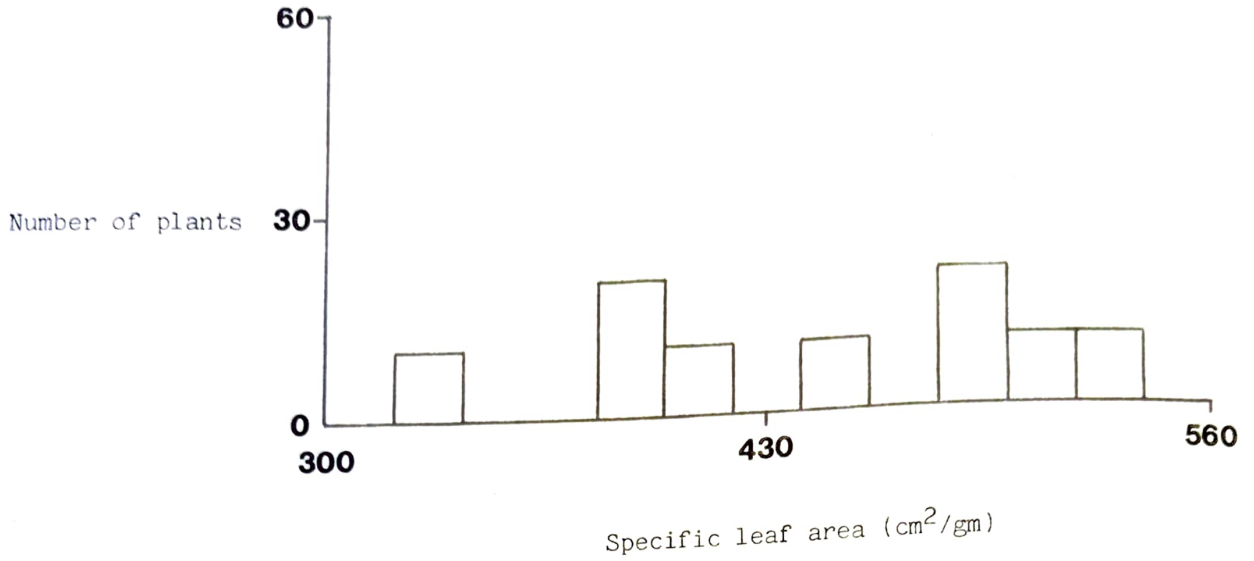


FIGURE 6. This graph demonstrates the diurnal rhythm of leaf thickness (●) and solar radiation for Plant B during a normal sunny day.

(a)



(b)

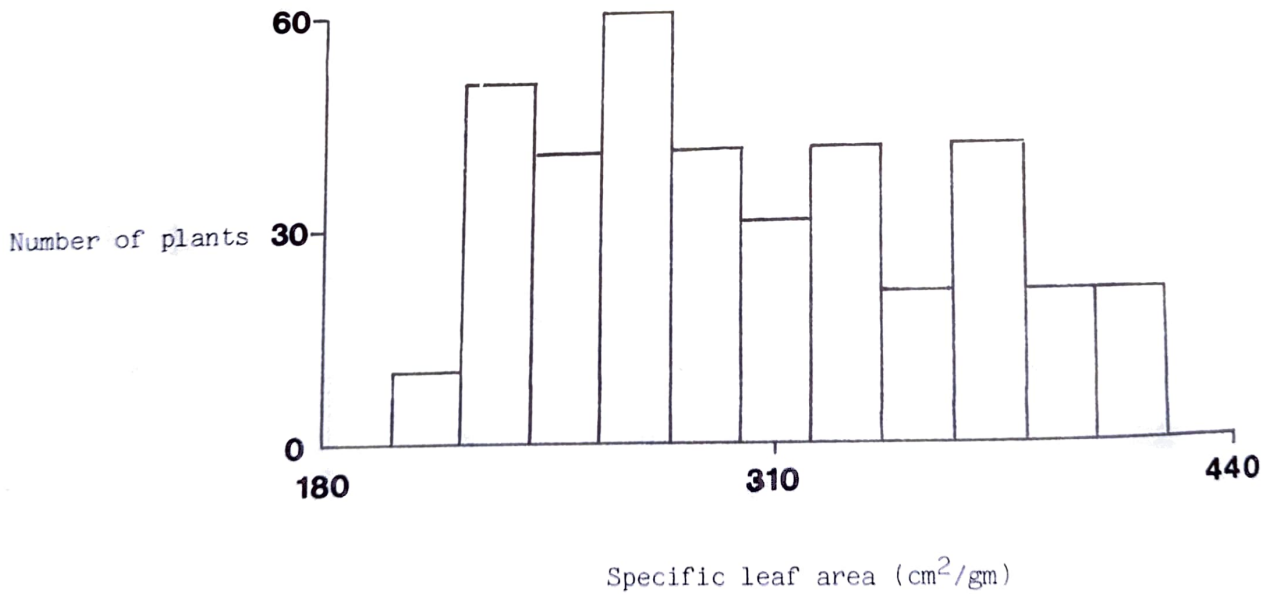


FIGURE 7. the following graphs show the changes in specific leaf area for Plant A between (a) site one (11,000 feet) and (b) site two (9,000 feet). Each square represents 10 plant samples.

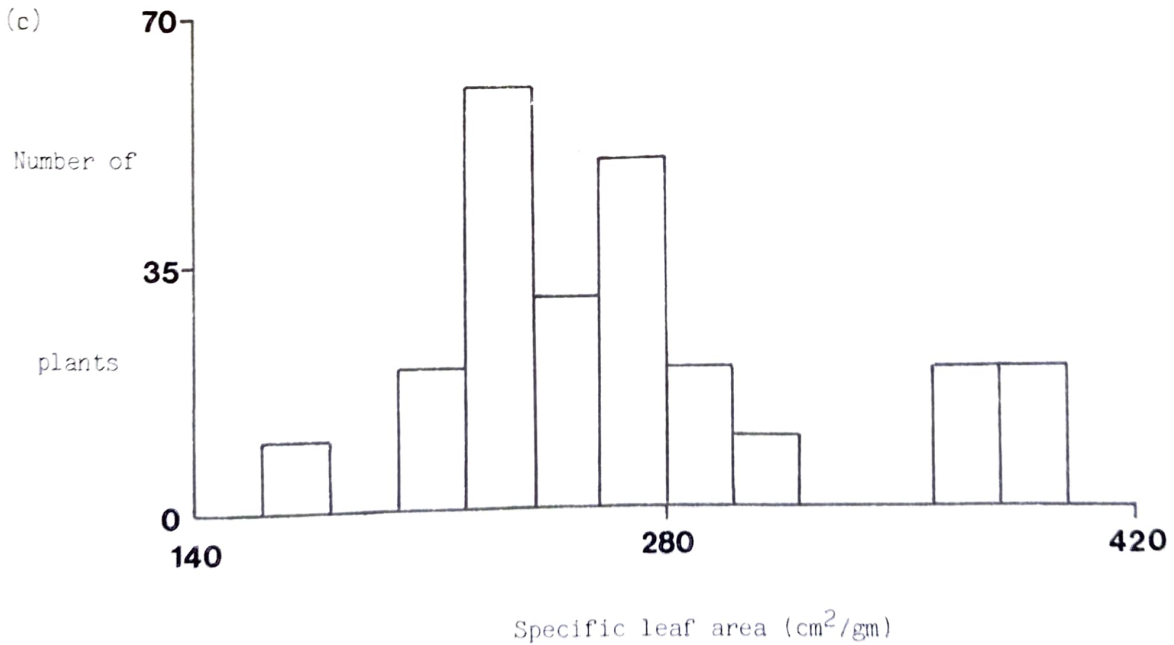
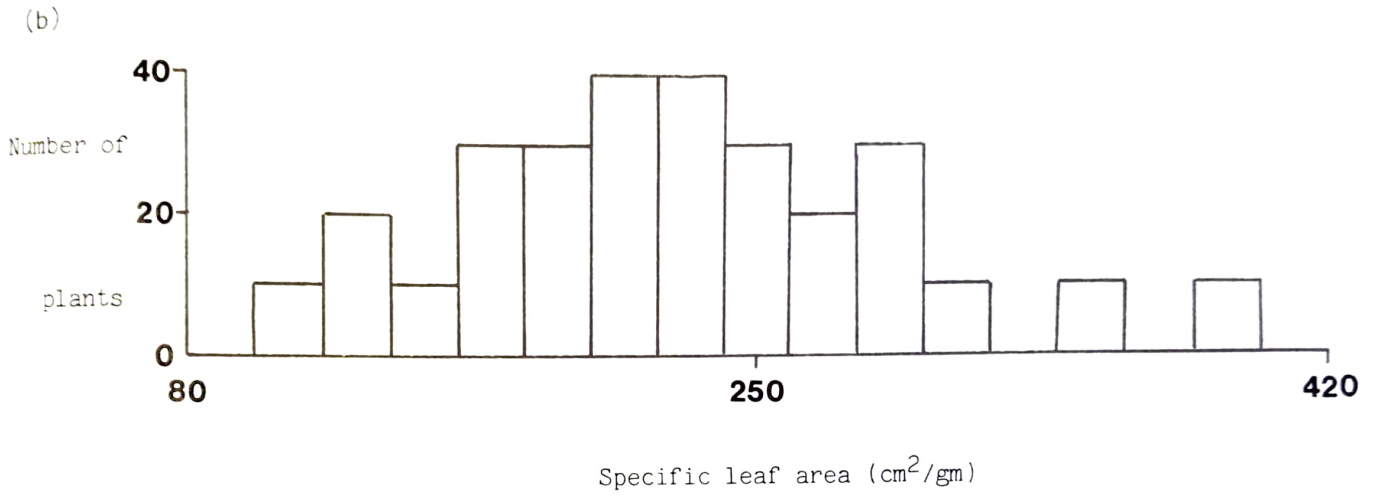
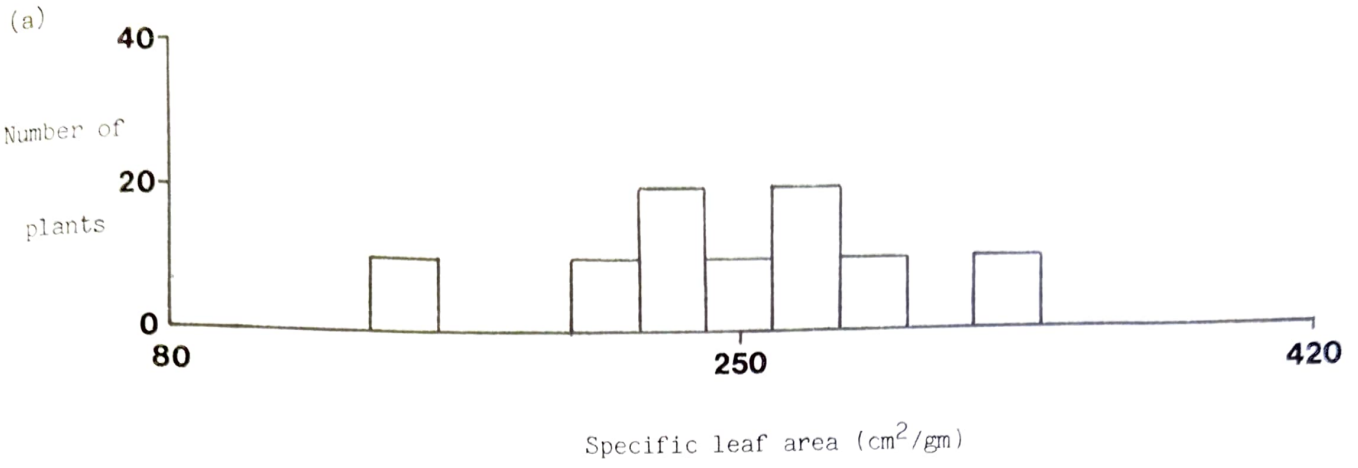


FIGURE 8. Graphs of the specific leaf area study on Plant B at (a) site one (11,000 feet), (b) site two (9,000 feet) and (c) site three (13,000 feet).

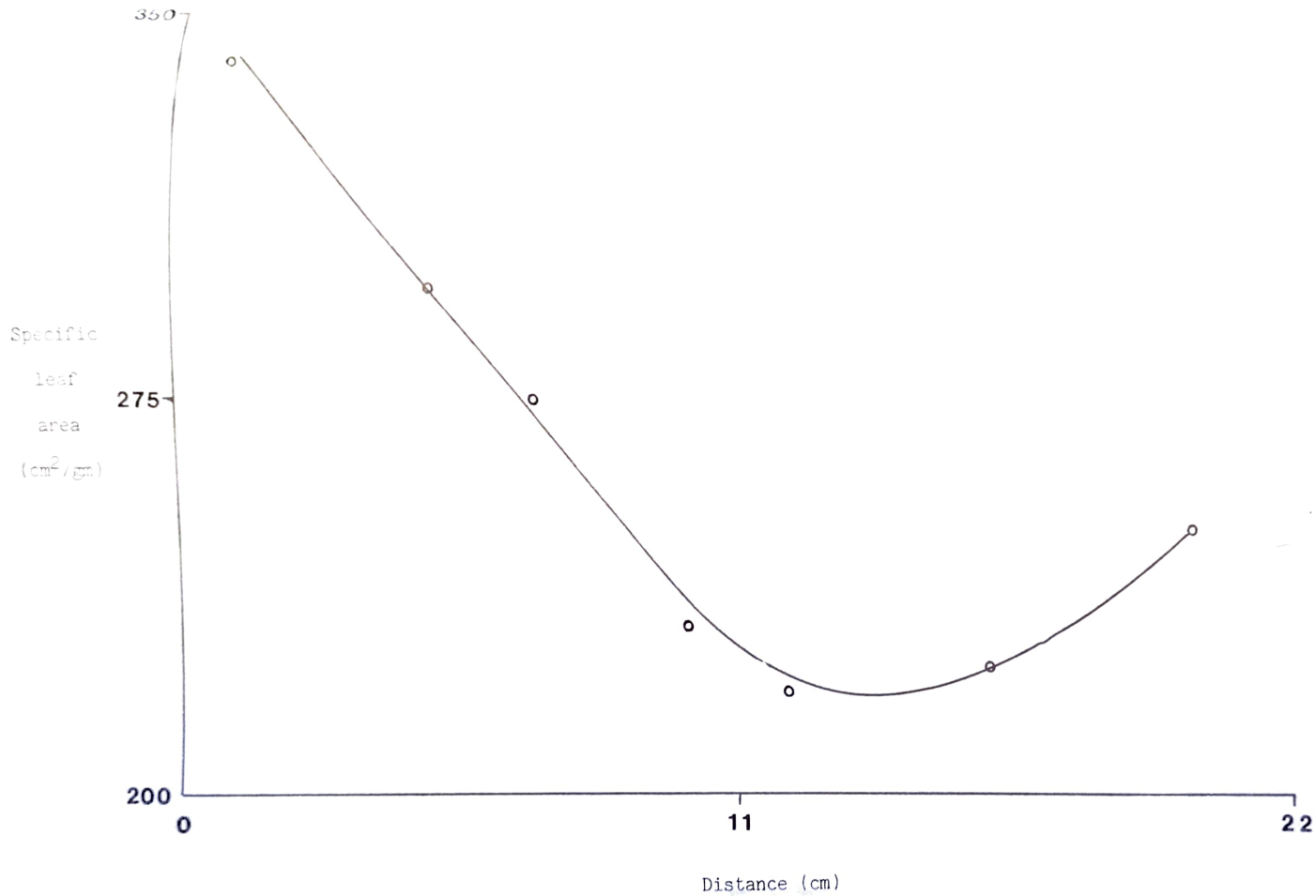


FIGURE 9. The following graph displays the results of a sun transect done on Plant B, described as variation in specific leaf area with increasing distance from shelter (at site one).

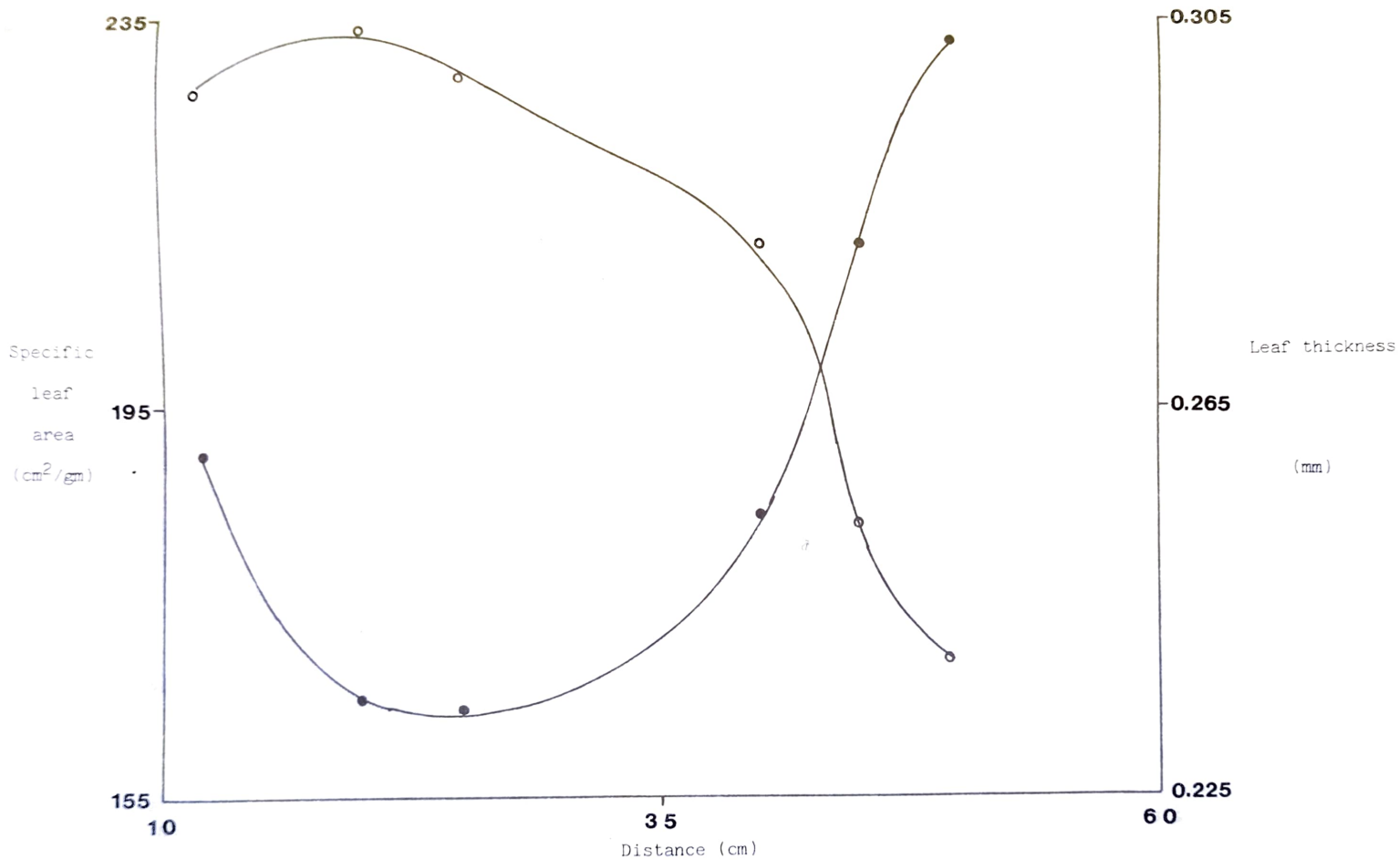


FIGURE 10. This graph shows the inverse relation existing between specific leaf area (○) and leaf thickness, using Plant A at site one.

THE LEAD PROJECT

SUMMARY

The level of lead in a typical protected crop such as the seeds of legumes in a remote region of Ladakh in the Himalayas is of a similar magnitude to that found in the U.K. Fallout of airborne lead is very low, the ratio of pod:seed lead levels being 1.5:1 to 2.0:1 compared with 10:1 to 15:1 in the U.K. Fallout is the major source of contamination in crops exposed to the air. Soil lead levels are low, 25 $\mu\text{g/g}$, but higher than the average levels per uncontaminated soil (10-15 $\mu\text{g/g}$).

Human activities have redistributed lead in the environment contaminating the biosphere (1). Our aims were to determine the levels of this contamination in remote regions of the Indian Himalaya and the extent to which this is airborne. The first part of the study was to determine lead levels in soil and vegetation and to measure the airborne component using the method of lead level differentials between exposed and non-exposed parts of leguminous plants. The second part of the study intended to monitor lead levels in the indigenous and non-migrant population of the region and to survey its environs for all potential sources of lead.

Considering first the latter half of the study, the desired means of measurement of body lead levels was by the collection and analysis of blood samples. Although lead is not a required nutrient and has no biological function, it is found in the blood of individuals in industrialised countries giving rise to the concept of "normal" blood lead (Pb-B) concentrations. Too much lead in the body, as reflected by a high Pb-B concentration is associated with human disease, and adverse biological affects can be seen even when the Pb-B concentration is relatively low (2). These are manifest as a deterioration of intelligence and behavioural changes (Reviews: (2), (3), (4)). The Pb-B concentrations of humans before lead pollution became a hazard, have been estimated to have been $0.2\mu\text{g/dl}$ compared with the normal U.S.A. range of 15 to 25 $\mu\text{g/dl}$ (5). The level of no-observed-adverse-effects is contraversial and the concept of thresholds of toxic effect is probably untenable. However, such a level in children cannot be set higher than 5 $\mu\text{g/dl}$ (6).

It was therefore of interest to look at a remote Ladakhi population, far removed from industrial development, where there is no mining and where the terrain is impenetrable to motorised transport. Furthermore, it was important that the population was static, unlike the hillfolk of Kashmir who migrate to the developed valleys for the winters. Limitations of time and money hindered our choices of sites but the village of Tassi Tonga (12,300 feet) in the Suru Valley of Northern Zaskar and Kangi, further north in Ladakh, closely met our criteria. Inadequacies of both sites concerned motorised vehicles. In recent years (1976) a rough track, one kilometre from Tassi Tonga has been negotiable by trucks for three months of the year at a frequency of less than two per day. The population has little changed its life style as a result of this development and only the young men have become more mobile. Kangi is only accessible by foot, positioned deep in a rugged gully, but is within ten kilometres of a metalled road. However, the prevailing winds at both sites were favourable with respect to the roads.

Despite the presence of a doctor of ayurvedic medicine in both villages and an interpreter, the collection of blood samples was, not unexpectedly, undesired by the village elders and, presumably, by our potential subjects. We thus turned our attentions to collecting scalp hair which would give an indication of total body lead concentrations. To our surprise this met with objections despite only requiring 5 to 10 grams from mid-way between the ears on the occipital region, a hank grown up to 2.5cm from the scalp. Our approaches were friendly and we stressed the importance of the collection for the health of the people themselves throughout our negotiations. Understandably the people were cautious if not suspicious of our intentions but with hindsight, a more thoughtful approach with considerable time taken first to gain their confidence would, I think, be likely to meet with more success. Sadly, however, time was short and such diplomacy was severely limited. Evidently the people placed great significance on hair, being part of one even after cut (regularly in their case), and for a stranger and a foreigner to remove it and conduct poorly understood tests upon it would be an act of trespass or, in the words of the interpreter, "an assault on the soul".

Thus the human element of the project had to be abandoned although it may be reported that lead technology appears not to have found its way significantly into the region in the form of soldered cooking utensils, drinking and storage vessels, lead water pipes and cisterns (no plumbing of any kind was present), lead paints, lead nipple shields for lactating mothers, lead toys and cosmetics (the heavily lead-laden and widespread Indian eye cosmetic, surma). Small numbers of tin cans had found their way to the villages and glazed earthenware cups and bowls were commonplace, both potential sources of lead. A further indication of the low profile of lead was the interpreter's ignorance of this metal and non-recognition by the villagers to references to a "heavy" soft metal.

We met with more success in our attempts to determine whether the major source of lead in grass and above-ground crops is fallout from the atmosphere. Airborne lead contamination has recently been a subject of great debate, more so in the light of the recent Lowther report (7). It has often been said that airborne lead is significant only in close proximity to the source of contamination but this has been refuted by Chamberlain (8); fallout rates can be substantial even in rural areas (9). Further, Tjell (10) found that airborne lead contributes 90% of lead in typical food crops consumed by humans and farm animals, even crops grown in farmland or mountain areas away from main roads and industrial sources. Rabinowitz (11), found that only at high levels of contamination does uptake from soil begin to compare with fallout, and Hirao and Patterson came to similar conclusions (12). In contrast, the Lowther Report concluded that fallout of airborne lead makes a negligible contribution to dietary and ingested lead. They assume that the only significant route from airborne lead to man is by direct inhalation.

A direct measurement of lead levels in the air is impractical and technically difficult for a small-scale study of this nature and we thus turned our attentions to measuring levels in legume plants, both pod and seed. Assuming, as seems reasonable since lead plays no part in plant metabolism, that there is no physiological partitioning of soil-derived lead between one part of the plant and another, then a difference measured would be a result of airborne contamination. This was indeed found, the average level for the pod being 1.5 to 2.0 times greater than that of the seed. In comparison, the Ministry of Agriculture and Fisheries have found the ratio

in rural Britain to be 10:1 and 15:1. Such levels were found to be independent of soil levels so confirming that the high pod lead level is from non-soil sources. In our Himalayan plants this source is small but significant, although sweat contamination is a possibility despite careful technique. Furthermore, it is a slight possibility that traces of soil distorted the pod measurement.

Lead levels in the seed were found to be similar to those found in the U.K. despite the 5 to 7-fold discrepancy between pod values in the two regions. Soil lead levels were found to be low, 25 μ g/g compared with an estimated 10 to 15 μ g/g (13) for the natural lead concentrations in soil. Such a difference correlates well with the pod:seed ratio in showing a low but significant level of lead contamination in this region, the implication here being that soil contamination of this level is also due to fallout of airborne lead.

Such fallout is of serious concern worldwide, entering food chains leading eventually to man (14) and it more directly contaminates skin, clothes, dust, etc., with the effect of accidental ingestion. It is becoming increasingly clear that no part of the world's surface; save the ocean depths, is free from such pollution and no human population can be considered unexposed. Airborne lead is the most important means of global dispersion and the permanence of such pollution, it never decays and it is cumulative in the soil (as in the human body), highlights the seriousness of the problem.

ACKNOWLEDGEMENTS

Our sincere thanks go to Professor D. Bryce-Smith of the Department of Chemistry at Reading University for his advice and to Dr N.I. Ward of the Imperial College Reactor Centre at Ascot for analysis of the samples.

REFERENCES

1. D.M. Settle and C.C. Patterson, *Science* 207: 1167 (1980), M. Murozomi et al., *Geochim Cosmochim Acta* 33, 1247 (1969).
2. U.S. Environmental Protection Agency, 'Air Quality Criteria for Lead', Office of Research and Development, EPA-600/8-77-017, Washington D.C., 1977.
3. J.D. Repko and C.R. Corum, *CRC Critical Reviews in Toxicology*, 1979, 6, 135.
4. J.F. Jaworski, *Effects of Lead in the Canadian Environment*, Environmental Secretariat, NRC 16736, National Research Council, Ottawa, 1979.
5. C.C. Patterson, *Arch. Environ. Health* 11, 334 (1965).
6. Conservation Society Pollution Working Party, 'Lead or Health', p.101, (1980).

7. H.M. Government Working Party Report 'Lead and Health', chairperson, Professor P.J. Lowther. HMSO 1980.
8. A.C. Chamberlain et al., 'Investigations into lead from Motor Vehicles', AERE R9198, HMSO, 1978.
9. (a) J.J. Huntzicker, S.K. Friedlander and C.I. Davidson, Environ. Sci. Technol., 1975, 9, 448.
(b) G.W.A. Fowles, Fd. Chem., 1976, 1, 33.
(c) M. Schinner, Environ. Pollut., 1980, 22 (A), 247.
(d) M.A. Healy and M. Aslam, Public Hlth., 1980, 94 (2), 78.
10. J.C. Tjell, M.F. Hovmand and H. Mosback, Nature, 1979, 280, 425.
11. M. Rabinowitz, Chemosphere, 1972, 4, 175.
12. Y. Hirao and C.C. Patterson, Science, 1974, 184, 989.
13. U.S. National Academy of Sciences, Washington, D.C., 'Lead in the Human Environment', 1980.
14. N.I. Ward, R.R. Brooks and E. Roberts, Environ. Sci. technol., f1977, 11, 917.
The same Authors, Bull. Environ. Contam. Toxicol., 1978, 20, 44.
N.I. Ward and R.R. Roberts, Environ. Pollut., 1978, 17, 7.

APPENDICES

I FINANCE REPORT

JOHN ZEALLEY

This will naturally fall into two parts, the fund raising activities and budget and secondly the actual spending of the money in the field.

(a) The Budget proposal and fund raising

The budget proposal was about five hundred pounds in excess of what was in fact needed, and this can largely be laid at the feet of the need to provide a contingency kitty, which was fortunately not needed. There were two parts to the proposal, those figures that could be justified by reference to British sources, e.g. airfares, and those which were informed guesses e.g. the cost of a mule for a day and how many days they'd be needed for.

In addition I also had to make allowance for the fact that our costs would vary considerably depending upon the extent of our sponsorship in kind, that is food and equipment. In the end a maximum and minimum sum was combined into a best guess and presented to CUETC who accepted it without asking any awkward questions. The total initial budget was about five thousand pounds.

The Budget Proposal

	£
Airfares to Delhi	2,000
Travel within India and lodging costs	800
Hire of mules and guides	600
Food in the field	500
Field Equipment	350
Insurance	150
Reports and Administration	250
Contingency	500
TOTAL	5,150
Personal contributions	1,500
Amount to raise	3,650

The fund raising was divided into two parts, commercial firms and Charitable Trusts. Without a doubt the latter were far more forthcoming and the majority of the sixty letters written to companies received a courteous refusal. In broad terms the breakdown of donors is given below.





Sources of Funds by type of Donor Body

	£
Cambridge trusts and Colleges	1,215
Other Charitable grant giving bodies	1,835
Commercial organisations (no contacts)	485
Commercial organisations (contacts)	470
Private individuals (friends/relations)	150
TOTAL	4,095

A detailed list of donors is given at the end and we are, needless to say, extremely grateful to them for their invaluable assistance.

Our fundraising was successful and this probably rested upon the amount of effort put in by individuals. In addition the professional standard of our prospectus undoubtedly instilled confidence that we were capable of doing what we set out to do, as well as the very good presentation of our case in interviews owing to careful preparation before each one. One notable failure in this field was a disco run at a local night club which whilst being good fun only made about three pounds profit. This caused an awful lot of anxiety and would have been better held earlier in the year and at a less expensive venue.

(b) The Expenditure

A set of accounts appears at the end of this report, however, it has to be said that I did not keep detailed accounts once we were in the field but largely made sure that we had sufficient funds remaining at the end of each stage to complete the rest of the expedition.

In terms of dealing with the ready cash a number of points can be usefully itemised:

(i) We took out the majority of our money in dollar travellers' cheques and as such lost a certain amount of money purchasing the necessary foreign exchange to do so. At the time we believed that the use of dollars would give us better financial security, however, it rapidly became clear that sterling travellers' cheques would have worked equally well, with no discrimination.

(ii) Having said that, we did find that the dollar currency we took out was very useful. This derived from two counts, first that a better rate of exchange was possible on street corners for dollars (larger denominations preferred) than for travellers' cheques in the bank and secondly that such exchanges could be done outside banking hours, which got the finance officer out of a couple of scrapes!

(iii) The State Bank of India consistently gave good rates, charged no commission and was to be found in Srinagar, Pahalgam and Leh. However, it is important to check up on local opening hours linked to religious observance (e.g. Muslim vs Buddhist vs Hindu) and particular public holidays.

(iv) The AMEX refund system really works, although its best done in person at the Delhi Offices. At this office they are very friendly and efficient, as well as being realistic. It took us less time to travel from Srinagar to Delhi than it did for the statutory telegram notifying loss to arrive, yet they still gave the refund. It is, however, important to obtain a piece of paper from the local police to show that you reported the loss. Keep a careful record of the numbers of cheques cashed and where and when. In particular be aware that a common trick is to take one cheque out of the wallet such that you don't notice when its gone until it's too late; hence count the cheques individually at least once each stop.

(v) Money spent on buying well-known branded western cigarettes and whisky at the Heathrow duty free shop can be easily recouped and more by selling in the "backstreets" of Delhi or Srinagar, however, the police require one to be subtle about it.

(vi) We found no significant price differences for consumer goods between Delhi and Srinagar and as such much effort can be saved by buying food and cooking equipment etc. in Kashmir itself.

Many of the individual costs of items are to be found in the equipment, food and transport report, however, an overall breakdown would be as follows:

<u>Category</u>	<u>£</u>
CUETC Expedition Levy	25
Air Tickets (Thai Economy Class)	2,000
Airport Tax (100 Rps per person on departure)	35
Travel Insurance	130
Pre-departure expenses (Prospectus, postage, etc.)	125
Expedition equipment bought in the U.K.	130
Expedition equipment bought in India	100
Food (both staples and luxuries)	200
Mules and guides	350
Trek in Zaskar	635
Lodging in Delhi (four nights)	50
House Boat in Srinagar (full board)	110
Films	150
Report and botanical analysis in U.K.	300
TOTAL	4,560

As mentioned above the total raised was 4,095 pounds and the difference between that spent and that raised (465 pounds) was paid by the members, as was their own personal costs in equipping themselves for the harsh climate, usually of the order of 150 pounds each. Thus it should be clear that the job of the financial officer on the expedition was not all that arduous and we were saved major financial problems by a mixture of good luck and ample funds. At this point I would like to list individually those bodies, companies and individuals who gave us funds, namely:

Donors to the Expedition

<u>Cambridge Trusts/Colleges</u>	£
The Cambridge Expeditions Fund	150
The David Richards Travel Fund	125
The Mary Euphrasia Mosely Fund	500
St John's College	440
<u>Charitable Bodies</u>	
The British Ecological Society	450
The Coggan Trust	100
HRH The Duke of Edinburgh	100
The Gilchrist Educational Trust	150
The Mount Everest Foundation	500
The Pike Trust	50
The Royal Geographical Society	350
The Vegetarian Society of Great Britain	50
The Westcroft Trust	35
The Woodard Schools: Grenville College	50
<u>Commercial Organisations</u>	
Barclays Trust Co. Ltd.	50
Central & Sherwood Plc.	20
The English Association Ltd.	25
The Hanson Trust Plc.	175
Heffers	10
Jardine Glanvill Services Ltd.	100
Taddale Investments	250
St Regis International Ltd.	200
Sinclair Research Ltd.	100
<u>Private Individuals</u>	
R.O. Barrat	10
Sir J. Eden Bt. MP	10
S. Friedlander, Esq.	10
D.J.L. King, Esq.	10
P.G. King, Esq.	50
Ms. B. Myles	20
P. Rippon, Esq.	10
D. Ryman, Esq.	10
S. Stein, Esq.	10
W.C. Young, Esq.	10

In addition, Mark Rothera would like to thank Banstead Rotary Club, and James Mayers Emmanuel College, Cambridge, for their contributions to their own personal expenses.

II FOOD REPORT

GRAHAM RADFORD-SMITH

During the planning of the expedition, the team decided to take a number of food products from this country that would not be freely available in India. As food officer, I was responsible for obtaining these provisions

for the group, and due to the generous support of a number of companies (listed below) we were able to take a variety of items with us. However, we were quite happy to sample the local cuisine during our short stays in New Delhi, Srinagar, and Leh, and found the food very tasty. The change in cooking style naturally had a slight effect on us, but we managed to avoid any severe stomach upsets.

Before leaving for the Lidder Valley, we had to obtain a number of food items locally. The most important of these were rice, dal, vegetables, spices, sugar, flour, and powdered milk. We decided to have rice as the basis for all our main meals, and use our own food products to make it more appetising. The daily menu was as follows: for breakfast we either tucked into a bowl of porridge, or Alpen (courtesy of Weetabix (Block Order scheme)) and followed this up by paratas with honey (courtesy of Gales Ltd), golden syrup (Tate and Lyle Ltd), or Peanut butter (Rowntree-Sunpat Ltd).

Lunch was usually quite short and snacky. We sometimes had soup (MacDougalls Ltd) and paratas or chapattis, or the local dal, with rice.

Dinner was our main meal of the day. We indulged in a lot of rice and the meat and vegetable products provided by MacDougalls. This was rounded off by either coffee or by a hot cup of chocolate (courtesy of Beecham's and Batchelor's).

Of course there were some other luxuries which we had brought with us. The chocolate (Rowntree Mackintosh) and toffee (Nonsuch Ltd) gave us that extra little bit of energy during a hard day's work, while the crunchy bars (Jordan's Cereals) provided us with all the bran we needed. The instant cold drinks (MacDougalls) were ideal in the hot, summer condition, and provided us with our vitamin C. Vecon (Modern Health Food Products) was used in hot drinks and as a supplement to the meat and vegetable products. The group were very impressed by all the products donated to us, in particular the dried foodstuffs, and the concentrated food products, and would recommend them to other groups planning expeditions.

Acknowledgements

MacDougalls Foods Ltd.	- Meat, vegetable, drinks, soups
Rowntree Mackintosh Sun-Pat Ltd.	- Peanut butter, Yorkies, Kitkats
Colman's	- Sauces, lemon juice
Beecham Foods	- Chocolate drinks
Batchelor's Foods Ltd.	- Soup, chocolate, drink
Walkers Nonsuch Ltd.	- Toffee
Jordan's Crunchy Bars	- Crunchy bars
St Ivel's	- five-pints (£5 token)

(Block Order Scheme)

Weetabix	- Alpen
Mornflakes	- Porridge
Tate and Lyle	- Golden Syrup
Gale's	- Honey
Arrowmint)	
Wrigley's)	- Chewing gum

III EQUIPMENT REPORT

Warnings of severe weather conditions in the mountains of Kashmir led us to somewhat over-equip ourselves, no bad thing but very costly. The hot day temperatures plummeted as the sun disappeared but didn't fall below 5°C. At 13,000 feet in Ladakh temperatures fell to about -5°C to -10°C with a little ice forming inside the flysheet. Mid-performance sleeping bags plus the much admired Helly Hansen thermal underwear proved more than adequate. Remember to take plenty of U.V. high protection cream or lotion for the high altitude especially for on snow. It is unheard of in Srinagar and totally inadequate perfumed moisturising cream is very expensive.

The mountains east of Srinagar experience the monsoon only mildly in August but moderate rain regularly from 2 - 4 p.m. each afternoon is sufficient to necessitate decent waterproofs. Lightweight plastic tarpaulins bought in Britain (don't buy Indian - all heavy canvass), were extremely useful for building a permanent shelter for such events as drenchings whilst static at camp and for our ponymen on the trek to have the rare luxury of shelter at night.

Primus stoves can be bought cheaply throughout the region and can be relied upon to cope with a busy time as long as sundry spare parts are carried - they're not as sturdy as their European counterparts but they do work. Avoid buying them, or anything else, in Government Bazaars; prices are greatly elevated. Clean kerosene can also be obtained throughout the region, contrary to advice in Delhi. Remember the benefits of a pressure cooker at high altitude and for cooking dehydrated food rapidly. All cooking pots ("Detchkis") and utensils can be readily bought and sold again.

An item which proved a much appreciated luxury was a Tilley lamp for those long evenings writing diaries and catching up on the years reading, even on the trek when the mantle had to be replaced every night. For simplicity bring mantles from Britain but, if in need, the commonplace Indian mantle can be doctored to fit and work adequately.

Remember to overestimate the amount of photographic film required. A miscalculation can be expensive, at least £4 (after extensive haggling) for 36 print film, and not without apprehension over quality and history.

Equipment can be readily sold in the larger places, especially photographic equipment. Camping gear will probably need to be sold to an established trekking agency, individuals having little idea of the high cost of quality equipment.

Finally, watch all possessions extremely closely, much of what we had with us was of great social importance to the Kashmiris, especially pen knives, writing implements and training shoes.

Acknowledgements

We would like to acknowledge the following companies for their generous support of the St John's College Ecological Expedition to Kashmir.

Primus - Sievert U.K. Ltd.
Swiss Cutlery (London) Ltd.
Tilley International P.L.C.

Troll Safety Equipment Ltd.
Base Camp International Ltd.
Tri-Wall Containers Ltd.
Flect Packaging Ltd.
T. Fillmore (Norwich) Ltd.
Plant Protection P.L.C.
Mountain Equipment Ltd.
Berghaus
Actionsports Ltd.

IV MEDICAL REPORT

Whilst out in India the expedition had its fair share of illness but nothing was severe enough to greatly hamper our activities.

Our first week was thankfully free of symptoms, culture shock, heat and humidity alone being sufficient. Then 24 hours of gastro-enteritis obtained from the waters of Lake Nagin in Srinagar came and went painfully yet rapidly.

Whilst in the region of Mt. Kolahoi the only problem of note was the extreme lethargy felt by all initially, some reacting to and acclimatising to the altitude rather more effectively. For one member exhaustion, depression and loss of appetite were severe for 3 days, including a rather melancholy 21st birthday celebration, followed by a night of Cheyne-Stokes breathing. A decision then to drop in altitude proved unnecessary due to a rapid improvement. NB: We ascended from 7,000 feet to 10,800 feet in 2 days. Be aware that unpleasant symptoms can occur in susceptible people as low as 8,000 feet.

The start of the trek signalled the start of more severe bouts of gut infection which, when persistent, were usually successfully treated by Flagyl. For two members the problem lingered for several frustrating and energy sapping days, the situation being exacerbated by the lack of bushes in Ladakh. Care was taken with water (puritabs) and food but occasionally the lure of the high mountain stream was too great so problems were not unexpected.

Our severest problem thankfully didn't appear until the departure lounge of Delhi airport. A high temperature and diarrhoea persisted for 48 hours and disappeared only for the temperature to return with myalgia. Suspected malaria was treated successfully by Quinine phosphate and Fansidar. The advised prophylactic, Chloroquine, was taken strictly according to instructions, starting before departure from Britain.

Medically, the expedition will be remembered for the Thursday morning blues (why does Chloroquine have to taste so terrible) and the discovery that the entire population of Kashmir (yet not Ladakh - curious?) appeared to suffer from chronic head and stomach aches. The pained expressions disguised their probable intent, to obtain insurance for future problems. Giving medicines is inadvisable. Word will spread fast with subsequent depletion of the medical kit unless prescription become unfairly and antagonistically discriminate. It will also perpetuate the belief that western medicine in the form of little white pills is the elixir of all

ills. Neither turning them away nor the resisting of the temptation to prescribe water purification tablets is easy but is the most sensible course to take.

We would like to thank Dr T.W. Davies and Mr Gurner of the Department of Community Medicine for their advice and preparation of the medical kit which is supplied through the Cambridge Expeditions Medical Scheme. Our thanks are extended to all pharmaceutical companies for their donations.

V TRANSPORT REPORT

We experienced very little problem transporting both ourselves and our initially bulky equipment around India. Problems with respect to excess baggage on buses etc. could usually be smoothed over and a reasonable bargain struck.

(a) Airlines

Thai Airways lived up to their high reputation and provided us with a high standard of travel at a price only marginally above the minimum available. It is worth booking early because they are very popular and rapidly fill up.

The tickets cost £400 each and in addition we were given a generous excess baggage allowance of 100 kgs; this was vital since excess is charged at a phenomenal rate and surface freighting is slow and less reliable. We packed all our gear (apart from rucksacs) into large waxed cardboard boxes which served very well, and the rucksacs all emerged virtually unscathed.

Internal airlines are cheap by western standards, e.g. fifty Dollars to fly from Srinagar to Delhi, but extortionate compared with other means of transport. Only to be used if in a real hurry.

An Airport Tax of 100 Rps is levied upon final departure from Delhi, so keep some loose change! A cheap and frequent bus runs from Delhi Airport to Connaught Circus.

(b) Railways

The railway system is hopelessly overloaded, hence for an expedition with equipment first class is preferable and second class is not too bad but with reduced security; we didn't try third class.

It is essential to book the overnight sleeper from Delhi to Jammu (The Shalimar Express) in advance. This is not done at the railway station but at the Northern Railways Office at Baroda House. The first class fare is twelve pounds single, for which one gets a berth in a four person compartment of a good standard. The train leaves at about four in the afternoon and arrives in Jammu about 6.30 the next morning.

On the return journey we travelled second class; this cost only four pounds each, and although far more crowded we had got more used to India by then and had no trouble coping - there is, however, very little room for luggage and a fully equipped outwardbound expedition would be both unpopular and vulnerable to pilfering.

The "inflight" catering is expensive and not particularly hygienic; a supply of bread and tinned cheese etc. would make the journey more bearable and less expensive. A good supply of purified water or bottled drink is a good idea. In general the railways are one of the definite Indian experiences.

(c) Buses/Coaches

Public transport is the only affordable means of movement for most of the population hence there are ample buses going to any destination you can probably think of.

With respect to the journey from Delhi to Srinagar, buses from Jammu to Srinagar connect at the station with the express services in both directions. As with trains there is a definite hierarchy of class. Going out we used a super deluxe (i.e. reclining seats and less than 10 years old) which cost £4.50. On the return journey we used A Class for £2.50. The latter was fine, although rather short of leg room. B Class buses are very old and hardly up to carrying the large number of people usually packed aboard. The journey takes twelve hours, or more and hence some degree of personal comfort is probably justifiable.

On Indian buses large baggage is packed on the roof and so it is important to ensure that the containers are moderately weather proof, although a tarpaulin is usually used to cover the load.

The other major bus journey we undertook is the Leh to Srinagar run. The journey lasts two days and costs £5, which is both daunting and encouraging. One leaves Leh at 7.30 a.m. in the morning and drives virtually non-stop until one reaches Kargil at 8 or 9 o'clock that night. The next morning the bus leaves at 4 a.m. and arrives in Srinagar at about noon, by which time one is dying for a seat that doesn't vibrate, roll or lurch. The journey is, however, actually brilliant and takes one through the spectrum from arid Ladakh to lush Kashmir and from Buddhist to Muslim culture.

(d) Mules and Things

The "and things" includes guides which although not a means of transport themselves can properly be associated with that function. The details are contained in the narrative, however, in bare terms the costs are as follows; a mule cost 45 Rps a day to hire in Pahalgam in the summer of '83. The mule drivers come with the mules and provide their own keep. Each mule will take up to 45 kgs, however, there are no scales and a good guide is essential in order to persuade the mule drivers to fill their side of the bargain.

For the first part of our travels, with one month's supply of food and a lot of weight in our own packs we needed seven mules. The limit on daily

distance walked will probably lie with the explorer rather than the mule, and of course varies widely with the type of terrain and the altitude. Usually between 15 to 25 kms a day can be achieved on a regular basis.

Guides are important because they provide local knowledge and can speak to the "natives". We paid £180 for a guide for a month, and £20 to his assistant, it is a sellers market and a good guide is usually worth the extra he commands. A good source of advice on guides may well be your houseboat owner.

For the trek in Zanskar we used a professional trekking agency, which cost us £635. With hindsight we believed that we could have done it more cheaply using freelance guides and mules, especially since we had a great deal of trouble with the guide and mules we had paid so highly to hire from the company. In general these people see money coming and a very hard nosed attitude is needed.

VI PHOTOGRAPHIC REPORT

The following equipment was used by the team:

Mark	-	Nikkormat FT	35mm Nikkor
		Rolei 35 LED	50mm Nikkor
			Vivitor 2X Teleconverter
			Skylight and polarizing filters
Robert	-	Praktica TL3	50mm screwmount
			200mm screwmount
James	-	Minolta Automatic	55mm
John	-	Konica	40mm 135mm
Graham	-	Minolta	50mm

The team was generally satisfied with the performance of the cameras in the field. In Kashmir the problem was keeping cameras dry whereas in Zanskar it was keeping the dust out. Plastic bags around the cameras proved to be a useful way of protecting them.

The film used was Fujichrome 100 ASA slide film. This proved to be very crisp in appearance but the colours were slightly washed-out. Its cheapness was the main attraction (£3.45 for 36 exposures, process paid). It is better to take more film than you need to India as it is difficult to obtain slide or other types of film there and the quality is unpredictable (often it may have been exposed).

The Camera Care Systems camera holders are useful in the field. The Cobra head was used for Mark's Nikkomat. It is important to use the thick waist belt with it as a smaller conventional belt tends to slacken and pull too much.

VII BIBLIOGRAPHY

- Kashmir, Ladakh and Zaskar
(1981) Lonely Planet Publications. South Yarra, Australia.
Essential reading.
Margaret and Rolf Schettler
- The Trekker's Guide to the Himalaya and Karakoram
(1982) Sierra Club Books. San Francisco.
Buy it!
Hugh Swift
- When Man and Mountains Meet
London: John Murray (1977)
Fascinating history of European exploration in Kashmir, Ladakh and the
Karakorams from 1820 to 1875.
John Keay
- A Journey in Ladakh
(1983) London: Jonathan Cape.
Captures well the feeling of Leh and Ladakh, with eloquent insight into
Ladakhi Buddhism.
Andrew Harvey
- The Himalayas
(1975) Amsterdam: Time-Life International.
Interesting sketches of various Himalayan regions.
Nigel Nicholson
- The Scottish Himalayan Expedition
(1951) London: J.M. Dent & Sons.
Lots of information about Garwhal.
W.H. Murray
- The Cultural Heritage of Ladakh Vol. 1
and Tadzisz Skorupski
(1977) Boulder: Prajna Press.
Excellent, authoritative information about the Indus Valley in Ladakh.
Many photographs.
David L. Snellgrove
- The Cultural Heritage of Ladakh Vol.2
and Tadeusz Skorupski
(1981) London: Aris & Phillips.
Covers the monasteries in Zaskar.
David L. Snellgrove
- Seven Years in Tibet
(1956) Pan.
Heinrich Harrer
- Zaskar - The Hidden Kingdom
(1979) London: Collins & Harvill Press
Michael Peissel
- National Geographic feature on Ladakh - March 1978.
- Shame & Midnight's Children
Salmon Rushdie
- An Area of Darkness
(1964) Penguin.
V.S. Naipaul
- The Traveller's Handbook - Wexas

Map Information

Best Overall Series of maps:

U.S. Army Map Service (AMS). U502 Series.
1:250,000 - contour interval 250 or 500 ft.
Completed before 1960.

Can order from Stanford's (see below).

Nos:	AMS U502	Sheets
	Srinagar	(NI 43-6)
	Kergil	(NI 43-7)
	Anontnag	(NI 43-11)
	Leh	(NI 43-8)
	Martselang	(NI 43-12)

Single Map of the Himalayas:

1:4,000,000 sheet - 'Indian Subcontinent'.
John Bartholomew & Son Ltd. - England.

Available at Srinagar Tourist Office:

'Trekking Route Map of Jammu & Kashmir'. 1st Edn.
Government of India, 1979.

Reg. No. 4660 PZE '80 (D.O. 9-1:250000) - 5023 'PZ
Reg. No. 4661 " " " " " " "

Stanford International Map Centre.
12-14 Long Acre,
London, WC2E 9LP.

- Sells some U502 sheets - allow some time.

VIII USEFUL ADDRESSES

U.K.

Royal Geographical Society, 1 Kensington Gore, London, SW7 2AR. 01 381 2057
(Expedition Advisory Centre)
For maps, expedition reports and general information on organising an
expedition to any location in the world.

India House, Aldwych, London, WC2B 4NA. 01 836 8484.

Kashmir Himalayan Trekking, 16 Soho Square, London. (Wing of Panpacific
Holidays)

Encounter Overland, 271 Old Brompton Road, London, SW5. 01 370 6951.

Thai Airways, 41 Albermarle Street, London.

INDIA

British High Commission, Chanakyapuri, New Delhi 21 110021.

Virat Tourist Lodge, 2344 Raj Guru Road, Chuna Mario, Pahagarj, New Delhi 110055.

Cheap hotel - 20-25 Rp per night. Reliable.

Nirula's Hotel, Connaught Circus, New Delhi.

Expensive hotel, but has an excellent salad bar if you want good food.

American Express, Connaught Circus, New Delhi and in the Hindustan Times House nearby.

Best place for refunds when travellers cheques lost.

Thai Airways, Connaught Circus, New Delhi.

Northern Railway Office, Baroda House, New Delhi.

Easiest place to obtain train tickets quickly.

Kashmir Himalayan Trekking - 17 Indian Oil Bhawar, Jarpath, New Delhi 110001. Tel. 352063.

- Boulevard Shpping Complex, P.O. Box 168, Srinagar, Kashmir 190001. Tel. 78698.

House Boat Premier - Bashir Ahmed Dar, House Boat Premier, Post Box No. 268, Dal Lake, Srinagar, Kashmir 190001.

Bashir is a trusty, reliable guide. He is renowned for making the best pancakes on the lake. A very friendly family who will look after you well.

Kashmir University - Dr Upeandhra Dhar, Medicinal Plants Unit, Kashmir University, Srinagar 190006.

IX DIPLOMATIC REPORT

1. Thai International - excess baggage (200 kg + 60 kg)
2. Customs - no trouble
3. Hotel - Tourist College
4. Srinagar - House Boat Premier
5. Trekking Agency
6. Guides, Ponymen
7. Local inhabitants, shepherds, etc.

There were a number of people and organisations with who we necessarily came into contact during the expedition.

We were very fortunate that Thai International Airlines granted us enough excess luggage to enable us to take all the essential equipment and supplies., They were only too willing to repeat this generosity on our return journey.

We did not encounter any trouble with the Indian customs' officers, but recommend fellow travellers avoid carrying penknives, as these will be confiscated if found.

We stayed on the Premier Houseboat in Srinagar (address in Appendix VIII) whose owners showed us great generosity, and provided us with a number of useful contacts. One of these, the Himalayan Trekking Agency, provided guides, ponymen, and any further equipment required for our trek. However, we felt that the ponymen could have been more co-operative.

Upeandhra Dhar and his student Virjee of the Medicinal Plants Unit, University of Srinagar, were both very helpful, providing information on the botany of the Kashmir Valley.

It is important to note that British Subjects (with a British passport) are allowed to spend as long a time as they wish in India, and are free to travel into all unrestricted zones. However, a government permit can be obtained, but may prove more trouble than its worth.

X ITINERARY

DIARY OF EVENTS

1		2		3		4											
Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	M
'82			'83													'84	A

1. The creation of the expedition: team assembles, projects formulated, location decided upon, permission gained, details submitted to the Cambridge Expedition Committee for approval. Prospectus printed.
2. The money raised from trusts, companies, friends and events. Food and equipment donated by companies and assembled. Contacts in India warned of our imminent arrival. Flights booked, personal equipment bought, vaccinations obtained, money converted to travellers cheques, background reading done.
3. Itinerary of expedition after leaving Heathrow on Thursday 28 July until its return to Heathrow on Thursday 29 September. (See below).
4. Post expedition work: project work completed. Analysis of project results. Assembly of report material. Contact with sponsors with brief details.

Detailed Breakdown of Expedition Itinerary

- 28th July 1983 - Flight London-Delhi, Thai Airways.
- 29th - 30th - In Delhi and coach trip to Taj Mahal.
- 31st - 1st August - Train from Delhi to Jammu - 12 hours.
Coach Jammu to Srinagar - 12 hours.
- 2nd - 4th - Preparations in Srinagar; food bought, guides hired, contacts at Kashmir University met.
- 5th - Local bus trip from Srinagar to Pahalgam.

Phase 1 Project work in Lidder Valley

- 6th - 7th - Trekking with mules and ponies hired in Pahalgam to the first research locations at 11,000 feet.
- 8th - 18th - Camp established, acclimatisation completed and Botanical and Ornithological Project work carried out.
- 19th - Trekking with mules to site 2 at 9,000 feet.
- 20th - 26th - Botanical and Ornithological Project work carried out.
- 27th - 28th - Brief trip to Tar Sar Lake 13,000 feet and collection of plant material made.
- 29th - Final day of Ornithological and Botanical work at Site 2.
- 30th - Trekking down to Pahalgam with local ponies.
- 31st - 1st September - Preparations for Phase 2 of the expedition made.

Phase 2 Trek to Zaskar and Lead Pollution Project Work

- Sept. 2nd - Pahalgam to Chandanvari - Early morning trek to Chandanvari 9,500 ft. 14 kms. 3-4 hours walk, overnight camping at Chandanvari.
- Sept. 3rd - Chandanvari to Sheshnagh - Trek Sheshnagh 11,500 ft. height, 3-4 hours walk, 10 kms. Steep climb at Pissu Ghati, overnight camping near the Sheshnagh Lake.
- Sept. 4th - Sheshnagh to Gulol Gali - Trek to Gulol Gali 4406 metres, overnight camping at the base of Gulol Gali.
- Sept. 5th - Base of Gali to Humpet. - Base of Gulol Gali to Humpet, overnight camping at Humpet.
- Sept. 6th - Humpet - Rest day at Humpet, optional walk over the ridge.
- Sept. 7th - Humpet to Kanital - Trek to Kanital 3-4 hours walk 13 kms, overnight camping at the base of the Boktal Pass.
- Sept. 8th - Kanital to Donada - Morning trek to Donada 8-9 hours walk, 4,600 metres, 23 kms. Overnight camping at Donada.
- Sept. 9th - Donada to Panikhar - Trek to Panikhar Village (Suru Valley) 3-4 hours walk, 16 kms. Overnight camp at Panikhar.

- | | | |
|------------|---------------------------------|--|
| Sept. 10th | - Panikhar to Parkachen | - Trek on the road or over the ridge. An excellent view of the Nun Kun Massif over the ridge Parkachen village, 10 kms. approximately. |
| Sept. 11th | - Parkachen to Shafat | - 32 kms. 5-6 hours walk, overnight camping at Shafat. |
| Sept. 12th | - Shafat to Rangdom | - Approximately 6 hours walk, camp near the village Tasitonga, 20 kms. |
| Sept. 13th | - Rangdom | - Rest day at Rangdom. |
| Sept. 14th | - Rangdom to Kangi Base | - Approximately 6 hours walk (river crossing) overnight camping. |
| Sept. 15th | - Kangi Base to Kangila Pass | - 7-8 hours traverse Kangila Pass 17,300 ft. Camp on other side of pass. |
| Sept. 16th | - Kangila Pass to Kangi Village | - Approximately 4 hours walk to remote village in Zanskar, afternoon optional visit to village. |
| Sept. 17th | - Kangi Village to Hanskot | - Trek over the ridge or through gorge. Overnight camping at Hanskot or Lamayuru. |

Final Movements

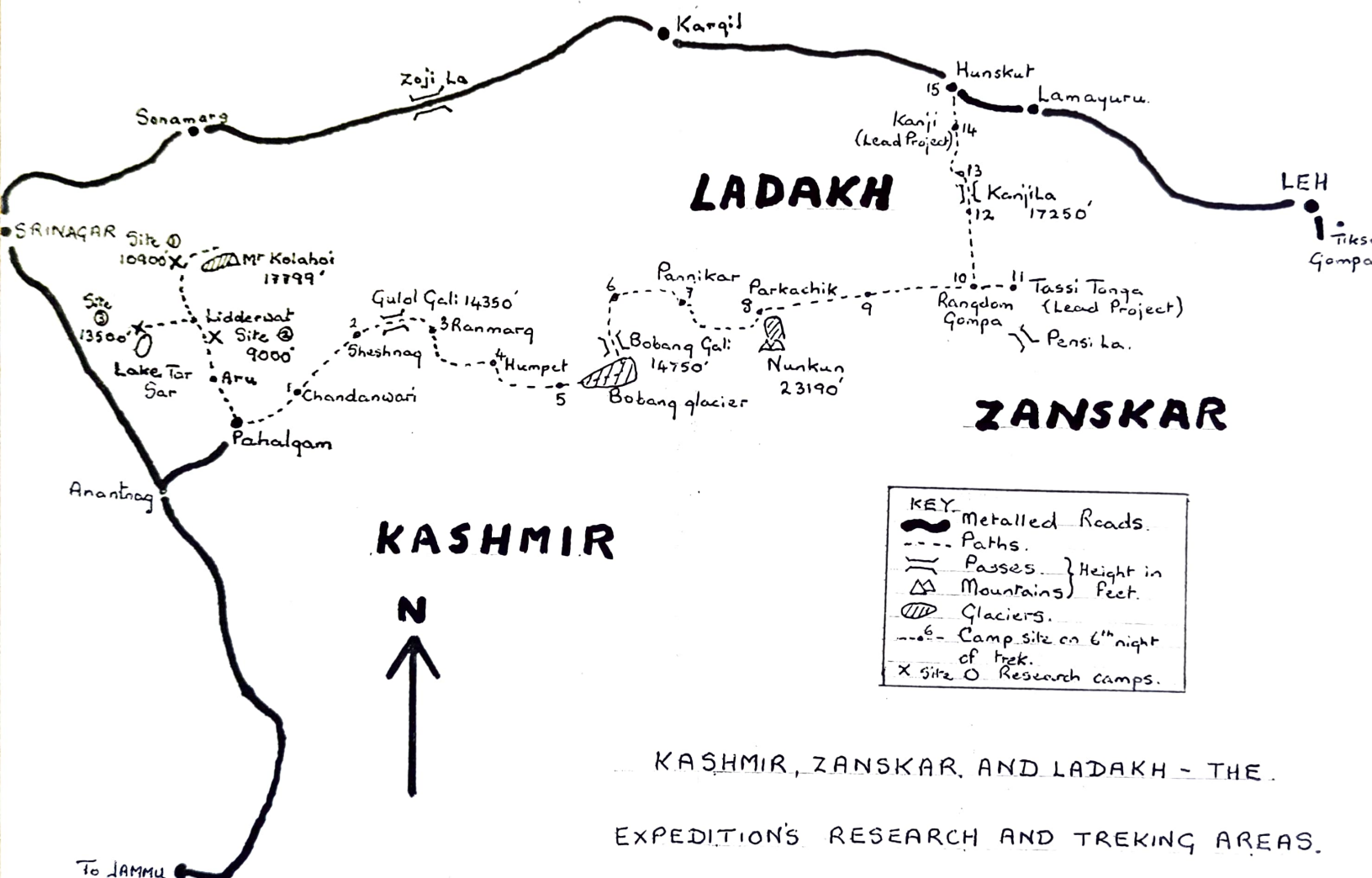
- | | |
|-------------|--|
| Sept. 17th | - Hitched a lift from Hanskot to Lamayuru by jeep and looked around impressive monastery there. Then hitched another lift to Alchi, very close to Leh. |
| 18th - | - Same lift took us to Leh. |
| 19th - 20th | - Time in Leh. |
| 21st - 22nd | - Travel by bus/lift back to Srinagar. |
| 23rd - 25th | - Time in Srinagar. |
| 25th - 27th | - Travel back to Delhi. |
| 28th | - Final day in India. |
| 29th | - Flight Delhi-London. |

ACKNOWLEDGEMENTS

Dr Nick Davies - Zoology Department
Dr P.O'Donald - Emmanuel College
Dr N.I. Ward - Imperial College, Reactor Centre, Ascot
Ms S. Sutton - Natural History Museum, London
Mr E. Holmes
Dr T. Davies - Cambridge Expeditions Medical Scheme
Mr Gurner - Cambridge Expeditions Medical Scheme
Dr Uppeandra Dhar - Head of Medicinal Plants Unit, Kashmir University
Sh. Virjee - Research Scholar, Botany Department, Kashmir University
Karma Tsering - Kansgi Village, Ladakh
Bashir and Mohd Subhan of Premier Houseboat, Srinagar
Thai Airways
Explorers and Travellers Club
Primus-Sievert U.K. Ltd.
Swiss Cutlery (London) Ltd.
Tilley International P.L.C.
Troll Safety Equipment Ltd.
Base Camp International Ltd.
Tri-Wall Containers Ltd.
Flect Packaging Ltd.
T. Fillmore (Norwich) Ltd.
Plant Protection P.L.C.
Mountain Equipment Ltd.
Berghaus
Opticron
Actionsports Ltd.
MacDougalls Foods Ltd.
Rowntree Mackintosh Sun-Pat Ltd.
Colman's
Beecham Foods
Batchelor's Foods Ltd.
Walkers Nonsuch Ltd.
Jordan's Crunchy Bars
St Ivel's
Weetabix
Mornflakes
Tate and Lyle
Gale's
Arrowmint
Wrigley's
The Cambridge Expeditions Fund
The David Richards Travel Fund
The Mary Euphrasia Mosely Fund
St John's College
The British Ecological Society
The Coggan Trust
HRH The Duke of Edinburgh
The Gilchrist Educational Trust
The Mount Everest Foundation
The Pike Trust
The Royal Geographical Society
The Vegetarian Society of Great Britain
The Westcroft Trust
The Woodard Schools: Grenville College
Barclays Trust Co. Ltd.
Central & Sherwood P.L.C.
The English Association Ltd.
Emmanuel College

The Hanson Trust P.L.C.
Heffers
Jardine Glanvill Services Ltd.
Taddale Investments
St Regis International Ltd.
Sinclair Research Ltd.
R.O. Barrat
Sir J. Eden Bt., MP.
S. Friedlander, Esq.
D.J.L. King, Esq.
P.G. King, Esq.
Ms. B. Myles
P. Rippon
D. Ryman, Esq.
S. Stein, Esq.
W.C. Young, Esq.
Prof. F. Hinsley, OBE - Master of St John's College, Cambridge.
Prof. D. Bryce-Smith - Department of Organic Chemistry, Reading University
Dr I. Woodward - Department of Botany, Cambridge.

And special thanks to Jane Jones of St John's College for hours of tireless typing and advice in drawing up the report.



KASHMIR, ZANSKAR, AND LADAKH - THE EXPEDITION'S RESEARCH AND TREKING AREAS.