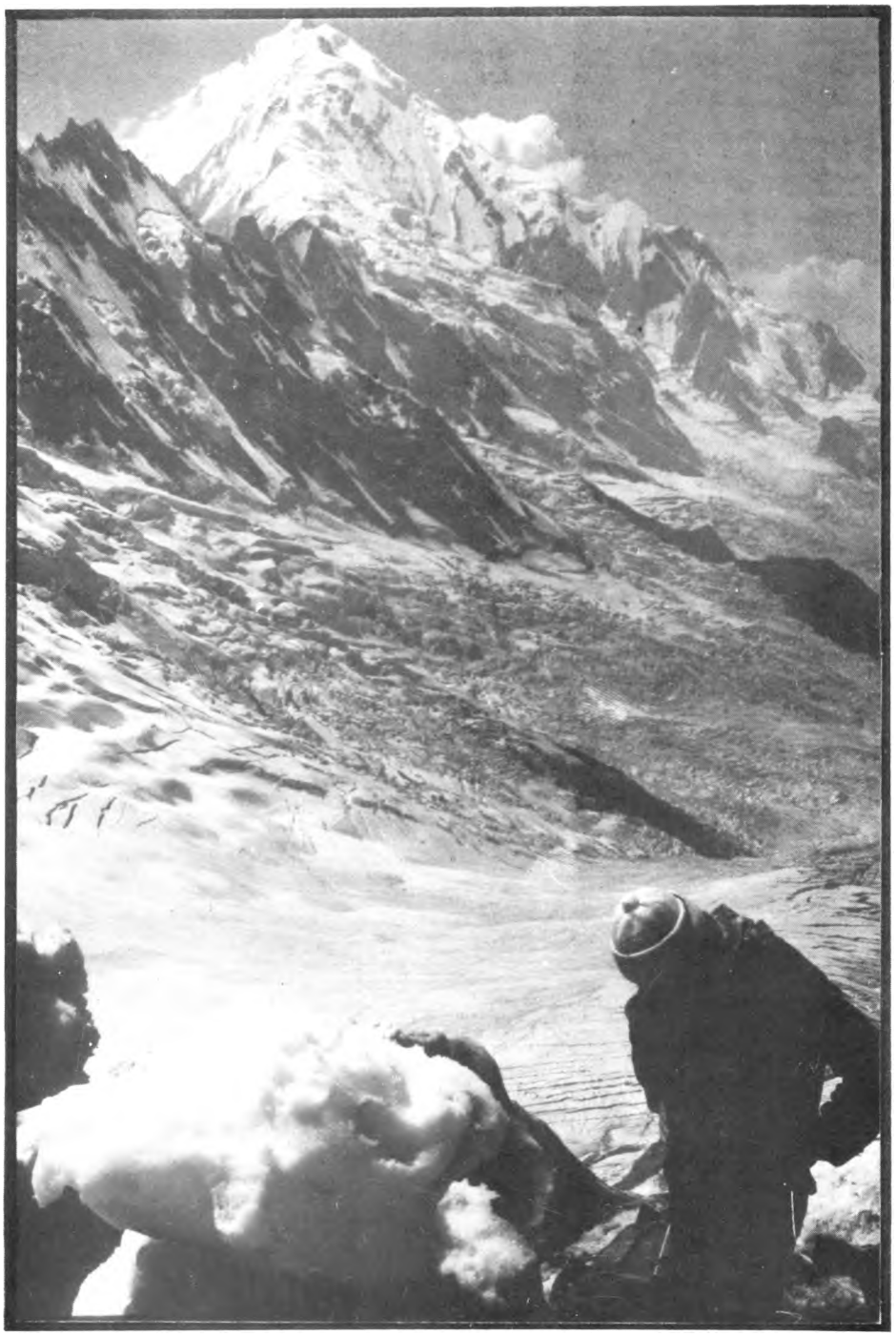
THE CAMBRIDGE KARAKORAM EXPEDITION 1984



FINAL REPORT

INTRODUCTION

This project began with birth of two babies in separate parts of Cambridge in October 1983. Ill-formed infants, they met one night in an alehouse of little note and plans began to brew.

The Hunza Valley was the mutual goal, hidden between the mountain wastes of the Karakoram and Hindu Kush, it boasted a fair-skinned population reported to live to extraordinary ages, living off apricots and glacial water. The Karakoram, above the Valley, holds the greatest concentration of peaks over 20,000 ft anywhere in the world and is the most glaciated region outside the poles. Thus, a young glaciologist was hooked. The inaccessibility of the Valley itself had been dramatically altered by the building of the Karakoram Highway, an awesome feat of engineering, which was completed in 1978 affording an excellent trading link between Pakistan and China which, in passing, also made study of this little-known area possible and resulted in a drastic alteration of the lives of the healthy Hunzakuts. Thus a medical student and a zoologist were also hooked.

Enthusiasm grew as we gathered more information on the region and the projects seemed to present themselves. The area appeared perfect for a glaciological study and in this, as in all aspects of the expedition we were greatly helped by the activities of the Royal Geographical Society's International Karakoram project which took place in 1980 as celebration of the Society's 150th anniversary. The projects were formed trying to put togetner the expedition as a study of several unique aspects of this area. We decided to concentrate on a study of the Minapin glacier above central Hunza. Another group would look at the effect of the social and dietary changes, associated with the building of the KKH, and on blood pressure in several villages in Hunza. The third project would focus on a particularly intriguing bird, - the Himalayan Snowcock which lies high above the valleys, up to the snowline at 18,000 ft, and remains little-studied.

Plans moved quickly and after recruiting a 'multi-purpose' metallurgist we produced our prospectus and set about establishing relevant contacts and raising funds. We aimed to try to get the bulk of the organisation dealt with before the summer since three members saw finals pending and loyalties would become stretched. This partly worked. We had always envisaged adding a fifth member to our team and in the event, since project pressure demanded and finances just about allowed, we gained two more of the species.

Each of the projects and all of the team bore up well in Hunza, and we think some useful results were produced. We found the area enthralling, the people charming, and would recommend others to follow.

The report begins with a short account of the members involved and a section describing the Hunza valley including a brief history of the region. The next three sections contain details of the scientific studies carried out. A detailed diary of our activities is then followed by a collection of articles recounting personal views of various aspects of the trip including trekking, bear attacks! and general impressions. The appendices contain what we hope will be useful (but possibly tedious) information for anyone planning a trip to Pakistan in the future. We hope that this report will prove interesting and helpful to those that read it.

Map 1 Pakistan- showing the overland route to Hunza

THE WHO

Jonathan Bamber. Age 22
1st year PhD student in glaciology at the Scott Polar Research Institute
Extensive climbing in Britain, Norway and the Alps.
Expedition leader

Marathan runner, glaciologist, vegan, rubber limbed climber, mogadon addict and tailor´s nightmare all packed into an economical 5´ 6" frame, Jon is....well, unique. A bit of a closet hippy (shadey past they say), he is into the wholeness of life; one knows not whether that refers to his skimpy shorts beneath his fair English chest, the sight of which as he runs through the streets of Gilgit (yes, ran in a temperature of 40^{o}C) sent grown men screaming for cover. He performed mountaineering feats (shh!) that induced feelings of admiration, incredulity, horror and fear in the rest of us and at all times his motivation and achievement bore an inverse relationship to health and feasibility What this man can´t achieve on half a pot of mogadon is probably beyond the reach of mere mortals. A leader of men, to be sure, but to be avoided when hassled. Advice to future expeditions - find someone who can understand this man. We couldn´t.

James Mayers. Age 21
3rd year behavioural zoologist
1983 St. John´s College Cambridge Ecological Expedition to Kashmir

True to the adage that one just can´t eat too much, this man threw everything and more at his ever tolerant guts and yet always came up smiling (and belching) and ready for more. Beaten only once after a devastating 24-hour gastronomic onslaught in Chitral, he was repentent only long enough to plan the next day´s menu. His darkest moment came not as a 3 metre bear stormed his tent at the dead of night nor as he risked life and limb at the end of a rope, Jon, asleep on the other end, but on the discovery of food supply decimation by the aforementioned bear.

This man is both musical and manually dextrous being able to whittle a 3 foot bough with a penknife from ten yards whilst making noises reminiscent of bouncing ping-pong balls in accompaniment to his snowcock friends and being able to keep a very large and fierce bear amused for hours with syncopated rhythms from his culinary drum kit.

Last seen, James was heading for the Amazon in search of giant otters and other elusive beasts. One pities them, the shy, retiring snowcock having yet to recover from the sight of the creased Mayer´s eyeball peering out from the depths of a very conspicuous and unhidable hide, telescope and the famous pad at the ready.

Irritating habits; monopolising a two man tent and being right.

Iain Stark. Age 21.
3rd year metallurgist
Scottish representative of Egon Ronay.

Accompanying this proud, canny Scotsman anywhere in Pakistani civilisation was a rewarding experience. Charm and persuasion would elicit the appearance of tea from nowhere at any time of day or night from the most reticent of salesmen. Not that he had any intention of buying anything, save for the ever present bottle of Coca Cola. He is rumoured to have crossed the Karakoram from Gilgit to Chitral only because supplies of the black gold were dwindling in Gilgit. Except for this prediliction, Iain´s suppertime cries of "not for me thanks" were those of the near anorexic in stark contrast to his successful pre-expedition demolition, with the help of his family, of all the most

desirable freebies that he had spent the year charming out of generous donors. He denies it all but adds, in unguarded moments, that the macaroons were jolly good.

This man, when not in a state of (justifiable) near hysteria over the close and frequent attentions of our large bear friend or hurling celtic abuse at revolting porters, lent a learned air to our camp proceedings, having the capacity, in almost any mental or physical (usually mud-encrusted) state, to discuss burning political or economic isssues of the day with any receptive mind. Sadly there were few of those about. Thermal underwear catalogue compilers need look no further - Iain models a mean pair of legs.

Paul Thomas. Age 22.
3rd year medic.
1982 Cambridge High Altitude Expedition to Nepal.

Mad Welshman, mystic, mythologist and dedicated epidemiologist, Paul is one of life´s dreamers with an imagination worthy of the Chelsea flower show... colourful, fertile and exclusive, all nurtured with a lot of manure. When not battling with a barrage of debilitating beasties, gangrenous limbs or manic depression over the medical project, he would achieve great feats.... in fact his feets are now propelling him to the far reaches of the Himalayas. When Paul decides on something he makes it happen, usually to the accompaniment of a horrendous ditty from his massive repertoire of songs for every occasion, unfortunately usually the wrong occasion and invariably thoroughly out of tune. For musical talent we do not consider ourselves amongst his greatest fans but he models a Hunza hat like no other.

As one of Hugh Swift´s disciples and greatest admirers, Paul had a near religious experience on discovering we were retracing the barely week old footsteps to the "tantalising Thui peaks" of the great pioneering author of Treking in the Himalayas and Karakoram himself.

Paul´s gesticulatory vocabulary is second to none. It was sheer joy to watch as he launched into a lengthy explanation of how to make a 24-hour urine collection and take tablets at the appropriate time to an audience that spoke not one word of English. Anywhere else it would have been censored but his performance was greeted with incredulous ecstacy.

Kevin Bishop
An American geography graduate studying Hydrology at the Geography department for one year.
U.S. Park Ranger.

Watch out Yogi, here comes ranger. When not reporting to paranoid bureaucrats so as to convince them that the Cambridge Karakoram Expedition was not merely a cover for his clandestine CIA activities, our colonial friend would be invariably found engaging in conversation with anyone and everyone who would listen and all were immeasurably richer for the experience. What information Kevin could not glean from your average Pakistani probably wasn´t worth knowing. His eloquence however was eclipsed by his immaculate attire and this combination clinched the post of expedition Public Relations Officer. Whilst the rest of us were dressed appropriately for a bench under the arches at Charing Cross (and, one might add, appropriately for an expedition), Kevin was a pillar of tailored sobriety. How he maintained those trouser creases is a total mystery.

His skill with the tongue was matched with mapping equipment and the great uncharted became the charted in the twinkling of a theodolite.

Nowhere was too far for this man when the bear arrived. In a flash he wisely fled to India leaving us wondering just what he had tucked away in the deep recesses of the largest rucksack we had ever seen. Rumour had it he threw great parties in its lower compartment.

Robert Holmes. Age 21/22.
3rd year medic.
1983 St. John's College Cambridge Ecological Expedition to Kashmir.

Not to be upstaged by last year, Rob undertook the role of practical parasitologist with zeal and after ten weeks of research contracted Salmonella and Giardia to join company with the malaria of the previous year. These new bugs were to be intimate companions through the autumn.

Overcoming occasional thoughts of cheesecakes, pints of Abbott and tennis skirts (plus contents) he mustered a camping and trekking heartiness others found hard to match (and, on occasions, tolerate) and characteristic sightings of this rightly endangered species were of excessive washing in glacial streams and of steel thighs, detached from all pain sensation, motoring off into the distance up never ending passes.

This clean cut physician performed miracles with a sphygmomanometer but was at times left wondering whether his bedside clinical skills, cultivated for soothing the fevered brow in Tunbridge Wells, were somewhat inappropriate for 80 year old Hunzakut warriors and Northern Area Polo champions.

But Rob's first passion is his gear. As the others solved the world's problems, he fiddled. As Rome burned Rob would have fiddled. And as to the cuddles he professes to needing, Paul is saying nothing.

Irritations: His bag of useful Things and writing postcards.

James Paul Iain Robert Jonathan

THE HUNZA VALLEY

HISTORY OF HUNZA

The history of Hunza is in essence related to its strategic position as one of the three points at which the Karakoram/Hindu Kush barrier can be broached giving access to the sub-continent of central Asia. Of the Chitral, Leh and Hunza routes the latter is the shortest, and easiest. It is this fact that has determined Hunza's course, more than any other, first in its relations with Sinkiang and Tibet and later as a possible strategic route for the once believed Russian threat on British India.

Sinkiang was very much in the past, and in character today also, an independant state long coveted by the Chinese. Sinkiang was conquered by the Chinese during the Han dynasty 206BC - 220AD and reconquered during the Tang dynasty (618 - 907AD). The Chinese control over Hunza and Gilgit however was repeatedly undermined by the Tibetans, holding Ladakh and Baltistan and of course the Sinkiang people themselves who refused to recognize Chinese sovereignty. The eventual result was the regaining of Sinkiang's independence in 751AD and the return of Hunza to an isolated community.

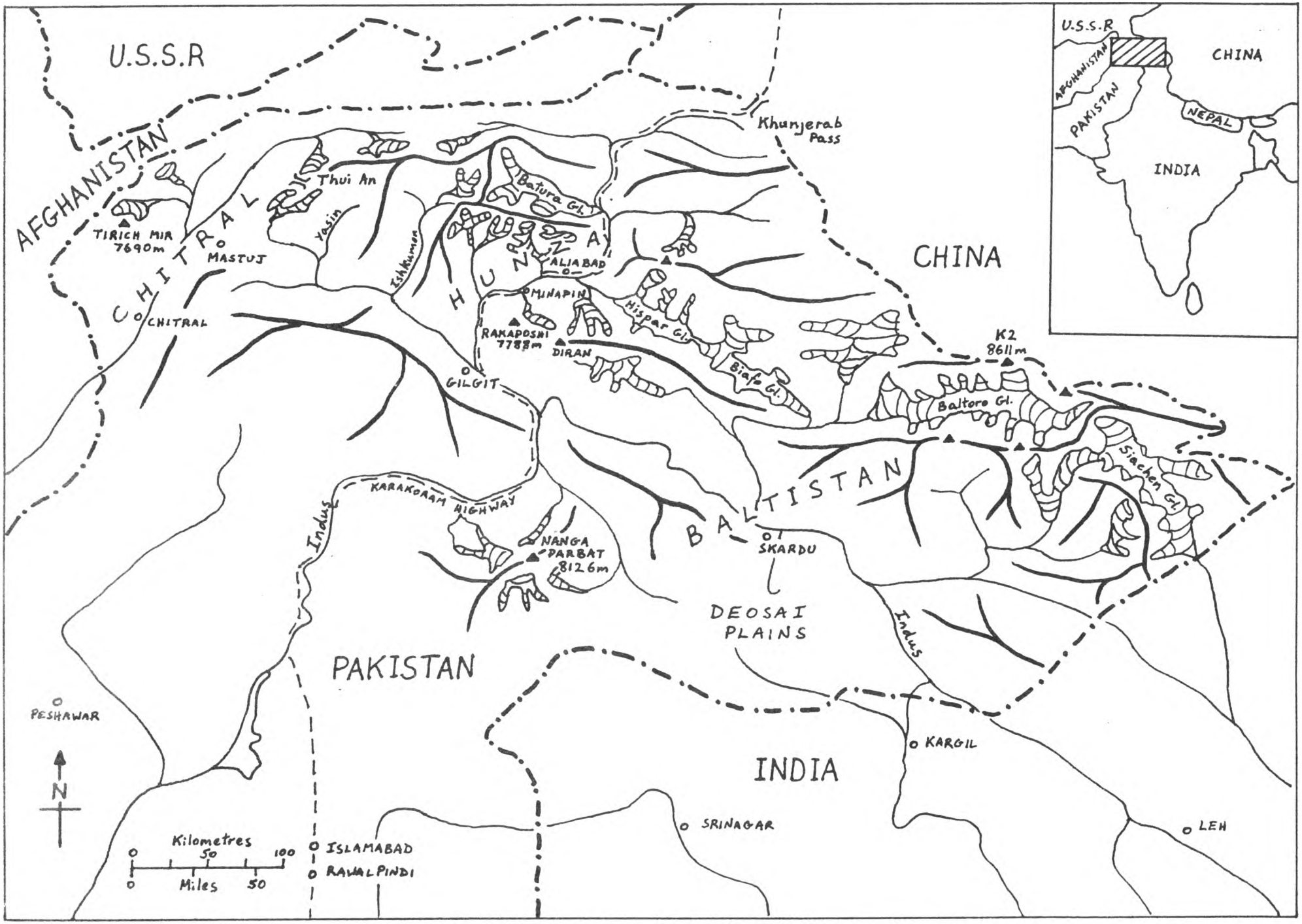
No record exists of the culture present in Hunza at this time. It seems likely that this period is that referred to by the Hunza legends of invasion from the north but questionable from linguistic and physical evidence whether this had an effect on racial mixing. The Islamic religion however is probably derived from central Asian sources.

From the security of their mountain retreat the Hunzakuts based numerous attacks into Chinese and Sinkiang territories an activity that was to continue with renewed vigour in the mid 1800's when the British sought to encourage trade via the Leh-Yarland route. This not only diverted income from the Hunza levy on trade through their valley but provided an ideal raiding target for the belligerant Hunzakut warriors. And when the spoils of caravan looting were not forthcoming there was always a trip into neighbouring Baltistan over one of the greatest glaciers in the world for slaves and the like.

Sinkiang in the meantime remained independant until the rule of Genghis Khan, lost during the Ming dynasty (1368-1644) before being tentatively regained in the 18thC by the Manchus.

In the early 1800's the possibility of an imperialist Russian advance on an equally imperialist British Raj became a cause for concern in the Whitehall corridors. The barrier of the KK was seen as the only barrier against such an invasion and yet its passes and valleys were totally unexplored. This remote mountain wilderness became the focal points for the Great Game (a name coined in the light of the recent invention of sporting life) between the sparring nations. Furthermore it was a time when great achievements were being made in exploration and successes by Younghusband in the Western Himalaya rivalled those of Livingstone in Africa. Yet despite the vast unknown and potential of this area, for almost a century the aim of early exploration was not to discover, commercialize but to seal and block the passes and hence the possible Russian threat. Consequently exploration almost without exception had a political basis.

But the situation was complicated by two main factors. Firstly the Kashmir area under the jurisdiction of Amritsar placed the whole area in the hands of a ruler of dubious allegiance to the British empire. To compound matters no boundaries had been set. Secondly with few exceptions the Dardic races of the Karkoram were amongst the most belligerant and unpredictable in nature. The result, after an intriguing wrangle, marvellously rendered in Keay's Gilgit Game was the establishment of the Gilgit Agency in 1878, and the taking of Hunza by Durand after



Map 2 The Northern Areas and borders

a particularly arduous campaign against ~4000 Hunza warriors in 1891. Within 2 years, a tribute to the lack of resentfulness of the Hunzakuts, they were fighting campaigns under a British flag in Chitral.

Recent History

In the foregoing discussion it will perhaps be evident the remarkable isolation the Hunza people have enjoyed throughout the majority of their history. Within the last 100 years, however, perhaps four significant events have substantially altered this degree of contact with the outside world. Firstly the defeat by the British in 1891, establishment of Pakistan's independance in 1947, the abolishment of the Murdam ten years ago and the construction of the KK highway.

Part of the reason for our visit to Hunza was to try and establish the effect of the building of the KKH. Though these later changes are dramatic and will have far reaching consequences in the next few years, it must be said that we underestimated the degree of 'acculturation' that had already occurred. The British started on a road building programme generally designed to increase accessibility to Hunza and this was followed by the availability for the first time of salt, sugar, tea, cigarettes and cotton in significant quantities. For the first time, Hunza men left the valley to find employment elsewhere. The first opportunity for this, and indeed until recently the most common, was to join the army, a position that readily suited the Hunza fighting tradition. This was more pronounced following the establishment of the Pakistan army on Independence where many would leave for ten years or more. Thus in our inquiries some 40% of all had spent five years or more away - a figure quite unexpected from what we had been led to believe about the valley.

Also of relevance in the mobility of the population has been the strength of the leadership of the Mir. Until recently the Mir played a central role in Hunza life, involved in presiding over local government sessions, arbitrating and deciding disputes, festivals, instigating irrigation schemes etc. This tradition goes back some 600 years and provides a major part of the coherence and identity of Hunza itself. Some 25 years ago, the Mir unfortunately failed to fulfill these tasks and one consequence was that the quality of land declined and people left the valley to seek employment elsewhere.

The population of Hunza currently stands at approximately 30,000. It is divided into Upper (Gugal), Middle and Lower (Hindi). This represents a fall off from a peak in 1970 of 45,000 when there was an obvious overcrowding problem, overuse and fractioning of land (land is still split, traditionally between sons when the father dies leading to smaller and more inefficient holdings). Over the period from 1970 many people left the valley to resettle in Gilgit (encouraged by the cheap land) or find employment in lowland Pakistan. It seems likely that the current population is still at the limit of what the land can support. Lord Curzon estimated the Hunza population as 6540 in 1894 and although this seems an underestimate (in the light of 4000 Hunza warriors involved in the defence of their valley aginst the British) it does give a figure some three orders of magnitude below the current level. In 1958 the population was estimated at 26-30,000.

Today, contraception is practiced but only to a limited degree. The Pill is beginning to become available but the cost is beyond most families. Injections are more frequently used, being effective for 3 mohths. The traditional practise where the husband left the wife until the child was weaned is declining. Family size remains on average at 4 - 5 children.

Most recently the construction of the KKH has been the most dramatic and most consequential event to effect Hunza. Initiated in 1960, the original intention was the linking of Swat, Chilas and Gilgit. However after the Pakistan/Indian war of 1965/66, more ambitious plans were adopted after former trading agreements were fixed with China and following a pledge by the Chinese to continue the building of the road on their side of the border.

The task was immense, stretching over 500 miles, much of it following the old silk route, from Islamabad to the 15400 ft Khungerab Pass on the Chinese border and encompassing some of the most unstable and

dangerous terrain in the world. Though work was carried out by local people, there was initially much resistance to the highway's construction and in essense much of the programme was carried out by the Pakistan Frontier Works Organization and Chinese roadbuilding teams (who concentrated particularly on bridge building) in numbers of 15,000 and 11,000 respectively.

The final section of the road was completed in 1978. Now the 70 mile Aliabad to Gilgit journey which once took three days by mule, takes 3 hours or less. Access to the major cities is similarly greatly increased. All of which indicates the prospect of immense change now facing Hunza.

"When men set their minds to it, they can kick a mountain into powder.

Dr. Mohammed Iqbal"

Agricultural Patterns

Hunza has always been primarily an agricultural community intensively farmed yet still basically a subsistence economy, with little trade, this necessitated by the isolation of the valley itself. However with increased access to the valley via the KKH the possibility of trade has emerged, particularly in the case of the Hunza fruit crop.

Principal crops have changed little over the last 100 years (and it is likely little before that) save the introduction of the potato by the British at the turn of the century. The principal grains are wheat, barley and millet, the current trend being towards wheat since this allows a second crop (usually maize) to be grown in addition. Buckwheat, lucerne and turnips (+ potato) form principal vegetable crops with carrots, onions and pulses are also being grown. Fruit cultivation is one aspect for which Hunza is famous and at one time this formed the foundation of the diet. Apricots, mulberries, peaches and apples are the main crops.

Cash crops. With access to markets in the cities greatly increased the prospect of a Hunza cash crop has presented itself, and may indeed prove the likely course of agriculture in the valley when Hunza becomes more fully integrated in the Pakistani economy. Fruit is of course the most likely export of which there is an abundance during the summer. Indeed the famous Hunza apricot, imbued with life giving properties may be found today on the stalls of some health food shops in the UK. However as yet this tendency is very new. There is a traditional scepticism within Hunza on this form of trade. Self-sufficiency has been the norm for centuries and it is unlikely to alter 'overnight' particularly with the older farmers. Furthermore, the road is not seen as an infallible link - it is frequently closed due to landslides reminding farmers that potential trade might well be haphazard. Finally there are at present government restrictions on goods leaving Hunza though it seems likely these will be lifted in the near future.

Irrigation. Irrigation is of course the central factor in the whole Hunza economy. The evidence is visible everywhere in uncultivated areas of the Karakoram of the barreness of the land without water. In Hunza itself cultivation is limited to a level on the hillside at which the irrigation channel runs. Above this are the grey brown hues of the ubiquitous scree. Because of the low rainfall, almost without exception these irrigation channels are fed by glacial melt water running from one of the side valleys or 'nalas'. The channel then runs along the hillside feeding smaller channels running off it which may serve two or more villages. As might be imagined with such a limited (though reliable) source, the control of water use is critical. Traditionally, as is the case in Baltit, this has been organised on a tribal basis a system now discouraged by the AKF favouring a more central and equitable management of water rights.

Maintenance of the water channels was once organised by the Mir as well as construction of new channels which must precede any attempt to cultivate new land. With the population growth this has been necesssary and is now overseen by the AKF.

Development

Great strides have been made in recent

years in bringing the northern areas of Pakistan (comprising the three main areas of Chitral, Hunza and Baltistan) into line with standards and progress elsewhere in the country. Much of the earliest work involved improvement in communications to these areas namely the building of jeep roads and establishment of subsidised flights to main centres all of which were government instigated schemes. The most explicit indication of how dramatic an effect such an improvement in communication can have is of course provided by the KKH. Since then however, at least in Ishmali muslim areas the Aga Khan Foundation has had an increasing role in the northern areas development programme.

The Aga Khan is the spiritual head of the Ishmail islamic sect, his followers believing him a direct descendant from Mohammed, - indeed the 49th Imam. The Aga Khan Foundation is a worldwide organisation with an aim to benefit religious and secular life of Ishmaili muslims throughout the world. In Pakistan a hierachical system operates from a national headquarters in Karachi with provincial headquarters in Gilgit and regional headquarters in Amabad for the Hunza valley. Though approval of programmes and allocation of funds is carried out on a national basis the regional headquarters enjoy a considerable freedom in deciding where the money and effort is best spent.

The AKF's involvement in the northern areas (and Hunza in particular) began principally in the mid 1960's after a series of epidemics had caused considerable suffering in the region. A series of 'minor' medical centres (see elsewhere) were established as part of a long term rationalised programme of health care. A programme of school construction was instigated in the 70's to mark the AK diamond jubilee. In the meantime UNICEF and the Government had completed a full-scale survey of northern area villages the results of which fully portrayed the development priorities. The AKF co-ordinated its efforts with those of UNICEF under the control of the Northern Areas government with the aim of implementing the findings. The present regional set up involves various committees concerned for example with housing, education, health etc formed by representatives from each village. The chairman of each committee sits with the general council which has responsibility for all programmes in Hunza.

As has been indicated, the role of the AKF has effectively replaced that of the Mir, but more than this it is a move away from a more trible system of government towards a local administration more attuned to local needs in the face of the changes now underway. Typical of this is its involvement in arbitration during disputes, once the function of the complex Hunza system of *progressive appeal. In addition* the AKF has aimed to encourage economic development - the cooperative scheme in Aliabad. On the development side the Rival Support Programme is responsible for major schemes, e.g. the construction of new water channels. Early schemes relied on the use of outside contractors, without much success and today a policy of self help is encouraged with local farmers being involved and the cost of one major scheme paid for by the RSP. Currently the Hussainabad water channel, extending land use above Baltit/Aliabad is nearing completion at a cost of 8 lacs. The supply of fresh clean water for domestic use has also been cited as a major goal yet the one scheme intending this, utilising a 4" plastic pipe from a spring source proved extremely expensive (35 lacs) and was eventually abandoned. As will be seen from the records, the use of unclean water accounts for much of the present disease level in the valley,

DIET AND HUNZA MYTH

Any account of Hunza without some mention of the 'Shangri-la' (an unfortunately overused epithet) it has been portrayed as would be remiss. A succession of travellers with preconceived ideals have visited the valley seeing only that which sanctioned those preconceptions (see the bibliography). The idea of some lost valley where everyone is happy and content is strong in the human imagination. However even allowing for this there is strong praise indeed for certain

aspects of the Hunza culture.

Of the men:

"An island of manliness in an ocean of trousered women" etc

It is in the idea of the disease free longlived Hunzakuts, however, that there has been most interest. It seems likely this notion was started somewhat inadvertantly by Sir Robert McCarrison, one of the most respected medical men of his time, who acted from 1904 to 1911 as Gilgit Agency Surgeon. From pioneering work on the cause of deficiency diseases McCarrison became interested in diet as a means to prevent disease. He cited lack of abdominal related diseases in Hunza and linked this up with dietary habits. McCarrison's observations were later taken up by G. T. Wrench, who effectively started the ball rolling with his book "The Wheel of Life".

As can be seen from the "Medical Records" the idea of Hunza as a disease-free society can be quickly discounted. However it may well be the case that the disease profile today is somewhat different from the situation 100 years ago. As can be seen from the hospital data a large percentage of complaints are related to dyspepsia and diarrhoea related illness. This contrasts the notes made by McCarrison at the beginning of the century. If this does reflect a real difference then recent changes in diet and the current overcrowding problem may be to blame.

With regard to claims of longevity in the Hunza valley the problem becomes even more difficult. Hunza is one of the three areas in the world (along with Vilcabamba in Ecuador and the Caucasus in Russia) where claims of long life have prevailed. Such claims are understandably regarded with scepticism, particularly in the case of Hunza where there are no birth or death records to certify age. Three doctors seem to have visited Hunza to investigate further these claims, two of whom are listed in the bibliography but whose works proved difficult to trace. A third, Professor Alexander Leaf of The Harvard Medical School visited all three areas of alleged longevity sponsored by The National Geographic Magazine. On presenting no concrete evidence he expressed a tentative half belief in the old age story, noting particularly the activity and physical well-being of the old and their active role in the community right up until the point of death.

The Hunza people themselves lay claim to longevity, though most admit that today with the loss of Hunza traditions this is a rarity. The diet is often singled out as the factor responsible for the Hunza health, particularly the diet of thirty years ago before the advent of jeep access to Hunza and the increased availability of external foodstuffs. Before this time the basis of the whole Hunza diet was the apricot, eaten raw, squeezed to form juice or boiled to form soup. Buckwheat or wheat bread was dipped in this brew or the flour itself cooked in the apricot extract. The apricot kernel was eaten as a nut or crushed to make vegetable oil. Tomatoes, marrows, beans, turnips, onions (and potatoes since the British) with some lentils formed the vegetable supplement. Apples, mulberries and peaches were also available in season but do not preserve as well as the apricot for the winter months. Very little meat or milk products were available because of the lack of pastureland, though animals were slaughtered for winter and butter (cheese) was made for this period.

In general the diet is characterised by a low animal fat intake. Meat and dairy produce only made up $1\frac{1}{2}$% total intake of 55 Hunza males in 1970. The calorific intake per day was 1923 Kcal with 50g protein, 36 g fat and 354 g carbohydrate. Also little or no salt was available.

Since the 1960's subsidised white flour has been available, also rice and increased meat (though intake is still low). Also salt is now readily available being taken in tea as well as food. Refined sugar is too widely used. Despite the availability and obvious use by some, it is difficult to estimate the extent to which these dietary changes have permeated the Hunza households.

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Hunza Post 1900 travellers accounts

1 Frank and Jean Shore. After you, Marco Polo.
Following the journeys of the illustrious traveller. A small portion devoted to Hunza.

2 Owen Williams. First over the roof of the world.
Again, Hunza in passing.

3 Peter Fleming. News from Tartary.
Devotes 15 succint and useful pages to Hunza.

4 Mrs. Lorimer. Language hunting in the Karakorums.
Nothing of real academic interest. The wife of Col. H. Lorimer assigns herself the task of recording events while accompanying her husband on his linguistic studies. Considerable time was spent in Hunza of which she writes favourably.

5 J. I. Rodale, 1948. The Health Hunzas.
Spent over 1 year in Hunza establishing various cottage industries, treating the ailments of the (surprisingly many) sick Hunzakuts and trying to convince the world of an ominous communist threat on the Karakoram. A little too possessed with the good old American Way.

6 Barbara Mons, 1958. High Road to Hunza.
Fairly short but captivating account, enhanced by some interesting facts and figures.

7 Dr. Allen Barik. Hunza Land. One of the few doctors to visit the area with the aim of assessing the health and longevity claim. Unable to locate this book.

More Scholarly Work

1 Life and works of Sir Robert McCarrison
Gilgit Agency Surgeon 1904-1911. Made first observations concerning medical matters in these areas. Particularly interested in diet as preventative medicine. Refers to Hunza.

2 G. T. Wrench (1938). Wheel of Life.
Popularized McCarrison's ideas leaning heavily on the Hunza lifestyle and diet as a means to self salvation and longevity.

3 Dr. G. W. Leitner - Languages and races of Dardistan Lahore 1877
- On the sciences of linguistics and ethnography with particular reference to Hunza
Largely unintelligible, these 2 works nevertheless give an interesting taste of the rest of Leitner's voluminous work, and to a certain extent of the eccentric, himself.

4. Drew, F. Jameo and Kashmir Territories. London 1875.
Biddulph, J. Tribes of the Hindukush.
Two of the classics, though heavy going at times, particularly Biddulph.

5 Lorimer Col. D. L. R. Burushaski Language in 1935.
The standard text on Burushaski, with an interesting introduction considering the origin of the language (and hence the people) and its relation (or lack of it) with other linguistic forms.

6 S. Shahid Hamid. Karakoram Hunza 1979.
Though sometimes lacking in captivating style, this is perhaps one of the more useful books on Hunza. Contains section on the 'pre-history' history and customs of the Hunza pople.

Kafiristan

Kafirs - speak very primitive form of Sanscrit (Aryan language). Chief deity Imra of Aryan's 'Indra'. Chairs, wine, coffins, statues - later conquest or infiltration by Greeks?

The ultimate in sourcebooks for this fascinating region is Dr. Suchuyler Jones - Bibliography of Nwistan and the Kalash Valleys (1969) - an assemblage of all hitherto published accounts of the area with an accompanying abstract of each work.

From this list the following may be of particular interest:-

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Journal of the Society of Arts Vol. 45. Nov 1896 - Nov 1897. London 1897 p573-581.

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General

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When Men and Mountains Meet (1972)

The Gilgit Game (1979).

Though he focuses particularly on the men who first explored this terrain and the political wrangles that often were associated with this exploration (from 1820 to 1900), the books give a remarkable insight into the geography of the region and a feel for the lifestyles of the inhabitants of these areas. Also a great read:

Naipul, V. S. Among the Believers.

Four journeys through Islamic Iran, Pakistan, Malaysia and Indonesia. Not a particularly superb account of Pakistan, but generaly succeeds in portraying the essence of Islam through its various international forms.

Newby, Eric. A Short Walk in the Hindu Kush. The irrepressible Newby en route to climb a mountain in Nwistan (Kafiristan).

Thapar Romila. A history of India 1.

From pre-Aryan times to the coming of the Moghuls in 1526. One of the more accessible 'histories'. Very useful in its account of the Mauryan and Kushana empires centered around present day Peshawar which provided the source and inspiration for the great Gandharan culture.

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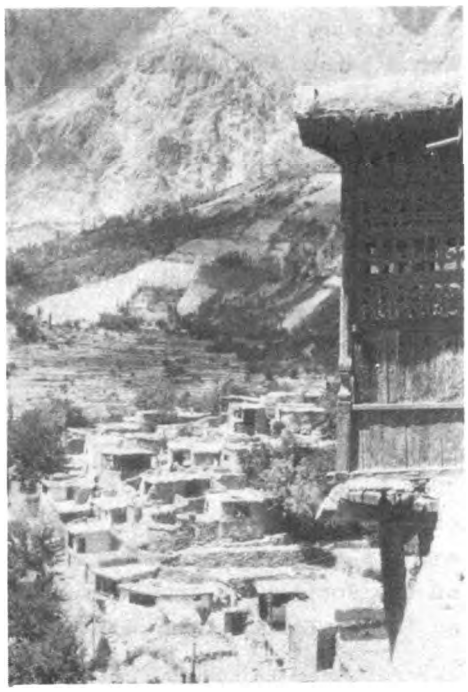


MEDICAL STUDY

MEDICAL ORGANISATION

There are three main bodies with inter-related roles to play in the health care of the Hunza valley. These are the "hospitals", the Aga Khan Minor Medical Centers and the Commercial Dispensers.

It is the government run hospitals which form the basis of the medical system. Despite being built to carry out minor operations and with a 10-20 bed ward (as in the case of Karimabad) the facilities and money available do not really allow for such treatment, the nearest source being Gilgit. Nevertheless operating potential is available as was seen in the recent visit of an English eye specialist who carried out a large number of operations in the Karimabad Hospital, albeit using mostly his own equipment.

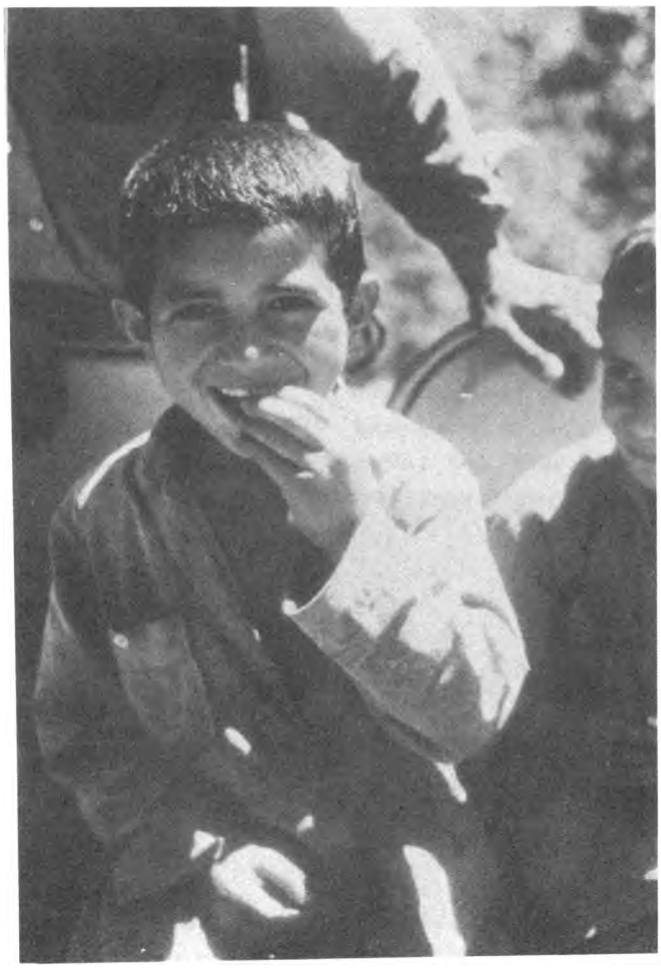
In the main however, the hospital simply acts as the surgery of the hospital doctor in the sense of a general practice in the UK. The doctors in these rural hospitals are usually newly qualified and the post is a compulsory period of two year´s work in the state health service. A doctor is usually sent to the region in which he is raised, an obvious benefit in the Northern Areas where many widely differing languages and cultures abound. There are currently two hospitals in middle Hunza at Karimabad and Aliabad and each serves large parts of upper and lower Hunza. They are served by one and two doctors respectively and four or five assistants who keep records, run the dispensary and look after the hospital. They have extensive practical experience and provide valuable back-up in the absence of the doctor. The doctor runs a morning surgery, rests in the afternoon, tends any hospitalized patients in the evening and is on call 24 hours a day, 7 days a week, 52 weeks a year. It is a tough and cften frustrating job. As the Karimabad hospital serves some 12,000 people mainly from the upper areas of middle Hunza and outlying districts, the doctor may be faced with well over 100 patients in a morning (see "medical records" for an indication of the complaints). Most cases are not serious and hence not treated or given aspirin and such like. Very serious cases may be admitted to the hospital ward. Because of finance, food can only be given to the patient for a few days, before relatives must contribute.

If drug treatment is necessary the doctor signs a chit which the patient takes to the hospital dispenser, if the drugs are available. Drugs via the government hospital are supplied free of charge but the supply is limited, delivery being irregular and the hospital often has to cope with a severe lack of drugs. Antibiotics (ampicillin, penicillin, streptomycin, suphonamides) and painkillers (Boscupan, paralgin etc) form the basis of the hospital dispensary. Despite widespread use there appears to be no antibiotic resistance in Hunza at present.

If the drugs are unavailable at the hospital the patient must go to the commercial dispenser where he must pay for drugs. Generally the doctor will send only a small percentage of his patients (2-5%) directly to the dispensers usually in the case where the drug is relatively infrequently used and never stocked in the hospital. Referal is more common when hospital supplies dwindle. Nevertheless there is a close interplay between the doctor and commercial dispenser; the latter from his own knowledge selecting his stock and sending a list to the doctor. The latter will also perhaps request certain drugs or advise on any new development in the medical drug field. In Pakistan, Glaxo, ICI and Wellcome repreeent the main drug companies, with Boots also playing a major role. A Doctor´s chit is not necessary to buy drugs. Any drug (except particularly dangerous drugs such as morphine etc) may be bought off the shelf providing one can pay. This obviously leads to problems e.g. the selling of incomplete

courses of tablets or even single "pills" without any real understanding of what the drugs do. With the blind faith of the majority of these people in the ability of western medicine and particularly the western pill as a wonder-working cure-all there is considerable opportunity for exploitation which fortunately has not occurred as yet.

Since the establishment of the government hospitals and health care in the early 1970's the role of the Aga Khan Minor Medical Centre has moved away from the general health of the population to a particular role in ante-natal, post natal and child care. Each of the larger villages has a centre, often staffed by one or more trained nurses and assistants. One of the great successes of the Aga Khan in recent years has been a full innoculation programme (BCG, Measles, Polio, DPT,). Aside from this, the main responsibility of the nurse is the general care of mother and the monitoring of the child during the first few years. A wide variety of drugs some very potent are kept in each centre, donated by the Aga Khan. The nurse has responsibility for prescribing these drugs. The centre also receives UNICEF supplies every month, again distributed via the AKF, though these supplies are mainly vitamin and iron supplements, rehydration salts. From the minor medical centres is also based a system of lady health visitors whose role is primarily education and advice on sanitation and hygiene to mothers which it is hoped may reduce dysentry and diarrhoea, still one of the major causes of infant mortality. Ultimately, though, the problem can only be solved by the provision of a clean water supply.



DISEASE PROFILES 1976-1984 IN TWO VILLAGES OF NORTH PAKISTAN

Introduction

A study of disease in the Hunza valley was carried out to investigate whether the present problems of the people have changed in the last decade as a result of building the Karakoram highway in concert with changes in lifestyle that have occurred, namely in diet, occupation, education and leisure activities. It was also pertinent to compare the disease profiles of Karimabad and Aliabad in the light of the marked differences in blood pressure between the two communities found in our main hypertension study. No objective analysis of possible causative factors and other risk factors would be sound unless set against the backdrop of a broader study of health and disease. Also of interest were seasonal trends that might become apparent so that impressions would not be based solely on the situation found in summer.

Our data was obtained from the records kept in the "hospitals" of Karimabad and Aliabad, poorly equipped health centres rather than hospitals despite ward areas for inpatients. Such centres are government run, staffed by one (Karimabad) or two (Aliabad) young and newly qualified doctors. These jobs are allocated by the state and constitute a compulsory two year period of state medical service usually to the community in which the doctor has been raised. The doctors are obliged to keep standard daily records which are submitted monthly to the regional health headquarters in Gilgit. Prior to the doctors arrival in Karimabad (1977) and Aliabad (1976) such records were kept by the dispenser with obvious limitations as will be discussed.

A difference in attitude and approach to the records between doctors and dispensers is clear. Both doctors we talked to appreciated the severe limitations of the short and very incomplete official list, yet made no attempt do more than satisfy the bureaurocrats by submitting their monthly figures in standard form. They saw no value in broadening the scope of the standard list because it was felt that the records played no part in fashioning health policy, rather they simply kept several clerks busy. In contrast the dispensers of the 1970's kept copious detailed records perhaps as a way of adding credence to their limited skills whilst not appreciating the records' irrelevance in central decision making. The dispensers' records were clearly a description of symptomology rather than disease, such data is obviously limited in its capacity to clearly elucidate disease profiles in the community but it has the advantage of minimising the risk of a misdiagnosis. With little or no formal training the records are clearly going to be somewhat inaccurate but their value is still beyond question in that broad trends will still be apparent, offering an insight into community health before the national policy of state rural doctors reached the remote Northern Areas at the end of the 1970s.

Criticisms of the records kept by doctors may also be made. The list is a limited one and, as such, a non specified "other diseases" category constitutes about 20% of the total. Furthermore, the classification is now one of both disease and symptomology, an unfortunate inconsistency, and certain diagnoses could not hope to be accurately made with the severe lack of investigatory facilities. The rapid turnover of medical staff under the present system of short term compulsory government postings adds a further limiting factor, figures may reflect the relative diagnostic skills rather than the actual situation. Finally it is clear that our figures represent a picture of the conditions presenting at the hospitals rather than the actual level and scope of disease in the community. The presenting pattern is highly susceptible to changes in fashion and the changes in the level of medical education and misinformation.

The limitations of the records obtained are obvious but the data is still of great value in answering our questions, namely how has the health of the people changed in the last decade of major social and economic upheaval and secondly can any differences be seen between the communities of Karimabad and Aliabad?

Hospital Use

Karimabad:	Population 12000	
	Autumn 1976 - Summer 1977	9352
	Autumn 1979 - Summer 1980	13342
	Autumn 1983 - Summer 1984	18476
Aliabad:	Population 15000	
	Autumn 1978 - Summer 1979	23448
	Autumn 1980 - Summer 1981	25688
	Autumn 1983 - Summer 1984	22364

The figures for hospital use are the total number of medical conditions entered into the dispensers and doctors records in one year. It is recognised that a single patient may be entered in several categories and so the figures do not indicate patient numbers. We were not able to obtain records for the same years in Karimabad and Aliabad but the trends are clear and the differences in the two communities in places are striking. There are several possible explanations for the doubling of numbers of patients at Karimabad's hospital whilst use of the Aliabad hospital has remained constant.

1) The population served by the Karimabad hospital has grown whilst Aliabad has remained constant. This is not borne out in discussions with village elders and the doctors. Whilst no census has been taken it is clear that the only significant change in population has been a slight fall in the population of Hunza as a whole with people moving to wealthier areas such as Gilgit and the lowlands where opportunity is greater.

2) The health of the people of Karimabad has deteriorated in the last decade. Again our discussions with people other than the doctor, who has only been there one year, suggest this not to be so. Rather, they stress the important progress that has been made, notably the immnunization programme of the Aga Khan Foundation.

3) The health services have improved greatly in the last decade in Karimabad whilst Aliabad already had a more developed set up by the early 1970s. This is not so, the two communities gaining improvements in their services concomitantly.

4) Aliabad, being a less traditional community, accepted medical assistance more readily than did Karimabad, a more insular and independant village, and rather more recently than the people of Aliabad, those of Karimabad have only now become health conscious as a result of developments in general education and thus in health education indirectly. This can be seen either as a positive or a negative development, as a rational awareness of the benefits of using the health services or as a move towards increased hypochondriasis. It would appear that both attitudes are coexisting. It could be suggested that as the valley is developing rapidly, the doctors are taking on an increasingly important social and welfare role in style similar to that seen in western communities. Quantifying stress and assessing whether it is on the increase is difficult but the subjective impression of doctors and dispensers in the area is that it is a growing problem.

Dr. Ejaz Tahseen, director of the Rural Health Scheme in the 1970s, has said that gaining acceptance proved no problem anywhere when starting to work in areas with no previous medical set up. Even the religious and social objections to male practitioners examining and treating women proved easy to overcome. Perhaps in spite of this, differences in the time scale of medical awareness and acceptance would appear to most likely explain large differences in hospital usage.

5) Other possible explanations are incomplete early records for Karimabad, although the rise in hospital usage is a steady one, and a different level of confidence in the personnel operating in the two health centres.

Disease Profiles

The records for both communities are presented on accompanying charts, each disease or sympton being presented as a percentage of the total hospital use for that year. It is accepted that there is considerable overlap between categories and a patient on a single visit may be recorded several times. The records may be most effectively discussed by considering each category individually although the overall impression is that there are no clearly identifiable trends over the last decade and the profiles for Aliabad and Karimabad are

very similar.

(a) Asthma

Asthma appears to be falling in both Karimabad and Aliabad as a result of earlier diagnosis now that the hospitals are well established and the families affected have been identified. Bronchodilators are used. The seasonal variation of an autumn/winter peak incidence is seen in both Karimabad and Aliabad.

(b) Bronchitis

This is the single most prevalent disease in both communities. The reason is threefold. Firstly, and most important, the homes are poorly ventilated and fires must be kept burning for the long and bitterly cold winter. Secondly, the summer is exceedingly hot and dry, all tracks through the villages becoming covered in a fine dust, the problem being compounded by summer mountain breezes. Thirdly, smoking is widespread amongst men, a habit gained usually whilst in the army.

There is hope that matters in the near future will improve for two reasons. Firstly in the last 4 - 5 years under the guidance and financial assistance of the Aga Khan Foundation, iron stoves have been introduced widely and these are not only more efficient but afford greatly improved ventilation. Secondly, smoking is now less common amongst the older population as a result of the Aga Khan's request of years ago that they should cease smoking. The majority, even the heaviest long term smokers, obeyed. Sadly, it is the young, striving for westernisation under a barrage of advertising which has now reached the Northern Areas, who have taken up the habit. Metal paving of the village tracks is a long way off, having little strategic importance in the eyes of the army engineers who build the roads in the mountains and so one bronchitic irritant at least will remain for some time to come.

The seasonal trend in both Aliabad and Karimabad is, as one would expect, for an increased incidence in winter and spring, especially the latter (March/April/May) which is at the end of the winter which is effectively of six months duration.

(3) Pneumonia

The scale on the charts is too small to indicate the fall that has occurred in the incidence of pneumonia in the last decade. Several possible explanations may be applicable. Firstly, vaccination of children has become widespread and so this common complication of infection is eliminated. Secondly, there may well have been mis-diagnosis in the days of the dispenser run hospital. Thirdly, effective use of antibiotics has reduced the risk of illness becoming complicated by pneumonia. There is little resistance at present despite widespread availability of antibiotics. The reason is partly financial and partly one of health education, the doctor's advice being sought rather than starting with self-medication. Standard doses may be given 12-hourly rather than 6-hourly and patients still respond.

No seasonal pattern is evident.

(4) Gastro-intestinal problems

Diarrhoea, dysentry, dyspepsia and helminthic infections can be seen to be huge problems in both villages. This is to be expected in communities that have no plumbing and sanitation, the water supply being provided by irrigation channels running from the melt water of the Ultar glacier. Whilst this system has been designed to supply fresh water to all parts of the villages with some channels avoiding the dwellings higher on the hillside and running untouched to those nearer the valley floor, there is inevitably contamination en route.

The problem does not appear to be more in Aliabad than Karimabad, despite Aliabad being in the valley floor and Karimabad high up the hillside. This is probably a combination of two opposite effects. On the one hand, the system of fresh water channels to the lower settlements is obviously reasonably effective and conversely the figures for Karimabad include Altit (which has the same doctor) which is in the valley floor and they are inevitably raised.

In both communities diarrhoea accounts for about 6 -8% of consultations and this figure has not changed in the last decade. A clear and expected seasonal trend is found, the problem being considerably worse in summer and autumn. Dysentry constitutes about $1\frac{1}{2}$% of cases and would appear to have fallen slowly but steadily in the past

decade. Again summer and autumn are the key seasons, especially the latter in Aliabad. Although the channels provide running water, there is inevitable stagnation and the risk of water borne diseases will rise at the end of the long hot summer. The dysentry is usually amoebic, especially in summer.

Taking the last decade as a whole, helminthic infections have been a more severe problem in Karimabad than Aliabad, the reasons for which are unclear. Most of these infections are of round worm, tapeworm being a rare occurrence because no pork is eaten (in the case of Taenia solium) and few cattle are in the area for Taemia saginata. Fish are not eaten so Dibothriocephalus Latus is unseen despite being a common problem in other parts of central Asia.

Helminthic infections are a problem throughout the year, the small peak there is being earlier in the year than for dysentry. Round worm infection (Ascaris Lumbricoides) involves the ingestion of ova which usually mature outside the body in soil rather than water so the late summer peak is less obvious. Hookworm, Threadworm, Trichinella and Filariasis are either rare or not seen.

Dyspepsia is a massive problem with a 15-16% incidence being recorded in 1983-1984. Whilst the figure has fluctuated little from 11-15% during the last decade in Aliabad it has doubled from 8-16% during the same period in Karimabad. Several reasons for this may be cited. Possibly diet has changed more greatly in Karimabad than Aliabad, but this seems unlikely in discussions about diet in the two villages. Both doctors blamed the irregularity of the diet, large seasonal variations and the habit, especially of women, of eating bitter goods and in particular the habit of chewing raw chilli. Dyspepsia is closely associated with stress and this may have a key effect on the changing figures. Alaibad changed its lifestyle before Karimabad and appears subjectively to have travelled further down the road towards acculturation. This perhaps explains why the dyspepsia figures settled earlier at the higher levels. Karimabad is a more traditional type of village that is only now undergoing the dramatic change associated with the building of the KKH. Dyspepsia may thus be reflecting the trend found in the BP survey, that change is beginning to occur in Karimabad but has already significantly occurred in Aliabad which, being actually astride the road, has been more directly and rapidly affected. Dyspepsia, in addition to being an indication of stress, can be associated with hypochondraisis; the rapid rise in the Karimabad figures may reflect increasing concern over health and simply an increased rate of presentation at the hospital.

(5) Skin diseases

Eczema and scabes were common and trichiasis and impetigo were also noted. Boils were highly prevalent. In both communities incidence hovers around 10-11% and has been constant over the decade. No seasonal trend is clear except a slight autumn peak associated no doubt with an intensely hot dry and dusty summer.

(6) Anaemia

The doctors attribute 60% of anaemia found to worm infection especially Ascaris (an inevitable overlap with the Helminthic classification is noted) and 40% dietry. Their treatment is to give anti-helminthic drugs, ferrosulphate, and multivitamins. If severe, iron is given intra-venously. The dispenser classification of the 1970s had four categories, nutritional, childhood pregnancy and blood loss. No seasonal or yearly trend is seen but hopes are high that this sympton will be seen more rarely as wealth rises and sanitation improves.

(7) Tuberculosis

This is still a common problem throughout the Indian sub-continent and the Northern Areas of Pakistan are no exception. BCG vaccinations are now administered by the Aga Khan Foundation but whether or not they will be effective as in the west remains to be seen because some BCG vaccination programmes in India have met with no success at all. Such discrepancies in BCG effectiveness between east and west have deepened the confusion over the mechanism of BCG-induced immunity to TB.

(8) Non-Toxic Goitre

This has been a major success story for the Aga Khan Health Foundation. Figures in 1976 showed Goitre to be a significant

problem (258 cases in Karimabad alone) and incidence has fallen dramatically to a point in 1983 where no cases presented at the hospitals in either Karimabad or Aliabad. This is due to the supply of salt with added iodine that has been introduced by the Foundation.

(9) Others

This category constitutes as much as 20% of the total incidence of disease/ symptomology in Karimabad and between 10-14% in Aliabad. The conditions seen are written in increasing incidence on accompanying charts.

Conditions with 10 cases or less were not included in the disease charts but those noted were the childhood diseases chicken pox, measles, mumps and whooping cough. The incidence is very low as a result of a full vaccination programme introduced in the late 1970s by the Aga Khan Health Foundation. However, records of 1976 show a low incidence so it is difficult to assess whether these diseases were always rare as a result of isolation and the small size of susceptible population or whether 1976 was simply not an epidemic year. Other conditions recorded were tetanus (vaccination given), typhoid, malaria (not endemic because of the high altitude; the disease is contracted in Gilgit and the lowlands of Pakistan) leishmaniasis, hepatitis, congestive cardiac failure, "growths" and hypertension. The latter two are especially interesting. Cancer would appear to have a very low incidence but that is probably the result of a combination of few facilities for investigation resulting in a poor diagnostic rate and death from other common conditions disguising the underlying killer. Facilities are gradually improving in Gilgit and incidence will no doubt rise with the increasing diagnostic capacity.

The absence of hypertension from the list indicates just how recent this condition has become a problem. One BP study revealed a significantly higher BP in Aliabad (121/87) than in Kariamabad (114/82) at $p<0.001$, and anecdotal evidence from medics in the area supports this finding. In Karimabad, Dr. Johar Ali quotes a figure of approximately 6 hypertensides in the year since his arrival whilst Dr. Aga Jan estimates that he sees several new patients a week in Aliabad. Such differences can no doubt be partly explained by different emphases on screening and criteria for hypertension but, these accepted, the indications are of a significant discrepancy between the two communities. Possible explanations are discussed in length in the BP project and these highlight the ongoing process of acculturation associated with the building of the KKH.

Clearly noted during our stay in Hunza was the high incidence of mental handicap (although very few cases of Down's syndrome). Such problems are the inevitable consequence of marriages within small communities. The situation is now improving as communications improve so reducing the isolation that leads to inbreeding. The Islamic fundamentalism that is currently increasing in favour is a counterproductive development in this respect but the majority of young people we met approved of a western style of partner selection.

Conclusions

A study of medical records can only be as good as the records themselves. In the early years of our study these were compiled by dispensers who, for all their experience and competance, could not be expected with no formal training, to have a high diagnostic capacity. In alleviating symptons however they were very effective and their important role in health care is laudable. One would expect records to improve greatly once doctors arrived but they are much the same for reasons already discussed. With these reservations, it is clearly apparent that not only are there no major differences between Aliabad and Karimabad but also that the pattern of disease has not changed greatly in conjunction with the social change that has accompanied the KKH. Falls have occurred in the incidence of non-toxic goitre and infectious diseases but the highly common gastro-intestinal maladies are just as prevalent, with dyspepsia on the rise due probably to a combination of dietary and stress factors. The gut conditions and bronchitis constitute between 40 and 50% of the hospitals' workload and show no signs of

falling. However, the increased wealth that the KKH is already bringing to the region will gradually have its effect on these problems by improving the water supply, sanitation and the heating and ventilation in houses. Whilst there is a tendency for health programmes in developing countries to concentrate resources on clinic and hospital facilities, it is clear that the health of the community would be most beneficially served by improvement in basic amenities and this is openly recognised by the doctors in the area. Progress in world health has been characterized by two medical breakthroughs, antibiotics and vaccinations, and by an increased standard of living in terms of a clean water supply, effective sanitation and better nutrition. These medical breakthroughs have already come to Hunza; it is the latter that is now needed, with the possible exception of diet which is arguably more likely to suffer from a generalised rise in the standard of living.

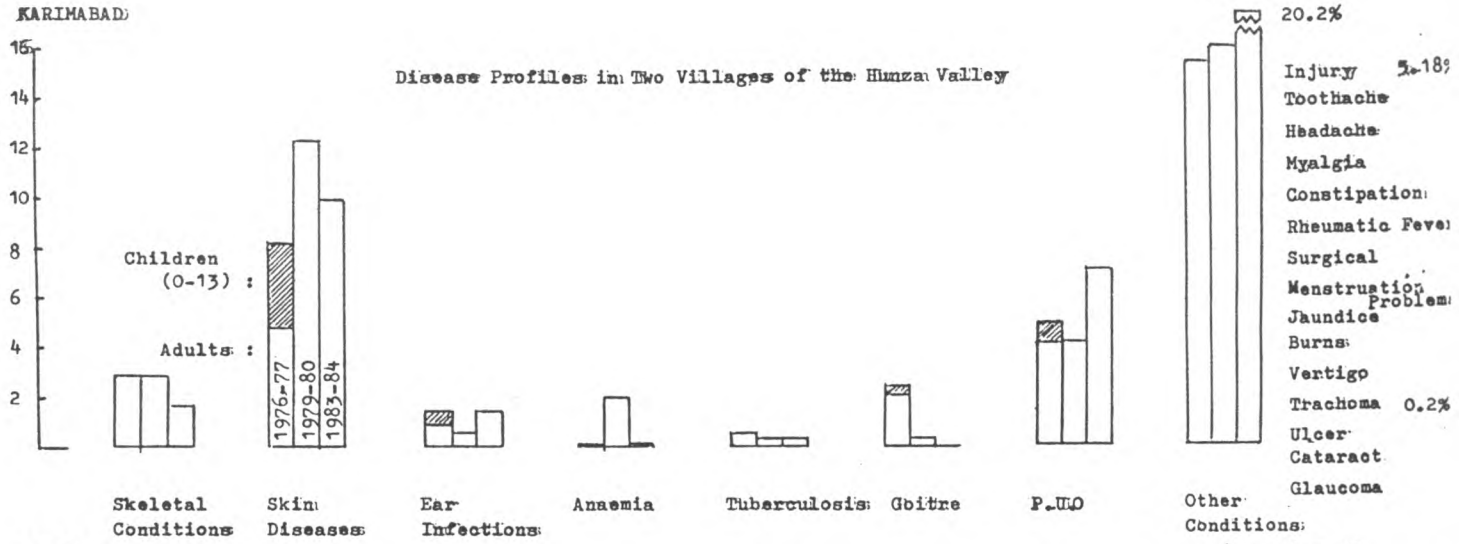
Relative incidence by season of disease presenting in the hospitals of Karimabad and Aliabad in 1983-1984

	KARIMABAD				ALIABAD			
	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer
Anaemia	+++	+	++	+	++	++	++	+
Asthma	+++	++	+	+	++	+++	++	+
Bronchitis	+	++	+++	+	+	++	+++	++
C.C.f	++	++	++	+	+	++	+	++
Conjunctivitis	++	++	++	+	++	++	+	++
Coryza	+++	+++	++	+	+	++	+++	+
Diarrhoea	+++	+	+	+++	++	+	+	+++
Dysentry	++	+	+	++	+++	+	++	++
Dyspepsia	+	+	++	+	++	+	+++	+++
Ear infections	+	++	++	+	+++	++	++	+
Helminthic infections	+	+	+++	++	+++	+	++	+++
Pneumonia	++	+	++	+	++	++	+++	+
P.U.O	++	+	++	+	++	+	+++	++
Rheumatic Fever	+	+	+	+++	+	+	++	++
Skeletal conditions	+	+	++	++	+	+	++	+
Skin conditions	++	++	+	+	++	+	+	++
Surgical procedures	+	+	+	++	+	+	+	++
Throat infections	+	+	+	+	++	+	+	+
Tuberculosis	+	+	+	+	+	+	+	+
Urino-genital conditions	+	+	++	+	+	+	++	+
Other diseases	++	++	++	+	+	+	++	+

Notes: (1) Autumn = Sept., Oct., Nov.; Winter = Dec., Jan., Feb.;
Spring = March, April, May; Summer = June, July, August.
(2) P.U.O. = Pyrexia of unknown origin; C.C.F. = Congestive cardiac failure
(3) Number of crosses indicates relative incidence by season within a community. Thus one cross in Karimabad does not indicate numerical equality with one cross in Aliabad.

KARIMABAD

Disease Profiles in Two Villages of the Hunza Valley



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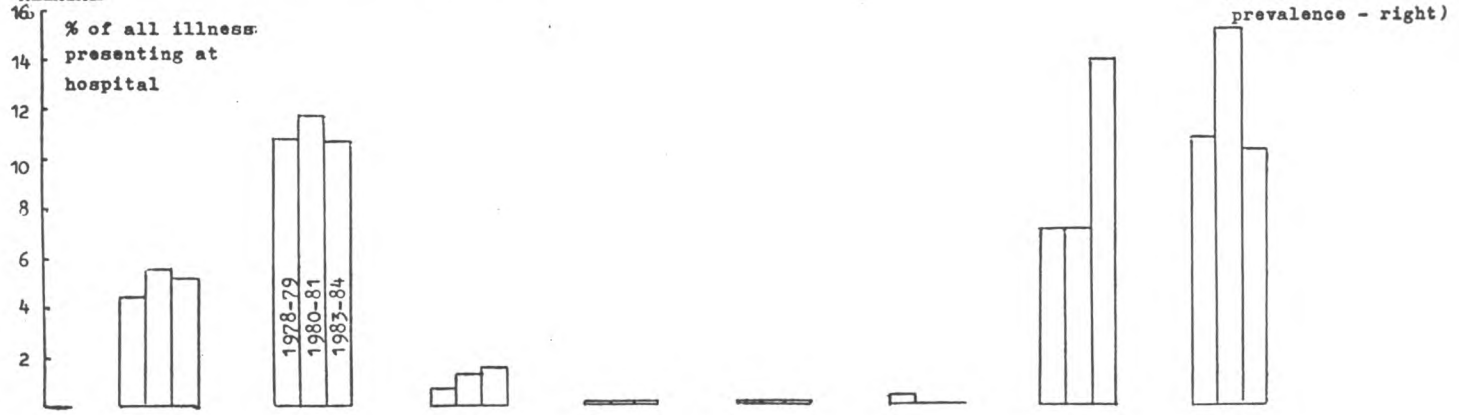
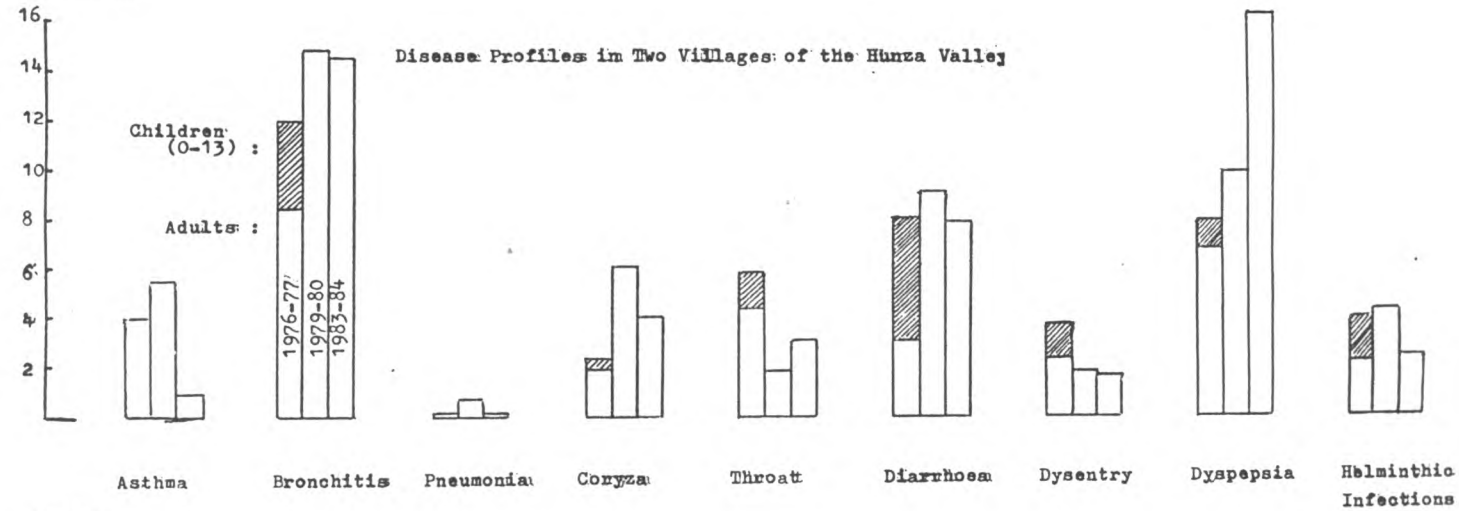


KARIMABAD

Disease Profiles in Two Villages of the Hunza Valley



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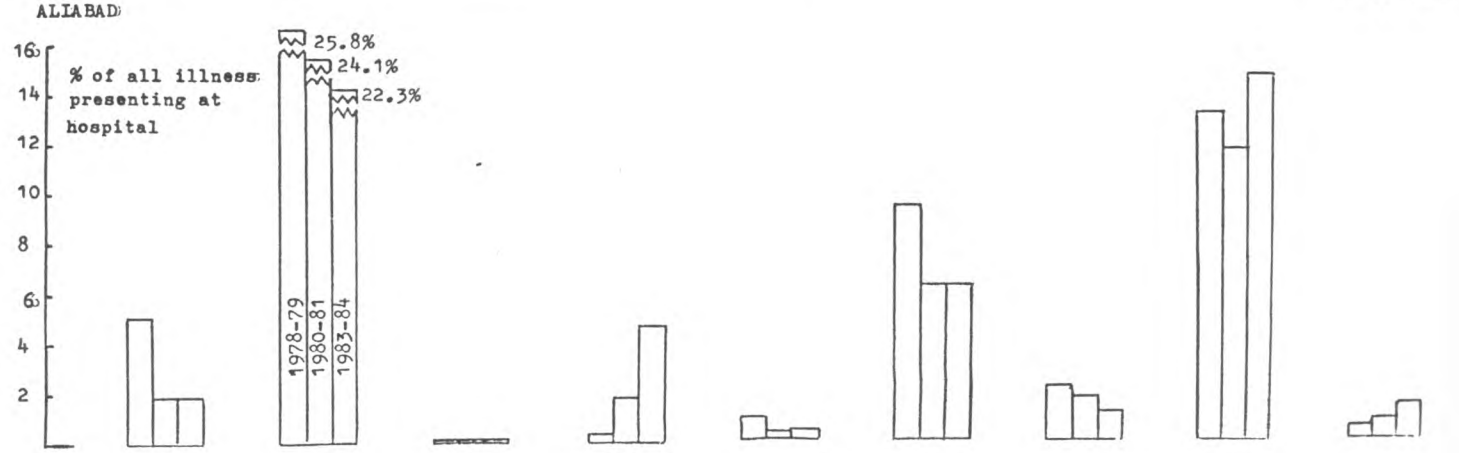

HYPERTENSION; - a Review of the Literature

Introduction

Essential hypertension is effectively the abnormal raising of blood pressure for which there is no obvious physiological cause. (In this, it is distinguished from primary hypertension, much less common, (5% of hypertensives) and usually with an obvious pathogenesis). It remains one of the most important risk factors which contribute to the range of cardiovascular disease and cerebrovascular disease currently accounting for the majority of deaths in middle-aged people (particularly men) in the industrialized west. It is estimated that 63% of all cases of coronary artery disease before the age of 65 in American males are attributable to elevated serum cholesterol, high blood pressure and cigarette smoking. Yet considerable differences between death rates can be observed between countries indicating the possible benefits of eradicating causative factors in the disease process. In the case of hypertension, however, despite many years of considerable research, no such culprit has been singled out although the possible risk factors have been established. Thus smoking, obesity, genetic, stress and dietary factors must explain the great variation in the prevalence of hypertension between and within populations and countries.

Genetic factors

It is now fully accepted that inheritance plays a major role as a determinant of high or low blood pressure in an individual. As early as 1934 Ayman[2] showed the prevalence of hypertension (140/90 mmHg or greater) in offspring aged 14-39 was 1:2 if both parents were hypertensive and less than 1:20 if neither parent was hypertensive. The hereditary factor is now recognised to involve a polygenic system [12,38] which in the population of South Wales has been estimated to account for 33% of the variability of blood pressure.[37] In the general population some 10-20% are hypertensive and this along with other evidence has led to the suggestion that only a genetically susceptible fraction of the population will develop clinical hypertension in response to the causative factor(s). This idea contrasts the earlier concept of an effect throughout the population proportional to the cause and has very important consequences in the interpretation of population studies, the hypothesis is often based on the latter assumption, as will be seen.

The exact nature of the genetic factors involved in the actiology of hypertension remain obscure, however. The role of the kidney has been strongly implicated in the concepts of Guyton[20] and with it the importance of electrolyte balance. Dahl enforced these ideas in his breeding of salt sensitive and salt resistant rats, a sensitivity that could be transferred by renal cross transplantation,[3,9,10] The animals also display abnormalities of sodium transmembrane exchange and some of these changes precede the development of hypertension and are also found in spontaneously hypertensive strains.

In Man, studies of normotensive children of hypertensive parents have revealed an enhanced rate of urinary sodium excretion[61] (as seen in the animal experiments) and in studies both on loncocyte and erythrocyte membranes of such children a reduced sodium efflux due to the reduced activity of the ouabain-sensitive sodium pump[22]. Other avenues in which genetic influence may predispose to hypertension include modification of kidney activity by raised plasma noradrenaline levels or increased sympathetic stimulation or via abnormality in renin release.

Genetic susceptibility to hypertension between races generally differs less than the differences within them. However there is one major exception, that of the high levels of hypertension in Negroes compared to their White or even Asian compatriots (as found in the Carribean, Kean 1941[28] Saunders and Bancroft 1942,[51] Johnson and Remington 1961.[24]) Similarly, American blacks have been shown to have consistently higher pressures than whites[85], Comstock 1957, Boyle 1970) and a report by Grim et al 1970[19] indicates this remains the case even when

Black salt intake is lower than White.

The idea that the black population may be genetically vulnerable to the preposed effects of salt, fits well with the hypothesis of early man as a salt conserver (Gleibermann) which will be discussed forthwith.

Dietary factors

Of these it is only electrolyte intake which is thought to be of major consequence in hypertension. On a low protein intake, primates show a reduction in blood pressure but under normal circumstances protein intake is believed to have a negligible effect. Similarly no direct influence of dietary fat on BP in man has been demonstrated though animal studies have shown an increased BP on feeding high fat levels, especially when the fat is animal in origin. The Framingham study failed to show any association between BP and caffeine intake.

Salt

Currently the most attractive candidate as the hypertensive evil is sodium. A wide body of evidence has accumulated in this field yet still much ambiguity exists, not least because of the probable complexity of the hypertensive disease process which it seems likely has several phases of differing pathogenesis. Still much favour rests with the salt hypothesis not least because of its dovetailing with the integrated concepts of Guyton, linking ABP with renal handling capacity. Furthermore it is evident that in the west our salt intake vastly exceeds our need (typically 150-200 mml cf. 10 mml) and indeed is unavailable in many primitive societies. In these societies the situation is very like that of early man in that salt conservation is favoured. It is only within the last 7-10,000 years since the dawn of agriculture that salt has been readily available, too short a time for any adaptation away from salt conservation and as such we may now be facing a salt overload, enhanced by an appetite for the mineral which exceeds its real need.

The bulk of the evidence for and against the salt hypothesis has come from 3 main study types - Interpopulation, Intrapopulation and Salt Restriction/Loading.

a) Interpopulation studies

There is now a great wealth of reports referring to blood pressure profiles of populations from many parts of the world.[62] Many of these studies aim to compare populations, and from this cross cultural data aim to isolate the probable factors that explain the differences. Typical of this type of study is that by Lowenstein[33] who reported two neighbouring Amazonian tribes, the Mundurucús and the Carajas, the former as a result of contact with the outside world, having changed in dress, diet and smoking habits whilst the Carajas retained their indigenous way of life. As a result of the changes the Mundurucús demonstrate a rise of BP with age whilst for the Carajas the highest BP values are actually in the young age groups. A similar but more complex picture of a changing society is seen from a study in the Solomon Islands.[42]

In a second type of study a population is followed from one environment to another and the changes noted. Perhaps the best example is that of the Samburu warriors of Kenya who when drafted into the army from their traditional rural setting show significantly higher systolic blood pressures.[52, 53] It is interesting that their salt intake increases dramatically (3.5 g/d to 16 g/d whilst in the army.

From all these epidemiological studies the most glaring point to emerge is that the process of "acculturation", usually to Western modes of life, brings about a change in the blood pressure profile of the population (see Figure 1) shown by a tendency for blood pressure to increase with age as it does in the west. Certainly not all non western societies show this absence of BP rise with age, but the ones that do (e.g. Bushmen of Kalahari,[25] King Bushmen of New Guinea,[58] Yanomamo Indians of the Amazon,[33,41] and Polynesians [48]) are generally characterized by the following[5]:-

(a) presence of chronic infection
(b) low fat and calorie, high fibre intake
(c) low levels of stress
(d) high potassium intake
(e) low sodium intake

They are often nomadic or hunter groups

rather than agriculturalists. One of the principal lines of evidence for the salt/hypertension hypothesis has been the fact that all observers note that groups with low blood pressures throughout life have a low salt intake in which it is not available for cooking or adding to food. Williams [62] cites only two exceptions to this[36, 60] and these studies have been criticised.

Gleibermann[16] usefully correlated mean systolic and diastolic blood pressures in adults aged 50-59 with daily salt intake from studies of 27 populations (see Figure 2). Of these, 11 were taken from 24 hr-urine collections, 10 by assessment by the original workers and 6 from estimations by Gleibermann herself. Salt intakes ranged from 1-22g and mean systolic BP from 101 mmHg to 163 mmHg. Systolic and diastolic BP in both sexes showed a significant ($p<0.05$) positive linear relationship with mean daily salt intakes. From this Gleibermann estimates a 0.1 mmHg increase in BP for each 1 mmol increase in sodium intake.

Despite, and perhaps because of, the striking nature of these results there has been considerable criticism of study methods, mostly justified.[56] BP measurement is frought with difficulties, primarily obtaining a basal BP measurement particularly difficult in the field where the subjects are far from used to western doctors and sphygmomanometers. There is also observer bias and the sheer complexity of changing cultural patterns which make it effectively impossibe to isolate any one cause from such a multifactorial problem.

Added to this are the difficulties of dietary sodium estimation. Dietary analysis on the basis of questionnaires on salt usage have proved notoriously unreliable and spot urine samples fail to give consistent correlation with values obtained from 24 hr urine samples. The latter are undoubtedly the most reliable but compliance with instructions is often low and they are hence difficult to collect correctly. Also there is usually considerable day to day variation indicating the need for several samples per individual and even this result may mark seasonal differences in sodium intake. Finally there is difficulty in obtaining accurate age estimations in many of these areas where no written record is kept.

Intrapopulation studies

Much of the resistance to the idea of sodium as a causative factor in hypertension stems from the inability of studies to show a relationship between salt intake and blood pressure within a population. However it is possible that this may be due to study design. Many of the investigations have relied on the assumption that hypertensive patients will have a higher sodium intake than normotensive patients. This of course is contrary to the idea outlined earlier that hypertension may only develop in a susceptible fraction of the population and as such may not differ in salt intake from normotensives. Furthermore for sodium/blood pressure regression studies within a population, huge numbers of subjects are often required for statistical significance which often present major practical difficulties. Of 7 such studies reviewed by Walter Foy[59] only two registered any significant regression slope. Similarly of ten studies comparing hypertensive and normotensive groups only two showed a higher hypertensive sodium excretion.

The data, as yet, however, is not sufficient to exclude a salt/blood pressure relationship within the general population. Several possible reasons have been given as to why no such relationship has been demonstrated.

a) Too much "noise" in the data.

b) Too small a range of salt intake within a population.

c) Salt intake in the West is of such excess that we are in effect at the right hand end of a dose response curve with even a moderate reduction in salt still exerting the maximum blood pressure response.
This explanation, however, contradicts evidence on the benefits of moderate salt restriction.

d) Hypertension becomes manifest in early life, so salt intake later in life will not affect the BP.
Again this theory predicts that alteration of salt intake in later life

would have no effect.

e) The pattern of salt intake and appetite may change with the severity of the hypertension.

As has been indicated, however, there is increasing belief in the idea of a salt susceptible population, an idea enhanced by recent discoveries of the sodium handling of hypertensive patients' cells and it may well be that the salt BP correlation may be best shown within this subset of the population.

Salt loading and salt restriction

Evidence in this field has indicated a case for salt restriction in the treatment of hypertension and indeed this has been advocated for several decades. However, there is still much dispute over the extent of sodium deprivation necessary to lower blood pressure.

It seems likely that any alteration in sodium intake does have a greater effect on the blood pressures of hypertensives than on normotensive subjects. These results have been obtained mainly from short term studies. Thus Kawasaki et al (1978)[27] divided a group of 18 hypertensives into 'salt sensitive' and 'non salt sensitive' on the basis of their BP response to a change in diet from low sodium (9mmol/day) to high sodium (249 mmol/day), salt sensitive subjects responding to the low sodium diet with a fall in blood pressure. In another study, normotensive subjects, however, changing sodium intake from 350 mmol/day after five days to 10 mmol/day for five days produced little reduction in blood pressure[43] and only extreme sodium loading (up to 1500 mmol/day) produced any significant rise in blood pressure.[34]

Whereas drastic dietary sodium reduction is almost certainly of benefit to the hypertensive patient (and is indeed the basis of the Kempner Rice-Fruit diet which succeeds in reducing blood pressures even in cases of malignant hypertension[29]), the case for moderate reduction of sodium intake is less well proven. In the study by Kawasaki et al quoted above, sodium reduction from 249 mmol/day to 109 mmol/day produced no significant change in blood pressure. Few other studies of moderate sodium restriction over longer periods have been reported, [35,39,47,54] and these are subject to criticism (Simpson 1979).[56] Recent clinical trials have shown, [26] however, the effectiveness of such a programme which Amery et al[1] quantify as a 10 mmHg reduction in systolic and diastolic blood pressure for each 100 mmol/day reduction in sodium intake.

In summary, it seems certain that very high levels of salt in the diet (i.e. around 250 mmol/day and greater) are involved in the pathogenesis of hypertension, at least in susceptible individuals. Though the evidence is weighty, it is not yet unequivocal that the current western average sodium intake of 170-200 mmol/day is hypertensogenic. There is little available evidence to affirm that moderate salt restriction lowers blood pressure though it is hoped that this is so, considering the impractibility of drastic reduction of dietary sodium.

Potassium Intake

There is growing interest in potassium as a negative correlate in the sodium/hypertension hypothesis, i.e. high dietary potassium has either a reductive effect on blood pressure or protects against a blood pressure rise. Such a role is expressed in attempts to correlate blood pressure with Na/K ratio.

Though few specific studies have yet been reported there is a certain amount of circumstantial evidence to support this idea. Thus the non-hypertensive societies cited earlier all have a relatively high potassium intake. The use of potassium salts in cooking frequently occurs and the large intake of unprocessed vegetable and fruit matter ensures high levels of potassium and low levels of sodium in the diet. The converse is true in western societies. This high potassium intake has been suggested as an explanation for the lower blood pressure and lower stroke mortality of the Akitu area of northeastern Japan, despite very high sodium intakes (more than 400 mmol/day). The Akitu people maintain their high potassium intake by the consumption of large quantities of apples.[50] A similar explanation is also forwarded for the low prevalence of hypertension in vegetarians (2% as opposed to 20-25% in the general population).

Although urinary potassium excretion has been correlated with blood pressure[17] opinion is not undivided on this. However several large studies have shown a significant correlation between Na/K ratio and blood pressure.[55, 63] In the case of studies involving alteration of potassium intake, conflicting results have been obtained. Potasium administration modifies salt hypertension in normal and salt sensitive rats but in man potassium supplementation in normotensive individuals with no family history of hypertension has lowered blood pressure,[31] showed no significant decrease[57] and even marginally increased blood pressure.[45, 46] However, in hypertensive patients and their normotensive offspring a high potassium diet (150 mmol/day and greater) does seem to have a consistent hypotensive effect.[49, 40, 23]

Taking blood pressure readings

Weight

Some sort of relationship between weight and blood pressure has long been known, though the exact association remains poorly understood. Lowe, (1964) found the effect of weight on BP to be negligible under 40, and above this age only a 3mmHg systolic and 2mmHg diastolic gain for each 10 Kg weight. However obesity in the young may well be predictive of hyertension in old age more so than the obesity in middle age. This was shown in a study by Hsu et al (1977) in a follow up study after 27 years of 3983 young aviators. The Framingham study showed normatensive fat people are more likely to become hypertensive and then hypertensives are more likely to become fat. Obviously an association exists, is probably causal, and seem to work both ways.

Stress

Despite the proven effects in raising blood pressure transiently, it still remains to be established that repetitive or continuous psychological stress leads to a sustained elevation of blood pressure.

Jonsson and Hansson (1977) found that prolonged exposure to industrial noise was associated with higher pressures in middle-aged men but this was not confirmed by 2 other studies (Apling et al 1977, Hedstrand et al 1977).

The Framingham study showed that heart rate has a high predictive value for later heart disease, it is assumed via a measure of the subjects alarm response at the time of examination. Compared to a value of 0.410 for HT itself, heart rate gives a regression value of 0.33 (smoking is 0.212).

In salt-sensitive rats, food shock conflict leads to moderate hypertension even in the absence of salt[9] whilst resistant strains show no rise in pressure. When salt is available, the food shock conflict produces far higher levels of hypertension, the implication being the synergistic effect of salt + stress on blood pressure.

An hypothesis on the Pathogenesis of Essential Hypertension

Previous ideas on the salt hypotehsis are currently undergoing radical reappraisal and adjustment on the full complexity of the hypertensive process is becoming evident.

Central to the concept of raised blood pressure has been the ideas of Guyton et al[20] who maintain that the essential feature of hypertension is the 're-setting' of the pressure natriuresis i.e. a higher pressure being needed to maintain a given sodium excretion. The implication is some form of kidney disorder. An excessive sodium intake (such as that seen in the West) increases exchangeable sodium in both normtensives and hypertensives but in the case of hypertensives it also increases blood pressure[6,14,17,45] to an extent greatly variable depending on the Na load. It appears that hypertensives have a lower 'tolerance' of Na load, increasing blood pressure to restore sodium balance. These findings are in agreement with Lever, Piccoli et al[32] who found a strong correlation with exchangeable Na and BP in older hypertensives but not in normotensives or in young hypertensives. The latter point is of importance and will be returned to.

In these older hypertensives, then, what is the mechanism behind the disease? Firstly salt has a major role at this phase of the disease since salt reduction seems to have the greatest effect in order patients.[43,44] Raised blood pressure over a period is likely to result in kidney damage which accentuates any blodo pressure problem. Further Na for the hypertensive may well produce greater effects on blood pressure due to celluar defects, particularly with regard to the Na/K pump.[7,13,15] This has important consequences in the vascular smooth muscle cell where the high internal sodium concentration causes vasoconstriction and hypertension, possibl via inhibiting sodium/calcium exchange so allowing a build up of internal calcium. This has been implied in the significant correlation[30] of BP with serum calcium. An

excess of Na transport inhibitor has also been cited in this process,[11,12] induced by a relative fluid volume excess. Following these changes a viscous circle occurs.

However, this scheme of events does not seem to be the case in the early stages of hypertension. The key point is the subnormal values of exchangeable sodium in young hypertensives[32] which does not accord with the idea of Na in hypertension, nor the ideas that essential hypertension passes through an early phase of volume expansion. Also in the initial prehypertensive phase the ABP/urinary Na excretion is set at a higher threshold, the reason for which is not yet known although there are some current theories to explain this which would be, in effect, the essential cause of the hypertensive process.

It is in younger patients that the greatest correlation (see figure 3) is seen between total body potassium and ABP. The possible value of K^+ in hypertension treatment has already been noted. K^+ may have two effective roles in protecting ag ainst hypertension. The first involves neurogenic systems and so neatly brings in the field of stress, long implicated in hypertension. in this case K has been shown to reduce Noradrenaline in the neuro-effector cleft by incrasing its uptake into the terminal.[4] Other experiments have shown K^+ to reduce hyperactive CNS pressor responses in Dahl salt-sensitive rats.[18] Secondly, dietary potassium may increase urinary Na excretion, as in the hypertensive patients a 250 mmol K diet has been reported to induce a marked natriuresis with large rises in plasma renin activity.[40] It may also act by inhibiting a circulating Na transport inhibitor.

Thus a possible mechanism for hypertensogenesis can be envisaged, perhaps 2 phase, with two main participants (see figure 4). Local dietary potassium allied with perhaps stress factors contributing to the first phase (A) before renal damage and Na/K pump malfunction leads to the more Na dependent second stage (B). Such a scheme would explain some of the difficulties encountered in the investigation of this disease.

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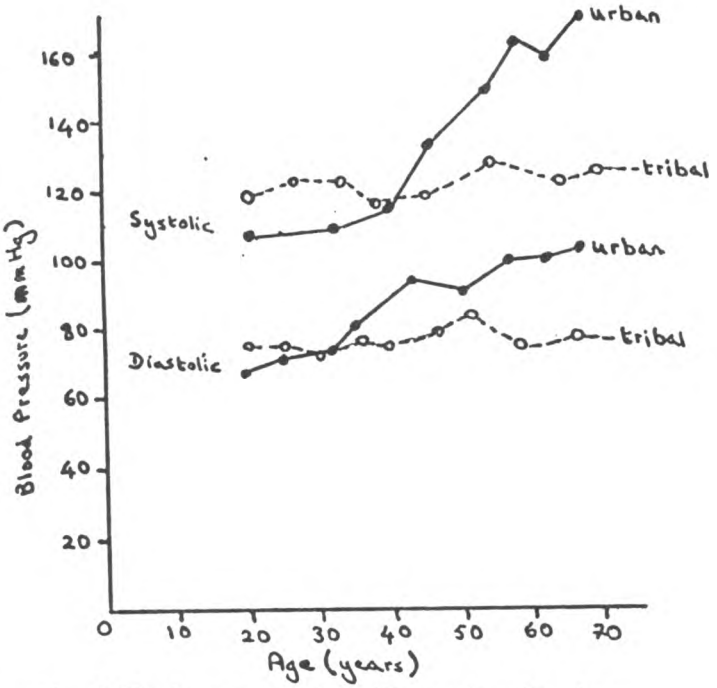

Fig. 1 Blood pressure rise with age in urban (acculturated) Xhosa people and tribal ("unacculturated") Xhosa people. (Ref P.S.Sever et al. Lancet 1980 July 12 (60).)

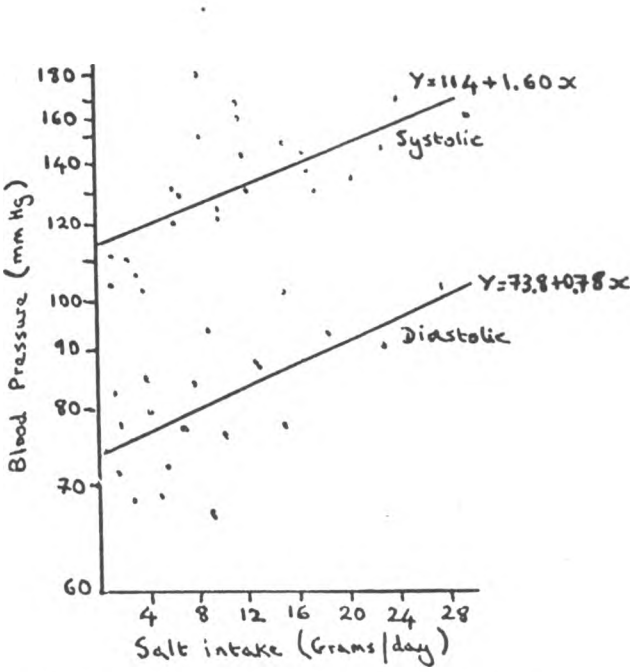

Fig. 2 Blood pressure rise with increasing salt intake in 27 populations drawn from literature (Ref. 16)

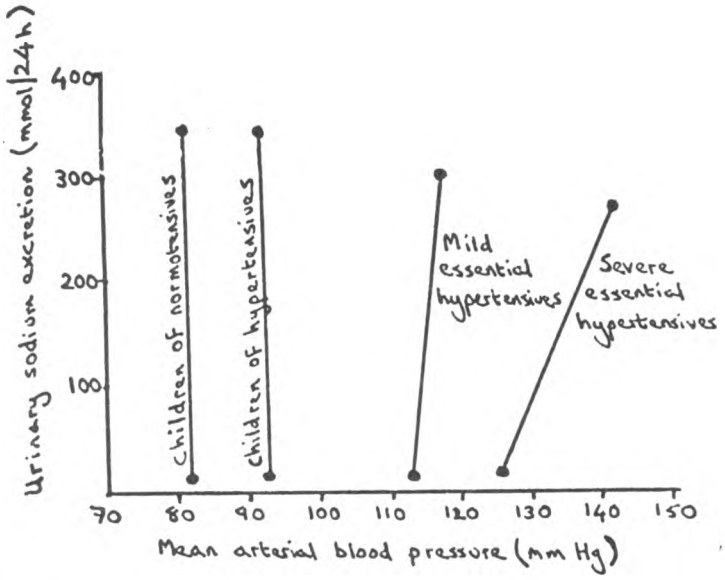

Fig. 3 Effect of a fall in dietary sodium intake (see text) on the relationship between urinary sodium excretion and mean arterial pressure (P.S.Parfrey from data in 43 and 44).

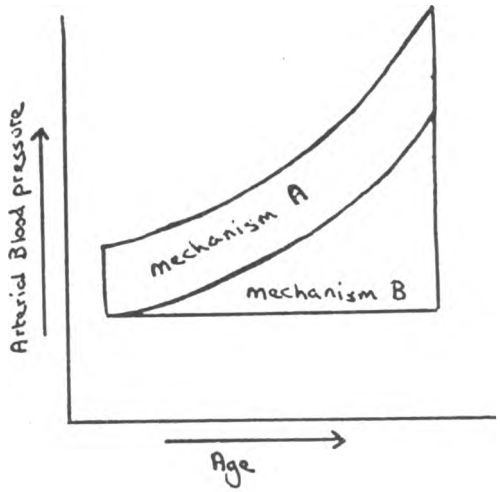

Fig. 4 Scematic representation of a possible two stage mechanism for raised blood pressure. A: early, slight effect
B: Later, large effect (see text).

Blood Pressure and Lifestyle in Two Villages of the Hunza Valley, North Pakistan

Summary

Two villages in the Hunza valley of Northern Pakistan, Aliabad and Baltit, were studied to test the hypothesis that the recent routing of the Karakoram Highway through the valley, may, via dietary and other changes, induce a process of 'acculturation' within Hunza leading to more western disease patterns, and in particular, increased blood pressure. Data on age, occupational history, smoking, anthropometry and blood pressure were collected for 193 individuals. In addition, 16 twenty four hour urine samples were collected for estimation of sodium and potassium excretion.

Systolic and diastolic blood pressures were significantly higher in Aliabad (located on the Karakoram highway), 121/87, than in Baltit, 114/82, ($p < 0.0001$), despite there being only 5 km and 100 m in altitude separating the two villages. This disparity could not be explained by village differences in age, height, Body Mass Index (kg/m^2)m, occupation and smoking levels. Although not quantitatively studied, our impression was that the dietary habits of the two villages were similar, the same crops being grown and food imported from the same sources. Total urine excretion of sodium and potassium was 167.9 m mol and 69.1 m mol respectively and the sodium/potassium ratio was 2.62, values of similar magnitude to those seen in western communities and t variance with the notion that such levels of salt intake lead to hypertension. Striking though qualitative differences in lifestyle and social structures of the two villages are the only apparent cause of blood pressure variation.

Introduction

There are many examples of societies where blood pressure does not follow the characteristic western pattern in which both systolic and diastolic blood pressure rise with age. [6,12,13,17,25] Hypertension is generally absent or infrequent in many rural societies and this compares with a 10-20% prevalance in western populations. Societies with low blood pressure are often primative 'hunter-gatherer' groups whose lack of acculturation is characterised by the presence of chronic infection, low stress levels, high fibre intake, low fat, protein and calorie intake and low sodium, high potassium intake. Currently the most popular theory of the aetiology of hypertension involves a dietary Na/K balance [5,15] and this is supported by interpopulation studies.[10,15,21] However cross cultural comparisons have been criticized in that the many differences between populations make the isolation of any one causative factor extremely difficult. Ideally, it would be best to follow a single population through this acculturation process but problems inevitably arise with the absence often of a control group unexposed to such change. Thus many studies compare populations which have moved to a western environment to their like who have remained in their original environments. Such studies are frought with interpretational problems with the immense number of non-quantitative variables to which the migrant population is exposed and which may play significant roles in the acculturation process. There is indication that the present situation in Hunza is an ideal one in which to study this acculturation process with respect to blood pressure. Change if occurring dramatically in the valley along the road whilst nearby communities of the same ethnic origin, same culture and with the same natural environment and dietery history have been considerably less affected. Such a set-up affords the opportunity for interpopulation studies of static communities which are essentially similar except for the recent imposition of a road and the westernization associated with it into the heart of one of the communities.

Much has been written but little substantiated about the health and alleged longevity of the Hunza people, though the cardiovascular fitness particularly of the elderly, has been noted.[14] Until recently, the Hunza diet was based on a high potassium fruit intake, particularly the apricot which was eaten raw as a juice, as a soup and as an extract for cooking. Peaches, apples and mulberries were, and still are also abundant.

Staples were in the form of buckwheat or wheat bread and tomatoes, marrows, beans, turnips, onions and, since the British, potatoes formed the vegetable supplement. Protein intake was low with little meat and other animal products due to lack of pasture land and, unlike the rest of the sub-continent, few lentils. Salt and sugar were also scarce. As recent as 1970, calorific intake per day per adult male was 1923 KCal with 50g protein, 36g fat and 354g carbohydrate, only $1^1/2\%$ of total intake constituting meat and dairy produce. The same dietary pattern persists fundamentally but white flour, refined sugar, rice and meat (the latter still low) are now more readily available with the advent of the Karakoram highway (KKH). Thus the small but progressive changes over the last 20-30 years have been enhanced since 1978, most strikingly in the huge increase in salt intake, primarily as salt tea, and refined sugar. Such changes and the anecdotal reports[9] of increasing hypertension draw our attention to the Hunza valley as an important area for study.

Subjects and methods

The study was carried out in July and August 1984 by two members of the Cambridge Karakoram Expedition whose other areas of study were glaciology and ornithology. The first village visited was Baltit in the Karimabad area, a small village at 2450 metres and 5 km by rough track from the KKH, the turning off point being Aliabad, our second village. The latter village at 2300 metres is actually bisected by the KKh and stretches along it for about 3 km, at no point migrating more than 200 metres from the road. Both villages are situated in the Hunza valley, 60 km north of Gilgit, capital of the Northern Areas.

Only male subjects were measured in deference to Islamic custom, 103 from the Baltit/Karimabad area and 90 from Aliabad. Subjects were randomly taken from village meeting and 'rest' areas where the men gather after the main work of the morning. We were assured that the entire male community visits such areas and a brief survey bore this out thus ensuring that our sample did not have any bias. The gathering was informed that nobody was to push themselves forward for measurement and anybody wishing to be measured who was omitted in our random selection was measured at the end of the session and not included amongst our data. Readings were taken at approximately the same time each day and all subjects were fully relaxed.

All blood pressure readings were taken by Paul Thomas and Robert Holmes. An observer comparison was made before starting and no statistically significant difference between us was detected. A standard mercury sphygmomanometer was used with a pulse sensitive microphone inserted in the cuff linked to a loud speaker so giving an auditory signal. The microphone proved to be very accurate at identifying the first systolic pulse, the reading then being taken from the mercury scale. The pulse sounds were also listened to over the brachial artery with a stethoscope and in practice there was little difference in the two values. At the time the blood pressure (BP) was taken the subject would be seated, relaxed, the cuff around the upper arm with its lower edge at the level of the heart. One reading would be taken to familiarise the subject with the procedure and discarded. After five minutes one of us would inflate the cuff and read and note the falling mercury scale whilst the other listened for the korotoff sounds, calling at systolic, diastolic IV and V phases. Positions were exchanged and another reading taken. This procedure was followed to minimise digit preference and observer bias in the regretable absence of random zero sphygmomanometers. After another five minutes the readings were repeated and an average taken of the lowest three.

Arm circumference, height and weight were measured, the latter using a calibrated pair of Krupps domestic scales. Standardised procedures were followed. A questionnaire was also completed using local interpreters assessing occupation, time spent away from the locality, smoking and age. All subjects were aware of their ages.

Sixteen 24-hour urine samples were collected using the inert marker 4-para-amino

benzoic acid[3] in the form of three tablets for the 24-hour period. It was hoped that this would give an indication of the completeness of the collection. The samples were collected in 2 litre plastic containers, preserved with Thymerosol and, after the volume had been measured, 25 ml aliquots were taken for sodium and potassium analysis in the U.K. by flame photometry, creatinine analysis by the Jaffe reaction and PABA measurement.

Statistical analysis was carried out by SAS on the University of London Amdahl computer.

Results

Of 207 subjects approached 193 agreed to participate in the survey, this constituting over 93% of the sample.

Table 1 shows the mean, standard deviation and error, maxima and minima for the pooled anthropometric and blood pressure data for the two villages. Table 2 compares this data in the two villages and shows that in Aliabad significantly greater mean values for weight ($p < 0.05$), arm circumference ($p < 0.05$) systolic blood pressure ($p < 0.001$) and diastolic blood pressures ($p < 0.001$) were measured. Figures 1 and 2 show the blood pressure and age profiles respectively in the two villages.

Simple analysis of the relationship of blood pressure with other variables revealed correlations which differed in the two villages. Pooling data (Table 3) showed a positive correlation between systolic BP and age ($p < 0.01$), weight ($p < 0.001$) and the Quetelet index or Body mass index (BMI = weight (kg)/height^2 (m^2)) ($p < 0.001$) whilst diastolic (4) phase correlated negatively with age ($p < 0.001$) and positively as did diastolic (5) phase, with weight ($p < 0.001$).

Table 4 shows how the picture differs in the two communities. In Baltit no correlation is obtained between systolic BP and age, arm circumference and BMI whilst in Aliabad positive correlation was found with all three. Figure 3 shows the relationship between systolic BP and BMI in both villages. In Baltit but not Aliabad, diastolic (4) BP correlates negatively ($p < 0.001$) with age. Figures 4 and 5 show the relationship between systolic BP and age and between diastolic (4) BP and age respectively in both Baltit and Aliabad.

Multiple regression analysis of the data was carried out revealing that the relationship between blood pressure and age is different in the two communities after anthropometric measurements had been taken into consideration. This was most significant for diastolic (4) BP which falls 0.14 mg Hg per year of age in Baltit ($p < 0.02$) and rises 0.03 mm Hg per year age in Aliabad ($p < 0.05$). Table 8 shows the mean blood pressure in each village by ten year age groups. After consideration of age, BMI correlates significantly with systolic BP ($p < 0.01$), diastolic IV BP ($p < 0.001$) and diastolic V BP ($p < 0.005$).

Analysis of covariance for both systolic and diastolic BP was undertaken, taking as covariates age and BMI. For both pressures there is a significant 'village' effect after the covariates had been taken into consideration.

Data on smoking habits revealed no significant differences between the villages by applying the chi-square test (Table 5) but significant differences were found in history of past residence ($p < 0.01$) and occupation ($p < 0.05$) as shown in Tables 6 and 7 respectively.

Table 9 displays the analysis of all sixteen 24-hour urine collections and reveals the poor compliance with instructions by reference to the percentage recovery in the urine of the inert marker PABA. A recovery of 88% or more indicates a full twenty-four hour collection. Only one collection satisfied these requirements. Our experience of the problems with 24-hour collections highlights the importance of using PABA to check for completeness. However the high excretion of creatinine measured over 24 hours in several collections and the similar value for 24-hour creatinine excretion obtained in the proven complete collection suggest that in some cases failure to detect 88% or more PABA in the urine may be the result of incomplete ingestion of the three PABA capsules. Table 10 thus shows the mean electrolyte values for collections with a measured 24-hour creatinine excretion greater

than 5.00 m mol. Differences in electrolyte measurements between Aliabad and Baltit were not found to be significant and the pooled data give a sodium excretion of 167.9 m mol and potassium excretion of 69.1 m mol in 24 hours, the Na^+/K^+ ratio being 2.62.

Discussion

The study was originally intended to compare blood pressure in the Hunza valley with a community of the same ethnic origin at a site of similar relief but far removed from the Karakoram Highway (KKH) and thus any supposed 'acculturation' effects. Aliabad was chosen as a second village in the valley to increase our Hunza valley sample size obtained in Baltit and the observed variation in BP between two villages only 5 km apart in the same valley was unexpected. Such a disparity between culturally similar villages has been found[17,23,24] though usually obvious dietary and lifestyle differences accompany BP differences.[16,22]

The highly significant differences in BP between Aliabad and Baltit cannot be explained by age and anthropometric data. The role played by the significant differences in occupation and past residence history could not be tested in the multiple regression model because categorisation was not a spectrum; rather groupings with no relationship, one to another.

Dietary factors have been implicated in the aetiology of hypertension and diet is thus an important consideration in identifying differences between the two villages. The indices of diet which were quantified were the twenty-four urinary excretion of sodium and potassium, a measure of the daily intake of these electrolytes. Significant differences between Baltit and Aliabad were not found. The diet of the Hunza valley had been already outlined and this qualitative assessment of diet was obtained by interview, observation and personal experience. The diet was standard throughout the middle Hunza valley.

Sodium intake as indicated by urinary excretion was high in the valley at 167.9 m mol/day which lies just below the range of average western sodium intake (170-200 mmol/day). If this value for sodium excretion is a true reflection of intake then there should be far more hypertension according to the salt-hypertension theory. Although BP values in Aliabad are significantly higher than in Baltit they still remain far below western averaes and both villages show an unacculturated BP-age relationship in that BP does not rise with age as is the norm in acculturated societies[23]. If the salt-hypertension theory is to be accepted then several possible explanations for the low BP may be offered. No data is available for salt intake or BP in the years preceding the KKH but dietary discussions and historical evidence suggest that salt is a recent addition to the Hunzakut diet. The recent adoption of a high salt intake may not yet have manifested itself as hypertension either simply because individuals have not had sufficient exposure to a high salt intake or genetic susceptibility to salt induced hypertension[7] has not yet developed in the community. Alternatively the potassium may have protective and even therapeutic effects against raised BP.[11] However though slightly higher than the west (60 mmol/24 hours), the potassium twenty four hour excretion of 69.1 mmol/24 hours seems low for a diet allegedly based on fruit and is far below the 150 mmol/24 hours high potassium diet seen to have consistent effects. The close similarity in electrolyte intake between Hunza and the west is underlined by a Na/K ratio of 2.62.

Both villages show an unacculturated BP-age relationship, the positive correlation ($p < 0.01$) between systolic BP and age in Aliabad being lost after multiple regression analysis. However this statistical procedure revealed differences in the diastolic IV BP-age relationship, BP falling with age in Baltit, characteristic of non-acculturated societies[22] and BP rising slightly with age in Aliabad. Such findings are consistent with the discovery of a higher BP in Aliabad (though still low by western standards) and it would appear that Aliabad is displaying the BP characteristics of a more acculturated community than Baltit, both in its mean BP and also in its BP-age pattern. Similar trends are seen in the positive correlation

of systolic BP with BMI ($p < 0.05$) in Aliabad which is not repeated in Baltit. Acculturated communities show a rise of BP with increasing obesity,[1,4] for which BMI is considered a good indicator[19] due to its correlation with body fat and its non correlation with height.

In view of the dietary constancy in the two villages and the inability of the covariates age and BMI in the analysis of covariance to explain BP differences, one is left with considerable difficulty in identifying other potential causative factors. Altitude has an effect on BP[2] (middle Hunza is at 2300 m) though a difference of 150 m between Aliabad and Baltit can be discounted. Other differences between the communities although not single factors are rather a collective impression of differing environments.

Baltit is the oldest village in the valley, traditionally the seat of the Mir (the title for the Hunza ruler) and still organized on a tribal basis. Of some five hundred houses, it is of a nuclear type and situated on the uppermost slopes of the valley side being first to receive the glacial melt water from a side valley which supplies water to and irrigates much of middle Hunza. An unsurfaced, single track road, negotiable by vehicles which supply the village and provide transport to Gilgit, connects the village with the KKH. Aliabad has developed much more recently and in 1978 became disected by the KKH, along which a small mercentile community has become established. Also of some five hundred houses, it is located near the valley bottom. A month in the valley left us with the subjective impression of marked differences in the pace of life, the peace of the hillside rural community of Baltit contrasting strongly with the noise and bustle of Aliabad, primarily it seemed as a result of the increasingly busy KKh being the central landmark in the village. Objective measurement of stress across linguistic and cultural barriers is difficult but the idea that stresses and strains of the western way of life cause hyerptension has been sited several times.[12,20] Interestingly animal experiments suggest that stress can act synergistically with sodium in the production of hypertension.[8] Somewhat in contradiction to this notion of stress as a hypertensive factor is that those Hunza men that have spent many years in the lowlands of Pakistan, often in the army, do not seem to have higher blood pressures than the mean of the village from which they originated. One may hypothesise that BP level is 'set' in youth before the men left the valley but if this is the case, of what consequence are the recent changes occurring in Hunza to its older population?

The differences in profiles of the two villages are substantiated by evidence from two doctors working in middle Hunza. One serving Baltit, although based in the very similar Karimabad, has, in one year of practice, seen twenty four hypertensive patients. The doctor at Aliabad sees two or three a week. A study of health records undertaken with this study revealed no major differences in the pattern of disease, hypertension accepted, but the finding that hospital usage in Karimabad has approximately tripled in eight years whilst in Aliabad it has remained constant at a higher level per head of population suggests that the difference in number of hypertensives is, in part, a reflection of screening differences.

This study has revealed differences in the blood pressure of two communities of the same ethnic origin, culture and only 5 km apart, not only the mean values but also the relationships between Bp and age and between BP and BMI which cannot be explained by dietary factors. Aliabad would seem to be undergoing a process of acculturation as a result of the recent building of the Karakoram Highway through its centre and the indication is that this process of change may have a future bearing on the health of the Hunza people.

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The study was completed in August 1984 by:

Paul Thomas Robert Holmes

as part of the 'Cambridge Karakoram Expedition 1984'

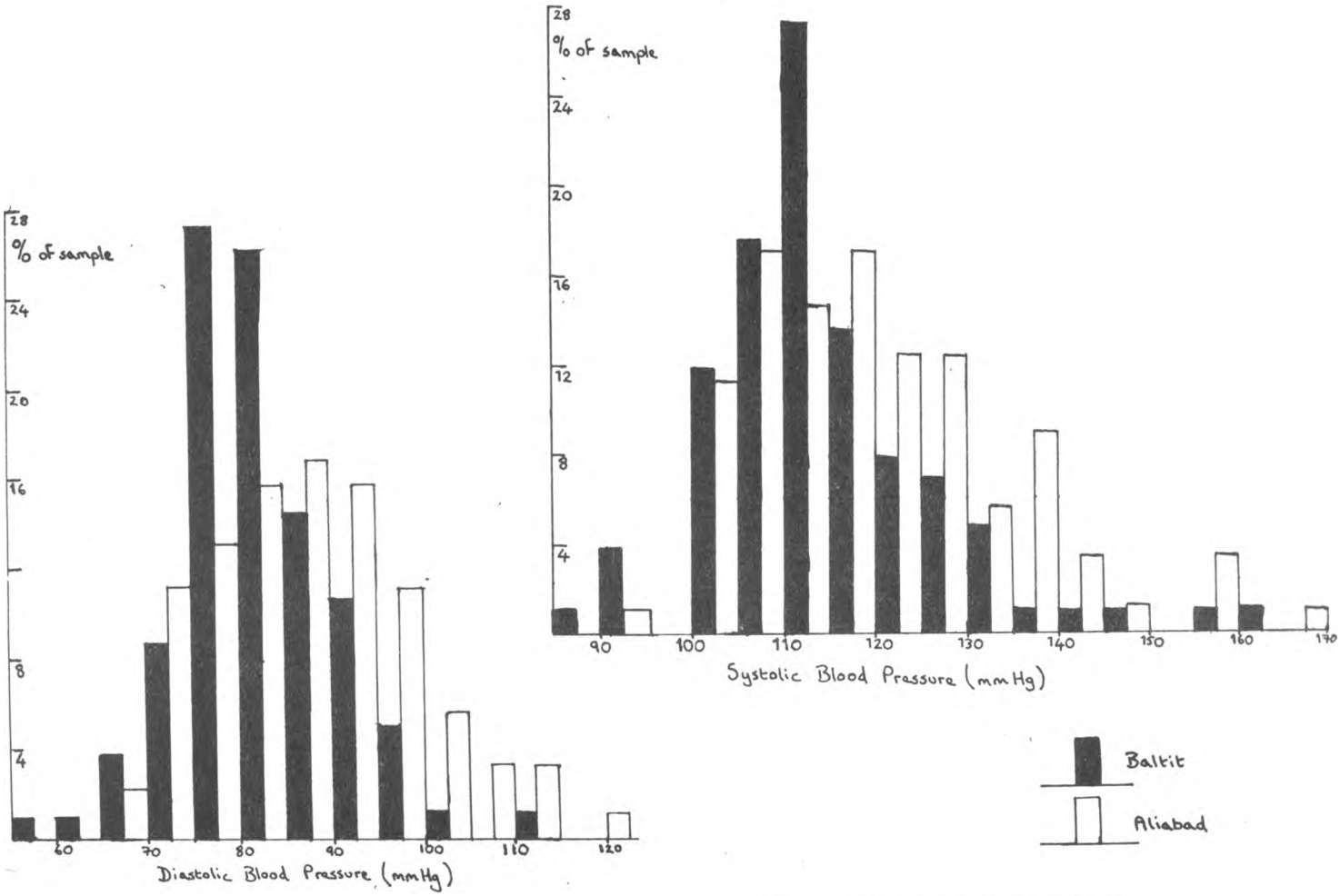


Fig. 1 Blood Pressure Profiles in Aliabad and Baltit

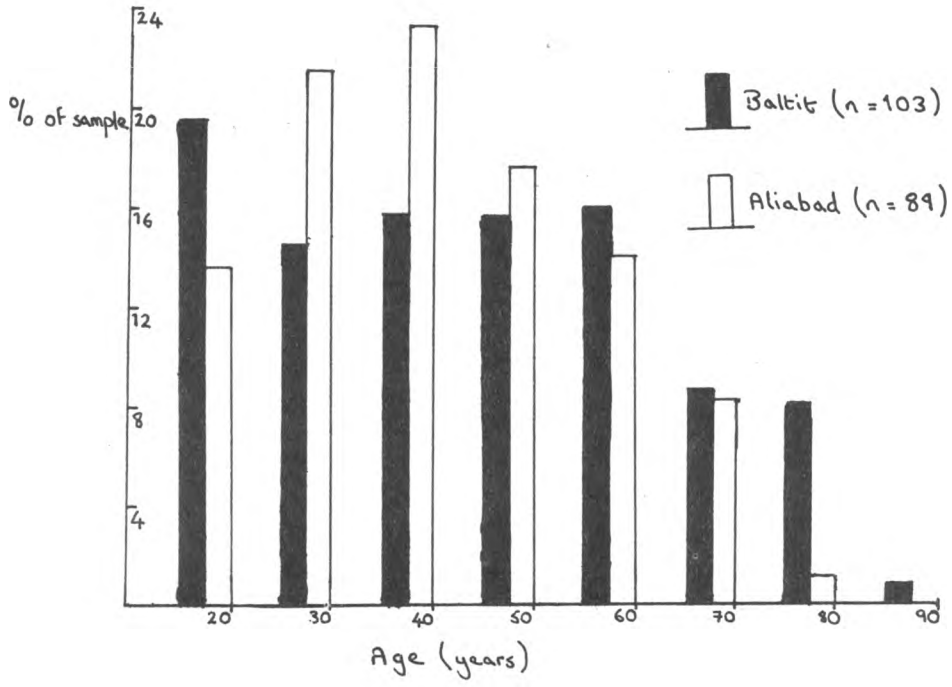
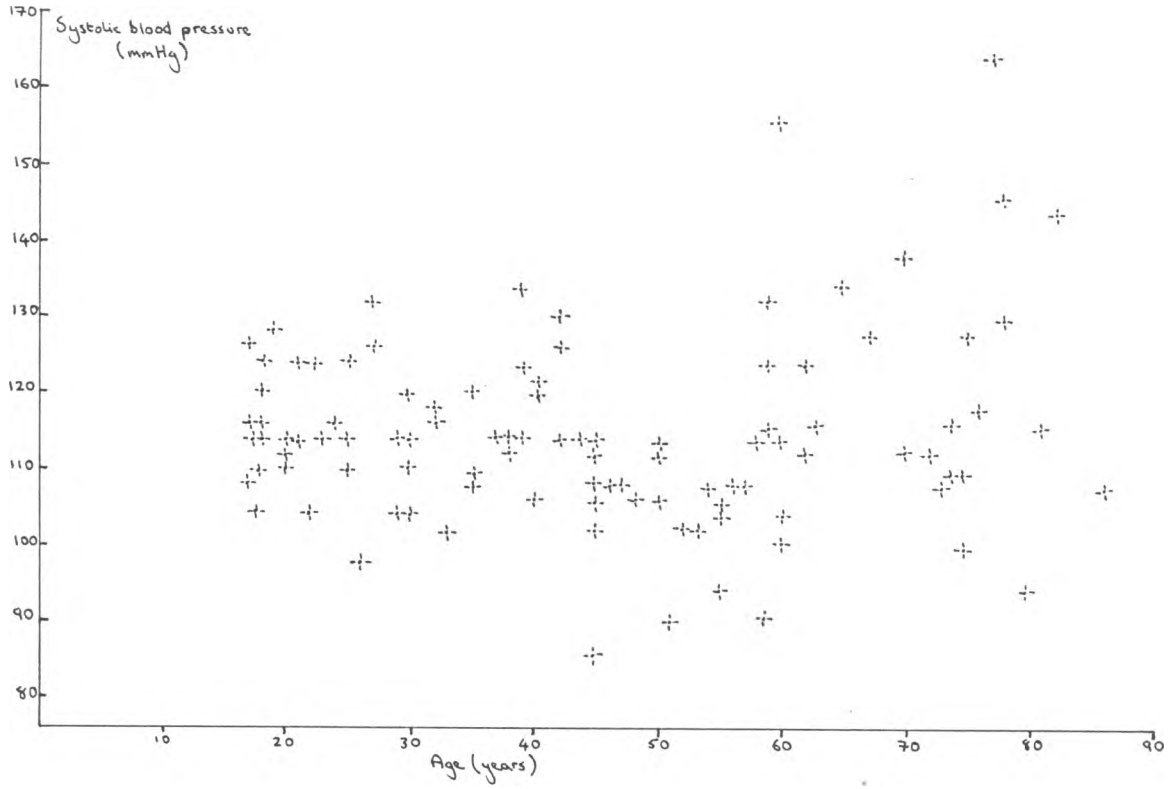
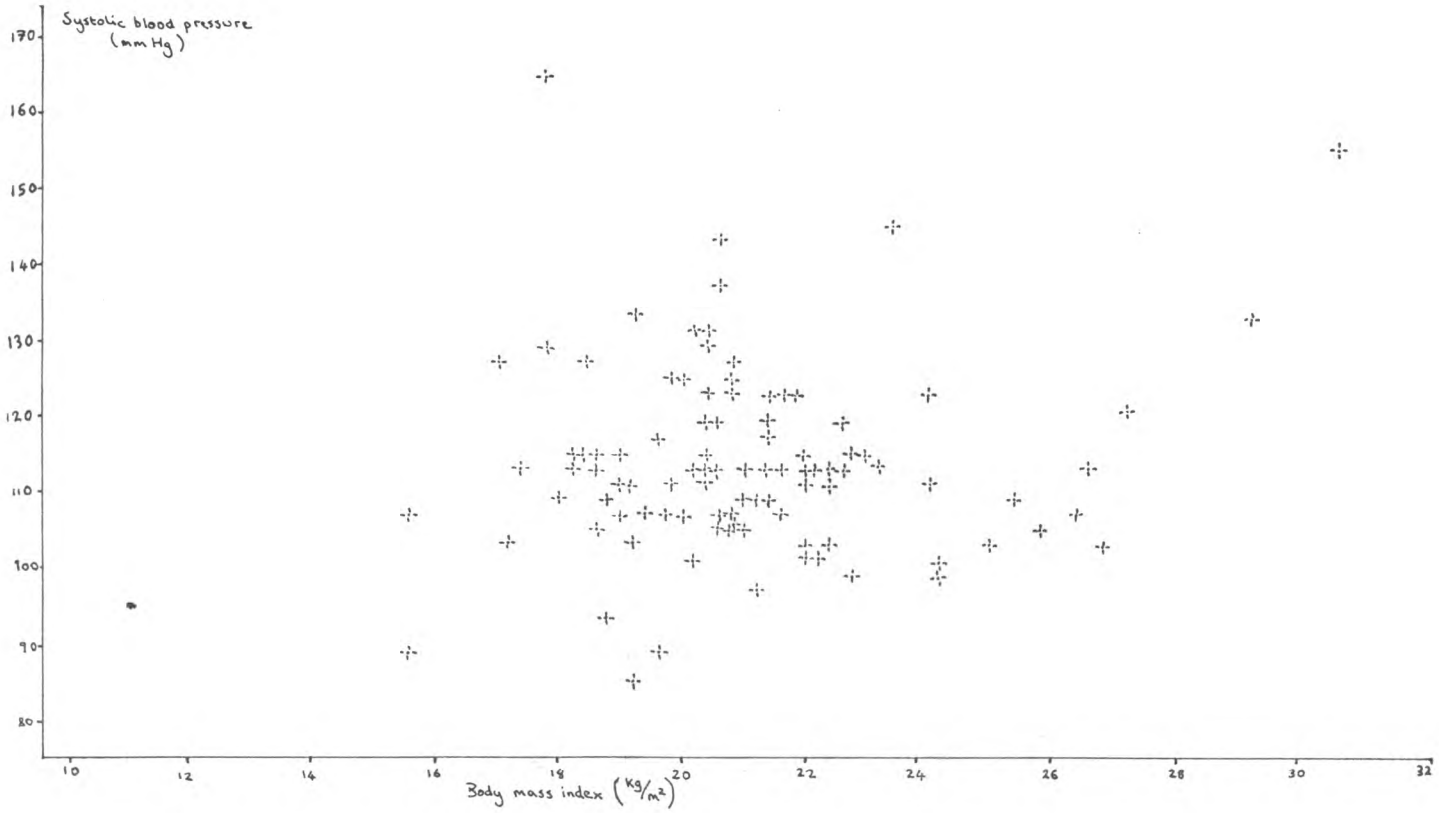


Fig. 2 Age Profile for Aliabad and Baltit



A/ Baltit



A. Baltit

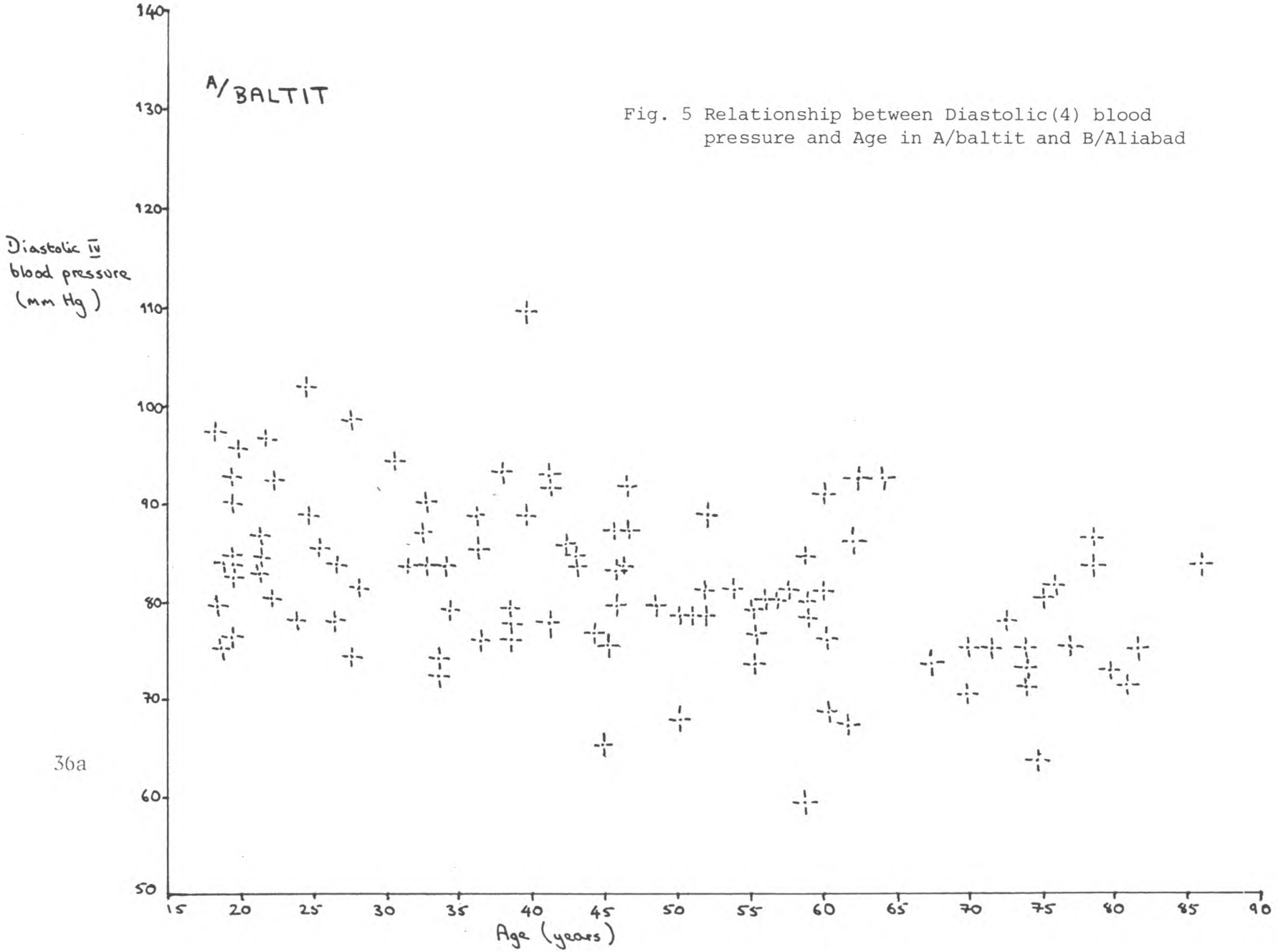
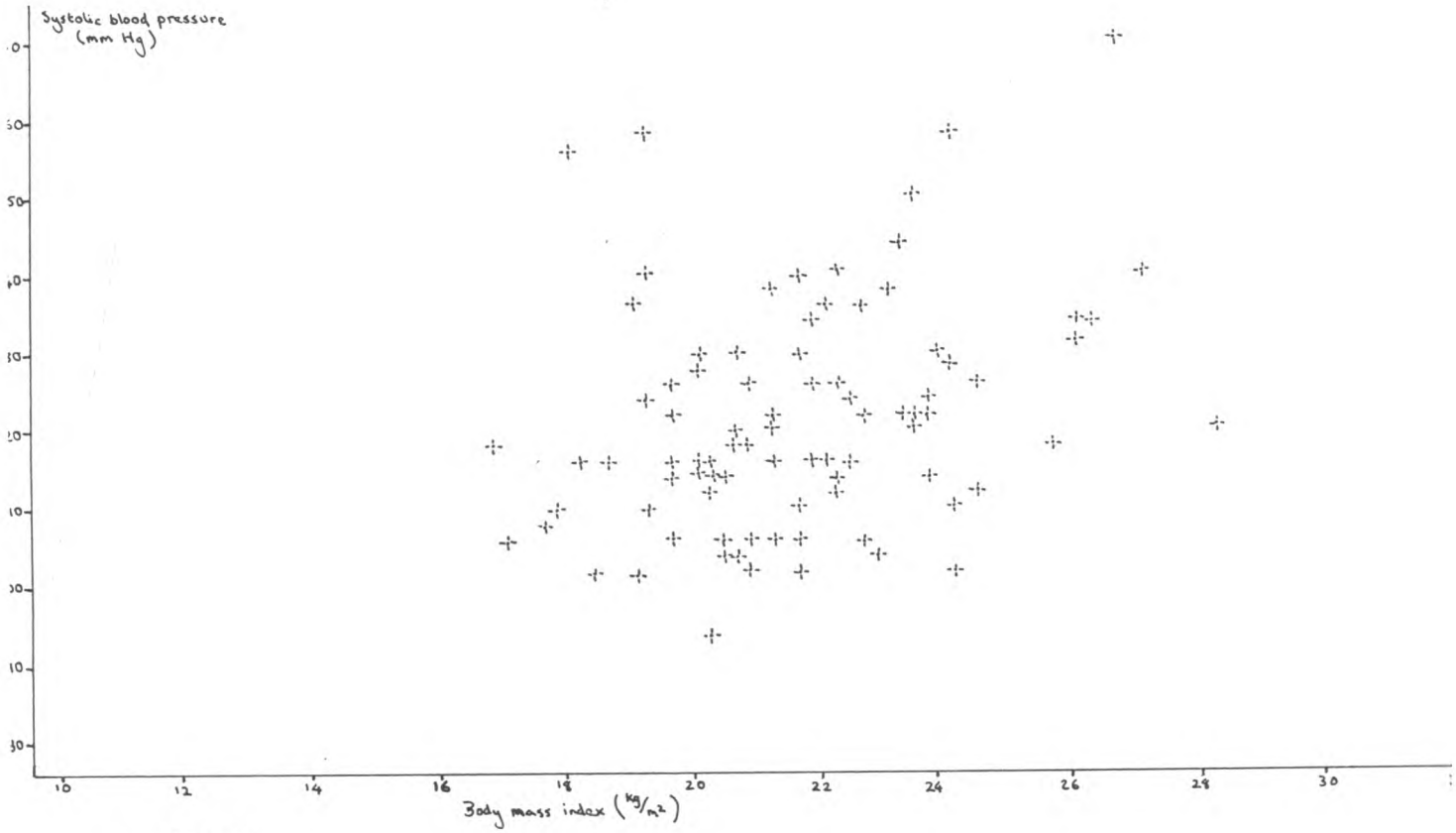
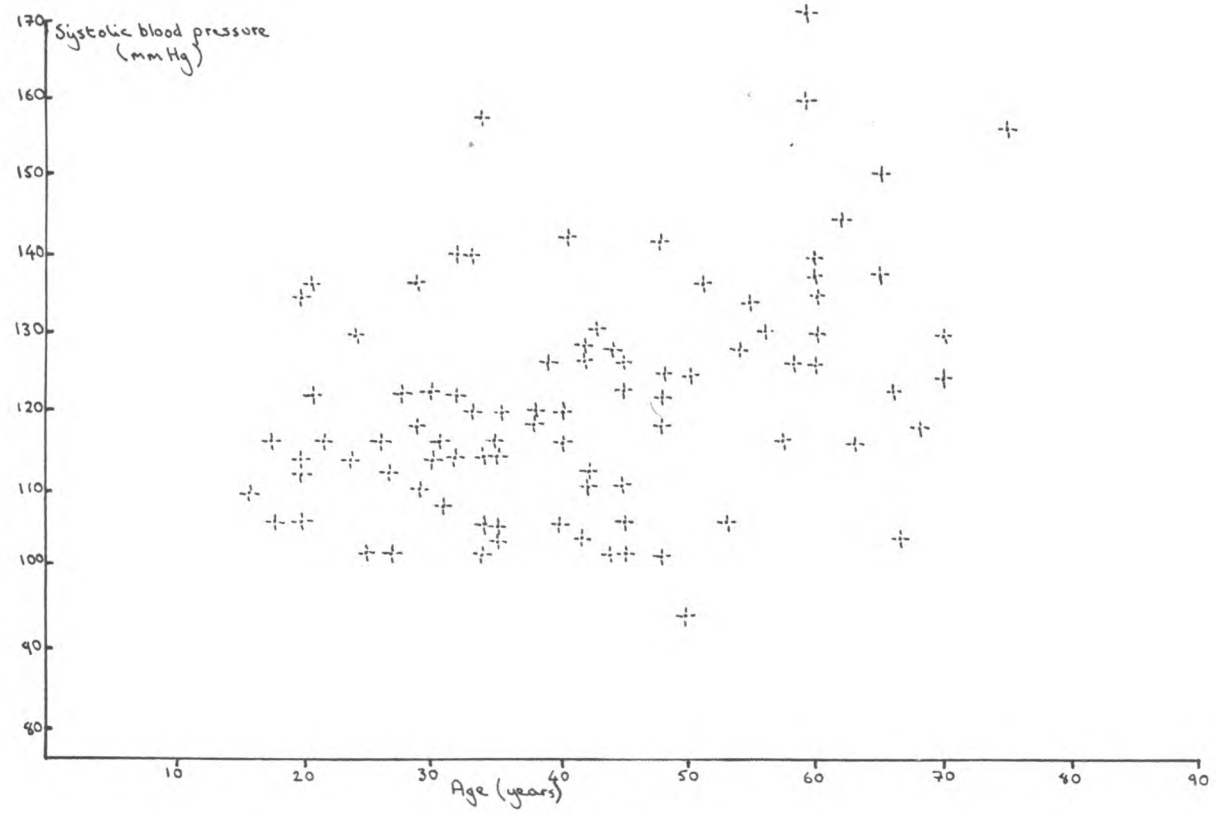


Fig. 5 Relationship between Diastolic(4) blood pressure and Age in A/baltit and B/Aliabad



B. Aliabad

Fig. 3 Relationship between Systolic Blood Pressure in A/ Baltit and B/ Aliabad



B/ Aliabad

Fig. 4 Realationship between Systolic Blood Pressure and Age in A/ Baltit and B/ Aliabad

Table 1. Mean and standard deviation and error, maxima and minima of pooled blood pressure and anthropometric measurements

Measurement	N	Mean	Standard Deviation	Min value	Max value	Standard error of mean
Age (years)	193	43.7	17.62	16	86	1.27
Systolic BP (mm Hg)	193	117.48	13.87	86	169	1.00
Diastolic IV	193	84.27	10.07	58	121	0.73
Diastolic V	158	75.97	9.98	56	112	0.79
Height (m)	188	1.66	0.06	1.42	1.85	0.01
Weight (kg)	187	59.25	8.70	41.0	99.5	0.64
BMI (kg m^{-2})	187	21.37	2.65	15.52	34.2	0.19
Arm circumference (mm)	178	263.01	23.37	190	330	1.75
Pulse rate	79	74.97	9.50	58	105	1.07

Table 2. Mean and standard deviation of blood pressure and anthropometric measurements by village

	BALTIT N = 103		ALIABAD N = 90		
	Mean	Standard deviation	Mean	Standard deviation	Significance
Age (years)	45.0	19.6	41.8	14.8	NS
Systolic BP (mm Hg)	114.3	12.5	121.1	14.6	p <0.001
Diastolic IV BP (mm Hg)	81.7	8.3	87.0	11.7	p <0.001
Height (m)	1.658	0.006	1.669	0.006	NS
Weight (kg)	58.0	8.1	60.7	9.2	p <0.05
BMI (kg m^{-2})	21.1	2.6	21.7	2.7	NS
Arm circumference (mm)	259	24.1	267	22.0	p <0.05

Table 3. Correlation of blood pressure with age, weight and BMI for pooled data

BP phase	Age	Weight	BMI
Systolic BP	0.196**	0.250***	0.245***
Diastolic IV	-0.211**	0.281***	0.251***
Diastolic V	NS	0.323***	0.299***

** p = <0.01 *** p = <0.001

Table 4. Correlation of blood pressure with age, BMI and arm circumference by village

Measurement		Age	BMI	Arm circumference
BALTIT	Systolic BP	NS	NS	NS
	Diastolic IV BP	-0.414***	NS	0.209
ALIABAD	Systolic BP	0.375**	0.242*	0.327
	Diastolic IV BP	NS	NS	0.226*

* p <0.05 ** p <0.01 *** p <0.001

Table 5. Smoking data in Baltit and Aliabad

	BALTIT		ALIABAD	
	Frequency	%	Frequency	%
Smoker	26	28	28	33
Non-smoker	54	58	44	53
Ex-smoker	13	14	12	14

X^2 = 0.679 DF = 2 0.10<P <0.50

Table 6. Past residence data in Baltit and Aliabad

	BALTIT		ALIABAD	
	Frequency	%	Frequency	%
	n = 61		n = 84	
Local all life	32	52	48	57
2-15 years away from Hunza	12	20	28	33
15-25 years away from Hunza	17	28	8	10

X^2 = 9.429 DF = 2 0.001 <P <0.001

Table 7. Occupation data in Baltit and Aliabad

	BALTIT N = 95		AlLIABAD N = 80	
	Frequency	%	Frequency	%
Manual	41	43	28	35
Business	17	18	20	25
Civil Servant	9	10	11	14
Student/Teacher	21	22	11	14
Driver/Mechanic	2	2	9	11
Army	5	5	1	1
2-15 years away from Hunza	12	20	28	33
15-25 years away from Hunza	17	28	8	10

X^2 = 11.94 DF = 5 0.02 <P <0.05

Table 8. Mean blood pressure in ten year age groups by village

	BALTIT BP (mm Hg)			ALIABAD BP (mm Hg)			Pooled data BP (mm Hg)		
Age	n	Systolic	Diastolic IV	n	Systolic	Diastolic IV	n	Systolic	Diastolic IV
<25	20	115	86	12	117	85	32	116	86
25-34	15	113	84	19	119	90	34	117	88
35-44	16	117	85	21	117	86	37	117	86
45-54	16	105	80	16	116	84	32	111	82
55-64	17	112	77	13	135	95	30	122	85
64	19	122	77	9	129	81	28	124	77

Table 9. Analysis of twenty four hour urine collections by village

	Volume urine (ml)	Sodium conc'n (mmol/L)	Pottasium conc'n (mmol/L)	Creatinine conc'n (mmol/L)	Sodium excretion in 24-hours (mmol)	Potassium excretion in 24-hours (mmol)	Na^+/K^+	Creatinine excretion in 24-hours (mmol)	%PABA excreted
BALTIT	920	171	61	7.6	157.3	56.1	2.80	6.99	90.5
n = 12	745	142	112	8.0	105.8	83.4	1.27	5.96	51.5
	810	220	70	9.5	178.2	56.7	3.14	7.69	61.1
	900	218	99	6.9	196.2	89.1	2.20	6.21	71.3
	540	179	167	8.5	96.7	90.2	1.07	4.59	37.6
	145	146	128	8.4	21.2	18.6	1.14	1.22	28.8
	410	212	91	6.2	192.9	82.8	2.33	5.64	38.3
	260	210	67	11.2	54.6	17.4	3.14	2.91	13.8
	680	244	58	5.2	165.9	39.4	4.21	3.54	58.4
	455	138	77	7.8	62.8	35.0	1.79	3.55	3.8
	425	262	93	8.4	111.4	39.5	2.82	3.57	30.9
	650	246	46	3.3	159.9	29.9	5.35	2.145	24.6
ALIABAD	1510	101	38	4.7	152.5	57.4	2.66	7.10	15.1
n = 4	1290	112	66	4.4	144.5	85.1	1.70	5.68	19.4
	815	239	49	6.3	194.8	39.9	4.88	5.14	22.4
	955	198	75	8.4	189.1	71.6	2.64	8.02	59.3
Mean N = 16	751	190	81	7.2	136.5	55.8	2.70	5.00	39.2

Table 10. Mean values of 24 hour urine analysis

	Sodium concentration (mmol/L)	Potassium concentration (mmol/L)	24 hr sodium excretion (mmol/L)	24 hr pot. excretion (mmol/L)	$\frac{Na^+}{K^+}$
BALTIT					
PABA-determined (n = 1)	171	61	157.3	56.1	2.80
Creatinine-determined (n = 4)	198	93	168.3	78.0	2.24
Mean (n = 5)	193	87	161.1	73.6	2.35
ALIABAD					
Creatinine-determined (n = 4)	162	57	170.2	63.5	2.97
VILLAGES COMBINED n = 9	179	73	167.9	69.1	2.62

GLACIOLOGY STUDY

1.1 **Introduction**

Few glaciers in the Karakoram have had any scientific investigations into their behaviour or structure. The Minapin (location shown in map 2) is however an exception to this rule. The position of its snout has been well documented over the last hundred years giving an excellent historical record of the overall mass balance (i.e. whether it is receding or advancing). In 1959 a German expedition made a photogrammetric survey producing a 1:50 000 map and calculating the velocity profiles at four different points on the ice.

Glaciologically it is of considerable interest. Its velocities, if reliable, indicate considerable sliding at the bed and are high even by Karakoram standards (600 m/year). Block-schollen motion has been observed and though the tongue and lower section is heavily crevassed and broken the upper basin is ideally suited for detailed investigations. Ogives have been noted (these are periodic arc shaped undulations of light and dark ice, the cause of which is not certain) as have well developed structures such as foliations (bands of different types of ice between about 1 and 10 cm in width). This area is free of snow for most of July and August and there is relatively little crevassing.

There were two parts to our intended work, the first being a plane table survey of the snout region and the second a detailed study of structural features in the upper basin and in particular the development of foliations. The rest of this chapter describes this work.

1.2 Description

The Minapin glacier is predominantly avalanche fed from a ridge running east-west between Minapin peak (7273 m) and Rakaposhi (7793 m). Starting in a col at about 5000 m it consists of two distinct sections:- 1) the upper basin and 2) the tongue and snout. These are described in more detail below however for a more complete description the reader is referred to Macbryde (1961) which includes a morphological study of the area and some botanical data on the fore-field. The glacier is about 11 km in extent covering an altitude difference of some 2500 m.

1.2.i) The upper basin

This is about 8 km long and 1.5 km wide and within this area are several tributory ice streams emanating from icefalls along the Rakaposhi ridge and split by four main rock outcrops. Fig.) shows the extent of the upper basin indicating the different flow units clearly defined by the lines of ice cored moraine. These separate streams converge where the valley narrows considerably, producing large lateral compressive strain and forcing the ice into a very broken and crevased zone, the ice fall. Little can be said about this region. The bedrock gradient is relatively steep here and flow rates are correspondingly high (of the order of 600 m/a). There must consequently be a large component of the velocity due to basal sliding and much of the debris observed in the meltwater at the tongue is probably produced in this region.

In the summer months the upper basin lies almost entirely below the snowline, being fed mainly by the 16 km ridge which shallows off into a more gently angled ice shelf that forms the southern boundary of this section. On the northern side is a high moraine bank which separates the flat side valley Kachelli from the ice (note this is where we established our base camp). Further downstream at the western end of this basin is another moraine bank and side valley known as Tacheferi which again separates the glacier from the valley side walls. At the confluence of the upper basin the valley narrows to about 800 m width and at this point the ice covers the entire cross section.

1.2.ii) The Tongue and Snout

After passing through the ice fall the surface still remains heavily crevassed and broken and in its lower reaches is completely covered with moraine. On the western side of the gorge the tongue does not reach the side walls but there is again a high moraine layer

marking the boundary of a small valley running almost the entire extent of the tongue to a level below the snout. This is split into two lobes with corresponding meltstreams. A detailed description of this region is given in the section on the snout survey.

2.1 SURVEYING THE SNOUT OF THE MINAPIN GLACIER

The snout is one of the lowest and most accessible in the Karakorams. For this reason, the record of advances and retreats for this glacier is one of the most comprehensive, though hardly complete, in the region. One of our expedition's projects was to resurvey the snout which had last been mapped in August, 1980 by the International Karakoram Project.

We started out early from the village of Minapin towards the glacier's snout in a token effort to evade the oppressive heat. There were three of us in the survey party. In addition to Ian and myself, Mr. Manzoon Ali, the lecturer in Geography at Gilgit College had graciously agreed to assist us. To undertake the mapping, our team had a peepsight alidade, plane table, hand-level, a few range staffs and seven days to spend before moving up to join Jon and James near the head of the glacier.

After leaving Minapin, we followed the trail which heads up the western side of the glacier's valley. After three hours hike we pitched camp near the summer home of several shepherds. Unfortunately, this camp was a 30 minute hike from the surveying. If we had travelled up the eastern side of the glacier's valley we could have camped right on the snout of the glacier. The trail to the site is used by the ice cutters working out of Minapin who provide the major source of refrigeration for Gilgit and other villages.

When the tents were up, we went out to reconnoitre the snout. The sight which spread out before us in the mid-afternoon glare was not exactly what we expected to find. In fact, there did not appear to be any glacier or ice at all, just a rubble-filled valley. Even with the help of maps from previous expeditions, it was quite difficult to visualize where the glacier was supposed to be. It wasn't until the next day when Ian got onto the rock promontory to the northeast of the snout (see Fig. 2.2.ii), near where the ice is quarried by the villagers, that we were actually able to see the entire snout of the glacier.

The next morning we began surveying in earnest. An 80 metre baseline was laid out and the first instrument set ups were made on the 20 hectare survey area. In the next five days, the outline of the glacier was surveyed in at a scale of 1:1500. As was to be expected, there were a number of difficulties. Even at 2400 metres on a glacier, the heat was enervating. The vertical relief on the snout was also a problem. The peep sight alidade is only designed to sight along gradients of less than about ten vertical degrees. The gradients on the glacier's snout were often signifcantly in excess of that. The relief also created a situation which led us to question certain fundamental principles of nature. One almost assumes that alongside Newton's laws there is an axiom which holds that rocks of a certain size, (somehwere between the volume of a small car and a telephone booth if one wants to get quantitative), should <u>not</u> move when you step on them. This surveyor, however, is willing to vouch that on the snout of this retreating glacier, all commonsense principles regarding immovable objects are freely contravened.

Aside from the inconveniences of torpid heat, unsteady footing and steep slopes, there were two problems in particular that future survey crews should consider, communications and locating the actual edge of the glacier. The alidade was often over half a kilometer from the features being surveyed in. As a result, the rodmen were out of contact with the instrument man for hours at a time. Sequences of points to be

surveyed in were agreed on before the team split up to go to work. After that, the day's progress devolved upon frenzied hand waving by the instrument man to try to attract attention and the intuitions of the rodmen, primarily the latter. Surveys that use stadia or electronic distance measurement will be spared the need to survey in all features with sightings from at least two separate instrument stations as one has to do when using a peepsight alidade but provision of some means of commuication, even if it is just binoculars and a large flag or two, should still be considered essential.

Locating the rodmen is one problem, locating the active margin of the glacier under its mantle of rock debris is quite another matter which often threatened to make a mockery of our efforts to define the edge of the glacier with a neat line on the map. It was quite a relief to hear from members of the 1980 expedition that they too had to exercise a degree of judgement in locating the glacier's snout. Fortunately, there are several distinctive interfaces between bedrock and ice which lend themselves to precise location. The eastern lobe of the glacier which extends into a deep and narrow rock gorge is a particularly prominent feature. The ice around the central rib of rock which divides the snout into two lobes also warrants close attention.

The present survey did not find grounds for distinguishing areas of "dead ice" from "live ice" as the 1980 survey did.

2.2 **Results**

Despite the considerable difficulties that prevailed the work was completed successfully. Figure 2.2 i compares the extent of the glacier in August 1984 with the extent recorded in August 1980. There appeared to be a discrepancy between the two maps with regard to the eastern lobe. Because the 1984 survey did not have the equipment to lay down an independent control network as accurate as that used in 1980, precedence was given to the 1980 map in preparing Figure 2.2 i . According to that comparison the glacier has retreated 10 metres on its eastern lobe. On the western lobe areas, classified as "dead ice" by the previous survey, have retreated up to 75 metres, and live ice on that lobe has retreated up to 40 metres. The most striking change in the snout has been the increase in the separation between the two lobes of the glacier. This has occurred primarily at the expense of the western lobe's width.

Figure 2.2 ii places these findings in the context of several previous observations. The 1984 survey is the 16th recorded since the first reconnaisance was made by Ahmed Ali Khan in 1889 (see Table 2.2). At that time, the glacier extended to roughly the position it presently occupies. Between 1889 and 1913 the glacier advanced some 1700 m down the valley. Since then, the glacier has generally been in retreat as the vast accumulation of rock debris which covers the lower two kilometres of the glacier will attest. It is very likely that the long interval between surveys may have overlooked interruptions in the overall pattern of retreat, such as the small advance recorded by the Chinese survey which placed the glacier's terminus some 150 metres beyond the 1961 boundaries. The results of the 1984 survey, however, indicate that the glacier is continuing to retreat.

2.3 **Prospects for future research**

Despite the large share of attention the Minapin Glacier has received relative to others in this region, there are still major gaps between surveys and precious little data beyond the bare outlines of the glacier. Clearly there is great scope for more systematic data collection in one of the world's most extensively glaciated areas. A very promising possibility in this regard is the role which the college at Gilgit might be able to play in the years to come. Mr. Ali, whose original specialization was in cultural geography, accompanied our team into the field because of his growing interest in glaciology and physical geography. During the course of the survey, we were able to share information and experience which not only helped the expedition, but will also hopefully be of use to Mr. Ali. He and his students will be ideally situated to collect their own data, as well as to make use of

local knowledge in the region.

In the case of our own expedition, the men who collected ice from the Minapin Glacier for sale may have been a valuable source of information about the activities of the glacier since they rely on it for their livelihood. Casual questioning about why some of the painstakingly built irrigation channels were empty also elicited information on the activities of the glacier. People were quite well aware that some of these dry channels had been cut off from their source of meltwater by the sustained retreat of the glacier.

Two other avenues for further research also come to mind. The major reason for surveying the glacier's snout is to begin to get some idea of the glacier's mass balance and patterns of movements, especially as the Minapin Glacier proved itself capable of very rapid advance in 1892-1893 when it moved 1100m. It would seem worthwhile, therefore, to gather more extensive information about the glacier's profile. A complete longitudinal section would be ideal, but quite difficult. An approach along the lines of the German expeditions in 1958 and 1959 which took a series of cross-sections may be more feasible. One site that seems to present an excellent opportunity for taking a cross-section is near Hapakun where the glacier makes a sharp bend. There the glacier rides over a shoulder of bare rock, providing an uncharacteristically good opportunity to monitor the glacier's movement.

Another area that might merit further investigation would be the discharge and sediment loads of the streams which drain the glacier. The discharge and sediment concentration of the stream from the western lobe, emerging at the bottom of the rock gorge, appeared to be several times that draining from the eastern lobe. Both of these streams, and most others in the valley, showed a marked diurnal variation in discharge, with volume and discharge increasing several-fold during the day.

OBSERVER	DATE	DETAILS OF SNOUT
AHMED ALI KHAN	AUG - SEPT 1889	2750 m FROM SITE OF FUTURE BRIDGE CROSSING ON MINAPIN RAVINE
CONWAY	1892	ADVANCE OF 1000 m. ROUGH SKETCH
KHANSAHIB ABDUL GAFFAR	1893	ADVANCE OF 1100 m
HAYDEN	1906	ADVANCE OF 275 m. MARKS MADE ON VALLEY WALLS. CAIRNS. PHOTOGRAPHS
MASON	1913	ADVANCE OF 200 m. FRESH MARKS MADE. PHOTOGRAPHS. "AN IMMENSE PACK OF BLACK ICE"
VISSER	1925	RETREAT OF 600-700 m. "AN INSIGNIFICANT NARROW STRIP OF ICE BURIED BENEATH RUBBISH." ROCK GORGE EXPOSED
TODD	1929	PROBABLY A 100 m RETREAT (ESTIMATE ONLY)
TODD	1930	CONSIDERABLY MORE MELTING REPORTED. 300 m RETREAT SINCE 1925
WOOLDRIDGE	1932	5-10 M RETREAT FROM 1930 CAIRN. "A MISERABLE TONGUE"
SHIPTON AND MOTT	1939	CONTINUED RETREAT ESTIMATED FROM SHIPTON AND MOTT MAP PUBLISHED IN 1950
GERMAN KARAKORAM EXP.	1954	c 750 m RETREAT SINCE 1925
GERMAN KARAKORAM EXP.	1959	c 40-100 m RETREAT SINCE 1954
CAMBRIDGE EXPEDITION	1961/1962	c 200 m RETREAT SINCE 1954
PAKISTAN AIR FORCE	1965	AIR PHOTOGRAPH SHOWS CONTINUED SHRINKAGE
ZHANG XIANGSONG	1978	ADVANCE OF 150 METRES COMPARED WITH 1961 AND REPORTED TO BE NEARLY AT 1954 POSITION
INTERNATIONAL KARAKORAM PROJECT	1980	NORTHERN LOBE RETREATED 100 m AT FURTHEST POINT SOUTH OF SNOUT, 10 m BETWEEN THE TWO LOBES, AND 0-15 ON SOUTHERN LOBE COMPARED TO 1961
CAMBRIDGE EXPEDITION	1984	EASTERN LOBE RETREATED 10 m, WESTERN LOBE RETREATED 50 m, AND THE GAP BETWEEN THE TWO LOBES INCREASED UP TO 75 m

TABLE 1. OBSERVATIONS OF THE MINAPIN GLACIER

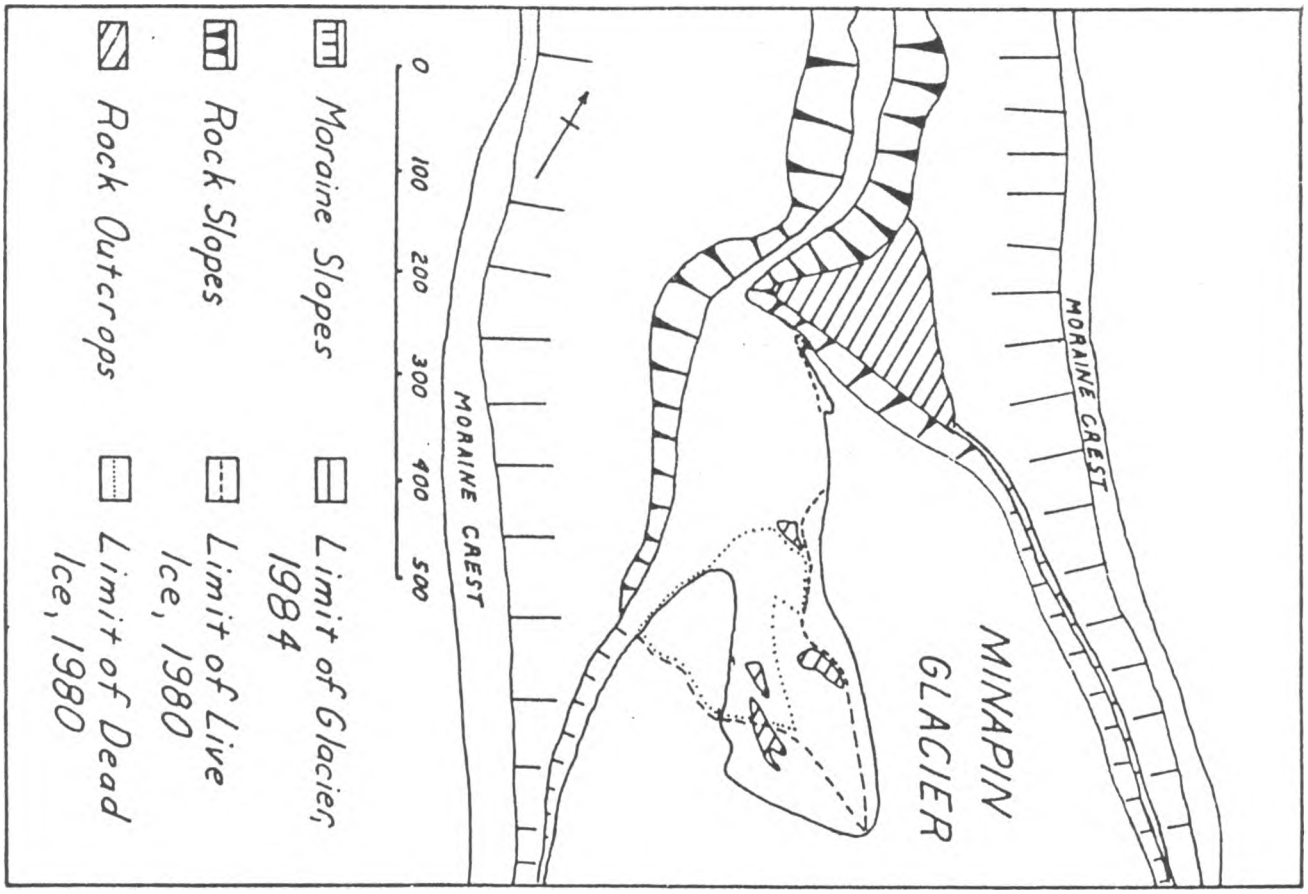


Fig. 2.2 i Comparison of the snout position in 1980 and 1984

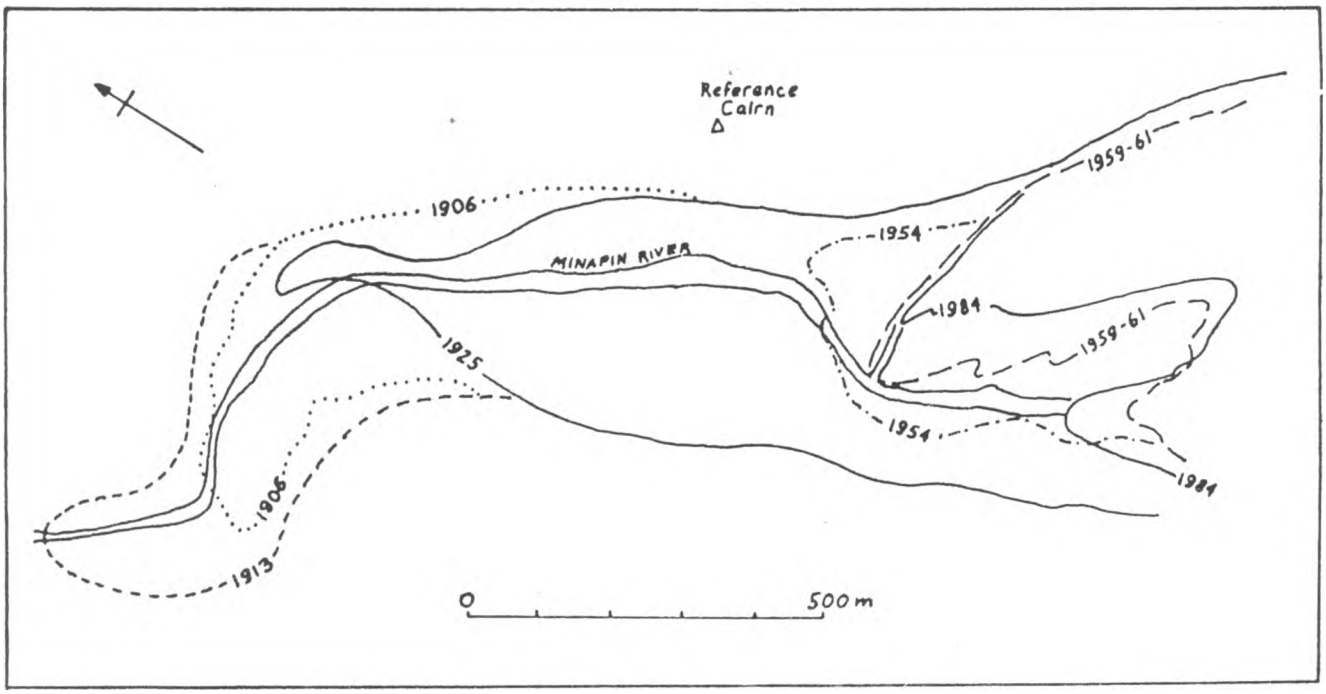


Fig. 2.2 ii Diagram showing historical record of the snout position.

Looking towards Rakaposhi from Minapin Village

Part of the ascent to the glacier base camp with the

3. UPPER BASIN STUDIES

3. 1 Introduction

Glaciers in the Karakoram are invariably temperate (i.e. at the pressure melting point throughout) and many have steep bedrock gradients producing high flow rates and considerable ice deformation. Measurements made by the 1959 German expedition of surface velocity profiles (fig. 3.5 i) gave values ranging between 300 and 600 m/a suggesting a very active glacier. It was intended to investigate the development of structures caused by these relatively high flow rates, and in particular, the formation and consequent deformation of foliations. Here the term foliations refers to alternate layers of ice which differ in crystal size and bubble content (and hence appearance) of which there are three main types, coarse clear (blue ice), coarse bubbly and fine bubbly (white ice). Coarse crystals usually have diameters ranging between 10-150 mm being larger in clear rather than bubbly ice and those of fine ice are less than 5 mm.

Foliation by its nature and definition is formed by the deformation of pre-existing inhomogenities. These are of several types such as stratification consisting of coarse ice split by layers of clear ice from refrozen meltwater during the summer. Crevasse traces may be another origin of foliation and any one region of ice may have several foliations superimposed all originating from a different source. The two aforementioned inhomogenities start out parallel and perpendicular to the ice surface respectively yet in the snout region these two features can have very similar dip and strike. The orientation and nature of a particular foliation (or any structure) is a function of its complete strain history, i.e. the cumulative strain. Thus to obtain a complete understanding of observed features it is necessary to find the strain rates over the whole upstream zone which is normally a huge undertaking. However by taking selective measurements of strain rate and making reasonable deductions about the flow it is still possible to build up a picture of the strain history of a particular feature and relate this to what is observed.

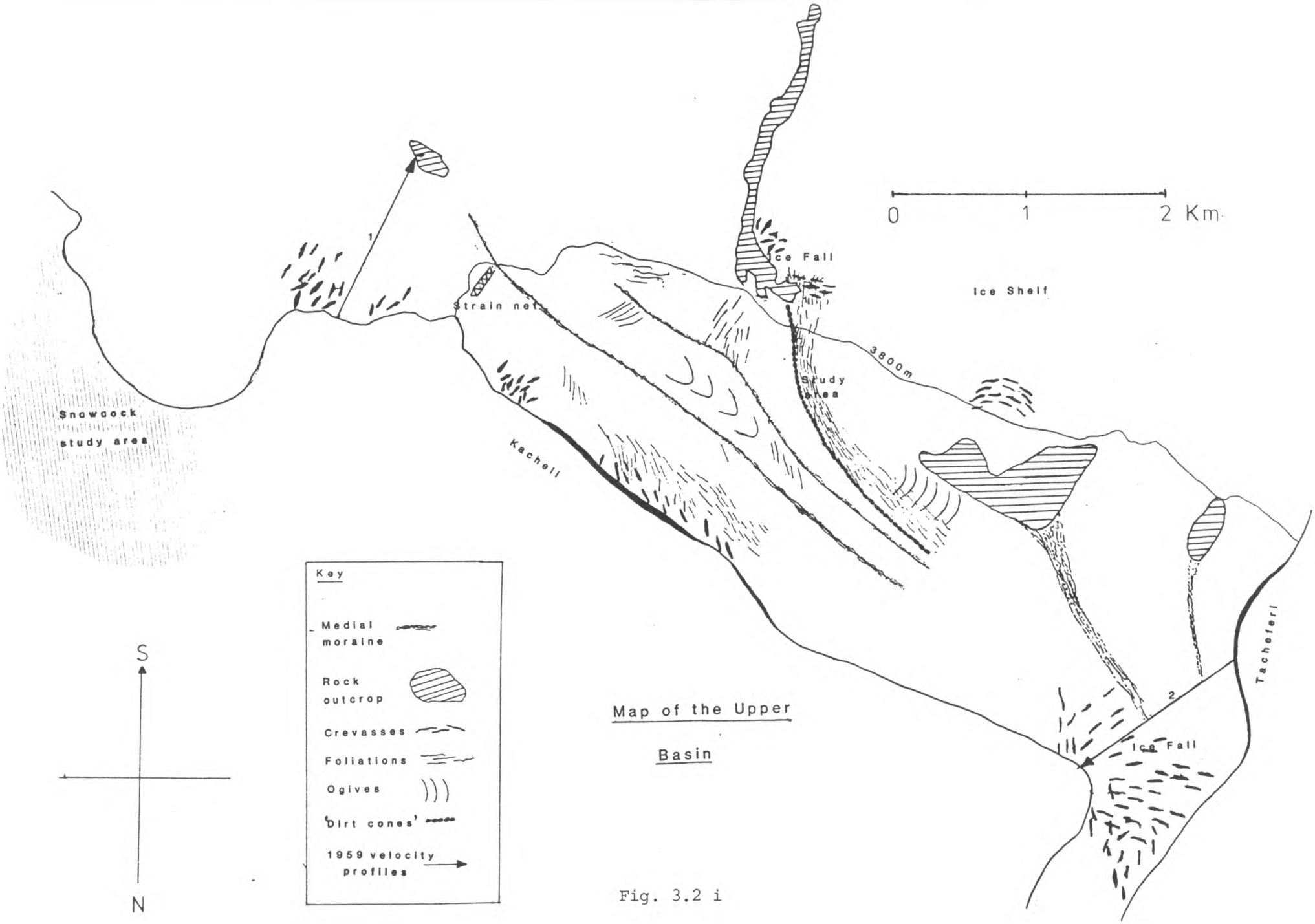
3.2. Observations

The Minapin, as previously mentioned, is well suited to such an investigation and in particular the ice streams on the southern side of the basin proved interesting being well defined separate flow units of a manageable size. The upper basin was extensively traversed and an ice stream (shown in Fig 3. 2 i) was found showing a very well developed longitudinal foliation (fig. 3. 2 ii). This tributary was separated from the main stream by a large band of medial moraine which had formed 'dirt cones' of up to 10 m high and between 10 and 15 m wide (fig. 3.2 iii). The eastern upstream boundary was formed by a large rock outcrop next to which was an ice fall which seemed to be the predominant source of ice into the tributory. It is approximately 500 m wide and 3 km long ending just before the narrowing of the valley. Downstream of the ice fall (but still above the level of the tributory) the ice becomes much less broken and the longitudinal strain rates are clearly considerably less than within the icefall which is moving faster than the neighbouring zone. Thus it would appear that ice is effectively being funnelled down the 'ice shelf' and into the basin where it is undergoing considerable lateral compression.

Fairly irregularly spaced layers of coarse clear ice 2 - 5 cm thick run perpendicular to the ice surface with a dip very close to 90° but tending slightly into the ice shelf. The strike is close to that of the medial moraine band becoming more parallel to flow further downstream (fig. 3.2 iv). These observations suggest a region of high pure stress between the tributory and main glacier, the minor stream moving faster than its neighbour.

3.3 Origins of the foliation

Such a heading may be slightly misleading as the precise origin of a given foliation can only be the result of conjecture. However it is suggested that the observed structure developed in a similar way



Map of the Upper Basin

Fig. 3.2 i

to that described by Hooke (1978). He argues that where the two ice streams meet the zones of foliation which were parallel to the rock outcrop separating they will be juxtaposed against each other. At this junction there will be considerable lateral compression and a corresponding vertical extension which will increase the dip of any longitudinal feature. This is borne out from the observation that the foliation could be traced back almost as far as the junction of the two streams. The original inhomogeneity could quite easily be sedimentary stratification resulting from a thick winter snowfall layer of coarse bubbly ice interlain with thin layers of clear ice from refrozen summer melt. Such an explanation would tie in well with observations.

The longitudinal foliation could be traced well into the icefall (Fig 3.2 V) and within this fairly broken region another structure consisting of irregularly spaced glands of clear ice approximately 2 cm thick could be seen. These layers were perpendicular to the direction of flow and their dip remained at right angles to the ice surface (fig 3.2 vi). These features were less continuous and less conspicuous and clearly unrelated to the observed foliation. Their cause is unknown.

Another area showing well developed foliation with folding was also located on the northern side of the basin about 3 km upstream of our base camp and 1 km below an icefall. The region is marked by the strain net in fig. 3.2 i. There were clearly very high strain rates in this zone and a considerable velocity gradient running laterally across from the valley wall into the main ice stream. It was hoped to obtain strain rate measurements in this zone using a triangular net of stakes as described by Hambrey (1978). Over a period of two days an array of 14 poles was set up as shown in fig. 3.2 i. Each stake was drilled in to a depth of 1 m using a hand-held auger and set out to form approximate equilateral triangles with sides of 30 m length. The drill could achieve about 1 m/hour and the diameter of the piping was chosen to match that of the hole as closely as possible. Left overnight they became well frozen in. The distance of each side was measured using a steel tape under standard tension (5 kg). Measurements were repeated until consistent and in general were accurate to within 1 cm.

Two problems were encountered with this work. Firstly it had been delayed by a week due to my illness meaning that only 12 days elapsed between distance measurements. Thus for a typical strain rate of 0.1/a the maximum possible displacement (i.e, if the flow is parallel to one of the sides) would be 10 cm. Although each individual distance measurement is consistent within itself this is not necessarily true for two done at diffferent times. Changes in air temperature and wind speed and direction both add errors to the calculated change in distance between poles. The second problem was that the ablation rate in this area was approximately double that observed by Macbryde (1961) for a similar altitude and time of year. This was most probably due to the proximity of lateral moraine and dirt. However it resulted in the need to re-drill every stake again adding a further error to the measurements. The results are consequently of a qualitative nature. Most of the strain net had strain rates of the order of the experimental errors. Close to the ice margin a value of 0.2/a was recorded confirming the deductions made from the orientation of crevasses in the area that there is a zone of strong shearing extending at least 200 m out from the margin.

3.4 Future work

A comprehensive temporal record of variations in snout position is of importance for several reasons. Firstly, it is of considerable significance to the villagers who are so dependent on its meltstream. It is also a useful indicator of climatically controlled glaciation in the region. Work is being done at Peshawar University on the temporal changes in glaciation in the Karakoram from Landsat imagery and such a record provides important 'groundtruth' data for this.

Well developed foliation such as that observed on the Minapin is not a common feature in valley glaciers and its origins and consequent deformation have only been examined on a purely qualitative basis in

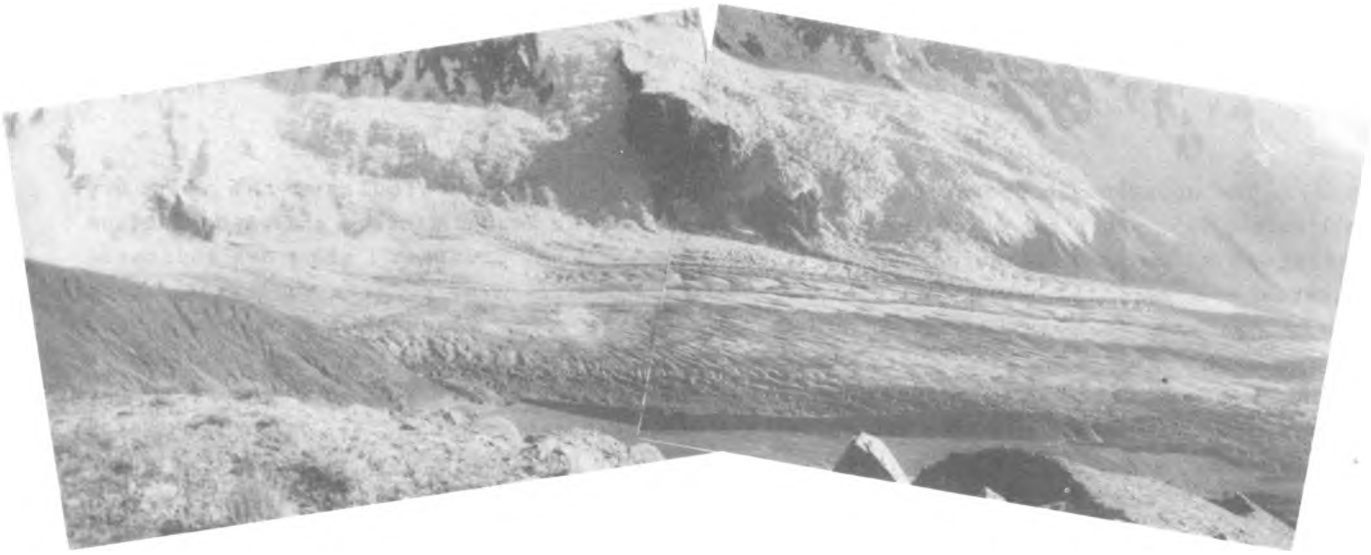


Fig. 3.2 v Panorama of Minapin Upper Basin showing the ice stream and ice fall studied. Ogives are also clearly visible.

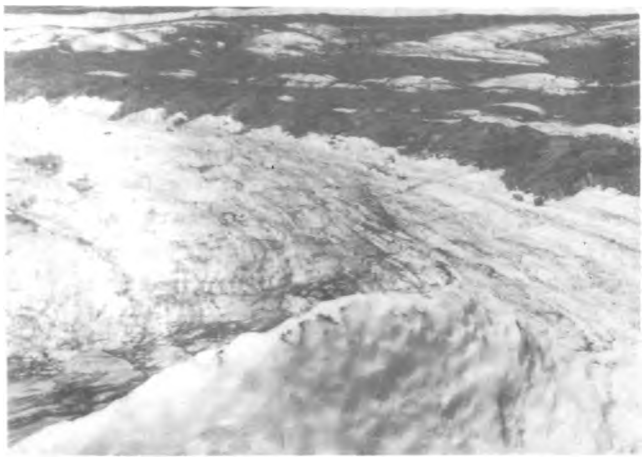


Fig. 3.2 ii Well developed foliation at the base of the icefall. The dirt cones are seen in the upper half of the figure.

Fig. 3.2 iii A view of the large 'dirt cones' defining the boundary between the 'ice stream' and the main glacier looking towards the ice-fall

Fig. 3.2 iv Further downstream. The foliation becomes increasingly parallel to flow and consequently the moraine.

Fig 3.2 vi Layers of clear ice 2-5 cm in thickness observed high in the icefall. Their dip remains perpendicular to the ice surface but they are a quite seperate structure from the foliation and probably originated from within the icefall itself whereas the foliation 'pre-dates' this zone

this study. The upper basin proved to be a very well suited laboratory for observing the development of structural features. High strain rates and stresses were apparent especially near the margins and at the junction of the ice streams. It is recommended that in making accurate measurements of strain rate the stakes should be drilled in at the end of the summer and then remeasured the next summer before too much melting has occurred. Very interesting conclusions could result from such work. In particular a line of stakes running down the centre flowline would give useful data if related to ice thickness and bedrock profile. However such work would need considerable time and financial support to be accomplished.

3.5 Glaciological Data on the Minapin

Details of snout surveys have been given in section 2 and are not given here. Schneider (1959) made a 1:50 000 map of the glacier and surrounding area using terrestrial photogrammetry. From similar data they also calculated the velocity profiles at four different places on the ice (fig. 3. 5 i), profiles 1 and 2 are indicated in fig. 3.2i. The results suggest a 'block schollen' type movement for areas of flow where the velocity gradient is very high near the margins but approximately zero in the large central section. This implies marginal areas of high pure shear acting perpendicular to the surface. Maximum velocities were calculated at 600 m /a - an unusually high value for a glacier close to steady state, and suggesting a large basal sliding component.

Previous ablation measurements, MacBryde (1961), were made for an area close to Tacheferi at an altitude of 3500 m and gave an approximate mean value of 6 cm/day. At an altitude of 2625 m near the snout it was 14 cm/day. Both values are averages for August. Results of 1984 measurements from the strain net gave an average value of 15 cm day (early August) at 3750 m. Localised data are strongly influenced by surface dirt/moraine content and obscuration from direct sunlight.

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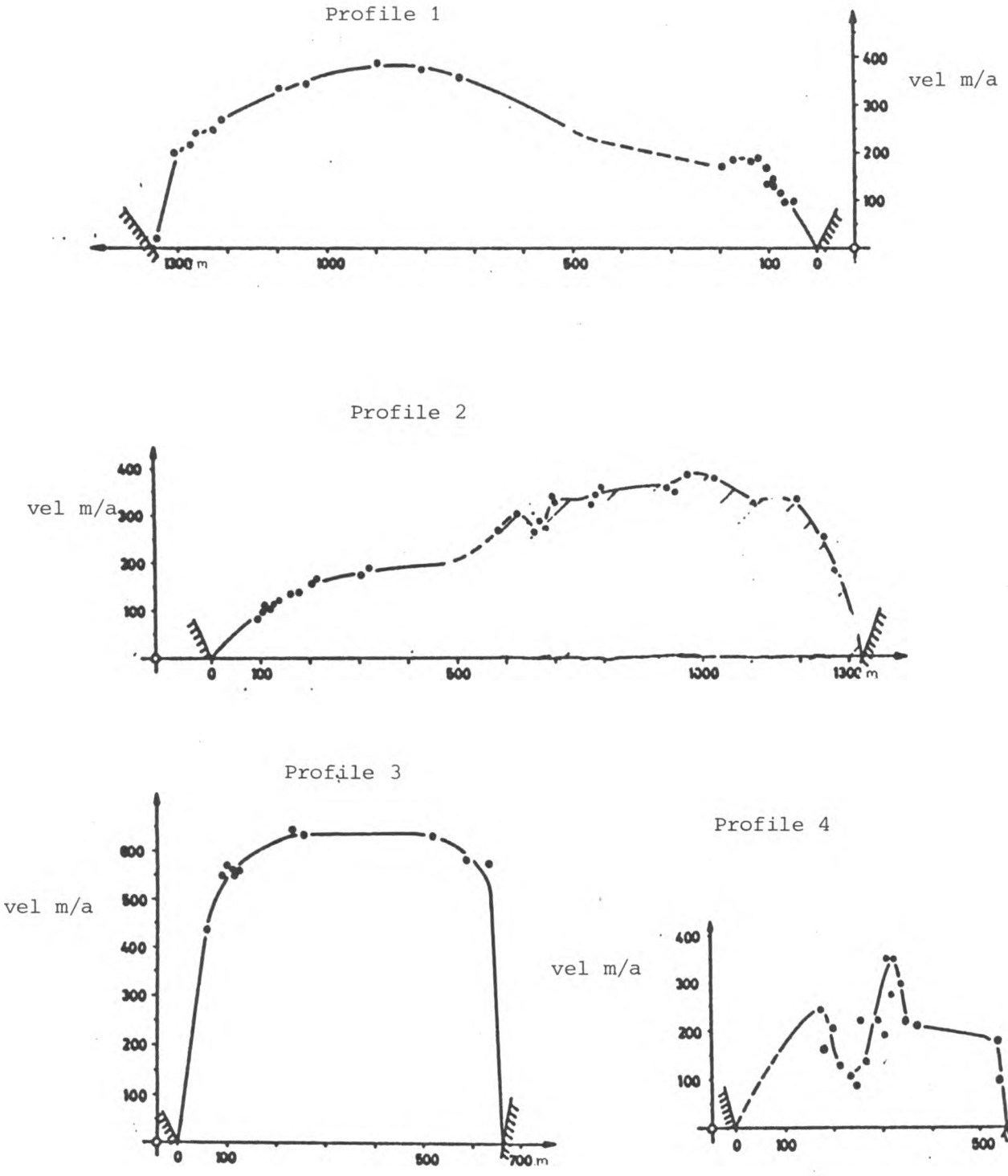

Fig. 3.5.1 Velocity cross profiles at four different sites in the upper part of the Minapin glacier (after Schneider 1959).

STUDIES ON THE ECOLOGY OF HIMALAYAN SNOWCOCK

(Tetraogallus himalayensis himalayensis)

IN HUNZA DURING THE SUMMER OF 1984.

James Mayers.

Emmanuel College, Cambridge

SUMMARY

This describes a study of the Himalayan Snowcock Tetraogallus h. himalayensis that was made on the slopes above the Minapin area in Hunza, Pakistan during the summer of 1984. Faecal analysis provided information on the diet, dropping densities and direct observation indicated the changing nature of the habitat usage, and observation also helped elucidate patterns of behaviour relating to the environment. The findings indicate that grasses and sedges are the most important constituent of the diet and that measurements of habitat usage and feeding activity correlate with the distribution in the habitat types of these species. Certain flowering dicotyledonous plants also appear to be of importance in the diet, although the utilization of these species seems to vary with time. Snowcock used all habitat types in the study area and typically covered them all in the course of a day. However, rock outcrop areas were favoured for night and midday roosts, upper alpine meadow areas were concentrated on for feeding and other areas were generally hurried over. Aspects of group sizes and behavioural patterns are discussed in connection with their likely relationship to the presence of predators.

INTRODUCTION

'It was reported to me when at Dras, that there were "two darned great turkeys running up the hill". This was my first introduction to the Himalayan Snowcock or Ram Chukar'. (Colonel R. Meinertzhagen, 1927).

'They are shy and go towards inaccessible points and thus tend to fall hundreds of feet when shot, so that when picked up they are badly mangled.' (H. T. Fulton, 1904).

Such is the nature of the literature on Himalayan Snowcock. This fine bird remains ill-studied due largely to its preferred habitat at seldom visited high elevations near the snowline in bare stony country from the Hindu Kush, over the Karakoram to the Western Himalaya. Ali and Ripley (1980) describe the general habits of Tetraogallus himalayensis and Bland (1984) has made a study of an introduced population in Nevada, USA.

To help elucidate how such a large game bird can be so successful in such an extreme environment, a working knowledge of the snowcocks' natural diet, use of habitat, and behavioural responses to the changing environment is required. This will also be helpful in comparative studies of other, directly threatened Tetraogallus species in isolating potential and actual threats from competition with grazing beasts and man.

This study took place on the alpine slopes above Minapin in the Hunza Valley during the summer of 1984.

STUDY AREA

The altitude range occupied by snowcock appears to be closely determined by the distribution of alpine meadow habitat. In the Karakoram these areas occur high above the dry valleys, above the conifer, birch and juniper zones anywhere between 3500 and 5500 metres in summer, although they may descend to 3000 metres in winter.

After preliminary surveys on all the major slopes below the snowline in the Minapin area, one fairly small (1.03 km^2) study area was chosen (between 3800 and 4500 m). This area extended from the northern edge of the Minapin Glacier with a ridge of moraine before, up a large south-facing slope with two broad bands of alpine vegetation separated and delimited at the top by two major zones of rocky outcrop, (see Fig. 3.2. in glaciology section). This area is likely to be typical of many such sites in the upper

valleys of Hunza. Observations of snowcock in similar areas to the west of Hunza were made after this study period.

Preparatory observations had indicated that at this particular time of year the diurnal activities of resident snowcock ranged well within these study area boundaries. Data collected outside the study area was largely limited to positional sightings of birds and some comparative dropping density measurements. Within the study area certain natural features were utilized as discrete observation points and a hide was constructed at a key location on the lower rocky outcrop zone.

METHODS

DIRECT OBSERVATION

From discrete observation points, using 8 x 40 binocular and 35 x 70 spotting scope, all birds within visible range were recorded in the following way:

1. Position in the study area, - a coded description with reference to the observation position.
2. Number of individuals and age-group if possible.
3. Habitat type in which birds found, the categories being: glacial moraine, scree or snow, semi-scree with scrub, three well vegetated meadow areas, - two rock outcrop areas. (Fig. 1).
4. Activity of birds, the categories being: resting, dusting, preening, feeding, calling, walking 'fast' and walking 'slow'. This was recorded at 15 minute intervals from an observation point.

The open nature of the study area meant that it was possible to scan substantial parts of several habitat-types from some of the observation points. Observation time tended to concentrate on areas in which there were birds. Habitat without snowcocks within the study area was regularly recorded however.

MEASUREMENT OF DROPPING DENSITY

Numbers of dropping sets per unit length of straight-line transect were used as an indication of habitat use. The assumption here is that the quantity of droppings is closely related to the time spent by the birds in a habitat-type. It has not been shown that snowcock defaecate at a constant rate however (see Discussion). A totally random defaecation rate might be a safer assumption, this would produce the same result in terms of long-term dropping accumulation.

Straight line transects were walked through the various habitat types and all droppings encountered within 0.5 m either side of the line were recorded. Dropping sets were defined as the quantity of faecal material which is deposited in one defaecation. In open habitat these small clumps (averaging 7 cm^3 for adult snowcock) were obviously distinct. Certain overhanging rocks in vegetated or scree habitat, and many such sites in the rocky outcrop zones, contained huge accumulations of droppings and distinct sets were harder to isolate. Estimates of the number of defaecations in such accumulations could be made by division of the total volume by the average for one dropping set. The habitat type in which found was recorded for each dropping set encountered during a transect, as was a rough estimation of time since its deposition (less than one month, greater than one month). The total length (m) of transect walked in each habitat was recorded so as to produce comparative estimates of "'dropping density' in the form of numbers of sets per unit transect length.

Most plants in vegetated habitats were less than 20 cm in height and so percent ground cover was used to define vegetated areas. Random quadrats (1 m^2) were used to estimate vegetation cover and delineate the habitat types, which were:

Scree = < 2% vegetation ground cover.
'Semi'scree' = > 2 < 10% ground cover
'Semi-scree' = > 10 < 20% ground cover.
Alpine meadow = > 20% ground cover; this was further divided by topographical criteria into: lower meadow, middle meadow and upper meadow.

There were also unvegetated areas of snow, moraine and rock outcrop.

Quadrats were also used to estimate percent ground cover of the predominant plant species in the meadow areas. (10 x 1 m^2 quadrats for each meadow). Spearman's Rank

Correlation Coefficient was used to test correlation between dropping densities and habitat characteristics.

FAECAL ANALYSIS

Direct observations of which plants were eaten yielded some clues as to the constituents in the diet but could not provide any quantification of plants eaten. (Some descriptions of the diet in the literature are shown in Table 1).

Diets of many herbivores have been determined with the use of microbiological analysis of faeces. (Zyznar and Urness 1969; Stewart 1967; Hansen et al 1970). Epidermal fragments and waxy cuticles of plants often escape the digestive process and are egested in the faeces. The specific identificiation of these fragments and their percentage representation is the basis of this analysis.

Dropping set samples from all habitat types and from both adults and juveniles were brought back for analysis in the laboratory. Adult and juvenile droppings were distinguished by average diameter (adults 10 - 14 mm diam,; juvs: 6 -9 mm diam.). In some galliforms it is possibe to distinguish between sexes by the bore size but this would be difficult with snowcock because of the small degree of sexual dimorphism. (Males: 1.8 - 3 kg; females: 1.36 - 1.8 kg, from Ali and Ripley 1969).

There are several key assumptions involved in faecal analysis of herbivorous animals. Firstly it is assumed that plant material eaten is represented in the droppings in the form of indigestible matter. In most plants it is epidermal fragments which survive the chewing and digestion process. Plant cell protoplasm (mainly protein and carbohydrate) is broken down during herbivore digestion and readily absorbed by the gut, but epidermal cells often have a thick, waxy layer of cuticle which is less easily digested. The problem is that different plant food items have different epidermal properties and are likely to be digested to different extents. This differential digestion has not been quantified. (see Discussion).

In this study the area of identifiable fragments of plant epidermis was recorded as well as their frequency of occurrence since the importance of species occurring as large fragments might otherwise be underestimated and vice versa for small fragments. The alternative approach might be to grind the samples over a mesh screen to give uniformity of particle size. This was not appropriate in this study however since the material became more difficult to identify. (Grinding does not necessarily produce size uniformity since e.g. grasses tend to split along their length and may pass lengthwise through the screen apertures).

Leaf epidermis only was counted since stems, roots and vascular tissue were much harder to identify. This was also necessary to give consistency since if other parts of the plant e.g. root tissues were more easily identifiable for one species than another then their importance might be overestimated.

Dropping samples were soaked overnight in 10% sodium hydroxide at 80^{o}C to dissolve the exterior mucus coat and cause the pellets to break up. Domestic bleach at 8% chlorine content, was diluted in the proportion 1:6 then added to the suspension while it was still warm to help clear the fragments of pigments and cell contents. After a few minutes in bleach the material was washed in warm water over a mesh sieve of 75 micron aperture size, through which only very small unidentifiable fragments could pass. A small amount of material was transferred to a slide and mixed with Hoyer's mounting medium (Hansen et al, 1970). The sample was spread homogenously across the slide under a 20 mm x 40 mm coverslip. Five slides were prepared from each composite dropping sample.

In addition to the dropping samples a plant collection was made of all species encountered in the study area. From this, reference slides were produced from many of the plant species found in the vegetated habitats. Small sections of leaf were ground fairly lightly with a mortar and pestle before washing and transferred to a slide. Five drops of Hertwig's Soln (Hansen et al, 1970) is added to the material on the slide and heated over an alcohol burner until the solution has evaporated. This clears the cells of protoplasm and pigments. Hoyer's medium is again used for mounting.

Slides of faecal material were examined under a binocular compound microscope at a magnification of X110 (or x 400 if necessary for final identification). The faecal fragments were identified by comparing them with the plant reference slides of drawings made from them. Plant identification characteristics varied greatly in relative size, shape and abundance but the main clues were from epidermal features such as the size and morphology of cells, the arrangement of stomata and trichomes, the presence of silica cells and the configurations of cell walls (e.g. crenellated or uniform), (Eseau, 1960).

Rather than account for every identifiable fragment of each plant species for each microscope field examined on a sample slide, a 'frequency conversion' technique was used which saved time. The first twenty fragments of leaf epidermis were recorded on each of five slides making a total of 100 fragments per composite sample, and giving percent frequency for each of the plant species involved.

The area of each fragment was measured using a graticule in the eyepiece of the microscope. Areas were recorded in square units and subsequently converted to mm^2 (1 unit = 0.16 mm^2). Systematic sweeps were made across the slide whilst counting fragments and alternate rows were used to avoid duplication.

RESULTS

DROPPING DENSITY AS AN ESTIMATOR OF HABITAT USAGE

Table 2 shows the results of the transect work in terms of droppings per 100 m. The 'scree' (less than 2% veg. ground cover), 'semi-scree' (2-10% veg.), 'semi-scree' (10-20% veg.) totals include counts from several widely separated areas. As in the other habitat types there were some large accumulations below overhanging rocks and these were recorded though not included in the transect data.

The measures suggest that over the longer term the habitat preference in terms of time spent in vegetated habitat is related to the following scheme of decreasing dropping density:

UM > MM > LM > SS10 > SS20 > S > Mor

The 'fresh' dropping densities however seem to suggest the following scheme of usage over the last month before the study:

UM > MM > SS10 > SS20 > LM > S > Mor

The indication of a decrease in use of the lower meadow is noteworthy here. (The pattern of total droppings and 'fresh' droppings do not correlate significantly: R_s = 0.829; Not signif.).

Table 2 also shows average percent ground cover of the plant species found in the vegetated habitat types. The percent ground cover of the predominant plant species in the vegetated habitats is shown in Table 3. (See Appendix I).

Various characteristics of the vegetated habitats were tested for correlation with dropping densities (Table 4 and Fig. 2). The correlations between monocotyledonous grasses and sedges and dropping density is most noteworthy since they are also the most prominent identifiable constituent of the faeces (see next section). Other correlations, of some of the predominant dicotyledous in terms of percent ground cover, are close to being significant but may be a result of the relationship between total vegetation and dropping density which is not far short of being significant itself. The correlation between 'fresh' dropping density and Sibbaldia cuneata may indicate a short-term preference for that plant. This may support the short-term habitat usage change indicated by the difference between 'fresh' and total dropping distributions (ie. very few 'fresh' droppings, 0.6/100 m in LM, and low incidence of S. cuneata in LM, 0.3% plant cover). The habitat characteristic correlations with dropping density could also be coincidental and dropping distributions might be related to the movement of predators for example.

FAECAL ANALYSIS AS AN INDICATOR OF DIET COMPOSITION

Samples were collected from several locations in each of the habitat types, both in open habitat and from roost sites. Comparison of samples from different habitat types showed no more difference than samples compared from the same habitat type, (as

might be expected when on average most of the habitat types are covered during the day). (See direct observation results). Comparison of 'fresh' and 'old' droppings indicated that they differed in composition, but no more than different samples of either 'fresh' or 'old' droppings did when they were compared. (However the sample sizes, less than 8 for each habitat type, may be too small to be conclusive). Droppings from juvenile birds were recognised by their small diameter and were collected. The droppings contained varying amounts of grit, most of which was washed out before slide preparation. About 60% of the material on a slide could be identified to some degree. The results are shown in Table 5.

The identifications of fragments were all made with reference to prepared slides of leaf epidermis from the plants. Thus, no other parts of the plant were sought for identification. It is very likely that non-leaf epidermis of some species was included in the fragment counts, being similar to leaf epidermis. Of the 40% unidentifiable plant matter, much of this is likely to be non-leaf matter of both species which do and do not figure in the list of identifiable fragments. It is possible that much of this material may indicate 'quantities of bulbous shoots and roots in the diet', (Ali and Ripley, 1969), and indeed some root epidermis could be identified, however it appears that leaves are the parts principally represented in this study.

Table 5 shows the large variation in proportions of the major plants represented in the droppings. If a small level of differential digestion is assumed and if amount of epidermis in the droppings does bear a relationship to amount taken in (see Discussion), then the following may be noticed:

1. Sibbaldia cuneata which is not the most common dicotyledon in the meadows (Table 3) is an important constituent in the diet, particularly in juvenile birds.
2. The grasses and sedges constitute about half of the total identifiable plant matter and are thus of importance in the diet, (again these are of low levels of abundance in the meadows although they tend to be more common than most groups in 'semi-scree-areas). This may be particularly so in winter months when less food from flowering dicotyledons may be available.

The differences between 'old' and 'fresh' droppings in terms of the percentage of fragments identifiable were no greater than between different 'old' and different 'fresh' samples. This might indicate that the suggested short-term change in habitat usage, (from the significant difference in the distributions, over the habitat range, of 'fresh' and total dropping densities) was due to something other than a change in vegetation over the months. The varying prevalence of raptors in the area may be a more likely explanation.

DIRECT OBSERVATION AS AN ESTIMATOR OF HABITAT USAGE AND SNOWCOCK ACTIVITIES

Table 6 shows the results of the 124 hours of direct observations in terms of birds/hour of observation/100 m^2 area of habitat. It is given in this form to try to correct the bias in observations of habitat to those in which snowcock were present. The figures are also corrected for the different sizes of the habitat types. It also shows the percentage of the hourly total of birds in each habitat. The data is divided into three board habitat-type categories and plotted in Figure 3.

In broad terms the figure indicates the following trends:

Snowcocks fly down to moraine in early morning from roost sites in outcrop areas. After a short period travelling up through moraine, birds come to meadow areas and have an opportunity to feed. There is a preference for a mid-day roost in outcrop. The meadows are frequented once more during the afternoon. In late afternoon there is a tendency to fly down to the moraine then travel up through the meadow areas to roost in outcrop once dark. This pattern was supported by several longer observations of groups of snowcock throughout the day.

The mean values for total birds/hour/100m^2 for each habitat type (Table 5) suggest the following hierarchy of total usage for the habitat types:

HRO > SS > LRO > Mor >> UM > S > MM > LM

For the non-roosting areas it suggests:

SS > Mor > UM > S > MM > LM

This appears to differ from the hierarchies suggested from the dropping density data which were:

Over longer-term - UM > MM > LM > SS > S > Mor

Over short-term - UM > MM > SS > LM > S > Mor

Indeed there is no correlation between the pattern of dropping densities and mean totals/hour/100 m^2. (With total droppings: r_s = -0.371; with 'fresh' droppings r_s = -0.086).

There does not appear to be any obvious correlation with any of the habitat characteristics which were compared with the dropping density data. It is likely that in correcting for hours spent observing habitat types, moraine and semi-scree habitats may be overestimted in terms of numbers of birds per hour because of the small amount of total observation time. Nevertheless, this direct observation data should give the best indication of habitat usage over the study period.

Table 7 shows the activities of the snowcocks scanned in the habitat types. Records were made of the activity of any birds seen from an observation point every 15 minutes. The activities recorded were: Feeding, Calling, Resting, Preening, Dusting, Walking 'fast', walking 'slow'. The activities are expressed as a percentage of the total scan records for each habitat type. Some activities can be performed simultaneously with others, i.e. snowcock may: Call and Walk, Call and Feed, Call and Rest, Walk and Feed. Thus the percentages of individual activities in a habitat-type may be greater than one hundred in sum. The data of Table 7 is represented in separate activity histograms in Figure 4.

A major finding to note is that the distribution of feeding snowcock over the non-roosting vegetated habitat types correlates with the distribution of dropping densities (Fig. 3). With total droppings/100 m transect: r_s = 0.829, p = 0.05; and with 'fresh' droppings/100 m transect: r_s = 0.945, p = 0.01. Thus the feeding component of habitat usage from direct observation correlates well with dropping density in vegetated habitat and suggests that in non-roosting areas, dropping density might be an indicator of past feeding activity.

Calling takes place in all habitat types. Resting rarely occurs in scree or moraine areas compared with meadow and rock outcrop areas, and the opposite is true of 'fast'walking. All observed preening took place in meadow or outcrop areas; dusting took place in meadow areas, (these samples are small though).

Table 8 gives the results of the activity scans for hours of the day. The results are expressed in terms of percentage of total scanned snowcock for each hour. The data for some of the activities is represented in Figure 5. From this figure it can be seen that calling rates reach peaks in early morning and early evening and that this occurs largely in moraine and scree habitat. If compared with Fig. 3, maximum Resting and Feeding times appear to agree with the greatest occupation of outcrop and meadow areas respectively.

GROUP SIZE

Figure 6 shows the distribution of group sizes observed in 'rocky' and 'meadow' habitats. The distributions are significantly different, (Two-sample t-Test: t = 4.277, d.of.f = 119, $p < 0.001$). The figure indicates that group sizes tend to be larger in rocky habitat.

Fig. 6 does not include one observation in late afternoon of a 'supergroup' of 34 birds. This occurred at 4.30 p.m. The birds were first seen moving from moraine to a scree area with snow patches over which they crossed. They travelled fairly quickly over scree and 'semi'scree' areas with some feeding on grass-heads, roots, and with some birds pecking at the ground, apparently for grit. There was also much displaying of white under-tail coverts by about eight individuals, and some aggressive encounters between pairs of birds. On coming into the upper meadow area the covey broke into four loosely-bound groups of 5, 7, 12 and 10. These groups periodically travelled slowly upwards, rested and fed for about 3/4 hour before separately moving up onto the high rock outcrop in three groups of 7, 12 and 15 (the group of 5 + the group of 10). The

splitting of this major group on reaching the meadow area supports the hypothesis that larger groups are preferred less in meadow areas. Foraging groups were larger in Bland's Ruby Mountains study, (Mean = 8, largest cohesive groups numbered 15 and 17), though he does not mention the habitat type for these groups.

DISCUSSION

The data from faecal analysis appear to support the correlations between certain habitat characteristics and dropping density (see Fig. 2 and Tables 4 and 5). The importance of grasses and sedges in the diet supports the fact that the distribution of these species across the range of vegetated habitat types correlates (r_s = 0.886, $p<0.05$) with the distribution of the quantity of droppings per 100 m transect across the habitat range. Thus, the availability of grasses and sedges in a habitat may be a factor in the level of preference for that habitat. The distribution of Sibbaldia cuneata across the habitats correlates with 'fresh' dropping density and this is also supported by its high incidence in the droppings, particularly the droppings of juveniles. Thus, S. cuneata may have been an important food source over the shorter term, and favoured by juveniles. The overall proportions of the range of plant species in adult and juvenile droppings were however, very similar.

There are several key problems in assigning too much significance to the results from faecal analysis. These arise from the lack of knowledge about the digestive process. The epidermal tissues of different plant species or parts of plant species are likely to be digested to different degrees. Thus, the relationship between the quantity of food taken in and its representation in the faeces is unlikely to be straightforward. All constituents of the diet may not be in the faeces, and relative frequencies of those that are may not indicate relative importance in the diet.

Fragments in the faeces are of variable size. Each plant species may be represented in fragments of a typical size but in what way should the sizes of fragments be taken into account in relation to the number of fragments? Again differential digestion is the unknown variable and for this reason the number of fragments and area of fragments are listed separately in Table 5.

The recognisable fraction of epidermal surface is different from species to species. Thus, those species which can be identified using only a small number of characteristic cell shapes, stomatal structures etc, may be over-represented in the data and vice versa for those requiring a large area of epidermis for identification.

Any quantification of the amount eaten purely using evidence from faeces is also hampered by the fact that the surface of epidermis corresponding to a unit weight or a unit volume is not the same for different parts of plants.

Short of examining the stomach contents of dead birds (which was impossible in this study), there are two possible routes to overcome the above problems:

1. Using digesting solutions to treat plant material. Marti (1982) describes a technique in which plant tissue and faeces are treated in a sequence of processes to produce a conversion factor. This is the number indicating the dry weight represented by one recognisable fragment of one species of plant or part of a plant. Thus the proportion of the weight of one component of the food is obtained by multiplying the number of particles of one plant by its conversion factor.

2. Feeding plant mixtures of known composition to caged birds. This method, (Eastman and Jenkins, 1970, for Red Grouse), involves feeding the known mixtures and looking at the proportion of identifiable fragments, again to produce a correction factor for each plant or plant part.

These methods can still only suggest that certain species/parts of species are broken down to different extents since, for example, plants in one mixture may be broken down to a different extent than in another mixture, or lignins produced in the cuticle at certain times of year may make recognition easier or greater, etc.

Thus, quantitatively reliable methods for diet determination have to account for differences in the possibility of recognising fragments as well as for difference in the stability of the epidermis, and for different relationships between surface of epidermis and weight.

Faecal analysis can produce good qualitative and quantitative results, but in this study only broad conclusions can be made about the general nature of the diet. More data is needed, and in particular a captive feeding programme would be informative. A working knowledge of the snowcock's natural diet would prove useful to establish the basis of its ability to thrive in such barren terrain, as well as helping to elucidate potential threats from grazing animals and man.

The dropping counts provide the only real method for estimating the long-term usage of the habitat. Over the shorter term it would be useful to clear measured areas of habitat and measure rates of dropping accumulation. However in this short study, accumulations would likely have been so small in most habitat areas, to provide little significant data. The 'fresh' dropping densities measured in this study were fairly small and were also likely to include well preserved droppings of different ages. The proportion of droppings remaining visible over time on a transect may possibly differ for the different habitat types. However, the most important un-measured variable is the rate of defaecations since if this is not roughly constant across the habitat range then estimates of habitat usage are rendered less reliable.

Overall direct observations appear not to bear a strong relationship to vegetation characteristics of the habitat. However when feeding activity is considered on its own, a good correlation is found with dropping densities and with the vegetation characteristics with which dropping density itself correlates. Observations may be limited by lack of observation of certain habitats at certain times, however the general trends in birds/hour/area are based on sufficient data to be notable. The distribution of birds may be more related to the need for different group sizes in different habitats or times.

It seems quite likely that the grouping behaviour is a response to the prevalence of raptor predators in the area, Himalayan Golden eagles Aquila chrysaetos daphanea, and Lammergeiers Gypaetus barbatus aureus were increasingly commonly seen contouring the clifflike rocky areas near the study area and sometimes in the study area itself. Five direct attacks by eagles on snowcock were observed, three of these at close range. All of these took place at the top of the lower rock outcrop area. An eagle flew close to a hidden arc of outcrop following the contour, out of visual contact. The snowcock would take-off, rising rapidly into the air with 6-10 wing beats before plummetting down the face of the outcrop in a precipitous fixed-wing glide with the primaries making a low humming noise. On all five attacks observed,

the eagle failed to keep up for more than a few seconds and the snowcock disappeared around some far outcrop or scree, or sometimes out over the glacier before looping back into the moraine. It seemed that the eagle was making these attacks at this point since it could achieve a reasonable element of surprise and the snowcocks were prominently exposed. Bland has noted many similar attacks in his Ruby Mountains study (pers. comm.). Interesting to note was the behaviour of snowcock when approaching the top of the outcrop. Having spent time roosting under overhangs and in crevices, often with several individuals or pairs in close proximity, snowcock would use one of many well-used pathways between the rocks and become increasingly vociferous, vigilant and hesitant as they approached the top of the outcrop and there would be much displaying of under-tail coverts. Once above this point they could branch off into either scree or semi-scree leading to the upper meadow area, and calling frequency decreased. It did seem that this behaviour would be likely to make snowcock much more obvious audibly and through loss of crypsis by the display of white under-tail coverts. Alternatively these behaviours were important because the increased risk of attack through display is outweighed by the benefit of alerting other members of the group to the potential danger. This benefit might accrue from a component of kin selection, i.e. warning kin of danger may prove genetically beneficial in the long term. Or it might be a result of the need to maintain group structure for long term benefits.

A variety of mechanisms may render group membership safer than solitary existence. Grouped prey often detect an approaching predator sooner than do solitary individuals, (Pulliam, 1973; Lazarus 1979, Powell 1974, Siegfried and Underhill 1975). This occurs even though each individual in a group usually spends less time in vigilance behaviour (Bertram 1980, Elgar and Catterall 1981) and can therefore allocate more time to other activities. Earlier detection increases the likelihod of escape; this advantage may be particularly large if group members give an alarm when a predator is sighted. (Charnov and Krebs 1975). Or the need for a group may be for directly selfish reasons e.g. the prey may aggregate in an attempt to place conspecifics between themselves and an attacking predator. If attack rate is independent of group size, and a predator kills only a single prey when successful, an individual benefits from a ´dilution´ effect in a group.

In the meadow habitats the reverse might be true. Large groups might be more conspicuous than small ones to a predator searching at a distance. Indeed the crypticity of snowcock in areas of vegetation with bare patches is remarkable. It seems likely that the generally smaller group sizes in meadow are a response to foraging needs. With the overall diversity of plant species available (and indeed those found in the faeces) in the meadows it seems unlikely that there would be much benefit from an increased rate of discovery of food sources that a group might bring. It also seems likely that, due to the open nature of the meadows, attack by predators loses much of the advantage of surprise and therefore large groups of prey to give an increase in overall vigilance may be less important. The meadow areas are quite steep allowing similar escape methods as in rock outcrop. (It is interesting to note that much of the moraine/scree area is flatter than the upper meadow, perhaps explaining their ´unpopularity´ much of the day, and in terms of dropping density (Fig. 2), and the speed over which they are travelled (Fig. 4).

This discussion remains conjectural with the present data but I suggest that the threatened or real presence of predators influences habitat usage and social behaviour to a large degree. That groupings tended to be larger towards the end of August when there was a greater raptor presence appears to support this. (There were a greater number of passes over the study area by eagles, Lammergeiers, and occasionaly Himalayan Griffon Vultures Gyps himalayensis in the last week than in other weeks).

The displaying of the white under-tail coverts by both sexes, as mentioned above, was a striking and clearly visible signal, frequently given in ´flashes´ by members of a

pair or certain members of a group whilst travelling uphill, or given for longer periods whilst calling at rest. Since these under tail-coverts are present in the female as well as the male it is likely that they have the effect of alerting other birds in visual contact that they act as a following signal. This function has been noted for Tetraogallus himalayensis by Meinertzhagen (1927) and Ali and Ripley (1969). It could also act as a signal to young that there is danger ahead when the female adopts a threat posture. Davison (1976) looked at pheasant species in which the female possesses striking tail or under-tail covert patterns and concluded that the major function of a striking tail is as a general alerting signal to conspecifics.. In the four species of pheasant studied in which under-tail coverts are also striking in females, (Koklass Pheasant, Pucrasia macrolopha, Elliot's Pheasant, Syrmaticus ellioti, Bar-tailed pheasant Syrmaticus humiae, and Mikado Pheasant Syrmaticus mikado) Davison concludes a similar function and suggests that the similarity of function accounts for the similarity of pattern between under-tail coverts and retrices in these species. Possession of a relatively short tail is common to all these birds and may have been important in the evolution of the correlation between plumage and behaviour.

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FIGURE 2.

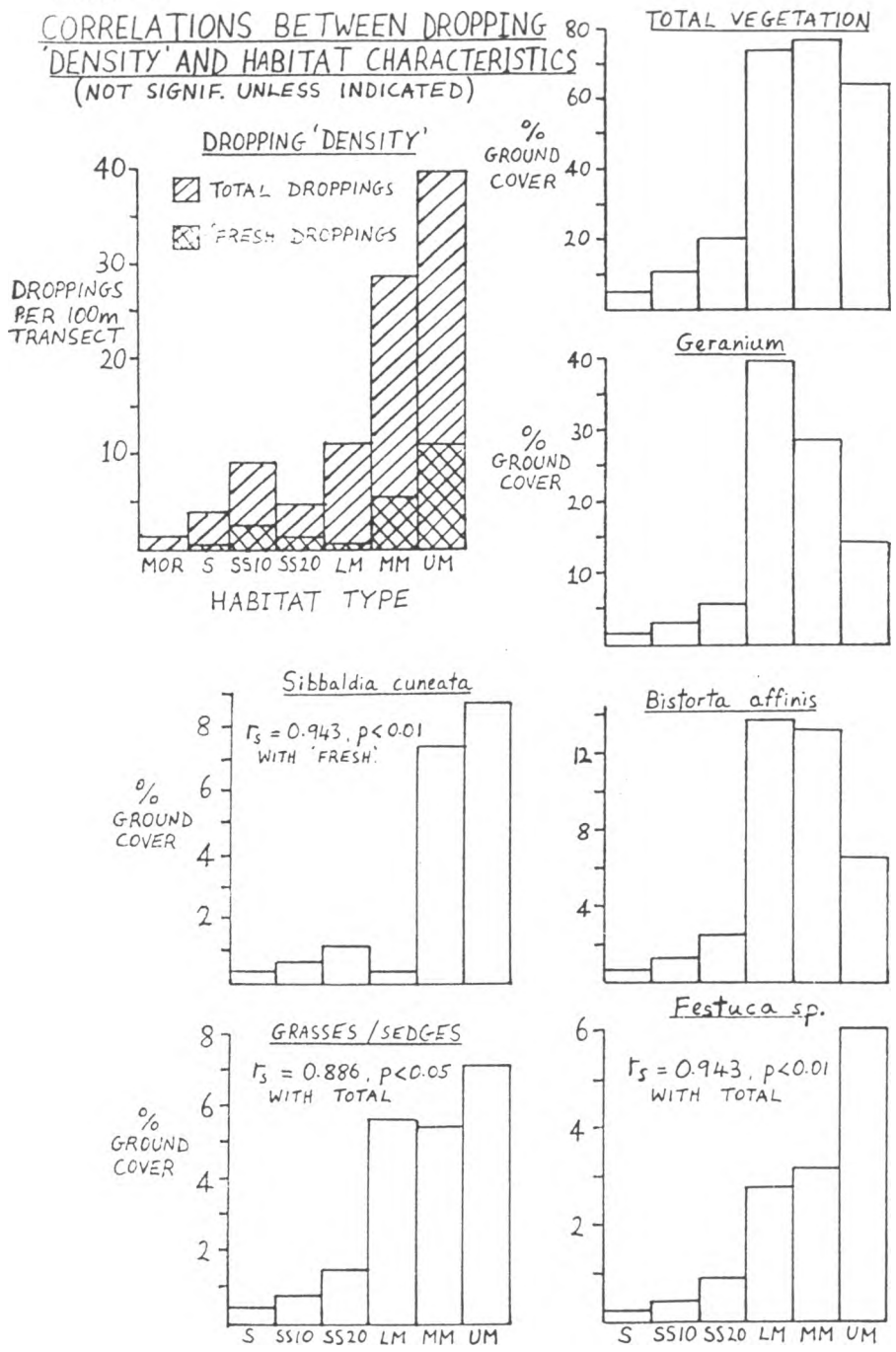


Figure 4. Activities of Snowcock in the Habitat Types

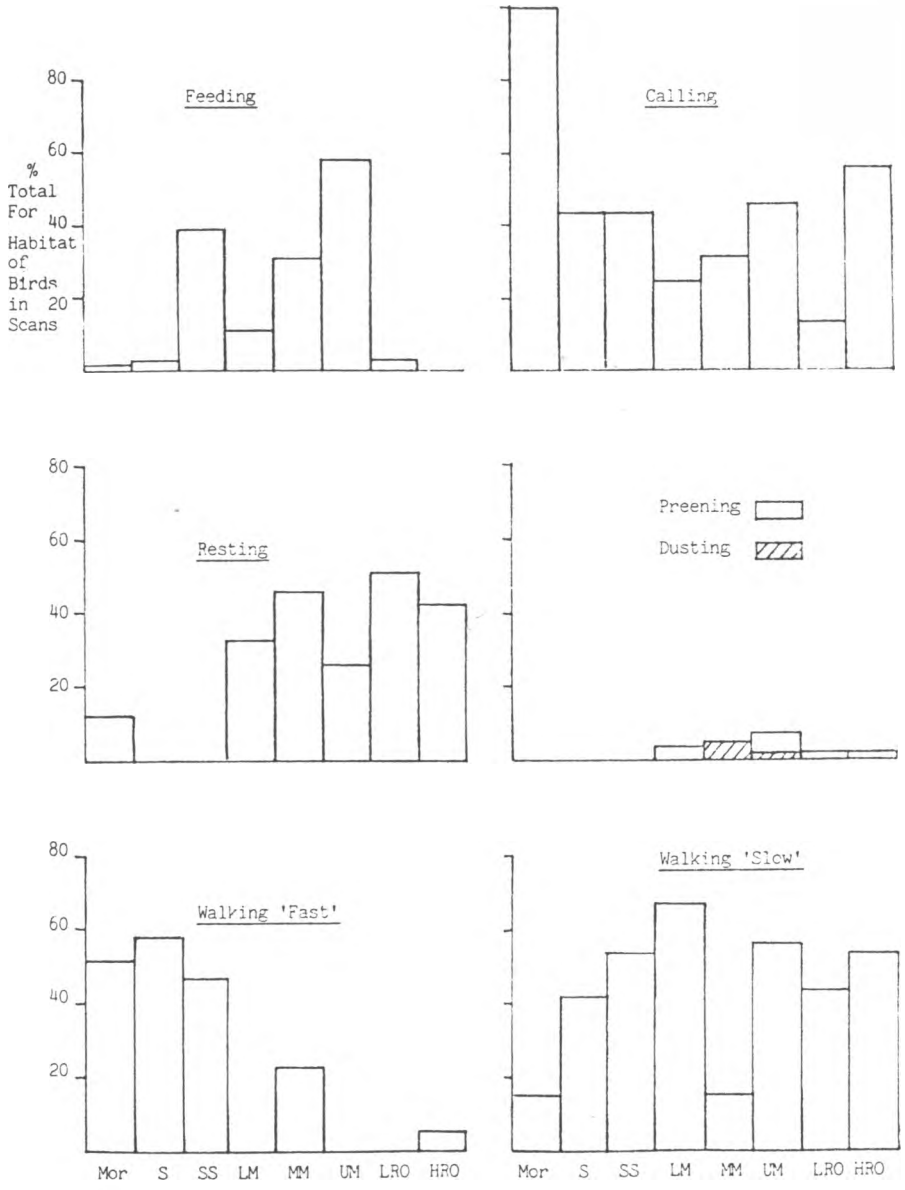
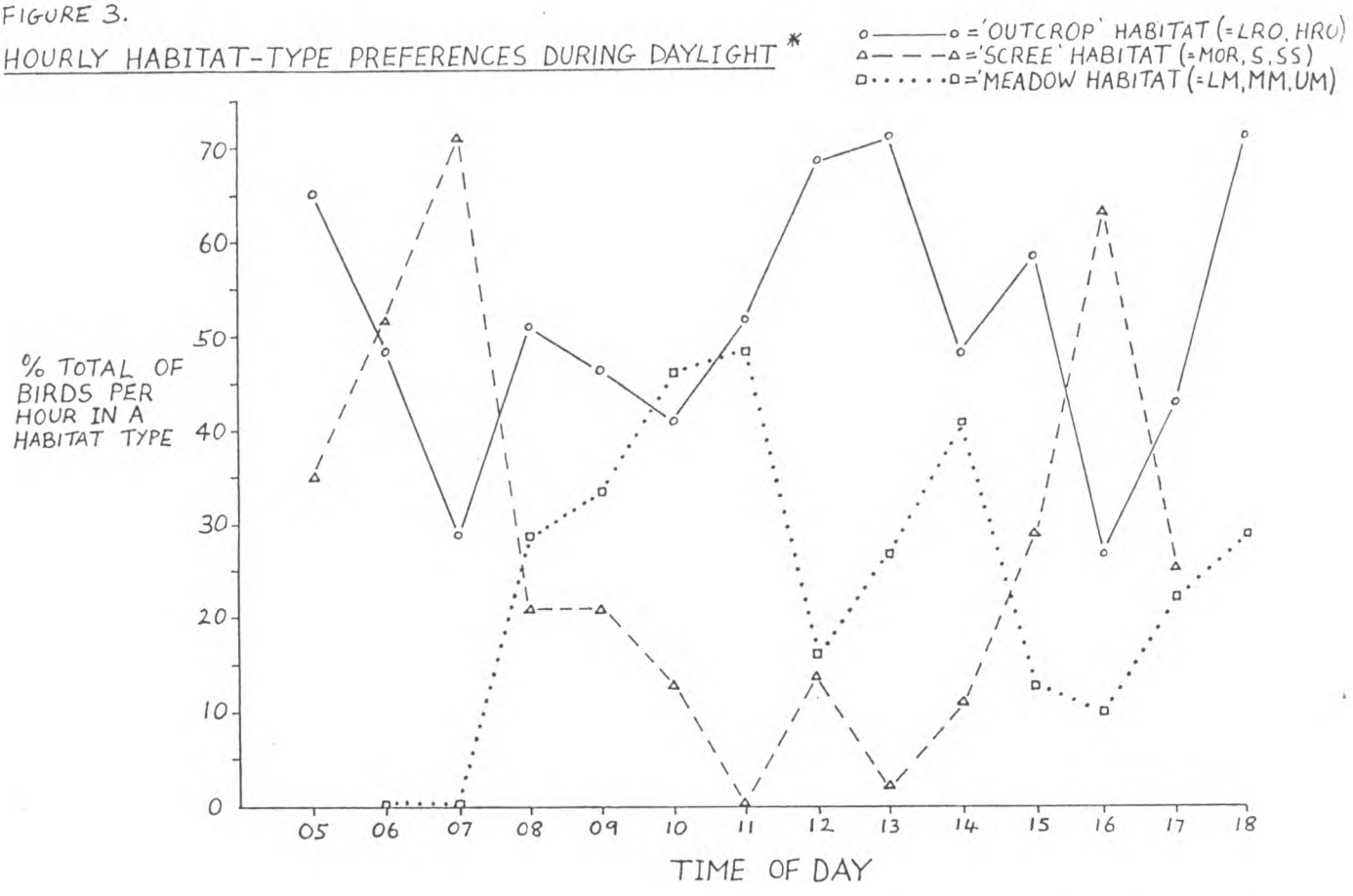


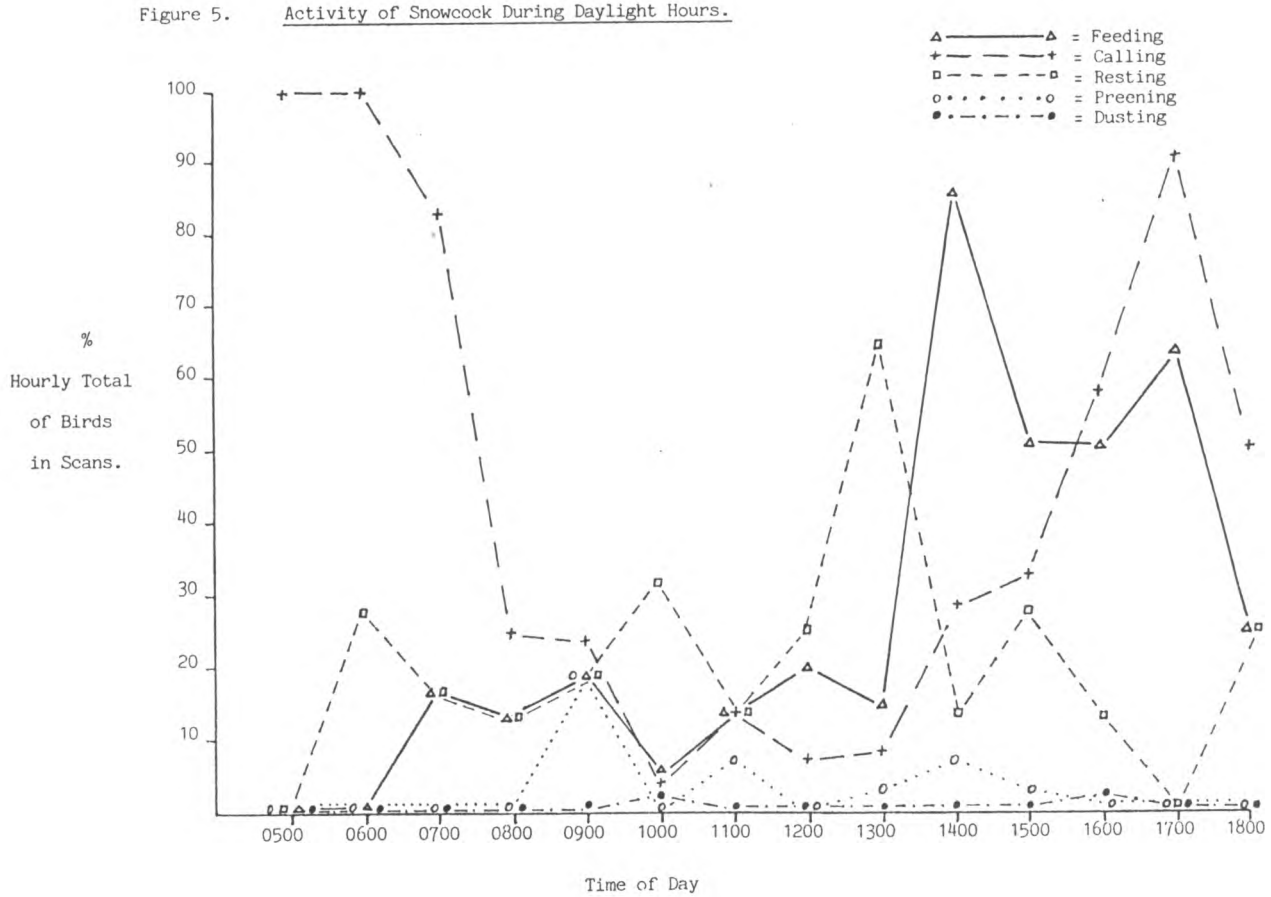
FIGURE 3.

HOURLY HABITAT-TYPE PREFERENCES DURING DAYLIGHT *



* CORRECTED FOR DIFFERENT AREA SIZES.

Figure 5. Activity of Snowcock During Daylight Hours.



APPENDIX

List of flowering plants collected in the study area above the Minapin Glacier.

(All plants found in meadow areas except:
* = also in 'semi-scree' and rock outcrop areas
@ = only in 'semi-scree and rock outcrop areas)

Epilobium augustifolium L.	Onagraceae	Tanacetum tomentosum DC (syn. S. senecionis)	Compositae
Sedum ewersii Ledeb.	Crassulaceae	Nepeta linearis Royle*	Labiatae
Rhodiola aff. wallichiana*	Crassulaceae	Dracocephalum nutans L.	Labiatae
Potentilla atrosanguinea Lodd (syn. P.argyrophylla	Rosaceaea	Pedicularis sp.	Scrophulariaceae
Potentilla fruticosa agg. var. pumila Hook.*	Rosaceaea	Myosotis cf. alpestris F. W. Schmidt	Boraginaceae
Bistorta affinis (D.Don) Greene (syn. Polygonum affine)*	Polygonaceae	Bergenia stracheyi (Hook F. & Thoms) Eng. @	Saxifragaceae
Rumex sp. (nepalensis?)	Polygonaceae	Salix aff. flabellaris*	Salicaceae
Rheum sp. (webbianum or tibeticum)	Polygonaceae	Delphinium cf. brunonianum Royle*	Ranunculaceae
Cicer microphyllum Benth.	Leguminosae	Silene aff. tenuis	Caryophyllaceae
Oxytropis sp.	Leguminosae	Gentiana thianshanica Rupr ex Kusn	Gentianaceae
Geranium aff. collinum*	Geraniaceae	Carex sp.*	Cyperaceae
Senecio cf. chrysanthemoides DC.	Compositae	Festuca sp.*	Gramineae(Poaeceae)
Taraxacum sp.	Compositae	Alopercurus himalaicus Hook.f.*	Gramineae (Poaeceae)
Anaphalis cf. triplinervis (Sims)*	Compositae	Phleum alpinum L.*	Gramineae(Poaeceae)

(Specimens now deposited in herbarium of C. A. Chadwell)

Table 1

Diet of Himalyan Snowcock, notes from the literature

Ali and Ripley (1981)	'Chiefly bulbous roots and tubers, and green vegetable matter incl uding grass shoots, along with which a good deal of grit is swallowed! Artemisia leaves, Ephedra berries and heads of a rye-like grass.'
Bland (1984)	'Casual observations of dropping contents suggested Potentilla, Carex, Trisetum, Deschampsia, Festuca, Poa and grit made up most of the summer diet. The flowering parts of the woody Potentilla fruticosa, and ripe berries of Ribes were also taken when available.'
Flint et al. (1984)	'Feeds on various parts of grassy and shrubby plants, also on bulbs, flowers, insects; in winter, on thin branchlets and seeds.'
Meinertzhagen (1927)	'Stomach contents; dried grass-stems, green food, small bulbous roots, with a plentiful supply of large quartzit grit.'

(Extensive accounts of the diet of Caucasian Snowcock Tetraogallus Caucasicus have been published by Baziev (1965), see Cramp and Simmons (1980).

Table 2 **Dropping Densities in the Habitat-Types (See Fig. 1)**

Habitat Type		% Veg. cover	Total Droppings per 100 m Transect	Total Transect Length Measured (m)	'Fresh' Droppings per 100 m Transect
Glacial Moraine	(Mor)	0	0.8	210	0
Scree: < 2% Veg. cover	(S)	<2	3.8	970	0.5
'Semi'scree' with 2-10% Veg. cover	(SS10)	2-10	4.6	250	2.4
'Semi'scree with 10-20% veg. cover	(SS20)	2-20	8.8	410	1.0
Lower Meadow	(LM)	74	10.7	1740	0.6
Middle Meadow	(MM)	76	28.4	610	5.3
Upper Meadow	(UM)	63	39.5	830	10.8
Lower Rock Outcrop	(LRO)	<5	*		*
Higher Rock Outcrop	(HRO)	<5	*		*
			r_s = 0.829		
			Not significant		

*Very large quantities in particular sites

Table 3

The Percentage Ground Cover of the Major Plant Species in the Three Meadow Areas

Species listed in Appendix but not included here occur at less than 1% ground cover in all meadow areas. Species occurring in semi-scree areas usually occurred in isolated clumps which totalled less than 20% vegetation cover.

Species			
Sedum ewersii	7.0	5.9	3.7
Potentilla atrosanguinea	<1.0	1.0	<1.0
Rhodiola aff. wallichiana	1.1	4.1	5.6
Potentilla fruticosa	<1.0	7.3	8.7
Bistorta affinis	13.5	12.9	6.5
Rumex sp.	<1.0	<1.0	<1.0
Oxytropis sp.	<1.0	3.4	5.5
Geranium aff. collinum	39.5	28.3	14.2
Taraxacum sp.	2.2	<1.0	<1.0
Anaphalis cf. Triplinervis	<1.0	<1.0	1.5
Myosotis cf. alpestris	1.1	<1.0	<1.0
Salix aff. flabellaris	<1.0	<1.0	2.0
Festuca sp.	2.7	3.1	6.0
Other Gramineae/Cyperaceae	5.4	5.3	7.0
Earth/Rock	25.9	24.4	37.0

FIGURE 6. GROUP SIZES IN 'ROCKY' AND 'MEADOW' HABITAT
($t = 4.277$, $d.of.f = 119$, $p < 0.001$)

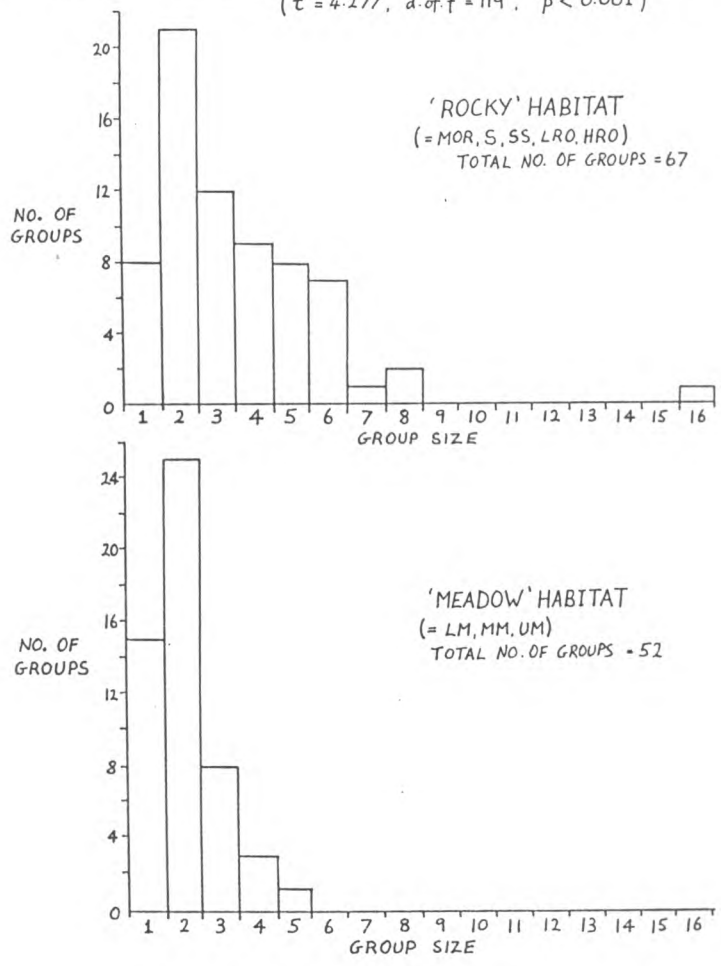


Table 4 Correlations Between Characteristics of the Habitat-Types and Dropping Densities. Spearman's Rank Correlation Coefficient (Campbell, 1974) (Not Significant Unless Shown)

Characteristic of Habitat Types	Correlation (r_s) with: Total Droppings	'Fresh' Droppings
Total Vegetation as % ground cover	0.771	0.486
Geranium Collinum as % ground cover	0.714	0.314
Sibbaldia cuneata as % ground cover	0.771	0.943 S(p<0.01)
Bistorta affinis as % ground cover	0.714	0.314
Total grasses-sedges as % ground cover	0.886 S(p<0.05)	0.6
Festuca sp. as % ground cover	0.943 S(p<0.01)	0.771

(See Fig. 2)

Table 5 **Composition of Identifiable Plant Matter in Snowcock Faeces**

ADULTS (Faeces: 10-14 mm diam, Mean = 13 mm) JUVS. (Faeces: 6-9 mm diam, Mean = 8 mm)

Plant Species	Mean % Total Number of Fragments	S.D	Range	Mean % Total area Fragments	S.D.	Range	Mean % Total Number of Fragments	S.D.	Range	Mean % Total Area of Fragments	S.D	Range
Geranium collinum	14	5.5	(9-22)	11	5.0	(3-24)	13	5.6	(8-18)	13	7.3	(4-22)
Sibbaldia cuneata	19	9.3	(1-35)	25	15.4	(1-60)	31	9.4	(19-41)	35	9.7	(24-46)
Bistorta affinis	5	2.9	(1-12)	4	3.0	(0-13)	0			0		
Salix flabbelari	1	0.4	(0-3)	0.5	0.3	(0-2)	0			0		
Unident Dicotyledo	4	2.8	(3-11)	2	1.6	(0-9	1	0.5	(0-3)	0.5	0.3	(0-2)
Carex sp.	4	2.8	(3-11)	2	1.4	(0 -7)	2	0.5	(0-3)	1	0.4	(0-2)
Festuca sp	2	1.2	(0-6)	1	2.9	(0-11)	3	1.3	(2-3)	0.5	0.2	(0-2)
Poa.sp.	14	10.7	(0.39)	24	12.3	(0-67)	24	5.4	(9-19)	18	6.5	(10-25)
Alopecurus himalacus	15	5.5	(6.27)	12	5.2	(4-21)	12	4.2	(8-15)	13	6.2	(8-18)
Unident Graminae/ Cyperaceae	17	13.3	(0.48)	8	6.7	(0-31)	23	8.6	(14-30)	17	5.2	(14-20)
Moss	4	2.9	(0.12)	11	6.5	(0-33)	2	1.0	(1-3)	3	1.2	(1-5)

Total Fragments counted per sample = 100 Total Samples = 21,	Mean Total area of Fragments per sample = 198 mm^2 Total Slides = 105	Total Fragments counted per sample = 100 Total Samples = 7,	Mean Total Area of Fragments per sample = 156 mm^2 Total Slides = 35

Some trace amount of fern were also identified

1 = Dicotyledons
2 = Grasses/Sedges (Graminae/Cyperaceae)

Table 6. Total Birds Per Hour of Observation, Corrected For Different Area Sizes. Total Hours Observation and Percentage of the Hourly Total Also Shown.

1 = Hours of observation, 2 = Birds seen/Hour of observation/100m^2, 3 = % Total/Hour/100m^2 for the hour of day

Time	Habitat Type																									Total
	Mor			S			SS			LM			MM			UM			LRO			HRO				
of Day	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3		2
0500	0.75	0.6	35																0.25	1.1	65					1.7
0600	1.5	5.8	52							0.5	0.0	0	0.5	0.0	0				0.75	5.3	48					11.1
0700	0.25	1.2	71							1.0	0.0	0	1.0	0.0	0				1.25	0.5	29					1.7
0800	2.0	0.0	0	0.5	1.0	21				3.25	1.3	28	3.0	0.0	0				3.0	0.0	0	0.25	2.4	51		4.7
0900				0.5	1.5	21				5.0	0.4	6	1.75	0.0	0	1.5	1.9	27	4.0	3.2	46					7.0
1000				1.0	1.0	13				1.25	0.0	0	0.75	1.8	24	2.0	1.7	22	1.5	1.6	21	0.25	1.5	20		7.6
1100	1.0	0.0	0							3.0	0.0	0	2.5	1.8	35	2.5	0.7	13	1.5	2.7	52					5.2
1200	0.25	0.6	2	0.75	1.5	6	1.0	1.6	6	6.75	2.0	8	6.5	0.0	0	1.75	2.1	8	4.5	17.1	69					24.9
1300				0.75	0.2	2	0.5	0.0	0	3.0	0.0	0	2.5	0.0	0	2.0	2.4	27	2.75	4.3	49	0.25	1.9	22		8.8
1400				0.25	0.0	0	0.5	0.5	11	3.25	0.0	0	3.75	0.6	14	0.5	1.2	27	2.5	2.1	48					4.4
1500							1.0	2.7	29	1.75	0.0	0	1.75	0.0	0	1.75	1.2	13	2.25	2.1	22	0.5	3.4	36		9.4
1600	0.5	11.7	30	1.5	9.5	24	1.25	3.6	9	1.5	0.0	0	1.5	0.0	0	2.5	3.8	10	1.0	0.5	1	2.5	10.2	26		39.3
1700				0.75	1.7	4	0.5	11.0	25	1.5	0.0	0	1.25	1.2	3	1.0	9.7	22	0.75	1.6	4	1.25	18.9	43		44.1
1800																0.25	0.5	71	0.25	0.2	29					0.7
Mean		2.8	27		2.1	11		3.3	13		0.3	4		0.5	6		2.7	24		3.0	35		6.4	33		

Table 7

Activities of Snowcock in Habitat-Types. Scans Made at 15-minute intervals. Percentage of Total Birds Scanned in the Habitat-Type in Parentheses.

	Habitat Type							
	Mor	S	SS	LM	MM	UM	LRO	HRO
Feeding (F)	1(1)	2(3)	33(38)	5(11)	8(31)	110(58)	3(3)	0(0)
Calling (C)	65(100)	34(43)	40(43)	11(24)	8(31)	86(46)	13(13)	41(55)
Resting (R)	8(12)	0(0)	0(0)	15(33)	12(46)	47(25)	49(51)	31(42)
Preening (P)	0(0)	0(0)	0(0)	1(2)	0(0)	12(6)	1(1)	1(1)
Dusting (D)	0(0)	0(0)	0(0)	0(0)	1(4)	2(1)	0(0)	0(0)
Walking 'Fast' (WF)	34(52)	46(58)	44(47)	0(0)	6(23)	0(0)	0(0)	4(5)
Walking 'Slow' (WS)	10(15)	33(42)	49(53)	30(67)	4(15)	105(56)	42(43)	39(53)
TOTAL	65	79	93	45	26	189	97	74

(see Fig. 4)

Table 8

Activities of Snowcock During Hours of the Day
Scans made at 15 min. intervals. percentage of Hourly Total in Parentheses

	Activity							
	F	C	R	P	D	WF	WS	Total
0500	0	6(100)	0	0	0	0	6(100)	6
0600	0	29(200)	8(28)	0	0	0	9(31)	29
0700	1(17)	5(83)	8(28)	0	0	0	5(83)	6
0800	2(13)	4(25)	2(13)	0	0	0	10(63)	16
0900	10(29)	12(13)	10(20)	10(20)	0	0	29(59)	49
1000	3(6)	2(4)	25(32)	0	1(2)	14(20)	30(64)	47
1100	2(14)	2(14)	2(14)	1(7)	0	0	8(57)	14
1200	22(20)	8(7)	28(25)	0	0	0	75(67)	112
1300	11(15)	6(8)	46(65)	2(3)	0	0	12(17)	71
1400	12(86)	4(29)	2(14)	1(7)	0	12(86)	2(14)	14
1500	20(51)	13(22)	11(28)	1(3)	0	2(5)	26(67)	39
1600	87(51)	99(59)	22(13)	0	2(1)	196(63)	21(12)	169
1700	72(64)	102(91)	0	0	0	8(7)	108(96)	112
1800	1(25)	2(50)	1(25)	0	0	0	1(50)	4

(See Fig. 5)

A Captive Snowcock

DIARY OF THE EXPEDITION

Summary

July 16th - July 31st: Travel and organisation
August 1st - August 28th: Project work and Climbing
August 29th - September 13th: Preparation for and undertaking of trek
September 14th - September 21st: Travel to UK

July 15th: Final frenzied activity executing the three Ps, packing, purchasing and panicking followed by a rendezvous at Bob's house to view Mick Burke's Expedition Film awards on TV. Rather than wet our appetites, it highlights the pitfalls of such trips. Self-righteously we declare our trip will be different. To bed feeling sick from the arduous task of demolishing all food supplies we are unable to take.

July 16th: London to Karachi courtesy of Air France. Uneventful except for budget breaking refreshments in Charles de Gaule airport and a very dreadful movie, comprehensible to anyone with a couple of neurons except IS who fails to discover the English sound track until the finale.

Met by our old Emmanuelian contact, Fakir, and whisked to the colonial oppulence of the Sind Club.

July 17th: An embarrassment. Thrown out of Sind Club officially for being under-aged but actually because PT revealed his legs at breakfast. Installed at Beach Luxury Hotel, all courtesy of Fakir. To all corners of Karachi making preparations. Karachi is a surprise; cosmopolitan, wealthy yet possessing a drab postwar pre-fab look and quiet compared to Indian cities, the model upon which we had based our expectations.

July 18th: Socially hectic. Interspersed between organising air freight, return flights and train tickets were lunch at the Karachi Boat Club (rejected once for inappropriate attire), an illegal drinks party with the Pakistani elite and dinner at the Hotel Intercontinental. Consciences are pricked that this was not our purpose in Pakistan. Others happily accept that it is our duty to accept such hospitality and plenty of suffering is to come later. IS gleefully takes such duties to heart choosing lobster, priciest item on the menu, whilst PT gets indigestion.

July 19th: Off to Lahore, RH, JM, KB and PT by train (60Rs for student), JB and IS by express coach (300Rs + non-stop Pakistani pop music) but only after yet more frenzied activity concerning stove gas impounded at the airport and meeting our first medical contact. PT and RH meet a Karachi medical student mentioned to us by Oxfam in the UK, who, as their drug monitoring representative in Pakistan, is running a one man crusade against commercial and marketing malpractices and drug abuses perpetrated by the multinational pharmaceutical companies. Despite the enormity of the task his determination and dedication to challenge unethical, if not illegal, activities is unflinching and our respect and admiration are immeasurable.

July 20th: Fall into the Orient Hotel (a seedy 45Rs each rip-off) with a life's time supply of dirt, tiredness and irritability from the 24 hour journey on wooden seats. The shower fails to do its duty but KB comes to our rescue.

July 21st: JM, JB, IS and KB to Rawalpindi by express coach (60Rs) whilst RH and PT attempt to track down medical contact number two.

July 22nd: RH and PT meet Professor Farakh Khan of the Postgraduate Medical Institute at Lahore University. Although enthusiastic to talk about his own work his help is limited simply giving them another contact. Very frustrated, having plenty of interesting encounters yet getting nowhere in a hurry.

RH and PT to Rawalpindi, finding an expensive yet highly recommended hotel, the Citizen (70Rs a double).

July 23rd: More contacting of yet more contacts and visits to the Pakistan Tourist Development Corporation (PTDC) to unravel the complexities of obtaining permission to enter restricted zones of the Northern Areas - they remain ravelled. JB and IS visit Peshawar University and Professor Tahirkheli, its Vice-Chancellor so as not to be outdone in

sociability by the medical contingent. Advice, equipment and a useful contact in Gilgit are all given. KB unwell but tears himself from his sickbed to join us for supper at the house of Peter Arnold, a fascinating globe-trotting oil drilling operations manager.

July 24th: PT to Peshawar to visit Dr. Mohammed Ilyas, a cardiologist who proves very helpful having undertaken much blood pressure research himself. He gives advice, a contact in Gilgit and offers us a chapter in his forthcoming book, Mountain Medicine, if the project works well. Despair turns to elation.

High hassle factor as JM and RH undertake hand-to-hand combat with two Morris Minor owning taxi drivers who require an arm and a leg to transport our gear and bodies from a sleazy hotel in Islamabad to the Citizen in Pindi. The final deal is just an arm and a coke on arrival.

As KB continues to die, JM and RH meet the remarkable Minister of PTDC, Lady Noor, to gain official status for our projects and to get permission for restricted areas. They fail on both accounts being categorically informed that they are wasting our time since its "all been done". "We all know glaciers move two inches a year, the medical project is in a book and I'll find a nice trek on which you can bird watch"! They then receive a lecture on the world's mis-understanding of Pakistan's highly democractic political system and are told that the country's economic failings would be overcome if the man in the street were "a more frugal fellow." JM and RH realise that the interview, though entertaining, is less than totally constructive and they bid their farewells. A low profile is evidently the best policy.

July 25th: KB returns from the dead and his efficiency is once more appreciated as he organises future travel. JM and RH scour the length and breadth of Pindi for equipment. Much coke-drinking, impromptu jam session with trumpeters in a music shop and tasteless headgear selection but nothing constructive. Items required are found eventually after advice from lady at Tourist Office. RH falls immediately in love. JM follows but denies it. JB and IS return elated by success in Peshawar. Capital of the North-West Frontier Province, it is a fascinating place, gateway between Central Asia and the sub-continent, frontier guardpost and commercial trading post, home of the warrior Pathans and more recently base for the Mujarhadeen guerillas in Afghanistan. All very well but IS assures us the interest lies in the ice-cream and milk shakes.

PT returns hassled from Peshawar with eleventh hour desires for weighing scales and another mercury sphygmomanometer. They say Pindi's bazaars have everything!?

July 26th: To Gilgit, RH and JM in 22 hours by readily overheated pre-war Bedford bus (80Rs) with metal seats designed for pigmies. Hot, sweaty, dirty, painful but good for developing scrabble skills. IS, KB and PT have more sense, flying PIA in two hours with stunning views of the Karakoram, Nanga Parbat especially, as plane flies through rather than over the mountains. Exhilarating but low on the masochistic and retrospective pleasure felt by bus. Cheap (170Rs) due to government subsidy. JB compromises by taking the minibus in 16 hours (150Rs) and arrives in better shape than the other navigators of the breaktaking Karakoram highway.

July 27th: Gilgit (4900 ft), historically volatile and alternately ignored and fought over, has always been a place which travellers must pass through for all central Karakoram destinations. Not particularly interesting in itself, it is friendly with comfortable cheap hotels and plenty of opportunity for gastronomic abuse before the austerity of the Karakoram proper.

Intensive, frustrating discussions amongst the six leaders finally formulate a tentative plan to reconcile three projects with widely differing requirements and objectives. Our expedition is big on logistics. Useful information on terrain, treks, transport and porters is obtained from G.M. Beig, whose shop sign informs us that he is anthropologist, shopkeeper and social worker (beginning to be required), and Mr. Karim, proprietor of the Tourist Cottage (20Rs, comfortable and best food in town). JM and RH do silly things like die of thirst and unfitness, climbing 'a small ridge' above Gilgit and are humiliated playing volleyball

with the army. Not to be outdone JB shocks the locals by jogging (a world first in the area) bare-chested in a temperature of 99.9°C. IS, PT and KB having not yet taken leave of their senses consume numerous cups of tea and biscuits with every shopkeeper in town in the cause of good international relations. Longlife milk and Jubilee chocolate bars become stable diet: JB disapproves as he takes another bite. IS drinks the town dry of cokes.

Manzoom Ali, a geography lecturer at Gilgit College and a contact of Professor Tahirkheli from Peshawar, agrees to accompany the geologists for the early stages of their project. PT and RH meet a local doctor, Ejaz Tahseen ex-director of the Rural Health Scheme, who offers constructive advice and at last the medical project looks like getting somewhere. An unlikely character, short, ruddy, rotund and smoking continuously he is fascinating and talks at length of his plans and hopes for the future, those medical in nature tempered with a realism that economics would govern the rate of progress, unusual in a country where enthusiasm tends to be boundless. As local director of the opium deintoxification centre he coordinates activities with the World Health Organisation and uses a combination of rapid drug withdrawal, supportive care and acupuncture as his therapeutic regime. After early setbacks his methods are showing promise. Respected throughout the Northern Areas, his advice and letters of introduction to local doctors and officials could prove invaluable.

July 30th: Having defied the laws of physics by loading absurd amounts of gear into a Suzuki open-backed mini minibus, fond farewells and good lucks are said and photographs taken. JB, IS, JM, KB and Manzoom Ali disappear into the heat haze, incongruous plastic guttering, crucial to the project, projecting spine-like from all corners of their chariot. Their destination, Minapin, is reached 3 hours and several vehicle man-handling exercises up 1 in 3 inclines later.

PT and RH travel in greater comfort to Hunza in a Ford Transit, all senses alive with stunning views of Rakaposhi, the bleak, barren and arid Karakoram and the tortuous precipitous highway; with the sound of piped Hunza music, a formless cacophony of drums and horns tussling for prominence, and of a goat bleating angrily under the seats, crushed between back doors and human hind legs; and with the smell of squashed apricots and the aforementioned goat's body secretions. Horror greets the journey's end as a bag of provisions, precious Yorkies and Kit-Kats included, is discovered severely depleted and a very contented smiling goat hops out of the van. PT and RH hope it will be very sick.

July 31st: The glaciologists and ornithologist(s) ascend to the snout of the Minapin glacier and meet for the first time examples of the scheming, irrascible, lazy and irritating porters of the Northern Areas who try every trick in the book to avoid moving more than a yard or two on each calendar day.

The medics are also energetic, climbing to the base camp of a British climbing expedition Ultar II to say hallo. Timing of the arrival could not be worse, the attempt on the summit having been abandoned for the last time. RH and PT make themselves scarce as faces burnt by weeks of sun, wind and ice-glare turn very long and very silent.

August 1st: JB and JM move up to Kachelli, a grazing area besides the glacier at 12000 ft and set up basecamp for the glaciology project. JB becomes ill and regrets the gallons of kurd he has consumed since striking out into the hills. IS, KB and MA attack the glacier snout with stripey poles and tall coffee tables.

It's day 17 of the expedition and at last RH and PT pump up the sphygmomanometers in anger. The day is spent bewildered by the huge discrepancies in BP measurement between the two workers. Agreement is finally reached.

August 2nd - 10th in Baltit; A time of frenzied activity, illness, lethargy and enthusiasm, all four states being interchanged so readily that it becomes exhausting just trying to work out how one feels at any one time. The project begins to take shape but not before white hairs sprout in abundance and faces take on a world-weary air. A word or two of the local lingo and

energetic sign language often have to surfice as interpreters find urgent business elsewhere. Pakistanis have a strong sense of duty insisting that as honoured guests we should be helped at all times, and yet they have no concept of punctuality and of sticking to agreements. Many a time frustrations nearly get the better of us as enthusiastic potential interpreters honour us with their absence. Slowly but surely we develop a routine and gain acceptance and familiarity making the project a lot easier. Dr. Johar Ali is interested and helpful but fails to fully appreciate our requirements for a random representative sample of the population. We resist his wishes for us to set up shop in the hospital and we move to the resting places in the village. Huge quantities of apricots are consumed and we regularly suffer the consequences.

August 2nd - 4th on the Minapin glacier: JM has a frustrating time combing the countryside for his study beasts whilst JB sits out a miserable and energy-sapping illness with occasional sorties onto the glacier. They get to know a French climbing group who are attempting Diran (and just about to abandon it) and especially enjoy the company of the group's talented and interesting Pakistan army Liaison Officer. JM finally tracks down his birds after advice from the officer of where to look.

August 5th: IS, KB and MA arrive at Kachelli having completed mapping the snout. They appear to have neglected to eat and JM and JB, now recovered, try to restore healthy excesses.

August 7th - 10th: IS and JM move up the glacier side to the snowcock study area and have a successful time frolicking in the alpine flower-clad meadows adding spice to the mundane daily existence of the numerous snowcocks. A hide is built to the amusement of the birds. Views of Diran, Rakaposhi and the glacier are stunning as is the taste of the daily picked rhubard.

KB, JB and MA litter the glacier with plastic poles in the cause of science.

August 11th: 00.30 p.m. - The Bear cometh to the Snowcock camp. Initial excitement turns to fear.

KB leaves unexpectedly for hydrological commitments in India. His bear sense is obviously good.

10.30 p.m. - The Bear returneth and the theories of a behavioural biologist that the bear would be tens of miles away are confounded. The novelty has worn off.

After a frustrating morning herding up urine containing tupperware pots that have gone astray, PT and RH bid farewell to the happy Hunzakuts and head for Minapin to play with the others for a while. They meet the French expedition Liaison Officer and are given valuable instructions on how to reach the others.

August 12th: IS and JM, their nerve having taken a severe pounding, return to Kachelli and are confused by the disappearance of KB. JB plays a true leader's part by negotiating the take over of huge quantities of French expedition supplies now that their climb has been abandoned. Morale soars with chocolate, cheese and coffee, to name but three, supplementing a very tedious diet.

PT and RH camp half way up to Kachelli and are thoroughly confused by the directions given down in Minapin. With no water supply a nocturnal meal of undercooked rice is had down on the glacier using melted ice and grit - morale hits a low low.

August 13th: An extraordinary day for PT and RH, first dicing with death in an ice fall, followed by total exhaustion on morraine. As the end seems close, and they are no longer strong enough to curse the others for camping in such a remote and hidden site, the camp appears out of the haze. Staggering in, they attack the French food, as if there were no tomorrow, suspecting its all only a cruel dream.

August 14th: To the horror of exhausted and unacclimatised RH and PT, the others have itchy feet to move up to the French camp no.1, to contemplate some climbing and, most important, to get away from the bear, who should not be daft enough to sit around on ice all day. All move up to a cosy hump of ice and rock at 14500 feet.

August 15th: JM and JB are up by dawn and set off across the glacier and up a ridge between Rakapashi and Diran. Progress is agonisingly slow and the others look on apprehensively, feeling the affects of the

altitude just sitting there. JM and JB set up camp soon after midday as the avalanche risk increases and PT descends to base camp to collect as much food as possibe for second climbing excursion.

August 16th: JM and JB continue ever upwards and worryingly out of sight of the spectators. PT rejoins IS and RH with all the food he can lay hands on and with stories of a terrifying night defending base camp single handedly from the furry beast. Huge relief that he is unharmed and self-recriminations that he should not have been allowed to go off on his own.

August 17th: RH, PT and IS set out for a peak along the north ridge of Diran and PT and RH are pleasantly surprised by their strength in the light of so little acclimatization. An exhausting snow gully is followed by a treacherous rock and scree slope. They bivvy for the night amongst rocks with devasting views from 18000 feet.

JM and JB reach their goal, the ridge, and JM then returns to their previous night´s camp whilst JB strikes on having masochistically set himself a new target and sets up camp further up the ridge.

August 18th: After a surprisingly good night PT, IS and RH set out for the top of their hill in a strong, chilling wind. Two hours on a steep ice slope brings them to the top and exhilaration is felt by all. Back slapping, chocolate eating and numerous photos are followed by a long tiring descent to the ice camp where JM is waiting with the news that JB is still on the mountain. Mixed feelings of admiration, apprehension and irritation are felt.

August 19th: Recuperation and planning for the next month.

August 20th: JB returns exhausted and depressed that he just failed to reach his target but it is still an amazing solo climb. Heavy conditions underfoot and shortage of time and provisions just beat him. PT consoles whilst JM, IS and RH return to base camp, snowcocking along the way. Sight on arrival is one of devastation, mauled gear strewn around the hillside and food no more. Much foot stamping and bear cursing followed by clearing up and a depressing food inventory is compiled. PT and JB return and the bear burns in hell twice more. 10.30 p.m. the bear returns to admire his handiwork and five revenge-crazed and hungry mountaineers leap around making a lot of noise and waving burning torches and ice-axes about. The bear is unimpressed.

August 21st: After being lost on the glacier for hours PT and RH eventually get down to Minapin to send up food supplies by porter and contemplate recommencing project whilst the others return to work, bear or no bear.

August 22nd: PT is ill in Minapin, not a place of choice in which to be ill.

August 22rd: Life-saving food arrives at Kachelli and the porter is a welcome addition to the tired and depressed bear minding force.

August 24th - 27th: RH manhandles sickly PT to Aliabad and the doctor and dispenser are met to discuss the medical project. Frenzied activity, measuring as if there were no tomorrow. JB, JM and IS arrive on the evening of the 27th, the latter two via business in Gilgit. They have successfully bored holes, measured poles, collected snowcock poo and alpine plants and bid farewell to the glacier and the snowcocks. IS needs psychological help with his understandable bear phobia.

August 28th: The turn of RH to die but, not wanting to miss the opportunity, joins the others on a dramatic trip up the KKH to Pasu and the Batura glacier, the most northerly point open to foreigners. Pakistanis are now allowed up to the Chinese border 50 km further north but we are prevented by the full might of the army´s Northern Division - well, we would have been if he was not having his lunch. Shame since snowcock, sweet and sour, is said to be quite a delicacy at the border. Scenery is spikey and desolate.

August 29th - 31st: Exhaustive preparations in Gilgit for the trek, purchasing food, cooking equipment and porters/guides, the latter proving difficult. Guides are an expensive and probably unnecessary luxury yet relying on porters in the locality of the trek could be a gamble. We compromise with a glorified Gilgit porter, Smiley, who speaks a few words of English and smiles a lot. We are assured that he will negotiate porters and remove hassles with our best interests at

heart. Much eating to build up strength for the trek - that is the excuse if one is needed.

September 1st: A jeep is hired at great expense (740Rs) and a rough but enjoyable 60 km journey is taken to Phakor in the Ishkommen valley, N.W. of Gilgit. A desolate and inhospitable rain and windswept place. Night spent at the house of a potential porter.

September 2nd: Start treking up out of valley towards Asambar Aghost, a 14,500 foot pass. Smiley and his porter friend are agonisingly slow especially after their mule collapses on them.

September 3rd: A daily routine develops of walking, eating, being stunned by amazing views and berating porters who become a thorn in everybody's side and an entire cactus in Iains. If there is something conceivable to complain about they will. Smiley stops smiling and we are accused of starving them, expecting them to walk more than 3 hours a day and going so far as to expecting them to carry something. Its all too much for Smiley and his ever changing band of merrymen and they revolt. We are revolted. IS gets close to manslaughter regularly but is caught, Swiss army knife in hand, just in time.

September 4th: Assambar Aghost is conquered and, although spectacular, familiarity breeds contempt as we wait hours for our pathetic porters. Camp by beautiful lake and swim at dusk. JM is horrified by RH's joyous ablutions.

September 6th: Rest day at Sandhi in the Yasin valley. Feel like fish in a goldfish pond as we camp in a ploughed field in the middle of the village with dozens of curious onlookers. Talking of fish, JM catches a trout and RH a bit of old blue rag. JB investigates a few mountains for future reference. Porter hassles reach new sophisticated heights.

September 7th: The group strikes out towards the Thui An Pass (14800). The pressures of being starved and having to carry as much as ten kilos less than he said he could in Gilgit is too much for Smiley and he decides to leave. IS brings out the champagne and is horrified when we dissuade Smiley at the eleventh hour. Our winning card is that he's yet to receive any money.

September 9th: Further porter rebelliousness concludes the day early and as a porter returns home in disgust, a miracle occurs with a new porter, immaculate references in hand, emerging from behind a rock in the middle of nowhere. Further pairs of eyes peer out from its depths.

September 10th: The Thui peaks are devastating as we ascend the glacier and in a gruelling five hours reach the pass. Our new porter is fit, agile and is even capable of stirring Smiley and his sidekick, Tintin, into action. They are close behind us all day.

September 13th: A few porter rebelliions and some delightful Yarkhun valley walking later we reach Mastuj our trek end. Days are ticking by and there is relief that JB, RH and IS may yet catch their flight home.

September 14th: Cosy jeep ride to Chitral with 14 people perched precariously in the back. Slight concern when the rough track disappears off a cliff and 3 hours are spent earning the Boy Scout Road Rebuilding badge. Great skill shown by locals, for whom this is an every day occurrence. Hot, dusty valley floor for a further five hours and limbs are set in unanatomical positions as we reach Chitral. Civilised afternoon in the appropriately named Garden Hotel at Chitral and excesses of local wine in the evening.

September 15th: Awoken to the sounds of camels eating the tents, a relaxing day is passed in Chitral, a colourful town with shades of the wildwest about it. Shifty looking Afghans are everywhere, refugees of the Russian occupation. Local resentment is tangible; crime has risen, feuds continually smoulder between Afghan factions and Chitralis feel their town has been overrun. Bazaars are bustling, their wares enticing and JB duly overdoses on hat purchases. Everybody overdoses gastronomically. Financial wizardry from JM. The last supper is held in the depths of a refugee camp, mean looking characters lurking in every shadow and anti-Russian posters everywhere. Very atmospheric and we feel that our very presence here is an unwritten undertaking to join the Mujardhadeen.

September 16th: Farewells at dawn in the shadow of majestic Tirich Mir as JB, RH and

IS leave by jeep for Dir via the 10500 foot Lowain pass. The jeep objects to most of the pass ascent and more unexpected treking occurs. Bus to Peshawar and extravagence in a Chinese restaurant. Peace in the oasis of the pleasantly squallid Khyber Hotel (20Rs).

September 17th: PT and JM visit the Kalash valleys, home of the Kalash people, believed to be descendants of Alexander the Great's armies and thus incongruously fair skinned. Only 5000 or so Kafirs or 'unbelievers' remain in the valleys of Birer, Bumburet and Rumbur and are gradually losing their identity under the influence of modern Islamic Pakistan.

JB, RH and IS see Peshawar, disappointing for its absence of Afghans in the wake of a recent purge by the army, and travel to Rawalpindi.

September 18th: RH heads for Lahore and miraculously books 1st class tickets for the train to Karachi for the following day and IS and JB follow after tracking down equipment sent from Gilgit and transfering it to Peshawar to be met by JM and PT - complex expedition logistics!

September 19th: JM and PT to Peshawar and hit good, bazaars and culture, probably in that order. RH, IS and JB have a remarkably peaceful time on a train.

September 20th: JM and PT are still eating in Peshawar. The others sit in a broken down train for 3 hours outside Karachi and finally reach Fakir's house a thankful base for recovery and final shopping. JB becomes very ill with a high fever and RH and IS are both incapable of eating, not a satisfactory state of affairs for the banquet laid on by our marvellous hostess. Very embarrassing. Traumatic time in the airport as luggage is ripped apart and mauled by a dog for drugs - images of Midnight Express. The length of IS's hair is blamed.

September 21st: JB, IS and RH return to England....all ill! PT and JM to Rawalpindi.

September 23rd: JM visits Taxilla, a remarkable archaeological site of three distinct cities discovered in 1852 and which thrived from around 600 BC to 500 AD.

September 26th: PT and JM finally reach Skardu, capital of Baltistan, by PIA after one cancellation and a second attempt which all but lands at Skardu before turning back. Stunning view of the main Karakoram peaks.

September 27th - October 1st: Trek up to the intoxicating Deosai Plains, 14,000 ft up, 5 km by 10 km, and crater-like surrounded by lofty peaks. The temptation to bag one of these peaks is too great and the ice axes are wielded again in anger. A bear pays his respects and both JM and PT swear those eyes are very familiar.

October 2nd: From Skardu to Rawalpindi where JM and PT part company, the former flying from Karachi to London on the 6th October and the latter braving the overland route via Iran and Turkey reaching GB by October 19th. He gives Iran a less than glowing reference but professes to having enjoyed the journey as a whole but not to wishing to repeat it in a hurry.

EXPEDITION PREPARATION

It all began, as the saying goes, with this "lost valley" you see. Having been raised on Connon-Doyle swashbucklers and never a group to forego a challenge, the gallant membership of the CKE from these heady days of October to the panicked nights of July then proceeded to devise the best possible means of finding it again.

Somebody, of course, had been there before. Rule number one - anywhere described as "lost" has probably just been misplaed for a while. Romantic ideas aside, it was a great help to know where the place was in the aim of getting 3 projects underway on the other side of the world.

The preparation in these months deserves treatment in epic proportions, as that is how it usually felt at the time. Now however aside from the agro and frustration (particularly with regard to the medical project) the main memory to come back, tinged with age, is of those fruitful expedition meetings. Passing the bag of life restoring Hunza apricots (available in all good health food shops!) We would make numerous lists and try to remember what it was of importance we were going to say. Then, at the stroke of the hour Jonathan would jump up, badminton racket in hand and head off to enhance the mind-body continuum. Some members would remain, sobbing into their coffees.

IN PAKISTAN

Somebody must have thought us a wholesome group of lads, as the money eventually came in, the flights were booked and we were soon winging our way to Karachi clutching precious 'Yorkie bars' and other necessities of life.

The next two weeks were a hazy mixture of mingling with Pakistani high society and battling to utilize our tenuous contacts for the medical project. Its best left for another of the group to describe but for me, the six of us in an assortment of travel stained baggy pants and flip flops being wined and dined at the Sheraton, didn't seem to work. By Islamabad frustration at lack of mountains had set in. My departing task was to assemble 30 m of 2" plastic pole. Nobody except Jon understood the essential meaning of this - indispensible trekking equipment?, guttering for the tent or perhaps just one Herculean task set by our leader to test expedition commitment? At the airport check in desk, there was a sombre shaking of the head as the officer eyed my wares. I was busily trying to look nonchalant, as if I just had a few extra paperbacks to take on board, the 15 ft. lengths of plastic pipe casually propped next to the ice axe.

"Only small plane, Sahib"

"Well, can't we strap it to the wing... or something?"

But never beaten by a task or lacking in the will to please P.A. got it all there in the end. A small saw was produced and the offending lengths reduced as I look on, wondering if the whole trip was now in peril.

PT

Gilgit to Glacier

A suzuki van normally used as a bus in Gilgit was commissioned to take us the forty miles up the Karakoram Highway to Minapin village. Packing the vehicle proved a time-consuming task and when finished plastic piping seemed to protrude from every conceivable place. We did not reach the village until the early afternoon and consequently decided to set off the next morning allowing time to hire porters and arrange loads. We stayed in (or more precisely on the grass outside) the government resthouse having carefully packed all loose equipment out of the reach of the inquisitive eyes and hands of the villagers. There was no lack of porters ready to offer their services but at what price? After long discussions with the local policeman who assured us that "the government approved rate is 110 rp/day for carrying 25 kg" we settled on this agreement - or so we thought. After carefully arranging 3 loads of 25 kg each we set off. The three porters carrying stick and lunch while all the loads were dumped onto a mule. The porters happily skipped along kicking their overladen beast into motion every so often while we struggled up with well packed rucksacks battling against the oppressive heat. After about 4-5 hours

walking we reached the first stop, a small shepherd´s hut, and we assumed that the next place with any water was another day´s walk away. [Kevin, Iain and Manzoon Ali, a lecturer at Gilgit Technical College, had left us slightly earlier to spend about five days surveying the snout while James and I carried on to set up the glacier base camp and start on the ornithology and glaciology work].

The next day´s walk lasted about 3 hours and took us to the side valley Tacheferi. The porters refused to go on without another day´s pay on the premise that "this is what all the other expeditions do". By this time I was beginning to feel the affects of a viral infection that incapacitated me for the next six days and consequently did not have the strength or inclination to argue. This meant another day´s pay for three porters plus an extra half day for their journey back, at a cost of some 500 rp. No amount of persuasion by James could convince them that their demands were unreasonable and we parted prematurely feeling cheated and very frustrated. What equipment we could not manage between us we left under a large boulder. One porter had remained faithful to our agreement and he guided us through the fairly crevassed region to the other side of the glacier and then onto Kacheli where we wished to establish a camp. It is quite easy to get caught up in a maze of crevasses on the crossing and it is strongly recommended to take some sort of guide on the first occasion to prevent many wasted hours of backtracking.

We arrived in the dark too tired to erect any shelter and by this time I was feeling very weak and ill. The next day our porter returned to the valley while we found a suitable campsite and levelled an area for the tents. My infection was now well established and flourishing leaving me weak and feverish and able to do little else than lie frustrated in my sleeping bag. It stayed with me for some six days after that. On two occasions during this time, out of complete frustration at wanting to do something, I had tried to return to Tacheferi to collect the remaining stakes both times ending in total exhaustion long before reaching the other side, I resigned myself to resting until in a fit state to work again and with the aid of some medication from the nearby French expedition´s vast stores of medical supplies my recovery was fairly uneventful.

J.B

IN KARIMABAD

On arrival in Karimabad Paul´s and my immediate act was to leave it. The heart of the village was rather depressing and a great disappointment with its abundance of fizzy drinks and biscuits stalls and multitude of little rest houses to catch Mr. and Mrs. Successful Professional from Germany and Japan on an adventure trip of a lifetime. Most grating on our pioneering nerves was a huge concrete shell destined to become a Hotel Intercontinental at a prime site with panoramic views of the Rakaposhi. Fortunately financial and legal wrangles have postponed indefinitely the installation of the habitat decor.

Baltat proved to be more satisfactory, a delightful community high on the hillside in the shade of Baltit Fort, once home of the Mir of Hunza. Steep and winding alleyways, footpaths and stairways snaked their way up between apparently ramshackle stone and wood dwellings which on closer inspection were found to be rugged and functional, in keeping with an environment which does everything by extremes. In the heat and dust of day the overwhelming impression was of contented lethargy and inactivity. Round the next corner a child might be playing with a home-made spinning top, an adolescent washing up in the irrigation canals or a woman scampering in the shadows about her daily business but for the most part all was peaceful and quiet with men sitting around under the poplars passing the time of day. Further groups sat around outside shops but to actually purchase something was a rare event.

We found a rest house nestled at the foot of the village and happily resisted the temptation for the duration of our visit to be lured down to Karimabad to a characterless but coke-ful hotel. Our chosen inn, however, was coke-less and characterful with a charming owner, Gulam Mohammed, a patriotic

and dignified ex-soldier, and even more charming children, sporadic electricity, fluorescent blue paintwork, a whose-who gallery of Pakistani generals in the 'restaurant', a balcony and continuous local music. The balcony afforded 280° views of the Hunza valley with Diran and Rakaposhi dominating the skyline. Terraced fields, winding irrigation canals, tall spindly poplars and splashes of orange from apricots lying on roofs drying in the sun completed the picture, typical of Hunza and marvelled at for centuries by travellers who were all struck by the peace and beauty in the depths of one of the world's most dangerous and inhospitable mountain ranges. Many a long and quiet evening was spent lying on charpois looking up at the clear night sky, dozing, dreaming, meditating, discussing our hang-ups (between us we possessed every hang-up known to man and a few besides) or simply talking the kind of nonsense that is induced by a lack of inhibition brought on by 4000 miles of rock and water separating us from the British Isles.

Hunza wine was furtively sipped on such occasions in reverence to local custom rather than Islamic decree. Subtle the drink was not but somehow seemed in keeping with the environment and only now could the finer points of the unique cacophony of the horns and drums be appreciated, the finer point being that the musicians need to be half cut not only to play that way but to also enjoy it. Attempts to secure the elicit brew for those gentle evenings nearly destroyed our reputations as learned and respected guests from overseas. Wandering along the tiny winding lanes beneath the Baltit Fort one moonless evening in search of the vendor of Hunza water (as it is euphomistically known) we stumbled upon what was quite clearly an house of ill-repute, although for all I know it may have a good reputation. As several young ladies appeared at windows we beat a hasty retreat wishing that our Anglo-saxon skins had a little more natural camouflage. Expecting to be shunned the following day by the upstanding members of the community as word spread like wildfire of our nocturnal activities, we prepared for a hurried and ignominious departure.

Our fears were unfounded and as the days went by warm acceptance became more and more obvious. It was a great feeling to walk through village with greetings and smiles from all quarters. Whilst being pleasurable such acceptance was not in the best interests of the project, and indeed a major problem was the maintenance of interest within the community once it was realised that our work was not only of no direct benefit to the villagers but also, as untrained doctors (a fact rarely fully understood) we were not prepared to treat other conditions we came to be known as blood pressure doctors. It became highly frustrating having to turn away concerned and anxious people who saw us as "good English doctors, much better than our Pak doctors". Furthermore English medicines were considered to be highly preferable to those of Pakistani making despite, in many cases, the same drug and formulation being used and, surprise, surprise, the manufacturer having the name Wellcome or Glaxo or ICI. By not having a large supply of such medicines we were bound to disappoint. Although not a subject that we felt able to discuss with Dr. Johar, it must have been very frustrating and depressing for him to generate little confidence in the community despite having had a fully 'western' training. Such a situation is a likely consequence of a clinic which rarely has more to offer than tonics and antacids despite the diagnostic capacity being there. It is hardly surprising therefore that few doctors are prepared to remain in rural communities like Karimabad after their compulsory stint. And such a position will persist whilst resources are diverted from the grass roots to the hospital specialties that not only keep the ruling classes in one piece but also generate international prestige. But then its the same story throughout the world and Pakistan has taken its rural health programmes rather more seriously than most. A further feature found in Hunza common to many parts of the developing world and indeed the West as well, is a misunderstanding of the scope of medicine, especially of its limitations. Little white pills from western medical gods are thought to be the elixir of all ills, and

little we could say seemed to lay such myths to rest. Such a reaction to western doctors could be understood even more when an English ophthalmologist arrived in Karimabad just before our departure. During vacation from his work in London he was setting up clinic in the village for three weeks and had all the equipment and nursing staff necessary for such a venture. People flocked from the whole of the central Northern Areas and many no doubt were to depart with that most dramatic (in the immediacy and magnitude of its effect) of operations, cataracts extraction, having been performed. Such successes in conjunction with the entire aurora surrounding this man and the confident professionalism that he transmitted (as well as a hefty dose of arrogance) bolstered the esteem in which high tech, high cost medicine is held.

For all the frustrations in Karimabad, the lingering memories are positive ones. The afternoon of August 5th will be long remembered as we set up shop at one of the prettiest rest spots in Baltit, in the shade of poplar trees and alongside the marble-like waters of the Ultar Glacier running in immaculately engineered water channels. Everybody was charming and highly cooperative and the atmosphere was warm and jovial. Beautiful and curious wide-eyed children jostled for ringside seats whilst customers quietly waited to be measured, among them an 82 year old Northern Areas Polo champion and a host of very odd looking retired British soldiers. And every face told a fascinating story.

The second lingering image is of a peaceful night on the 9th August, sipping wine nibbling world beating apricots and celebrating 22 years, most of which spent in a world far removed from this. As contented thoughts turned dreamy my little world was shattered by Paul vomiting with great virtuosity and flair over the balcony. It was only to be expected; we had been healthy for a full 24 hours and in a show of expedition solidarity I joined him an hour later - my birthday drew to a close in noisy and painful fashion. R.H.

GLACIER LIFE

On arriving at our destination we discovered that the French expedition the villagers had talked of was camped on the other side of a small meltstream (which provided our water supply). The two groups generally kept to themselves bar a very lyrical Pakistani liaison officer who, clearly uninterested in mountaineering and the progress of his French team, had little else to do but write poems and recite them to us!

After about six days the survey party arrived and started helping with the upper glacier projects. The camp was usually unoccupied for the large part of th day at which point the cows (Kachelli is used as a summer grazing ground) would move in and start groping for things to eat. Anything left out was vulnerable to their incessant foraging and all food, pans, equipment etc., had to be placed under stones or canvas. However even this measure did not prevent them from managing to trample over one of the tents and defacating on a large store of food. While the French were still around their cook usually managed to keep them away but when they left the situation deteriorated considerably and whatever measures we took the stubborn creatures would still manage to do some damage. I may be vegetarian but there were some nights when I seemed to relish the thought of a piece of fresh steak!

During the day temperatures never fell below freezing though down glacier winds made it necessary to be well clad. Crampons, axes and ropes were necessary only for those few occasions when travelling above the snowline and for mountaineering purposes. Stoves also proved generally unnecessary as there was plenty of good firewood and it is so nice to come home to a real fire especially if tonight´s guest is a 3 m long bear!

J.B

Last night's tiff with the porters resurfaces like an unwelcome whiff of sleeping bag odour. Our man "smiler" is told via a local dude whose English, as usual, puts our stabs at Burushaski to shame, and whose acrylic 'Dayglo' jumper is the talk of the village, that he is not worth the body he's printed on. He's paid one hundred rupees a day to carry 25 kg, to cook, to liaise with locals, to help collect firewood, and to do impressions of Pope Pious IV, none of which he does to our western imperialist satisfaction. His resigned tone as he repeats his oft-muttered slogan, 'no, no chapatti no, you problem, me no,' is almost as funny as the indignantly irate trekking fivesome who strut and gesture to maximum melodramatic effect. Threats from smiler and his chum of leaving us to eek it out as they take to the hills eventually subside and the charade seems to have done the trick once more.

We are two days out of the Yasin Valley and its a week since we started our spree from the Iskumon Valley, to which we jeeped from Gilgit. Coming up the valley of the Gilgit River there were many messages left in white stones, large enough to be visible right across the valley:

WEL COME TO OUR BEUVED HAZI IMAM

The folks around here were Ismailis, members of the sect which in the Middle Ages produced the original Assassins but in recent times has become less puritanical in its orthodoxy compared with the Shias and Sunnis. The Aga Khan has been their leader for centuries, the Hazir Imam of the Ismailis, who traditionally has been weighed at regular intervals so that his weight in gold may be charitably dispersed. In 1983 the present Aga Khan ventured from his home in Paris to show himself to his Pakistani adherents. He had flown up this valley in a helicopter and was enthusiastically received wherever his chopper grounded long enough for him to make a speech. Welcoming messages in a local tongue would presumably have been lost on someone much more familiar with Europe than Asia, hence the weird sight of English words 20 feet high along the mountainsides of the Hindu Kush.

From Iskumon we crossed over to the Yasin Valley via a pass of stunning geological colour and we were now heading for the Thui-An. At 14,760 ft the Thui has only very recently been 'open' due to its proximity to borders both Chinese and Afghan.

The next two evenings in this barren chasm-like upper valley produce a couple of memorable characters each of whom surface from beneath boulders as we make camp. Both of these well-weathered worthies had borne the brunt of the eccentricities of several mountaineering expeditions and were thus well-versed in the common likes and dislikes of the potentially fruitful pockets of the species with the rucksack.

The first is a lean, blanket-wearing sage with a couple of tombestone teeth and the manner of one who hears much and is in the habit of providing learned advice from the confession booth. During our customary afternoon niggle with 'smiler' this gaunt figure was a keen observer and frequently bent over towards one of us to mumble something which may have been relevant to the situation but seemed more like a furtive tout of forbidden nylons, or an offer to take the burden of all our sins at the expense of a half-dozen Hail Mary's.

The next evening we were saluted into camp by a lively old burgher who produced various references on headed notepaper from expeditions who had attempted one or more of the 20,000 ft Thui peaks which towered above us. Glowing reports without exception, they spanned some fifteen years. A bit of a scout-master this one, runs a tight outfit round here I suspected. He soon had us arranged in camp to his satisfaction, and started to take orders for supper as we sat at a stone reproduction of a table for five at the classiest joint in town. He didn't actually cook us a meal but eggs were produced and pancakes by candlelight slipped down nicely whilst our friend crept back under the rock to take tea with his wife.

He accompanied us the next day, in his plastic sandals, up the Thui Glacier followed by a hard slog up a few thousand feet of

Typically cheerful Kalash girls

Kalash woman adorned with brightly coloured jewellery and head dress

The Porters version of Polo !

scree slope to the pass. The Thui peaks to each side were like 20,000 ft monoliths, no way up them without being daft I thought (Jon's misty eyes said otherwise).

The route over the other side seemed to slide into the abyss rather than give us the gentle scenic wind down into the upper Yarkhun Valley. The trekking legs of the team members were in full idiosyncratic expression as we descended. The massive-booted Stark lets them swing downhill like there's no tomorrow whilst the uphill, sprung-steel appendages of Holmes are reticently dainty on the descent. Hoppetty-skip for those unpredictable Bamber limbs, and old Thomas still can't work out why his legs keep rubbing together as he shambles along, boot on one foot, flip-flop on the other, whistling the barber-shop version of the 'Gone with the Wind' theme. Meanwhile I slope along getting abuse whilst leg-monitoring.

A few days along the Yarkhun Valley, - sublime hasish-growing country punctuated with areas of completely barren shale, and we arrive in Mastuj where we call for tea, an end to all trekking, and the abolition of porters. Hashish is offered by all, not least the Mastuj police, the first encountered in our valley descent. We bid a tearful farewell to 'smiler' and chum, (nuff said).

We're getting a jeep to Chitral from here, at least that's the plan. Sure enough there it is the next morning, and as we pile in to fill the jeep together with a couple of Chitralis there seem to be an awful lot of people come to wave us off. Half an hour later when the jeep moves off, every one of them is aboard, there are 17 of us. Although likely to lose a few around the first couple of hairpin bends we just have to hang on to something or somebody and hope that not too many bits are striking out. Within an hour we are descending a cliff face, but don't reach the bottom for another four since we have to rebuild the road twice where it has given way over the precipice, at least 34 hands come in handy here.

Many hours of dusty valley and eventually Chitral hovered into sight. Historically famous for the Siege of Chitral which saw heroic deeds from the small British garrison in the fort who held out against the Chitrali hordes, while Colonel Kelly struggled over the passes from Gilgit to save them. It is now more noted for its heavy contingent of Afghans who have fled their country over the hill and are now living in large camps in many places along Pakistan's western border. Right then, much of this was lost on us as we dazedly fell out of the jeep, slumped to a small hotel whose landlord greeted us warmly as we collapsed at his feet in a lifeless heap.

CHITRAL

The spectacle from the garden of that hotel the next morning would have heartened the most jaundiced traveller. Taking tea and cakes under the shade of mighty trees as the dust swirled around the bazaar below. Looking north up the valley, fifty miles away, but in the sparkling air looking as if it wasn't too far beyond the outskirts of town, reared the magnificent shape of Tirich Mir. It was over 25,000 ft. high, completely white, some of its faces gleaming, others dull. It was the highest peak in the Hindu Kush and it stood guard over Chitral whilst peering into Afghanistan.

In the bazaar all necessities for life were available, from melons to catapaults. Ballistics were inseparable from masculinity from the moment a child could stand up. Chitral was full of small boys looking up into trees, or crouching behind the dry-stone walls, each with a catapault in his hand, ready to shoot birds. Their aim, as we observed, was distressingly good. Others used bows, two-stringed affairs with a leather strip in the middle; the sling, from which a stone would be fired. Only slightly older marksmen would be seen swaggering through the valley with a rifle on their backs.

This superfluity of deadly marksmen had certainly resulted in the obliteration of most ibex, markhor and urial that had once roamed the mountains in numbers. Outside the town polo ground, a tin plate had been nailed to a fence post. On it was painted a beautiful large cat with the caption, in two

languages, 'Snow leopard. Please do not kill me. I am declared protected animal'. We had heard some tales of one or two leopards in the upper valleys. They were lucky to have survived. Someone had shot half a dozen holes in the picture on the tin.

We encountered what had once been a snow leopard in the bazaar. The man selling it sat proudly behind his stuffed exhibit. He must have had fun putting it together; a well cut up leopard skin had been stitched together into a rough resemblance of its former owner's shape, complete with a broomstick up its tail and a couple of yellow plastic buttons for eyes. He wasn't saying where it had come from, only how many rupees to buy.

Groups of men sat on their hunkers in all the shop entrances, the odd sale not distracting too much from the days chewing of the cudd. Apart from staring at us, the only distractions were to look over the groups of Badakshani men who tramped through the bazaar. The Badakshanis were from over the top in Afghanistan and most came from an encampment of Mujahideen a few miles down valley. Their faces were wider than the Chitralis, they often led farting camels and wore enormous ankle boots and huge swathes of dishcloth on their heads. They trudged through the bazaar close together, not sure of whom to trust perhaps, their faces blank and unsmiling. I would not have wished to be a Russian in their path.

After bidding a tear-stained, not to say tea-stained farewell to the others, Paul and I were left with some more time. Time to make for Kafiristan thought we. So, after a healthy infusion of fruits and cakes we made for the Kalash Valleys. Just down from Chitral there is a defile leading into the mysteries of Rumbur, Birir and Bumboret, the three valleys whose people have remained infidels in the eyes of Islam. Their practising of a religion idolising horses and other figures carved primitively from wood in this remote area had led the Victorians into wild speculations such that Kipling, who never went there, chose it as the setting for his swashbuckling story, 'The Man who would be King.' Their origins are obscure, one infamous theory ascribes their fair skin and good looks to the seeds of Alexander's armies.

We did not have much time in Kalash but it was a remarkable experience. Many weeks in the Northern Areas had been almost completely devoid of contact with women. Those that were met generally had to turn their heads and if approached would be hustled away by other women or berating men. Thus, it came as a welcome, yet disarming shock to be suddenly face to face with grinning Kalash girls wanting nothing more than to laugh at me and completely unabashed at pulling my braces. They all wore heavy black gowns with beautifully adorned head dresses and necklaces of bright beads, shells and silver. The words 'proosht, proosht,' were all you needed to get a giggling reception. It was nearly maize harvesting time and it was eerie to see slow moving, black-clad figures circling all the high maize fields playing flutes to keep the birds off.

Despite being a considerable asset in terms of attracting travellers, the pagan Kalash are something of a embarrassment to the Islamicizing government. There are large cash incentives to convert to Islam and many Kalash have succumbed to the strategically placed mosque down-river. The Kalash have a very rich cultural heritage and one event in which this is much expressed is a funeral at which there is much ceremony and dancing. However this is also a very expensive event for the departed's family. Thus, a frequent phenomenon at the mosque is the arrival of the very sick, or their relations asking for conversion to Islam and its reward. In this way the dead can afford their funeral; the problem being that some near-corpses get better and are stuck with a demanding religion they were forced into by circumstance. We had to leave Kalash just as we had begun to enjoy the feel of the valley.

(There are some good books on the Kalash and their history, see bibliography).

J.H.

Diary of a minor adventure

Tuesday

I decide I am going up to where the French Camp 2 was, just below the main slopes of the mountain and about 4 hours slog from our camp. Everyone else suddenly show unusual enthusiasm and decide to come too. We set up a reasonably luxurious camp on some carefully levelled snow giving an excellent vista of the impressively unstable looking slopes across the glacier. James and I decide to see how unstable they really are the next day.

Wednesday

We do not manage to get away until 7.00 a.m. and I am sure it is pure folly to be wandering through that lot during the day. However the brain is not an entirely logical organ (especially after it has been living on lentils and foul smelling rice for the last week and a bit of mountaineering gives it an excuse for indulging in the relative pleasures of some freeze dried meals). Emotional criteria can often outweigh purely pragmatic ones and the idea of conquering this sparkling, icy pyramid had been brooding in the depths of mind for many months and was growing stronger with every stride.

Then IT happened, what I had been dreading all morning (excitement mounts). The zip on my trousers broke. 'Oh my God I'm done for' I thought. The prospect of sustaining frostbite in such a sensitive area was mind boggling. While my mind boggled my trusty companion fumbled in his pockets and produced THE safety pin. What I owe to my faithful comrade I shall never know. However I digress.

We established a camp that was as safe as we could make it and surveyed our precarious surroundings and possible routes to the ridge. We had about three man-days of food left as we had only planned to come this far believing the rest to be beyond the reach of this ill-equipped duo, having talked to the French about the conditions up to the ridge. However the possibility of reaching the French high point on the ridge was all too seductive and it did not take much effort in convincing James of the attractiveness(?) of such an objective.

Thursday

Both being exhausted from our previous day's effort we again started out far too late for my liking, at about 7.00 a.m. By 11.00 a.m. the snow had become unbearably soft and at that altitude progress became painfully slow. As is so often the case, the final snow slope seemed an age in coming and altitude and exhaustion testing both of us to the limit. James proved himself a most reliable and steady partner and it was reassuring to both my nerves and will-power to have him with me. Finally reach the ridge by dusk (about 7.00 p.m.) and to our delight and amazement find a tent some 100 m away. The howling winds forced us to crawl to it. Alas no food but at least a sanctuary. Like sitting in a car when it is raining the weather inside a tent sounds far worse than it is and it was with considerable effort that we forced ourselves out into the rapidly cooling night air. Very proud of our achievement we ploughed a way back to the camp 1200 m below - the reassuring glow of the head-torch providing us with a pleasant feeling of security as though a bit of twentieth century magic could somehow protect us from our environment. Get back to the camp by midnight.

Friday

Spent today recovering, or trying to, and abseiled down a crevasse that the French camp 3 had fallen down to try and retrieve any food or gear. Do not find much however. My burning desire to go for the summit has now reached the uncontrollable blaze stage but I am all too aware that we don't have enough food to do it or time to go down and pick up more. Long discussions ensue and we decide that James will go back down while I will go for a summit bid. He goes and I suddenly feel very isolated, very fragile. Mull around, improve the camp, fidget, go to bed at 4.00 p.m. but do not sleep at all.

Saturday

Up by midnight, away by 2.00 a.m. with my kit and all the food. Perfect, blissful night - cloudless with a brilliant 3/4 moon to light the way, snow good. Took a more direct route which I deeply regretted after a steep snow section lead to an alarmingly

avalanche prone convex slope. Save an hour and break my neck - very clever, but it did not budge and I reached the ridge by 1.00 p.m. What am I doing here? This must be madness. What if a storm breaks? What if I get altitude sickness? What if.... I have barely enough food for tomorrow let alone getting back down. A wave of thoughts and doubts prey on my isolation. I make a brew and long awaited, much appreciated hot meal.- Take 3 sleeping pills - no sleep.

Sunday

Up by 12.00 and gingerly poke a lonely head out of a lonely tent. Another perfect night - perfectly calm, perfectly clear and cold. Even with this good omen my enthusiasm and strength seem well submerged in a pool of doubts and tiredness. I had not slept for 3 days and I was hoping to gain 3400 m in altitude in the same length of time. Make a few brews, have no appetite. Pack and fiddle with various bits of equipment until eventually at 2.00 a.m. I get away. The snow is beautifully firm and crisp and not a hint of wind in the air. Very quiet, very still. Progress is good and my confidence in reaching the summit grows as I find my way up the 2.5 km ridge. Gaining the crest of a steep slope I seemed to have reached the final summit slope and it was only 8.00 a.m., 6 hours and I am almost there! I am quite overwhelemed, partly by the tremendous sea of peaks stretching from Nanga Porbat in the south to the great 8000´s of the Baltistan range, and partly at the prospect of being successful in my ambitious hope to be the first Brit to plant his ice axe on this lofty summit. ´Reach the top by 9.00 back at Camp 4 by 12.00, oh what a tremendous day´. I could feel the strength and determination flowing back into my euphoric brain, but not unfortuately into those slightly less sympathetic limbs that had the task of getting me up there.

My pace slowed somewhat and the slope did not seem to be getting much shorter as the minutes floated by. O.K. so I´ll be on top by 10.00, what is an hour? I dump my sack by a rock outcrop as I do not think I will need it until my return. Have a rest - it is hard work this. My breathing is rather heavy and though not suffering any obvious altitude symptons I feel very light-headed. Start to pace myself a few steps and then a rest. Must not stop too long or the snow will start to soften. This slope seems to be ever so longI feel as if I have been on it for days or months. I can SEE the summit but it´s such a struggle to reach it. The snow is now very soft and deep and in places I am up to my waist in it. This really is becoming painful - if only James were here to encourage and share the burden, if only I had more strength, if only. The summit is just 200 m away, I could run 200 m in 30 seconds, I cannot stop after having got this far. Putting one foot in front of another totally exhausts me. I have been lying here for an hour now and have not gone more than 5 m in the last two. My mental commitment was total - I could not have wanted to reach that summit more but my body was not so eager. Three days lack of sleep, insufficient food and the altitude were getting their own back on my presumptuous and impetuous belief that I could conquer this malevolent mountain. By 1.00 p.m. I make the inevitable decision to turn round and let the mountain win this time. I slip, slide and tumble down resting every ten minutes or so. It is far easier to see a route up a slope than down it and after having lost my tracks I find myself in a seemingly insoluble maze of crevasses and am forced to go back up a little way. It is so tiring, so painful I end up crawling on all fours a few feet at a time. Eventually by about dusk I am in sight of the ridge camp and I discover a most welcome cashé of food, a packed tent and some gas cartridges. Totally exhausted I just about manage to cook a hot meal and devour the 2-man-day ration pack in one go. Again could not sleep.

Monday

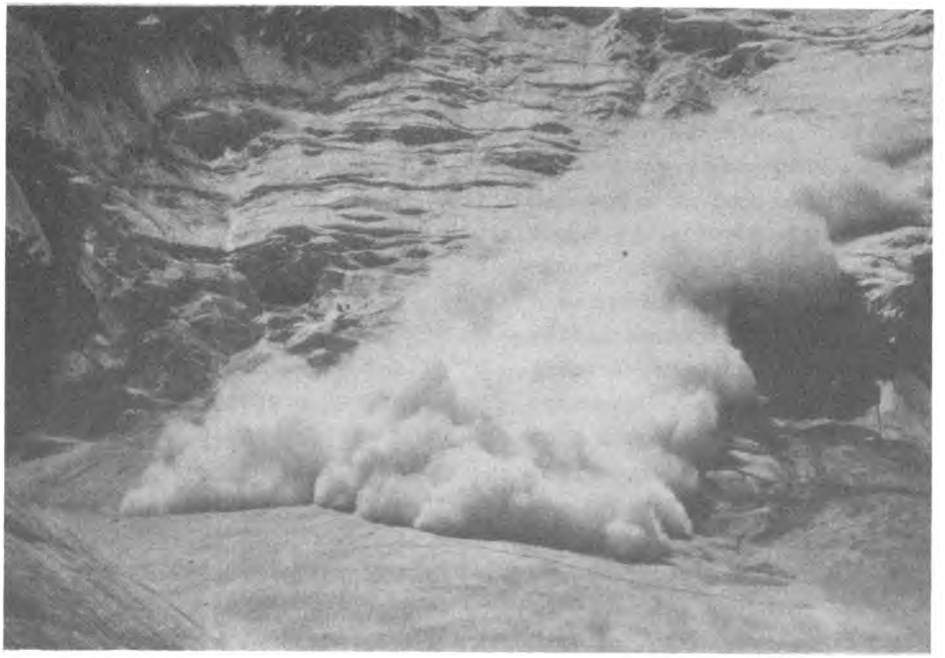
Set off by 8.00 a.m., taking some fixed rope and deadmen I am quite confident of reaching our mid-slope camp safely. To my surprise the frozen snow provides a quick descent and after several welcome cups of tea I dismantle our camp and set off down the final 1000 m to return to the land of the living. When I eventually reach our Camp 2 only Paul is left and he lovingly prepares copious supplies of hot food and drink which seem to do little to return my physical

strength but work wonders a on very disappointed mind. After a rest (which threatened to turn into total paralysis if I didn't move pretty soon!) we made our way back to Kacheli and the others only to find that in our absence the bear had demolished our supplies and scattered our equipment over the hillside. My only consolation was the thought of what 55 packets of dehydrated beef goulash must have done to the beast's digestive system.

Epilogue

The story almost has a happy ending as one item that survived the bear attack was a tin of 'Mont Blanc' chocolate mousse which was generously donated to the J. Bamber restoration fund. Needless to say a product of such a highly medicinal nature procured an almost instantaneous (about 1 week!) recovery to life and limb and, so I am told, even produced a fleeting grin.

J.B



An impressive avalanche on part of the Rakaposhi ridge

Meanwhile the tireless search for Snowcocks continues unabated !!

APPENDICES

TRANSPORT

KARACHI - LAHORE (1280 km)	2nd class train	Autorickshaw in cities - make sure that if there is a meter it is used. Get student discount from PTDC. Take to Rail office - Main Station Karachi a day or more in advance. Rs60 each. 26 hours - hot, dead sweaty, difficult to keep an eye on lots of gear
	'Flying coach'	New and speedy Japanese machines - air-conditioned, very comfortable. Rs300 each.
LAHORE - RAWALPINDI (275 km)	'Flying coach'	Highly competitive run. Rs60 each.
PINDI - PESHAWAR (167 km)	'Flying coach'	Rs40.
PINDI - GILGIT	Aeroplane	PIA. - 2 hours, every day if weather OK, can get one of 2 tourist (618 km (718 km KKH) -KKH) priority seats on each flight by getting a chit from Flashmans Hotel before booking at PIA office. Stunning view of Nanga Parbot, hairy landing at Gilgit. Rs. 150.
	PTL (PTDC) Coach from Flashmans Hotel	Minibus -often used when few planes because of weather but runs runs regularly anyway. Slightly more comfortable than NATCO bus. Rs. 100.
	NATCO bus From Pirwadhai Bus Stand	Bus looks like a Christmas cake, needs many changes of parts, stops to chat to every person encountered en route. 22 hours up spectacular Indus gorge on KKH. Very cramped. Rs70.
GILGIT - HUNZA	NATCO buses	Several buses daily going both ways, stopping everywhere very cheap. Same in Chitral area (Skardu etc).
	Suzukis -	In Gilgit - to outskirts, one or two rupees. Can hire whole vehicle to go up to Hunza if you have much gear - still cheap.
	Jeeps -	Only option for non-metalled roads. About 10rs per mile.

Diplomatic and Bureaucratic

In this country the first official procedures should be made through the Pakistani Embassy. They can supply details of how to obtain permission for scientific or mountaineering/trekking activities. Regarding the latter the B. M. C. also has some useful information. Obtaining permission is a lengthy and time consuming job and may need to be initiated at least a year before you plan to go. An alternative, easier and quicker approach for small expeditions working in non-sensitive areas is to effectively go as tourists but to inform the local District Commissioner of your plans who is usually only too pleased to assist.

We found in Pakistan that the British Council in Islamabad were very helpful and had considerable experience in dealing with small expeditions. A meeting with the Minister of Tourism, proved less productive. We had obtained a letter of approval from Prof. Tahirkheli (the Vice Chancellor of Peshawar University) addressed to the District Commissioner in Gilgit and were assisted in the field by a Pakistani lecturer from Gilgit Technical College. For a small scientific expedition such as ours this level of 'government approval' proved more than adequate and in general the local authorities in Gilgit, Minapin (the local 'policeman'), Karimabad etc., were only too happy to advise and assist us as necessary.

Freight

The only real bureaucratic problems we encountered were involved with obtaining our air freight from the airport authorities. Almost all our equipment had been taken as personal luggage on our flight from London due to a generous 20 Kg/person extra allowance Air France had given us. However a box of butane gas cartridges had to come on a cargo only shipment because of its hazardous chemical class. In general obtaining freight should not be too problematic though undoubtedly very time consuming and if much needs to be sent in this way it is recommended that one or two members fly out earlier to save long delays in waiting for freight to be cleared by Customs etc.

Insurance

This was taken out through the B. M. C. as they have a scheme specifically designed for expeditions and the cover required can be adapted to your particular requirements. The cost for six people for nine weeks was approx. £380 which gave £800 personal belongings, £2000 expedition equipment, £5000 medical cover and £5000 rescue costs.

FINANCE

Our original estimated budget was produced after some initial snooping at air fares, previous reports from Pakistan and crystal balls; it was as follows (for 5 people):

Flights	2000
Road transport	150
10 days in Islamabad	300
Porters	200
Food and accommodation in Hunza	600
Interpreter	200
Insurance	300
Film	150
Equipment	300
Administration	150
Report etc.	250
TOTAL	4600
+ 10 contingency	5100
Personal contributions	-1500
Amount to be raised	3600

At this stage, we were still a four-man team, looking for a fifth. Having two members who had been on similar-style expeditions however, we knew which areas would be most likely to be productive in terms of fund raising. We therefore concentrated: 1) on charitable trusts, whose criteria for support we fell under. 2) Companies with a particular connection to our destination, aims, or members. 3) Former schools, current colleges and departments. 4) Companies mainly food and equipment who might support the expedition through donations or hire of their products. Prospectuses with accompanying letters were sent all over the land, as well as the odd one to an American oil tycoon and suchlike. Our major success was in gaining one of five Royal Geographical Society - British Sugar Awards which put the expedition on very sure footing reasonably early on and was of much help in gaining attention from other interested bodies. Financial position by May/June was a major influence on us being able to take on a 6th expedition member which ensured a greater success with the projects.

INCOME

Abbeydale Trust	50
W. J. Adkins	50
Biocon Ltd.	75
Prof. D. Brewer	20
Coral Samuel Trust	500
Edinburgh Trust No.2 Account	150
Emmanuel College	200
Fortismere School	25
Gilchrist Education Trust	200
Dr. D. Giles	10
Gordon Wigan Fund (Zoology)	50
Jesus College	350
Mount Everest Foundation	500
Nacanco Ltd.	200
Pakistan Burma Shell	150
Royal Geographical Society - British Sugar Award	1000
Ryvita Ltd.	10
Scottish & Newcastle Breweries	100
Sir Samuel Scott of Yews Trust	500
St. John's College	230
Westcroft Trust	25
Worts Travelling Scholarship	75
	4480
Personal Contributions	1600
TOTAL	6080

EXPENDITURE

An initial statement of account:

Pre-departure	3329
In Pakistan	2341
Post-expedition	410
	6080

Pre-expedition expenditure

Return travel to Karachi for 6	1910
Insurance	424
Film	270
Air Freight	87
Medical Kit and Rabies jab	67
Prospectus + administration	185
Equipment	366
C.U.E.T.C. Expedition Levy	20
	3329

Pakistan (Av. exchange rate = RS: to the pound

Bus/train Karachi - Lahore	56
Bus Lahore - Rawalpindi	20
Flight/bus Rawalpindi - Gilgit	49
Accom. + food etc Karachi to Minapin (2 weeks)	576
Accom. + food etc. during Projects and Trekking	720
Jeep Gilgit - Iskumon Valley	40
Porters during Trek (2 weeks)	160
Jeep Mastuj - Chitral	16
Accom. + food etc in Chitral	16
Accom + food + travel to Karachi for 3	240
Accom. + food + travel to Baltistan then Karachi (2 weeks) for 2	448
	2341

Balance - For report: Printing and sending 410

Equipment

As it was planned to set up a camp at about 4000 m by the side of the glacier and that everything we needed would have to be carried up there it was necessary to obtain much of the more important items of equipment in Britain for quality and weight considerations. A list of the basic items taken is given below. Parafin stores were brought in Islamabad as was most of the cooking and eating utensils. The most expensive item being an extremely useful pressure cooker at a cost of 170 rp (£91). Some of these things were resold again in Gilgit and so this had little affect on the budget.

A certain amount of mountaineering was planned for the end of the trip or while up at the glacier camp. Consequently every member had the basic ice climbing tools, harness etc.

Plastic folding water carriers were found very useful and we took 2 x 2 gallon containers.

The Saunders space packers proved very versatile and simple to erect and we were most satisfied with these though they are not strong enough to withstand severe storms such as on a mountain.

Down is the most useful insulation as the weather was generally dry and there was plenty of sun. It is lighter, warmer and less bulky than the equivalent in man-made fibres.

Koflach plastic boots were used for much of the glacier work and climbing and proved excellent at keeping feet dry and warm.

One item that in retrospect would have been extremely useful was either barbed wire or an electric fence. This may sound undesirable in such a remote environment but a considerable amount of food was lost and equipment damaged both by grazing cows and a black bear. The cows became a real menace eating absolutely anything left out (including reoprene crampon straps!!).

To the glac.

1 Ultimate peapod

1 Ultimate 'The Tent' trampled on by cows!

2 Saunders Space Packer plus.

2 ropes (1 stolen by porters)

3 Epigas stoves + propane/butane fuel

(for mountaineering)

crampons, axes, helmets etc.

Deadmen, ice screws...

2 parafin stoves.

Scientific equipment

A hand operaterd ice drill was loaned to us by the Scott Polar Research Institute and was capable of about 1m/hr depending on the operator! A compass/clinometer (Silva 15 TDCL) was used for dip and strike measurements. 1 1/2 inch diameter plastic drainpiping was used for the stakes being the only available choice and a spring balance and 100 ft steel tape were employed for inter stake distance measurements.

All the surveying equipment was generously loaned to us by the Geology and Geography Department of Peshawar University and consisted of a plane-table, tripod, simple alidade, level and stadia rods. For the ornithology the most important items were a pair of binoculars, a telescope; Canon kindly loaned a 500 mm reflex lens and body for the photography.

MEDICAL REPORT

As is customary for Cambridge expeditions an extensive medical kit was supplied through the Cambridge Medical Scheme thanks to the tireless work of Dr. T. Davies and Mr. Gurner in the Department of Community Health and the generosity of the British pharmaceutical industry.

The logistics of the expedition were such that at times there were no less than three groups and it was important to divide all important drugs equally amongst the groups. For urgent lotions and creams this proved impossible and was an irritation rather than of serious concern.

No serious illness befell the group whilst in Pakistan but a host of gastraintestinal disorders, predominantly infective, were to plague all six members of the group. Symptons of nausea, vomiting and diarrhoea were most common, the latter especially, and in but a few cases these bouts were self-limiting and eased within forty eight hours without treatment.

Lomotil and codeine phosphate for symptomatic relief of diarrhoea were avoided where possible in order to promote passage of pathogens through the GI tract. Only on long bus and train journeys were such medications taken. Care was taken to avoid dehydration which was exascerbated by high altitude and high day temperatures. Electrolyte tablets were useful supplements.

An approved regime of trimethoprim and erythromysin was used in two severe and prolonged attacks of gastroenteritis and on three ocassions metronidazole (flagyl) was successfully used for Giardiasis (unspecific GI symptoms, steatorrhoea and 'eggy burps'). Other antibiotics supplied were ampicillin, cloxicillin, tetracycline and penicillin.

Persistent low grade infection was in retrospect a major problem, particularly amongst those working in the Hunza valley, resulting in a degree of lethargy and weakness. Severe heat also took its toll. Persistent Giardia, lamblia and Salmonella paratyphi infections on return to Britain proved troublesome for one of us, especially the Salmonella which for three months caused nausea, diarrhoea and weight loss.

Despite the high altitudes attained during the trip, acute altitude sickness was not a severe problem, everybody acclimatizing quickly and displaying only mild symptons of headaches, weakness and dyspnoea. Frusemide, a diuretic, was included in the kit in case of the complications of pulmonary and cerebral oedema but if sensitivity towards widely differing rates of acclimatization is shown and no 'altitude heroics' undertaken, then such serious complications should not arise. Acetazolamide is not considered a safe means of assisting rapid ascent except in emergencies. Mogadon, for sleeping when first at high altitudes, was a great help for one of us.

The pain killers supplied in the kit were Panadol, Aspirin, and DF 118. At no time was serious pain relief required.

Of great benefit were antihistamine tablets and creams for allergies and bites. Powders for combatting lice and fleas were thankfully not required.

Gauze, cotton wool, bandage, plasters, safety pins (large and small), scissors, tape, antiseptic creams and fluids and tincture of iodine are all essential items for treatment of trauma, although bulky and heavy.

For a mountainous expedition such as this, high factor Ultra Violet screening scream and lip salve are essential; severe sunburn is not just cosmetically displeasing, it can ulcerate skin and introduce infection.

Prior to departure vaccinations against typhoid and cholera were obtained and the state of immunization agaist TB and tetanus checked. Shared vials of rabies vaccine were organised and administered to give some protection and minimise cost. The day before leaving injections of gamma globulin were adminstered to give some protection against hepatitis A.

Prophylatic antimalarial drugs were taken throughout the trip and for six weeks afterwards, maloprim and chlorquine (avlochlor) to minimise risk of malarial resistance. Chloroquine and Fansidar were included in the medical kit for treatment.

Useful addresses

The Embassy of Pakistan,
35 Lowndes Square,
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Pakistan International Airlines,
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British Embassy,
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