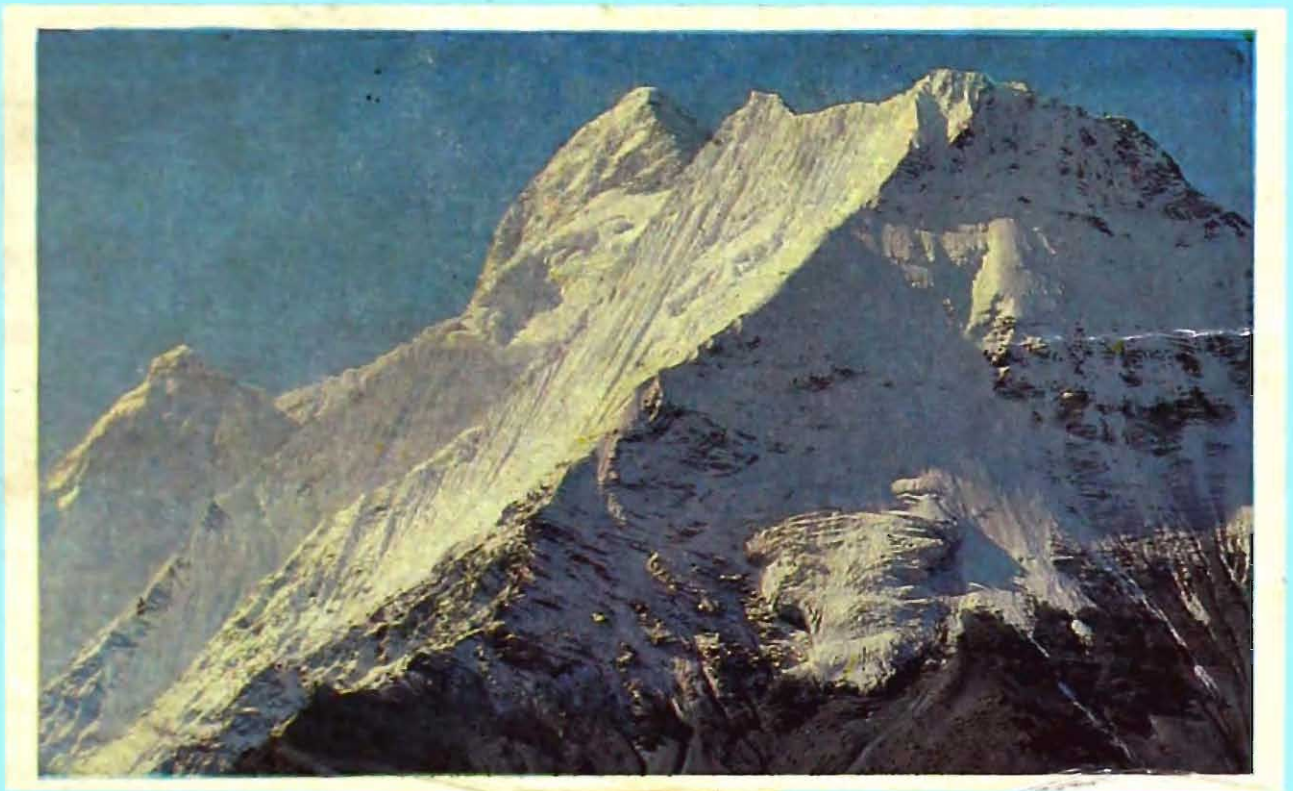


FAUNA OF CONSERVATION AREAS: 1

**FAUNA OF
NANDA DEVI NATIONAL PARK**



B. S. LAMBA

**ZOOLOGICAL SURVEY OF INDIA
1987**

FAUNA OF CONSERVATION AREAS

ZOOLOGICAL SURVEY OF INDIA

FAUNA OF
NANDA DEVI NATIONAL PARK
(MAMMALS AND BIRDS)

By

B. S. LAMBA

ZOOLOGICAL SURVEY OF INDIA, CALCUTTA



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PREFACE

India's richness in biological diversity is manifest in its magnificent wildlife. Unfortunately this unique living resource has suffered heavily, over the past hundred years or so, on account of socio-economic pressures in the wake of human population explosion. For the sake of developmental activity unimaginative changes were made in established land use practises which resulted in large scale destruction of wildlife habitat. This habitat destruction coupled with ruthless exploitation has played havoc with wildlife population through the country.

Since the turn of century at least 30 species of mammals and 14 species of birds of the Indian subcontinent have severely been threatened with extinction. One species of mammals i.e., Cheetah, *Acinonyx jubatus* and two species of birds, viz., Pink headed Duck, *Rhodonessa caryophyllacea* and Mountain Quail, *Ophrysia superciliosa* have already become extinct. Many species e.g. Tiger, Leopard (Panther), lion, Sloth Bear, Chinkara, etc. have become extinct locally where formally these were common (I.B.W.L., Expert Committee Report, 1970).

Most of the wildlife in India is now concentrated in conservation areas only. The conservation areas comprising of 53 National Parks (including 15 Tiger Reserves) and 247 Sanctuaries Wildlife Sanctuaries are spread over the length and breadth of India. Some of these areas are under consideration for being declared as Biosphere Reserves.

The Indian Board for Wild Life had in their XV meeting held on 1st October 1982 under the Chairpersonship of the then Prime Minister, Late Mrs. Indira Gandhi, noted with concern the paucity of information on wildlife of conservation areas in the country. The Board desired that Zoological Survey of India should also take up the faunal exploration of conservation areas (Tiger Reserves, National Parks and Sanctuaries, etc.) with special reference to wildlife.

Consequently Zoological Survey of India included the "Qualitative Faunal Assessment of Conservation Areas" as a regular programme in their Seventh Five Year Plan.

The present attempt is the first step in that direction. An attempt has been made to list the wildlife found in the Nanda Devi National Park with coloured illustrations of prominent forms. It is fully realised that there are a number of shortcomings and lacunae, but this is the best that could be achieved with the present manpower and resources. We look forward to better performance future in augmentative with resources.

B. S. LAMBA

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Partronage, guidance, help and assistance received from all the above said agencies, organisations, officials and individuals for conducting studies culminating in this report are gratefully acknowledged.

FAUNA OF NANDA DEVI NATIONAL PARK

CONTENTS

	<i>Page</i>
PREFACE	... iii
ACKNOWLEDGEMENTS	... v
THE PARK :	
LOCATION	... 1
ACCESSIBILITY	... 2
TOPOGRAPAY	... 2
MAJOR GLACIAL & STREAM SYSTEMS	... 3
TREKS AND CAMPSITES	... 4
GEOLOGY	... 9
CLIMATE	... 17
VEGETATION	... 18
FAUNA	... 21
APPENDICES	
APPENDIX I—MAMMALS	... 22
APPENDIX II—BIRDS	... 25
PLATES	

THE PARK

LOCATION

Long before Eric Shipton and H. W. Tilman, the duo of great explorer-mountaineers, set foot on its virgin soil in 1934, to penetrate into Nanda Devi (Rishi) Valley had been the cherished dream of all mountaineers worth their salt. So great was the challenge thrown by its rugged and difficult terrain to the skill and stamina of the explorer that it attracted mountaineers from all over the world. Many attempts were made but W. W. Graham, who reached Trisul Nullah in 1883 and Dr. T. G. Longstaff, who peered down the valley from Longstaff Col. in 1903, were partially successful.

The Nanda Devi National Park, comprising an area of about 800 km², is situated between 30°16'—30°32'N latitudes and 77°44'—80°02'E longitudes. It covers an altitudinal range varying from 2100 m to 7817 m. The park is a cup-shaped valley surrounded by high mountain walls studded with almost seventy, named and unnamed, high peaks (Plates V, VI, VII), rendering it an almost impregnable fortress. Some of the better known peaks from west to east are Dunagiri (7066 m), Changbang (6864 m), Kalanka (6931 m), Nanda Devi East (7434 m), Nanda Devi West (7817 m or 25,645'—the second highest peak of the Himalayan Range in Indian territory) and from east to west are Nandakhat (6631 m), Devsthan (6678 m), Maiktoli (6805 m), Mrigthuni (6855 m), Trisul (7120 m), and Bathartoli (6352 m).

The Park lies in Chamoli district of Uttar Pradesh. Its northern boundary starts from confluence of Rishiganga and Dauliganga rivers then it runs along the Lata ridge and Dunagiri Changbang, Kalanka Peaks finally enters the crest of Rishi Pahar. The eastern boundary runs, along the boundary between Chamoli and Pithoragarh districts, from the crest of Rishi Pahar to Nanda Devi East Peak and then upto the point where boundaries of Pithoragarh, Almora and Chamoli meet. From this point the southern boundary runs along the boundaries of Chamoli and Almora districts where it passes through Nandakhat and Malthuni Peaks upto the point where inter-district boundary turns abruptly to the south and then runs along the ridge to the Nanda Ghunti Peak. From here the western boundary runs along the ridge to the Raunti Peak and along Raunthigad river upto the confluence of Rishi Ganga and Ravgad rivers and then further along Rishi Ganga upto the point where Rishi Ganga meets Dauliganga (figure 1—map).

ACCESSIBILITY

The area remains under a thick carpet of snow for more than half of the year and hence accessible only for a limited period of about five months (i.e. from June to October) in a year.

There are only two entry points to the park area, viz., Lata Kharak above Lata Village and lower Rishi Gorge near Village Reni. Both the villages of Lata and Reni are located on the Joshimath—Malari motor road.

The trek originating from the first entry point i.e. Lata Village and passing through the high mountain passes of Lata Kharak and Dharansi to Dibhrugheta in the Rishi Valley.

The trek originating from Reni Village, running along Rishi Ganga river through the almost vertical "Rishi Gorge" too leads to Dibhrugheta, from Dibhrugheta onwards there is a single common trek upto the base of Nanda Devi Peak.

The Lata trek (Plate I) although more strenuous of the two is considered less hazardous and is more popular. Nevertheless the Nanda Devi trek is considered to be one of the toughest in the world and attracts a large number of mountaineers and trekkers from all over the world.

The Lata trek leads from Lata Road-head via Belta Kharak (2750 m), Lata Kharak (3700 m), Dharansi (4150 m), Dibhrugheta (3350 m), Deodi (3300 m), Ramani (3500 m), Bujgerha (3950 m), Patalkhan or Tilchauni (4100 m), to Sarsopatal or the Nanda Devi base camp (4200 m). The various diversions, which lead to the base camps of various other peaks viz., Dunagiri, Changbang, Kalanka, Hunuman and Trisul, off the main trek are also shown in the figure 1 (map). A lot of physical endurance and mountaineering skill is required to reach the Nanda Devi base camp. At several places, as shown in the figure 2 by dark oblique lines, along the trek one requires additional support of 'fixed ropes' for a safe passage.

TOPOGRAPHY

As already stated, the park area is a cup-shaped structure which is demarcated by a high enclosing mountain range offering icefalls and corniced ridges to the outer world. The area is segmented by a series of parallel ridges, with a north-south trend in the north and south-north trend in the south, emanating from the encircling mountain ramparts. The most important is the Devasthan-Rishikot ridge which divides the Rishi Gorge at the base of Nanda Devi and separates the 'Inner

Sanctuary' or 'Upper Rishi Gorge' from the rest of the Rishi Gorge or 'Outer Sanctuary' or 'Lower Rishi Gorge' (Plate X). The Inner Sanctuary is a vast glacial zone intermingled with numerous alpine meadows (Plates VII & VIII) and is further divisible into the North 'Inner Sanctuary' (Plate IX) and South 'Inner Sanctuary' by Nanda Devi mountain. Whereas 'Outer Sanctuary' is mostly a thickly forested zone of which the north facing slopes are more formed than the south facing slopes. Both the inner as well as outer sanctuaries are traversed by a large number of valleys extending from half a km to about 5 kms, running in north-south direction. The graphic representation of the valleys (and their offshoots) is presented in Fig. 3.

MAJOR GLACIERS AND STREAM SYSTEM

The upper-half, particularly the inner surface of the cup-shaped park spotting numerous high peaks, embraces a major glacier system. It consist of Ramani Glacier (Gl.), Changbang Gl., and North Rishi Gl., in the north and south Nanda Devi Gl., South Rishi Gl., Trisul Gl., Bethartoli Gl., Ronti Gl. and Nanda Gunti Glacier in the south. The northern system is by and large at a lower altitude with a bigger area. The southern glaciers are more active than their northern counterparts though, like all Himalayan glaciers, they have been retreating and their lower stretches are collapsed heaps of rubble and glacial debris (Plate IV) with the lateral morains forming high, distinctive ridges above the subsiding glaciers.

Each glacier system gives rise to ablation streams, the North Rishi and the South Rishi streamlets which flow along the precipitous cliffs of Nanda Devi originate from the North Rishi Gl. and South Rishi Gl., respectively. A short distance below their confluence, the Rishi stream flows into its stupendous upper gorge, cutting at right angles across the Devistan-Rishikot-Ridge.

Clearing the upper gorge, the east to west flowing Rishiganga receives the temultuous Ramai stream, raching down a precipitous gorge which drains the Ramani glacier basin on the north and a little further down-stream, the Trisul torrent joins the Rishiganga from the south, draining the extensive basins of the Trisul and Bethartoli glaciers. The Ramani and the Trisul glacier systems from an important and conspicuous feature of the 'Outer Sanctuary'.

The Rishi stream continues along its chasm receiving various torrents from both sides, some by narrow impassable gorges, other as graceful waterfalls, to finally enter the awe-some lower gorge guarded by over-

hanging cliffs, and skirt the Lata peak to merge with the Dhauliganga near Reni Village. The Rishi Gorge cuts all the ridges at right angles, and is, therefore, difficult to negotiate. Except for this narrow, stepped-sided gorge the entire basin is well above 2000 m (figure 1-map).

TREKS AND CAMP SITES :

There are two main entrances to the Park, (i) The Dharansi Pass beyond Lata village and (ii) The Rishi Gorge in village Rini. The treks originating from both these entry points join at Dibrugheta at the foot of the Dharansi Pass.

As already stated the park area is broadly divisible, topographically, into four major segments. From Dibrugheta onwards four different treks lead to these four major segments of the park, in fact, to the base camps of the major peaks situated in these segments. These four major segments being :

- (i) South Inner 'Sanctuary'
- (ii) North Inner 'Sanctuary'
- (iii) South Outer 'Sanctuary'
- (iv) North Outer 'Sanctuary'

The various treks, as detailed below, have been indicated in the map (Fig. 1). And also a Graphic representation of the trek is shown in Fig. 2.

Trek a — To *Sarsopatal* / *Main Nanda Devi Base Camp* in South Inner 'Sanctuary'.

Trek b — To *Tala Base Camp* / *North Rishi Glacier* in North Inner 'Sanctuary'.

Trek c — To *Trisul Base Camp* / *Trisul Area* in South Outer 'Sanctuary'.

Trek d — To *Common Base Camp for Dunagiri, Changabang, Kalanka* etc in North Outer 'Sanctuary'.

The trek through Dharansi Pass (4253 m.), originating from Lata (Village) road head, is more strenuous and physically demanding but less hazardous. The trek through Rishi Gorge, originating from village Rini, presents a much greater risk of physical injury as it involves travelling along a high and narrow ledge of an almost vertical rock-face over a number of Kilometres. Both these treks join at Dibrugheta, from where the four main treks into the Park originate from.

A brief description of all these treks is attempted in the following pages.

Lata-Dibrugheta Trek

route : Lata road head $\overset{3 \text{ km}}{\text{---}}$ Belta Kharak $\overset{3 \text{ km}}{\text{---}}$ Lata Kharak
 $\underset{10 \text{ km}}{\text{---}}$ Dharansi $\underset{4 \text{ km}}{\text{---}}$ Dibrugheta.

Camp Belta Kharak (2700m/9,020')

The first camp site along the main trek about 3 km from Lata road head (Plate III). It is situated on the NW facing slope of about 30°. As it takes only 2-3 hours to reach this camp from the road head, trained mountaineers do not stay here for the night ; instead they proceed directly to the next camp i.e. Lata Kharak. For others, who need gradual acclimatization and adjustment to high altitude, a stay for a night or two is indicated.

Camp Lata Kharak (3700 m/12,136')

From Belta Kharak onwards, it is tiring and steep uphill trek (more than 1000 m. in 3 km or so) to Lata Kharak, but one is well rewarded by the glorious views of the snowy peaks of Ronti, Nanda Ghunti and Bethartoli across the Rishi Ganga. This camp site is an open, broad grassy ridge which is covered with flowers during summer and with snow during winter. It is always windy and cold. The ending tree-line with *Rhododendron* spp. is another remarkable feature of this place. Almost every party/individual heading for the Nanda Devi Park spends a night or two here. From here fine views of the northern face of Bethartoli Himal and Trisul massif extending to south can also be seen.

Camp Dharansi (4150 m/13,612')

To reach Dharansi from Lata Kharak, one has to go uphill for about 10 km along trek across the Dharansi Pass (4253 m.). When approaching the Pass one gets the first glimpses of Dunagiri (7068 m) and immediately after crossing it, Nanda Devi West (7817 m.) can be seen. From Dharansi the trek trails across the Malathuni Pass (4238 m), where the western face of Hanuman Peak (6076 m) can be viewed. The camp site (Plate II) is situated high above, to the north of Rishi Ganga, comprises of remains of a retreating glacier consisting of scree and boulders, but is surrounded by numerous luxuriant alpine meadows which provide good habitat for Bharal or Blue Sheep (*Pseudois nayaur*), during summer. In 1981, i.e. during our first trip, we witnessed here the snow fall as late as on 17th August.

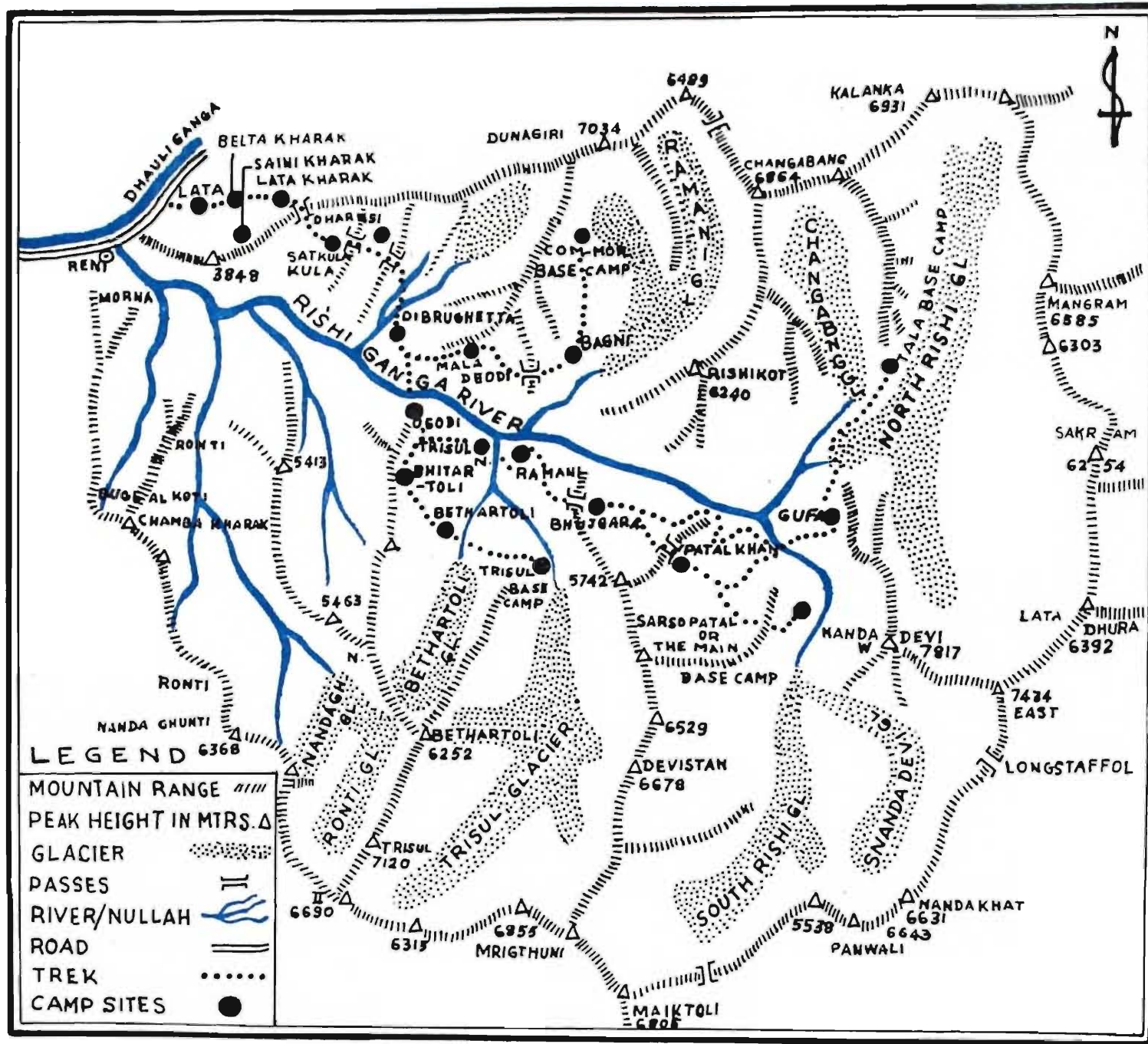


Fig. 1 Map of Nanda Devi National Park

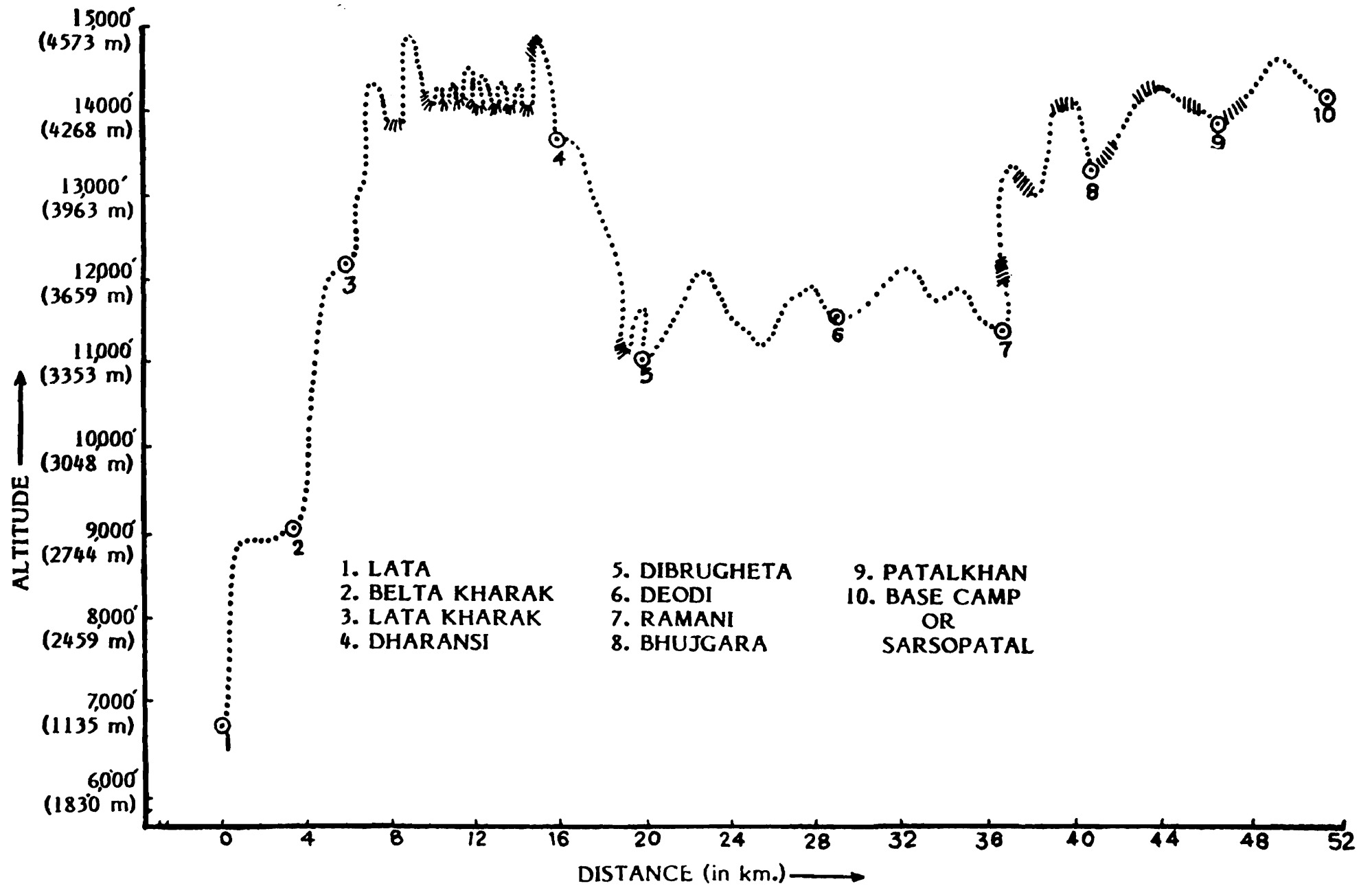
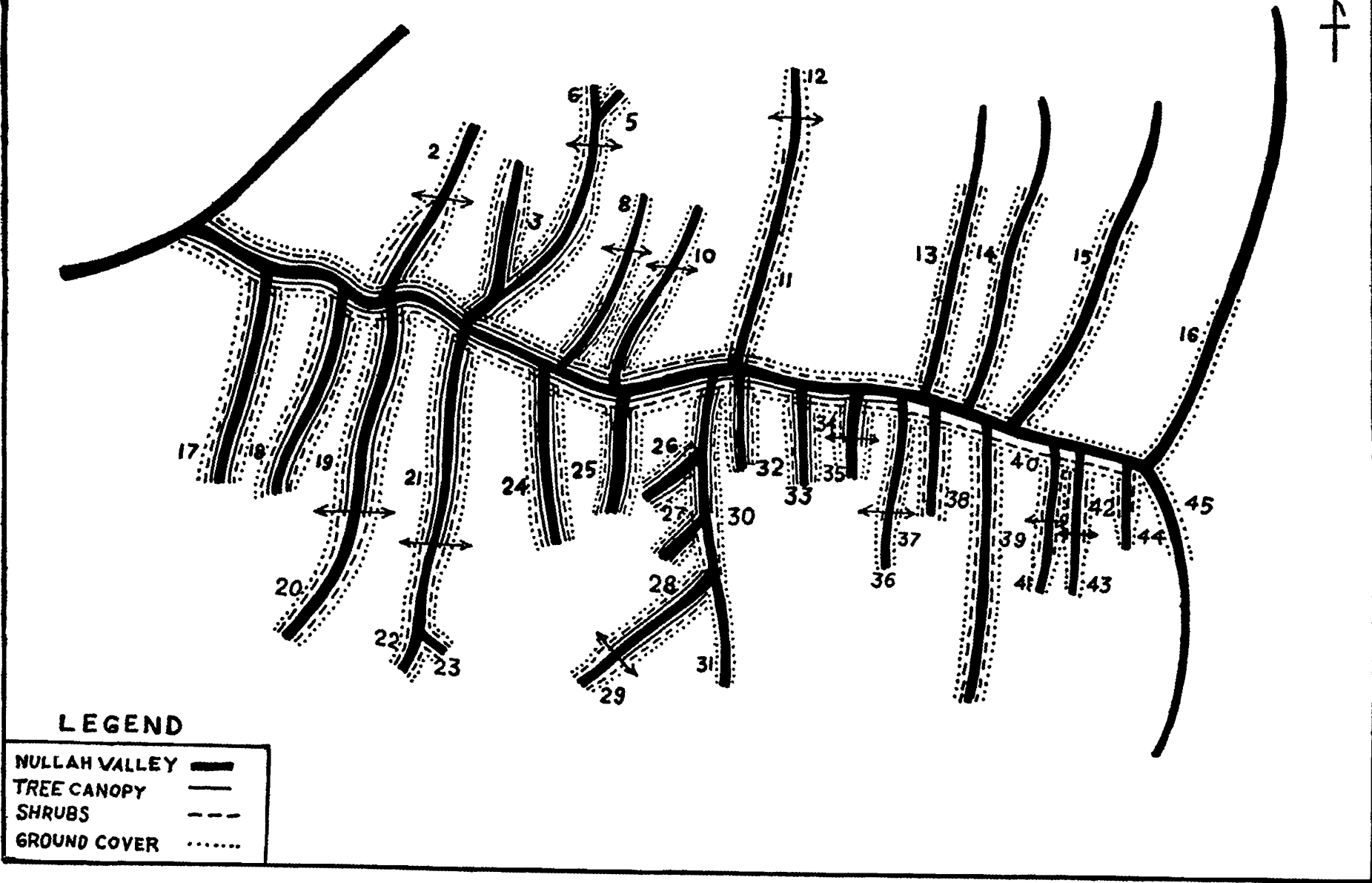


Fig. 2 Map of Nanda Devi Trek : A Graphic representation

**Fig.3. GRAPHIC REPRESENTATION OF VALLEYS WITH VEGETATION COVER
IN NANDA DEVI NATIONAL PARK**



Trek-d Dibrugheta-Common Base Camp of Dunagiri, Changabang and Kalanka Peaks.

Route :

Dibrugheta $\xrightarrow{5 \text{ km}}$ Malla (Upper) Deodi $\xrightarrow{8 \text{ km}}$ Bagani
 $\xrightarrow{10 \text{ km}}$ Common Base Camp

Camp Malla (Upper) Deodi (3850m/12,268')

As already stated under the Trek-a that from Dibrugheta to Deodi one has to cross a number of ridges, and while doing so one comes across a north to south flowing nullah known as 'Tulpani Nullah'. Having crossed this nullah, which finally feeds the east to south flowing Rishi Ganga, instead of going towards Deodi (of Trek-a) one takes north-eastern turn and finally heads to Malla or Upper Deodi.

Camp Bagani (4300m/14,454')

To reach Bagani from Malla Deodi one has to negotiate an eight kilometer up and down trek across several ridges. Bagani is situated on a north-east-facing hill-slope of about 45°. In fact, it is a good grassy slope with sporadically distributed *Salix* spp. bushes.

Camp Common Base Camp (4750m/15,580')

It is about 10 km² steadily uphill trek from Bagani to the Common Base Camp. Shortly after leaving Bagani for the Base Camp one gets a panoramic view of Changabang Peak and having reached at the Base Camp that of the Dunagiri, Kalanka, and Changabang together. Altitudinally, it is the highest Base Camp that we visited in the Park.

GEOLOGY

Yugi Maruo (1979) a geologist from the University of Ryukyu, Japan, who had accompanied the Indo-Japanese Nanda Devi Expedition has described the geological formation along the Rishi Ganga as follows :—

“Lithostratigraphy And Structural Features
Along the Rishi Ganga

“The crystalline rocks of the Vaikrita group and lower part of the Tethys sediments are well exposed along the Rishi Ganga with monoclinical structure dipping to NE-E or to SE...They are tentatively

subdivided into four formations from tectonically lower position as follows :

- 1 Lata Formation
- 2 Ramani Formation
- 3 Kharapatal Formation
- 4 Martoli Formation

The Lata Formation thrusts on the Munsiri Formation of Valdiya (1978) and comes into contact with the Ramani Formation along a NNE-SSW trending transverse fault. However apparently a direct continuation of the Lata Formation to the west is overlain by an affinity of the Ramani Formation in the Alakananda valley (Heim and Gansser, 1936). The boundary between the Ramani Formation and the Kharapatal Formation was presumed to be a thrust fault, and the Kharapatal Formation, in turn, is thrust over by the Martoli Formation. A number of thin dykes and sills of alitic granite have intruded into upper part the Ramani and middle part of the Kharapatal Formation. Middle and upper parts of the Kharapatal Formation show predominantly sedimentary aspects, although they have been metamorphosed to have the greenschist facies assemblages. The author would place the lower limit of the Tethys sediments at the base of the Kharapatal Formation”.

“Lata Formation :

Rocks of the formation occur in the lower course of the Dhauli Ganga and of the Rishi Ganga. In the lower half of the formation, garnetiferous mica schists and garnet mica quartzose schists predominate, and mica quartzites are subordinate constituent. They are fine to medium grained and well cleaved, and alternate in various scale from several to some tens of cms. Between the confluence the Rishi Ganga and the Dhauli Ganga and Bhangiul they are mylonitised and are associated with some coarse augen gneisses a few metres thick. A schistose amphibolite about 10 m thick occurs alongwith the augen gneiss near the confluence. Some thin bands of calc-silicate schist are intercalated in the mylonitic zone. Highly sheared sericite-chlorite quartzites at Tapoban are likely to belong to the Munsiri Formation and the probable Vaikrita thrust runs at Bhangiul with about N-50°W trend and about 30° NE dip. Apparent thickness of the lower half of the formation is about 3500m.

A thick series of mica quartzites overlies the alternations of the garnet schists conformably. The quartzites are fine to medium grained

and cleaved parallel to bedding plane. Medium grained garnet mica quartzose schist are interbanded in various horizons of the quartzites. The quartzites are cut by a NNE-SSW trending fault at Debrugheta. Observed thickness of the series of quartzites is about 3500m. in the present area.

The quartzites are certainly the direct eastern extension of what Heim and Gansser (1939) described in the north of Joshimath along the Alakananda valley where they estimated the thickness to be 9500 m. There the thick quartzite overlies garnet mica schists and is overlain by a highly metamorphosed sedimentary series of gneisses, augen gneisses and calc-silicate rock (Heim and Gansser, 1939). They believed a normal succession from the garnet mica schist to at least the top of the quartzites. In the schists and quartzites of the Lata Formation, foliation planes marked by preferred oriented micas are approximately parallel to bedding planes where they are recognizable. The foliations rotate gradually from N50°W strike 30°-40° NE dip near Bhangul to NS strike and about 40°E dip nearing the transverse fault. Gentle undulations with axes of roughly NW direction weakly develop on the foliation planes.

The NNE-SSW trending transverse fault is likely to be the southern extension of the Malari fault of Shah and Sinha (1974) and Gairola (1975). In a Landsat imagery a NNE-SSW directing lineament from Malari to Debrugheta is clearly recognizable. The lineament can be traced further to the south, to the Wan valley where MCT shows an acute bend in tectonic map of Valdiya (1978)...Heim and Gansser (1939) described abnormal strikes of NNE, which are almost perpendicular to the normal strikes, over the distance of 20 kms. in the Wan valley. The Malari-Debrugheta fault may extend to the Wan valley, and it may be right lateral fault of regional scale."

"Ramani Formation :

Across the Malari-Debrugheta fault highly metamorphosed rocks of the Ramani Formation are distributed on both sides of the Rishi Ganga. It is composed of pelito-psammitic gneisses, calc-silicate gneisses and migmatite with abundant feldspar porphyroblasts and quartzo-feldspathic leucosomes. Aluminosilicate (Kyanite and sillimanite) bearing garnet mica gneisses and garnet mica quartzose gneisses prevail in lower part and some thin layers of calc-silicate banded gneisses are intercalated. The gneisses are partly transformed into K-feldspar porphyroblast augen gneisses or to migmatites with tourmaline and garnet bearing quartzo-

feldspathic leucosomes. The transition from the gneiss to the migmatite is gradational, as sporadic feldspar porphyroblasts and quartzofeldspathic leucosomes are gradually becoming frequent. As the amount of leucosomes increases, sillimanite tends to appear in melanocratic portion.

The amount of the migmatites and augen gneisses increase upwards, and it is almost entirely composed of the migmatites and augen gneisses in the middle part of the formation. The leucosomes diminish gradually in upper part of the formation, and the migmatites pass into well cleaved fine to medium grained pelitic-psammitic gneisses with some intercalations of mica quartzite and calc-silicate banded gneisses.

A pile of the calc-silicate banded gneisses of about 1500 m thick occur at the top of top formation. The gneisses are characterized with minutely alternating banding structure of a millimeter to some tens of centimeter. The banding are composed of fine grained black layers which contain minute flakes of biotite and is characteristically rich in microcline, medium to coarse grained layers of green color, for which diopside and green hornblende are responsible and of white marble layers. These layers often show rhythmic alternations, and it might reflect original sedimentary structure having thin beds of different carbonate contents.

Foliation plane of gneisses and migmatites fluctuate from N20°E strike and 40°-50° SE dip to N60° E strike and 30° SE dip in lower part. While the foliation shows rather consistent strikes of about N20°E and dips of about 30°SE in middle and upper part of the formation. Small scale open folds with axes of N80°W to N70°E are observed on the foliation planes throughout the formation."

"Kharapatal Formation :

Rocks of the Kharapatal Formation belonging to the Tethys sediments exposed in the upper course of the Rishi Ganga and in the basal part of the Nanda Devi massif. It consists predominantly of well cleaved black pelitic schists in the lower and middle part of the formation. Some layers of mica quartzites alternate with the black schists in the lower part, and seams of calcsilicate schist with garnet and actinolite porphyroblasts are intercalated in the middle part of the formation. The black schists appear to be ferruginous with numerous tiny grains of magnetite under the microscope, and are very rich in biotite. It is probably responsible for characteristically black appearance of the schists.

In the upper part grey to black, fine grained calcareous phyllites are interbedded with sericite-quartz pelitic phyllites. These phyllites are characterised with occasional biotite and chlorite spots of microscopic scale. Peculiar spotted phyllites with abundant sieve-like biotite porphyroblasts which were called the Budhi schist in the Kali valley (Heim and Gansser (1939) were collected from a talus below the wall on the right back of the Dakhni Nanda Devi glacier.

Grain size and grade of metamorphism of the rocks within the Kharapatal Formation visibly decrease structurally upwards. In the lower part the schists are medium grained and metamorphosed to the amphibolite facies. While they are fine grained and weakly metamorphosed, and their original sedimentary textures are partly preserved in the middle and upper parts. Apparent thickness of the Kharapatal Formation is about 3500 m.

Foliation planes of the schists and phyllites are parallel to bedding planes where they are discernable. The foliation planes strike about N20°E and dip 20°-30° to SE in the basal part, and they rotate gradually to N50°W strikes and about 25°NE dips around the base camp. Microfoldings with axes of N70°W to EW weakly develop on the schistosity planes throughout the formation. The lower and upper boundaries have been intensely mylonitised and magnetite mineralization has taken place in the upper contact with the Martoli Formation.”

“*Martoli Formation* :

Both the Nanda Devi Main and the East peaks and their southwestern face are composed of calcareous sandstones, white sericite quartzites and green to dark grey phyllites. Earlier Heim and Gansser (1939) sketched from a distance a succession of these rocks on the eastern face of Nanda Devi East peak. They also described a direct extension of the succession in the upper course of the Gori Ganga, and named it as the Martoli Formation (Heim and Gansser, 1939, Gansser 1964). Gansser (ibid) estimated the thickness of the Martoli Formation to be about 4000 m in the Gori Ganga. While the apparent thickness in the present area is about 2000 m. It is likely that only the lower half of the Martoli Formation described by Heim and Gansser (1939) is distributed in the present area.

Gansser (ibid) believed that the Martoli Formation conformably overlies his Budhi schist formation which is likely to correspond to the upper part of the Kharapatal Formation in the present area. However,

the writer observed a large scale overturned fold with an axis of about N50W in the lower part of the formation...Such a structure is not seen in any part of the Kharapatal Formation, and the boundary zone between the formations is intensely mylonitized. The boundary runs with about N50W strike and 15°-20° dip to NE, being almost concordant with the structure of the Kharapatal Formation. It may be mentioned that the martoli Formation thrusts on to the Kharapatal Formation in the present area.

The calcareous sandstones occur below an altitude of about 6200 m and above 6800 m on both the western ridge which stretches from the Main peak and the eastern ridge which extends from the East peak... They are mostly fine grained, well bedded and their calcite contents vary considerably one bed to another. The sandstones are featured with their brownish yellow weathered surface. Around the crest of the overturned fold on the east ridge, the sandstones are isoclinally folded in smaller scale with horizontal axes of about N50W direction. Well developed axial plane cleavages of the folds which cut the bedding plane almost in the right angle strike N50W and dip about 15° to NE.

The sericite white quartzites are distributed at an altitude of about 7300 m on both of the ridges and on the top of Main peak. A large blok of conglomerate similar to the Nanda Kot conglomerate of Heim and Gansser (1939), i.e., pale green quartzose matrix and rounded quartzite cobbles and boulders of pinkish color, was collected on the side moraine of the Dakhni Nanda Devi Glacier near the base camp. The conglomerate is acutely and isoclinally folded. From the structures the conglomerate is expected to be interbedded in the calcareous sandstones occur below the altitude of 6200 m.

The green to grey phyllites occur between the altitudes of 6200 m and 6800 m on both of the ridges. They are fine grained sericite quartz phyllites and contain sporadically detrital calcite grains of size up to several millimeter, and are intercalated often by calcareous seams. The phyllites are intensely folded and crenulation cleavage develops cutting the bedding planes obliquely."

"Tourmaline Leucogranite :

A series of dykes and sills of aplitic granites have intruded into the calc-silicate banded gneisses of upper part of the Ramani Formation and lower and middle part of the Kharapatal Formation. They are mostly a few meter thick and relatively thicker aplitic granites, about ten to

thirty meter, are observed in the lower part of the Kharapatal Formation near Pathalkhan. The granites diminish upwards and none is found on the southern flank of the Nanda Devi massif.

They are medium to coarse grained muscovite leucogranites and consistently contain a fair amount of tourmaline. A small amount of biotite is occasionally present. The granites show faintly developed foliation in some places, but they are mostly free from deformation indicating their post-tectonic emplacement. As will be described later a certain effect of contact metamorphism by the leucogranites is discernible in the lower part of the Kharapatal Formation."

"Mineral Assemblages And Metamorphic Grade :

In the successions of metamorphic rocks described above, metamorphic grades will be deduced from mineral assemblages commonly present in pelitic rocks. Observed mineral assemblages in respective part of the formations. Among the aluminosilicates (Als) and ferromagnesian minerals which can be plotted on the Thompson projection (Thompson, 1957), sillimanite (Sil), Kyanite (Kya), staurolite (Sta), almandine garnet (Gar), biotite (Bio), muscovite (Mus) and chlorite (Chl) were observed in the present area.

Specimens collected from the Lata Formation yield only mineral association Gar-Bio which does not indicate any specific metamorphic Grade. However Heim and Gansser (1939) reported Kya-Gar-Mica schists from the Alakananda Valley below the thick quartzite series. It may show that the absence of Kyanite in the present area can be ascribed to unfavourable composition of the rocks rather than unfavourable metamorphic condition to form Kyanite, and that the rocks of the Lata Formation belong to the Kyanite almandine high grade...of Winkler's scheme (1976). Similarly assemblage Kya-Gar-Bio in lower and upper parts of the Ramani Formation and lower part of the Kharapatal Formation represent the Kyanite almandine high grade (IV).

In specimens having assemblage Sil-Kya-Gar-Bio in the Ramani formation, kyanites are often included in the garnets, and the garnets are surrounded by aggregations of the fibrolite and biotite. It may show that the polymorphic transition from Kyanite to sillimanite have taken place and Kyanite is present in metastable state. The assemblage Sil-Gar-Bio in the migmatite represents the sillimanite almandine high grade (V).

In the specimens having assemblage Sil-Sta-Gar-Bio, muscovite is absent. It is likely to indicate that muscovite has been used up in the reactions $\text{Sta} + \text{Mus} + \text{Quartz} + \text{Als} + \text{Bio} + \text{H}_2\text{O}$ proposed by Hoschek (1969), or $\text{Sta} + \text{Mus} + \text{Quartz} - \text{Als} + \text{Gar} + \text{Bio} + \text{H}_2\text{O}$ suggested by Thompson and Norton (1968). The reactions mark a transition from the almandine medium grade to the almandine high grade (Winkler, 1976). In the same specimen garnet crystals which co-exist in contact with staurolite have elongate sieve-like skeletal shape similar to that of staurolite. It may point out that the latter reaction have actually taken place as staurolite being replaced by garnet.

Likewise in the specimens having assemblage Kya-Sta-Gar-Bio, in lower part of the Kharapatal Formation, muscovite is absent. Two types of Kyanite were recognized in this case. The one type of Kyanite is oriented to the direction of the foliation and slightly deformed. The other is not oriented, not deformed and is rich in inclusions with helicitic texture..., thus featuring post-tectonic crystallization concerning to the regional metamorphism which formed the foliation. Some of the post-tectonic Kyanites show cruciform twins which are very common in staurolite, and it suggests that the Kyanites replaced staurolites in post-tectonic stage. Accordingly it is probable that either of above mentioned reactions which mark the transition from the almandine medium grade (III) to the almandine high grade took place in the post-tectonic stage. This can be explained by the post-tectonic emplacement of the leucogranites in lower part of the kharapatal formation.

In middle part of the kharapatal formation, neither kyanite nor staurolite is seen. Mineral associations Gar-Bio and Bio-Chl probably represent the almandine low grade (II) of Winkler (1976). In upper part of the Kharapatal and in the Martoli Formations, garnet is no longer present. It can be supposed to be below the almandine stability field (I).

Thus..., so called normal metamorphism is seen in the successions from middle part of the Ramani Formation to the Martoli Formation, where metamorphic grades decrease upward gradually from the sillimanite almandine high grade (V) to the low grade (I). No significant gap or jump in the metamorphic grade is seen at the tectonic boundaries between the respective formation. While metamorphism seems to be reverse in the lower half of the Ramani Formation, to the supposedly underlying Lata formation where metamorphic grades decrease downward from the sillimanite almandine high grade (V) to the Kyanite almandine high grade (IV).''

CLIMATE :

The Nanda Devi complex is situated at the turning point where the Himalayan chain changes its N. W. to S. E. trend to a west to east trend and the entire southern mountain-wall with its extensions to the west and east along the Trisul II Jatropani ridge and the Nanda Khat range beyond the Traill's Pass respectively exposes a continuous southern aspect to the lower foothills and the sun. These slopes, as also the western watershed ridge of Trisul and Bethatoli and its westward bifurcation of Nana Ghunti, cause considerable updrafts of warm air throughout the year, resulting in high precipitation and heavy cloud cover during the rainy season these ranges receive the full blast of the S. W. Monsoon and rainfall is extremely heavy. The monsoon effect starts being felt in the third week of June. From within the Park are witnessed daily fantastically tumultuous cloud formations over the mountain walls on south and west, with spectacular displays of lightning.

The eastern mountain divide also has daily cloud build-ups, but these are far less spectacular than along the southern wall, a fact which is explained by the drier climate of the Milam area, lying as it does beyond the main Himalayan range. The same is true of the northern wall, though Dunagiri dominating the Dhauri gorge pulls up considerable warm air. Its influence creates the late afternoon cloud and mist on the Lata ridge and the Dharasi Col. The snow conditions, with thick snow cornices overhanging the southern ridge and the more active glaciers like the Nanda Devi South, the Rishi South and the Trisul Glaciers, suggest heavier snowfalls on the southern side. Among its other unique qualities the park, by virtue of its configuration, enjoys a sub-climate of its own. There is obviously a mass of cold air on the basin which exerts a significantly powerful effect on the precipitation of the Almora and Chamoli Districts.

The cold air on the basin creates a dry climate with low annual precipitation. Inside the park, the snowline was well above 4500 m as against the heavy winter snow on the Dharasi Col. and the Malthuni ridge considerably below this altitude. Snow is thicker and generally at lower altitude on the southern side of the park than the northern, which conforms to the general conditions on the south and north aspects of mountains in the northern hemisphere. The entire northern side of the park receives more direct sun rays and is consequently warmer, with more rapid thawing of snow.

While the glacial basins and upper slopes experience strong diurnal winds, the gorge itself, unlike other major Himalayan valleys, is very sheltered because the flanking ridges divert the air currents up their sides. The Malthuni and the Rishikot ridges have a dramatic influence on the warm air blowing into the gorge. While strong winds are a regular feature on the higher slopes from a couple of hours after sunset almost to sundown, the nights are invariably calm. The diurnal winds produced clouds in the afternoon and there was usually a light drizzle or sleet towards the evening. Occasionally as late as the last week of May there is light snow fall all over the park, and wide-spread snowfall as late as middle of June. With the onset of the monsoon stream in the third week of June, there is considerable inflow of warm air up the gorge resulting in light mist over the high meadows and this warm air has a profound effect on the wintery conditions which linger on into summer. Under its influence, the winter snow rapidly melts. While considerably curtailing the hours of insolation, the mists and low clouds in June keep the soil moist, a factor not found in the drier inner Himalayan valleys or on the Tibetan Plateau. Thus, the Nanda Devi Park, though receiving little precipitation, supports a lush vegetation than other secluded valleys.

A very distinctive feature of the weather around Nanda Devi is the fact that unlike other major Himalayan peaks the great mountain has very little cloud formation on it in the afternoons.

VEGETATION : (Plates VII & VIII)

The park is very rich in Flora. The information compiled from the publications of the Botanical Survey of India and other expedition reports reveal that more than 200 species of plants (eight species of Pteridophytes ; five species of Gymnosperms ; One hundred eighty eight species of Angiosperms grow in the park. Of these, about 15 species e.g *Aconitus* spp., *Circeaster agrestis*, *Epipogium aphyllum*, *Listera* sp., *Meconopsis aculeata*, *Nardostachys grandiflora*, *Orchis latifolia*, *Podophyllum hexandrum*, *Saussurea obvallata* (to mention a few) are considered rare and endangered.

Altitudinally, the vegetation of the park can be classified broadly into three categories :

1. Sub alpine forest
2. Moist alpine scrub
3. Alpine meadows

The sub alpine forest comprises three different canopies : Upper, Middle and Lower or the ground cover. The upper canopy is formed of *Abies pindrow*, *A. spectabilis*, *Rhododendron campanulatum* and *Betula utilis* tree species ; the middle canopy consists of comparatively smaller tree like shrubs *Rosa*, *Viburnum* and *Jasminum* etc ; and the ground cover is composed of various herbs and grass species. This forest type is generally met with in the Lower Rishi Gorge at an altitude of about 3500 m and is restricted only upto Ramani in the east.

The moist alpine scrub forest consists of several pure stands of *Betula* and *Rhododendron* species.

The alpine meadows (Plate VII) are composed of numerous shrubs (e.g. *Rhododendron anthopogon*, *Juniper* and *Salix species*), herbs (e.g. *Aconitum*, *Cynanthus* and *Polygonum species*) and grasses (e.g. *Dontonia*, *Fostuca* and *Poa species*).

The various valleys referred to in topography can be broadly classified into three categories as small (upto 1 km. length), medium (upto 2 km. length) and large (upto 3 km. length or more). The vegetational cover in these valleys can be broadly categorised as :

1. Tree cover
2. Shrubs and grasses cover
3. Grasses cover

Each valley was surveyed and approximate vegetational cover in extent and quality is represented in figures No. 3 and is detailed in Table No. 1.

TABLE—1
Vegetational Cover of the Valleys

Code No.	Name of the valley (Nullah)		Vegetation cover		
			Tree	Shrub	Grass
<i>Valleys situated in the North</i>					
1.	Dharansi Nullah	a	A	A	A
2.	„ „	b	D	D	A
3.	Dibrugheta Nullah	R	B	A	A
4.	„ „	La	A	A	A
5.	„ „	Lb	D	A	A
6.	„ „	Lc	D	A	A
7.	Tulapani Na		B	A	A
8.	„ Nb		D	D	A
9.	Unnamed Na		A	A	A
10.	„ Nb		D	D	A

(Cont.)

Code No.	Name of the valley (Nullah)	Vegetation cover		
		Tree	Shrub	Grass
11.	Bagni Na	C	A	A
12.	„ Nb	D	D	A
13.	Patal Khan Opp. NR	D	B	B
14.	„ „ NL	D	B	B
15.	North Rishi Glacier N	D	B	B
16.	Nanda Khat N	D	D	C
<i>Valleys situated in the south</i>				
17.	Morna N	A	A	A
18.	Pungrani N	A	A	A
19.	Ronti Na	A	A	A
20.	Ronti Nb	D	A	A
21.	Dudgnaga Na	A	A	A
22.	„ Nb	D	A	A
23.	„ Nc	D	A	A
24.	Ringual Sangul N	A	A	A
25.	Deodi NL	A	A	A
26.	Bethartoli Na	A	A	A
27.	„ Nb	D	A	A
28.	„ Nc	A	A	A
29.	„ Nd	A	A	A
30.	Trisul Na	B	A	A
31.	„ Nb	D	D	A
32.	Ramani NL	A	A	A
33.	„ NR	A	A	A
34.	Bujgara NLa	A	A	A
35.	„ NLb	D	D	A
36.	„ NLc	D	A	A
37.	„ NRb	D	D	A
38.	Patalkhan NL	D	A	A
39.	„ NR	D	A	A
40.	Sarsopatal NL _{1a}	D	A	A
41.	„ NL _{1b}	D	D	A
42.	„ NL _{2a}	D	A	A
43.	„ NL _{2b}	D	D	A
44.	„ NR	D	C	A
45.	Devstan N	D	D	C

Note :

A = Full length of valley

B = Approx. 2/3 length of valley

C = Approx. 1/3 length of valley and

D = Absent

N = Nullah/valley ; R = Right ; L = Left (and a, b, c & d part off)

FAUNA : (Plates XI-XIV)

On account of difficult terrain and inhospitable climate the wildlife species inhabiting the Himalayas were relatively less exposed to human exploitation till about the second quarter of the century. With the opening up of the Himalayan hinterland firstly for development plans for the hill areas, especially construction of roads in these hitherto remote areas, large scale deforestation for providing more farmland to the landless and construction of huge multipurpose hydel projects ; and secondly for construction of border roads and deployment of security forces along the northern frontiers especially after Indian independence most wildlife species in hitherto remote and inaccessible himalayan hinter-land have also been ruthlessly exploited (Lamba, 1978). As a result, the wildlife populations have been drastically reduced. Many a species have disappeared from vast stretches of their former habitat/territory. A number of them are now threatened of their very existence and survive in viable populations in Nanda Devi National Park area only.

The park has a great diversity of fauna. The fauna of the park exhibit adaptations to a number of high altitude ecological factors like atmospheric cold, aridity, intense insolation, radiation and the snow cover, progressive attenuation of air and humidity with increase in altitude. As a result their bodies are covered with dense and long hairs/feathers etc. which protect them from the severe atmospheric cold. The colour of their body is usually dull and light which provides resistance to these animals against intense insolation and radiation. Thus, indeed, these animals have a resilience which the low land animals often lack.

MAMMALS :

13 species of mammals belonging to 8 families and 5 orders have been observed (Appendix I). Atleast 6 of them are endangered or threatened and have already disappeared from the neighbouring areas.

1. The Snow Leopard or Ounce, *Panthera unica*.
2. The Himalayan Black Bear, *Selenarctos thibetanus*.
3. The Musk Deer, *Moschus moschiferus*.
4. The Himalayan Tahr, *Hemitragus jemlahicus*.
5. The Bharal or Blue Sheep, *Pseudois nayaur*.
6. The Serow, *Capricornis sumatraensis*.

BIRDS :

As many as 80 species of birds belonging to 27 families and 10 orders have been observed in the Park area (Appendix II). Atleast the following eight are already endangered or threatened.

1. Himalayan Golden Eagle, *Aquila chrysaetos daphanea*.
2. Eastern Steppe Eagle, *Aquila rapax nipalensis*.
3. Black Eagle, *Ichinaetus malayaensis perniger*.
4. Himalayan Bearded Vulture or Lammergeier, *Gypaetus barbatus aureus*.
5. Himalayan Snowcock, *Tetraogallus himalayensis himalayensis*.
6. Western Tragopan or Western Horned Pheasant, *Tragopan melanocephalus*.
7. Impeyan or Himalayan Monal Pheasant *Lophophorus impejanus*.
8. Koklas Pheasant, *Pucrasia macrolopha*.

APPENDIX-I

MAMMALS

Order : PRIMATES

Family : CERCOPITHECIDAE

Genus : **Presbytis** Escholtz, 1821

1. **Presbytis entellus schistaceus** (Hondgson), Langur, Entellus Monkey

Ellerman and Morrison-Scott (1951). Checklist : 205.

Status : Common.

Distribution : Restricted to the Lower Rishi Gorge (The outer sanctuary). Often seen in birch forests and other patches of forest in the Park.

Order : CARNIVORA

Family : URSIDAE

Genus : **Selenarctos** Heude, 1901

2. **Selenarctos thibetanus** (G. Cuvier), Asiatic Black Bear

Ellerman and Morrison-Scott (1951). Checklist : 239.

Status : Uncommon.

Distribution : Mostly found in the Lower Rishi Gorge. Leaves plenty of foot prints in the soft ground.

Family : MUSTELIDAE

Genus : **Mustella** Linnaeus, 1758

3. **Mustela kathiah** Hodgson, Yellow-bellied weasel.

Ellerman and Morrison-Scott (1951). Checklist : 259.

Status : Common

Distribution : Everywhere in the Park. Often seen among boulders at 4000-4400m.

Family : FELIDAE

Genus : **Panthera** Oken, 1816

4. **Panthera pardus** (Linnaeus), Leopard.

Ellerman and Morrison-Scott (1951). Checklist : 316.

Status : Uncommon.

Distribution : Found in the Lower Rishi Gorge. Difficult to observe on account of its nocturnal and shy habits. Leaves plenty of foot prints in the river bed and soft ground.

5. **Panthera uncia** (Schreber) Ounce or Snow Leopard.

Ellerman and Morrison-Scott (1951). Checklist : 320.

Status : Rare.

Distribution : Mostly found in the Upper Rishi Gorge (Inner sanctuary). Very difficult to sight this highly endangered felid on account of its nocturnal and shy habits, and its limited populations and distribution. Often leaves plenty of foot prints in the soft ground and snow.

Order : ARTIODACTYLA

Family : BOVIDAE

Genus : **Capricornis** Ogilby, 1837

6. **Capricornis sumatraensis** (Bechstcin), Serow.

Ellerman and Morrison-Scott (1951). Checklist : 399.

Status : Common.

Distribution : Confined to lower part of the Lower Rishi Gorge. It prefers thickly wooded gorges and can often be seen in the mornings

and evenings when it comes out to graze on the ranges herbage of the more open slopes.

Genus : **Hemitragus** Hodgson, 1841

7. **Hemitragus jemlahicus** (H. Smith), Himalayan Tahr.

Ellerman and Morrison-Scott (1951). Checklist : 403.

Status : Uncommon.

Distribution : Mostly found above the tree line on the cliffs & ledges of Dharansi Col. and its adjoining ranges in the Park.

Genus : **Naemorhedus** H. Smith, 1827

8. **Naemorhedus goral** (Hardwicke), Goral.

Ellerman and Morrison-Scott (1951). Checklist : 401.

Status : Uncommon.

Distribution : Found only on the outer slopes of the ridges, forming Park boundary, in the NW of the Park.

Genus : **Pseudois** Hodgson, 1846

9. **Pseudois nayaur** (Hodgson), Bharal or Blue sheep.

Ellerman and Morrison-Scott (1951). Checklist : 410

Status : Very Common.

Distribution : Throughout in the Upper Rishi Gorge (the inner sanctuary) area of the Park. Frequently seen on the alpine meadows in the mornings and evenings when they come out for grazing.

Family : CERVIDAE

Genus : **Moschus** Linnaeus, 1758

10. **Moschus moschiferus** Linnaeus, Musk Deer or Kastura.

Ellerman and Morrison-Scott (1951). Checklist : 353.

Status : Common.

Distribution : Throughout the Park in the sub-alpine birch forest. Difficult to observe on account of its concealing habits. Leaves several "Latrine" sites (distinct groups of pellets).

Order : LAGOMORPHA

Family : LEPORIDAE

Genus : **Ochotona** Link, 1975

11. **Ochotona roylei** (Ogilby), Royle's Pika.

Ellerman and Morrison-Scott (1951). Checklist : 450.

Status : Very common.

Distribution : Throughout the Park. Frequently observed among boulders between 3500 and 4450m.

Order : RODENTIA

Family : MURIDAE

Genus : **Alticola** Blanford, 1881.

12. **Alticola roylei** (Gray), Royle's High Mountain Vole

Ellerman and Morrison-Scott (1951). Checklist : 670.

Status : Uncommon.

Distribution : Occasionally seen, feeding on grasses, at Upper Deodi (3850m) in the Park.

Genus : **Mus** Linnaeus, 1758

13. **Mus booduga** (Gray), Little Indian Field Mouse.

Ellerman and Morrison-Scott (1951). Checklist : 609.

Status : Uncommon.

Distribution : Occasionally seen at Latakharak (3700m) in the Park.

APPENDIX II

BIRDS

Order : FALCONIFORMES

Family : ACCIPITRIDAE (Hawks, Vultures)

1. **Aquila chrysaetos daphanea** Severtzov, Himalayan Golden Eagle.

Salim Ali and Ripley (1978), H. B. No. 166, vol. 1 : 273.

Baker (1928), FBI No. 1746, vol. 5 : 68.

Distribution : Normally from c. 1850 m to c. 3000-5000 m.

2. **Aquila rapax nipalensis** Hodgson, Eastern Steppe Eagle.
Salim Ali and Ripley (1978), H. B. No. 169, vol. 1 : 278.
Baker (1928), FBI No. 1748, vol. 5 : 70.
Distribution : Mostly upto 2500 m.
3. **Ictinaetus malayaensis perniger** (Hodgson), Black Eagle.
Salim Ali and Ripley (1978), H. B. No. 172, vol. 1 : 283.
Baker (1928), FBI No. 1755, vol. 5 : 83.
Distribution : Mostly upto c. 2700 m.
4. **Gyps himalayensis** Hume, Himalayan Griffon Vulture.
Salim Ali and Ripley (1978), H. B. No. 181, vol. 1 : 302.
Baker (1928), FBI No. 1709, vol. 5 : 13.
Distribution : Normally between c. 600 and 2500 m.
5. **Neophron percnopterus ginginianus** (Latham), Indian Scavenger Vulture.
Salim Ali and Ripley (1978), H. B. No. 187, vol. 1 : 312.
Baker (1928), FBI No. 1715, vol. 5 : 23.
Distribution : Usually from c. 2000 m. up along the Himalaya locally.
6. **Gypaetus barbatus aureus** (Hablizl), Himalayan Bearded Vulture or Lammergeier.
Salim Ali and Ripley (1978), H. B. No. 188, vol 1 : 314.
Baker (1928), FBI No. 1716, vol. 5 : 26.
Distribution : Normally between c. 1200 and 4000 m.

Family : FALCONIDAE (Falcons)

7. **Falco tinnunculus tinnunculus** Linnaeus, European Kestrel.
Salim Ali and Ripley (1978), H. B. No. 222, vol. 1 : 365.
Baker (1928), FBI No. 1740, vol. 5 : 61.
Distribution : Recorded between 1000 and 3500 metres alt.

Order : GALLIFORMES

Family : PHASIANIDAE (Pheasants, Partridges)

8. **Lerwa lerwa** (Hodgson), Snow Partridge.
Salim Ali and Ripley (1969), H. B. No. 227, vol. 2 : 6.
Baker (1928), FBI No. 1993, vol. 5 : 433.
Distribution : Common between 3000 and 5000 m.

9. **Tetraogallus himalayensis himalayensis** G. R. Gray, Himalayan Snowcock.
 Salim Ali and Ripley (1969), H. B. No. 232, vol. 2 : 13.
 Baker (1928), FBI No. 1989, vol. 5 : 426.
Distribution : Normally between 4000 and 5500 m.
10. **Alectoris chukar chukar** (J.E. Gray), Chukor Partridge.
 Salim Ali and Ripley (1969), H. B. No. 236, vol. 2 : 18.
 Baker (1928), FBI No. 1972, vol. 5 : 402.
Distribution : Usually between 1200 and 5000 m.
11. **Lophophorus impejanus** (Latham), Impeyan or Himalayan Monal Pheasant
 Salim Ali and Ripley (1969), H. B. No. 290, vol. 2 : 88.
 Baker (1928), FBI No. 1928, vol. 5 : 335.
Distribution : Found between c. 2600 and 5000 m. altitude.
12. **Pucrasia macrolopha macrolopha** (Lesson), Koklas Pheasant.
 Salim Ali and Ripley (1969), H. B. No. 305, vol. 2 : 113.
 Baker (1928), FBI No. 1911, vol. 5 : 310.
Distribution : Common between c. 1500 and 4000 m.

Order : CHARADRIIFORMES

Family : CHARADRIIDAE (Plovers, Sandpipers, Snipes)

13. **Scolopax rusticola rusticola** Linnaeus, Woodcock.
 Salim Ali and Ripley (1969), H. B. No. 411, vol. 2 : 292.
 Baker (1929), FBI No. 2167, vol. 6 : 252.
Distribution : Normally between 2500 and 3700 m.

Order : COLUMBIFORMES

Family : COLUMBIDAE (Pigeons, Doves)

14. **Columba leuconota leuconota** Vigors, West Himalayan Snow Pigeon.
 Salim Ali and Ripley (1969), H. B. No. 513, vol. 3 : 120.
 Baker (1928), FBI No. 1858, vol. 5 : 224.
Distribution : Chiefly between 3000 and 5000 m.
15. **Columba hodgsonii** Vigors, Speckled Wood Pigeon.
 Salim Ali and Ripley (1969), H. B. No. 520, vol. 3 : 131.
 Baker (1928), FBI No. 1867, vol. 5 : 234.
Distribution : Commonly found between c. 1800 and 4000 m.

16. **Streptopelia orientalis orientalis** (Latham), Rufous Turtle Dove.
Salim Ali and Ripley (1969), H. B. No. 530, vol. 3 : 142.
Baker (1928), FBI No. 1870, vol. 5 : 238.
Distribution : Upto c. 2500 m.
17. **Streptopelia chinensis suratenis** (Gmelin), Indian Spotted Dove.
Salim Ali and Ripley (1969), H. B. No. 537, vol. 3 : 152.
Baker (1928), (FBI No. 1873, vol. 5 : 242.
Distribution : Normally upto c. 2500 m.

Order : CUCULIFORMES

Family : CUCULIDAE (Cuckoos)

18. **Clamator jacobinus serratus** (Sparrman), Pied Crested Cuckoo.
Salim Ali and Ripley (1969), H. B. No. 570, vol. 3 : 194.
Baker (1927), FBI No. 1472, vol. 4 : 167.
Distribution : Summer visitor, straggling upto c. 4000 m.
19. **Cuculus canorus canorus** Linnaeus, Kuckoo.
Salim Ali and Ripley (1969), H. B. No. 578, vol. 3 : 208.
Baker (1927), FBI No. 1451, vol. 4 : 135.
Distribution : Normally between 600 and 4100 m.

Order : STRIGIFORMES

Family : STRIGIDAE (Owls)

20. **Bubo bubo bengalensis** (Franklin), Indian Great Horned or Eagle-Owl.
Salim Ali and Ripley (1969), H. B. No. 627, vol. 3 : 273.
Baker (1927), FBI No. 1660, vol. 4 : 414.
Distribution : Normally from 1500 m. to 2500 m.

Order : APODIFORMES

Family : APODIDAE (Swifts)

21. **Collocalia unicolor** (Jerdon), Indian Edible-nest Swiftlet.
Salim Ali and Ripley (1970), H. B. No. 685, vol. 4 : 29.
Baker (1927), FBI No. 1608, vol. 4 : 346.
Distribution : Normally upto c. 2200 m.
22. **Chaetura sylvatica** (Tickell), Whiterumped Spinetail Swift.
Salim Ali and Ripley (1970), H. B. No. 692, vol. 4 : 37.
Baker (1927), FBI No. 1606, vol. 4 : 344.
Distribution : Normally upto biotope c. 1700 m.

Order : CORACIIFORMES
 Family : UPUPIDAE (Hoopoe)

23. **Upupa epops ceylonensis** Reichenbach, Ceylon Hoopoe.

Salim Ali and Ripley (1970), H. B. No. 765, vol. 4 : 128.

Baker (1927), FBI No. 1581, vol. 4 : 311, 312.

Distribution : Normally upto c. 2200 m.

Order : PICIFORMES
 Family : CAPITONIDAE (Barbets)

24. **Megalaima virens marshallorum** Swinhoe, Himalayan Great Barbet.

Salim Ali and Ripley (1970), H. B. No. 777, vol. 4 : 147.

Bekar (1927), FBI No. 1427, vol. 4 : 106.

Distribution : Normally between 1000 and 3000 m.

Family : INDICATORIDAE : Honeyguides.

25. **Indicator xanthonotus radcliffi** Hume, West Pakistan Orange-rumped Honeyguide

Salim Ali and Ripley (1970), H. B. No. 793, vol. 4 : 165.

Bekar (1927), FBI No. 1450 (Part), vol. 4 : 131.

Distribution : Found between 1500 and 3000 m.

Family : PICIDAE : Woodpeckers.

26. **Picus squamatus squamatus** Vigors, Himalayan Scalybellied Green Woodpecker

Salim Ali and Ripley (1970), H. B. No. 807, vol. 4 : 182.

Bekar (1927), FBI No. 1337, vol. 4 : 7.

Distribution : Found between 1000 and 3300 m.

27. **Picoides himalayensis himalayensis** (Jardine & Selby), Garhwal Pied Woodpecker

Salim Ali and Ripley (1970), H. B. No. 837, vol. 4 : 217.

Bekar (1927), FBI No. 1360, vol. 4 : 32.

Distribution : Found between 1000 and 3900 m.

Order : PASSERIFORMES
 Family : ALAUDIDAE (Larks)

28. **Calandrella cinerea dukhunensis** (Sykes), Rufous Short-toed Lark

Salim Ali and Ripley (1972), H. B. No. 886, vol. 5 : 21.

Bekar (1926), FBI No. 1222, vol. 3 : 326.

Distribution : Seen only once in Dibrugheta.

Family : HIRUNDINIDAE (Swallows)

29. **Delichon nipalensis nipalensis** Moore, Nepal House Martin.

Salim Ali and Ripley (1972), H. B. No. 932, vol. 5 : 76.

Bekar (1926), FBI No. 1144, vol. 3 : 230.

Distribution : Normally between c. 2000 and 4000 m.

Family : LANIIDAE (Shrikes)

30. **Lanius tephronotus tephronotus** (Vigors), Eastern Tibet Grey-backed Shrike.

Salim Ali and Ripley (1972), H. B. No. 945, vol. 5 : 92.

Bekar (1924), FBI No. 716, vol. 2 : 297.

Distribution : Common between 2700 and 4500 m.

Family : DICRURIDAE (Drongos)

31. **Dicrurus leucophaeus longicaudatus** Hay, Indian Grey Drongo.

Salim Ali and Ripley (1972), H. B. No. 965, vol. 5 : 119.

Bekar (1924), FBI No. 775, vol. 2 : 370.

Distribution : Normally upto 3000 m.32. **Dicrurus hottentotus hottentotus** (Linnaeus), Haircrested or Spangled Drongo

Salim Ali and Ripley (1972), H. B. No. 973, vol. 5 : 131.

Bekar (1924), FBI No. 782, vol. 2 : 370.

Family : CORVIDAE (Crows, Magpies, Jays)

33. **Nucifraga caryocatactes hemispila** Vigors, Himalayan Nutcracker

Salim Ali and Ripley (1972), H. B. No. 1043, vol. 5 : 233.

Bekar (1922), FBI No. 46 (part), vol. 1 : 66.

Distribution : Distributed between c. 2000 to 3300 m., occasionally straggling lower or higher.34. **Pyrhacorax graculus digitatus** Hemprich A Ehrenberg, Himalayan Yellowbilled or Alpine Cough.

Salim Ali and Ripley (1972), H. B. No. 1045, vol. 5 : 236.

Baker (1922), FBI No. 49, vol. 1 : 70.

Distribution : Normally between 2700 and 5000 m.35. **Pyrhacorax pyrrhacorax centralis** Stresemann, West Himalayan Redbilled Cough.

Salim Ali and Ripley (1972), H. B. No. 1046, vol. 5 : 239.

Baker (1922), FBI No. 48 (part), vol. 1 : 68.

Distribution : Found between 2400 and 3500 m.

36. **Corvus macrorhynchos intermedius** Adams, Himalayan Jungle Crow.
Salim Ali and Ripley (1972), H. B. No. 1054, vol. 5 : 252.
Baker (1922), FBI No. 7, vol. 1 : 28.
Distribution : Found between 1800 and 4500 m.
Family : CAMPEPHAGIDAE (Cuckoo-Shrikes, Minivets)
37. **Pericrocotus ethologus favillaceus** Bangs & Phillips, West Himalayan Longtailed Minivet.
Salim Ali and Ripley (1971), H. B. No. 1085, vol. 6 : 32.
Baker (1924), FBI No. 738, vol. 2 : 323.
Distribution : Normally occurs between 1200 and 3400 m.
Optimum zone 1800-2400 m.
Family : MUSCICAPIDAE (Babblers, Laughing Thrushes and Flycatchers)
38. **Garrulax variegatus similis** (Hume), Western Variegated Laughing Thrush.
Salim Ali and Ripley (1972), H. B. No. 1289, vol. 7 : 22.
Baker (1922), FBI No. 163, vol. 1 : 174.
Distribution : Usually between 1800 and 3300 m.
39. **Garrulax lineatus lineatus** (Vigors), Simla Streaked Laughing Thrush.
Salim Ali and Ripley (1972), H. B. No. 1314, vol. 7 : 46.
Baker (1922), FBI No. 172, vol. 1 : 180.
Distribution : Normally between 1200 and 3000 m.
40. **Garrulax erythrocephalus erythrocephalus** (Vigors), Redheaded Laughing Thrush.
Salim Ali and Ripley (1972), H. B. No. 1324, vol. 7 : 57.
Baker (1922), FBI No. 148 (part), vol. 1 : 163.
Distribution : Normally between 1800 and 3300 m.
41. **Muscicapa leucomelanura leucomelanura** (Hodgson), Western Slaty Blue Flycatcher.
Salim Ali and Ripley (1972), H. B. No. 1423, vol. 7 : 170.
Baker (1922), FBI No. 645, vol. 2 : 219.
Distribution : Normally between 1800 and 3300 m.
42. **Muscicapa sundara whistleri** (Ticehurst), Western Rufousbellied Niltava.
Salim Ali and Ripley (1972), H. B. No. 1431, vol. 7 : 180.
Baker (1924), FBI No. 684 (part), vol. 1 : 259.
Distribution : Normally between 1600 and 2700 m.

43. **Rhipidura hypoxantha** Blyth, Yellowbellied Fantail Flycatcher.
Salim Ali and Ripley (1972), H. B. No. 1450, vol. 7 : 206.
Baker (1924), FBI No. 699, vol. 2 : 275.
Distribution : Normally between 1800 and 3600 m.
44. **Phylloscopus proregulus simlaensis** Ticehurst, Western Pallas's Leaf Warbler.
Salim Ali and Ali (1973), H. B. No. 1954, vol. 8 : 158.
Baker (1924), FBI No. 868, vol. 2 : 467.
Distribution : Normally between 2200 and 3300 m.
45. **Regulus regulus himalayensis** Bonaparte, Himalayan Goldcrest.
Salim Ali and Ripley (1973), H. B. No. 1629, vol. 8 : 197.
Baker (1924), FBI No. 944 (part), vol. 2 : 539.
Distribution : Normally from c. 2500 m. to c. 3500 m.
46. **Erithacus pectoralis pectoralis** (Gould), West Himalayan Rubythroat.
Salim Ali and Ripley (1973), H. B. No. 1647, vol. 8 : 221.
Baker (1924), FBI No. 543, vol. 2 : 92.
Distribution : Normally between 2700 and 4500 m.
47. **Erithacus cyanurus pallidior** (Baker), Kashmir Redflanked Bush Robin.
Salim Ali and Ripley (1973), H. B. No. 1654, vol. 8 : 230.
Baker (1924), FBI No. 550, vol. 2 : 101.
Distribution : Normally between 2700 and 3600 m.
48. **Phoenicurus caeruleocephalus** (Vigors), Blueheaded Redstart.
Salim Ali and Ripley (1973), H. B. No. 1670, vol. 8 : 251.
Baker (1924), FBI No. 553, vol. 2 : 104.
Distribution : Usually between 2400 and 3900 m.
49. **Phoenicurus ochruros rufiventris** (Vieillot), Eastern Black Redstart
Salim Ali and Ripley (1973), H. B. No. 1672, vol. 8 : 255.
Baker (1924), FBI No. 526, vol. 2 : 266.
Distribution : Normally between 3300 and 5200 m.
50. **Phoenicurus frontalis** (Vigors), Bluefronted Redstart.
Salim Ali and Ripley (1973), H. B. No. 1675, vol. 8 : 258.
Baker (1924), FBI No. 526, vol. 2 : 266.
Distribution : Normally between 3000 and 5300 m.

51. **Rhyacornis fuliginosus fuliginosus** (Vigors), Plumbeous Redstart.
Salim Ali and Ripley (1973), H. B. No. 1679, vol. 8 : 266.
Baker (1924), FBI No. 535, vol. 2 : 81.
Distribution : Mostly between 1200 and 4300 m.
52. **Hodgsonius phoenicuroides phoenicuroides** Gray, Hodgson's Shortwing or Whitebellied Redstart.
Salim Ali and Ripley (1973), H. B. No. 1680, vol. 8 : 269.
Baker (1924), FBI No. 491, vol. 2 : 21.
Distribution : Normally between 2400 m and 4400 m.
53. **Enicurus scouleri scouleri** Vigors, Little Forktail.
Salim Ali and Ripley (1973), H. B. No. 1684, vol. 9 : 7.
Baker (1924), FBI No. 525, vol. 2 : 65.
Distribution : Chiefly between 1800 and 3300 m.
54. **Saxicola torquata prezevalskii** (Pleske), Tibetan Collared Bush Chat.
Salim Ali and Ripley (1973), H. B. No. 1696, vol. 9 : 27.
Baker (1972), FBI No. 496, vol. 2 : 30.
Distribution : Seen upto 2500 m.
55. **Saxicola ferrea** Gray, Dark-grey Bush Chat.
Salim Ali and Ripley (1973), H. B. No. 1705, vol. 9 : 37.
Baker (1924), FBI No. 502, vol. 2 : 36.
Distribution : Mostly between 1500 and 3300 m.
56. **Chaimerrornis leucocephalus** (Vigors), Whitecapped Redstart or River Chat.
Salim Ali and Ripley (1973), H. B. No. 1716, vol. 9 : 57.
Baker (1924), FBI No. 534, vol. 2 : 79.
Distribution : Mostly from 1800 m to 5300 m.
57. **Myiophonus caeruleus temminckii** Vigors, Himalayan Whistling Thrush.
Salim Ali and Ripley (1973), H. B. No. 1729, vol. 9 : 79.
Baker (1924), FBI No. 614, vol. 2 : 180.
Distribution : Normally between 1000 and 4200 m.
58. **Zoothera wardii** (Blyth), Pied Ground Thrush.
Salim Ali and Ripley (1973), H. B. No. 1731, vol. 9 : 83.
Baker (1924), FBI No. 584, vol. 2 : 145.
Distribution : Usually between 1200 and 2400 m.

59. **Zoothera mollissima whiteheadi** (Baker), Western Plainbacked Mountain Thrush

Salim Ali and Ripley (1973), H. B. No. 1738, vol. 9 : 92.

Baker (1924), FBI Nos. 600 and 601, vol. 2 : 163, 164.

Distribution : Mostly between 2700 and 4000 m.

60. **Turdus albocinctus** Royle, Whitecollared Blackbird.

Salim Ali and Ripley (1973), H. B. No. 1749, vol. 9 : 110.

Baker (1924), FBI No. 570, vol. 2 : 129.

Distribution : Normally between 2100 and 4000 m.

61. **Turdus rubrocanus rubrocanus** G.R. Gray, Western Greyheaded Thrush.

Salim Ali and Ripley (1973), H. B. No. 1758, vol. 9 : 122.

Baker (1924), FBI No. 572, vol. 2 : 132.

Distribution : Usually between 2100 and 3000 m.

Family : TROGLODYTIDAE : Wrens

62. **Troglodytes troglodytes nipalensis** Blyth, Nepal Wren.

Salim Ali and Ripley (1973), H. B. No. 1771, vol. 9 : 133.

Baker (1922), FBI No. 458, vol. 1 : 445.

Distribution : Mostly between 2700 m. and 5000 m.

Family : CINCLIDAE : (Dippers)

63. **Cinclus pallasii tenuirostris** Bonaparte, West Himalayan Brown Dipper

Salim Ali and Ripley (1973), H. B. No. 1775, vol. 9 : 142.

Baker (1924), FBI No. 479, vol. 2 : 4.

Distribution : Mostly upto 4000 m.

Family : PRUNELLIDAE (Accentors)

64. **Prunella collaris whymperi** (Baker), Garhwal Alpine Accentor.

Salim Ali and Ripley (1973), H. B. No. 1778, vol. 9 : 146.

Baker (1924), FBI No. 620 (part), vol. 2 : 188.

Distribution : Normally between 3600 and 4500 m.

65. **Prunella strophciata jerdoni** (Brooks), Western Rufousbreasted Accentor.

Salim Ali and Ripley (1973), H. B. No. 1782, vol. 9 : 152.

Baker (1924), FBI No. 629, vol. 2 : 197.

Distribution : Usually between 2700 and 4000 m,

Family : PARIDAE (Tits or Titmice)

66. **Parus major nipalensis** Hodgson, Nepal Grey Tit.
Salim Ali and Ripley (1973), H. B. No. 1793, vol. 9 : 168.
Baker (1922), FBI Nos. 51, 54, 55 (part), vol. 1 : 74, 77.
Distribuiion : Mostly in the foothills upto c. 1800 m.
67. **Parus monticolus monticolus** Vigors, Greenbacked Tit.
Salim Ali and Ripley (1973), H. B. No. 1799, vol. 9 : 174.
Baker (1922), FBI No. 59, vol. 1 : 80.
Distribntion : Mostly upto 3600 m.
68. **Parus melanolophus** Vigors, Crested Black Tit.
Salim Ali and Ripley (1973), H. B. No. 1802, vol. 9 : 178.
Baker (1922), FBI, No. 63, vol. 1 : 83.
Distribution : Usually from 2000 m to 3500 m.
69. **Parus rubdiventris rufonuchalis** Blyth, Simla Black Tit.
Salim Ali and Ripley (1973), H. B. No. 1804, vol. 9 : 180.
Baker (1922), FBI No. 66, vol. 1 : 85.
Distribution : Mostly between 2700 and 3600 m.
70. **Parus dichrous kangrae** (Whistler), Western Brown Crested Tit.
Salim Ali and Ripley (1973), H. B. No. 1807, vol. 9 : 184.
Baker (1922), FBI No. 68 (part), vol. 1 : 87.
Distribution : Normally between 2400 and 3300.
71. **Aegithalos concinnus iredalei** (Baker), Western Redheaded Tit.
Salim Ali and Ripley (1973), H. B. No. 1818, vol. 9 : 200.
Baker (1922), FBI No. 7 (part), vol. 1 : 93.
Distribution : Mostly upto 2400 m.

Family : SITTIDAE (Nuthatches)

72. **Sitta leucopsis leucopsis** Gould, Western Whitecheeked Nuthatch.
Salim Ali and Ripley (1973), H. B. No. 1832, vol. 9 : 217.
Baker (1922), FBI No. 117, vol. 1 : 130.
Distribution : Normally from 2100 m. to 3000 m.
73. **Tichodroma muraria nepalensis** Bonaparte, Wall Creeper.
Salim Ali and Ripley (1973), H. B. No. 1839, vol. 9 : 226.
Baker (1922), FBI No. 457, vol. 1 : 441.
Distribution : Mostly above 3300 m., upto 6400 m.

Family : CERTHIDAE (Tree Creepers)

74. **Certhia familiaris hodgsoni** Brooks, Kashmir Tree Creeper.
Salim Ali and Ripley (1973), H. B. No. 1842, vol. 1 : 232.
Baker (1922), FBI No. 450, vol. 1 : 434.
Distribution : Normally upto c. 3000 m.
75. **Certhia himalayana himalayana** Vigors, Himalayan Tree Creepers.
Salim Ali and Ripley (1973), H. B. No. 1847, vol. 9 : 237.
Baker (1922), FBI No. 444 (part), vol. 1 : 430.
Distribution : Mostly between 1500 and 3600 m.

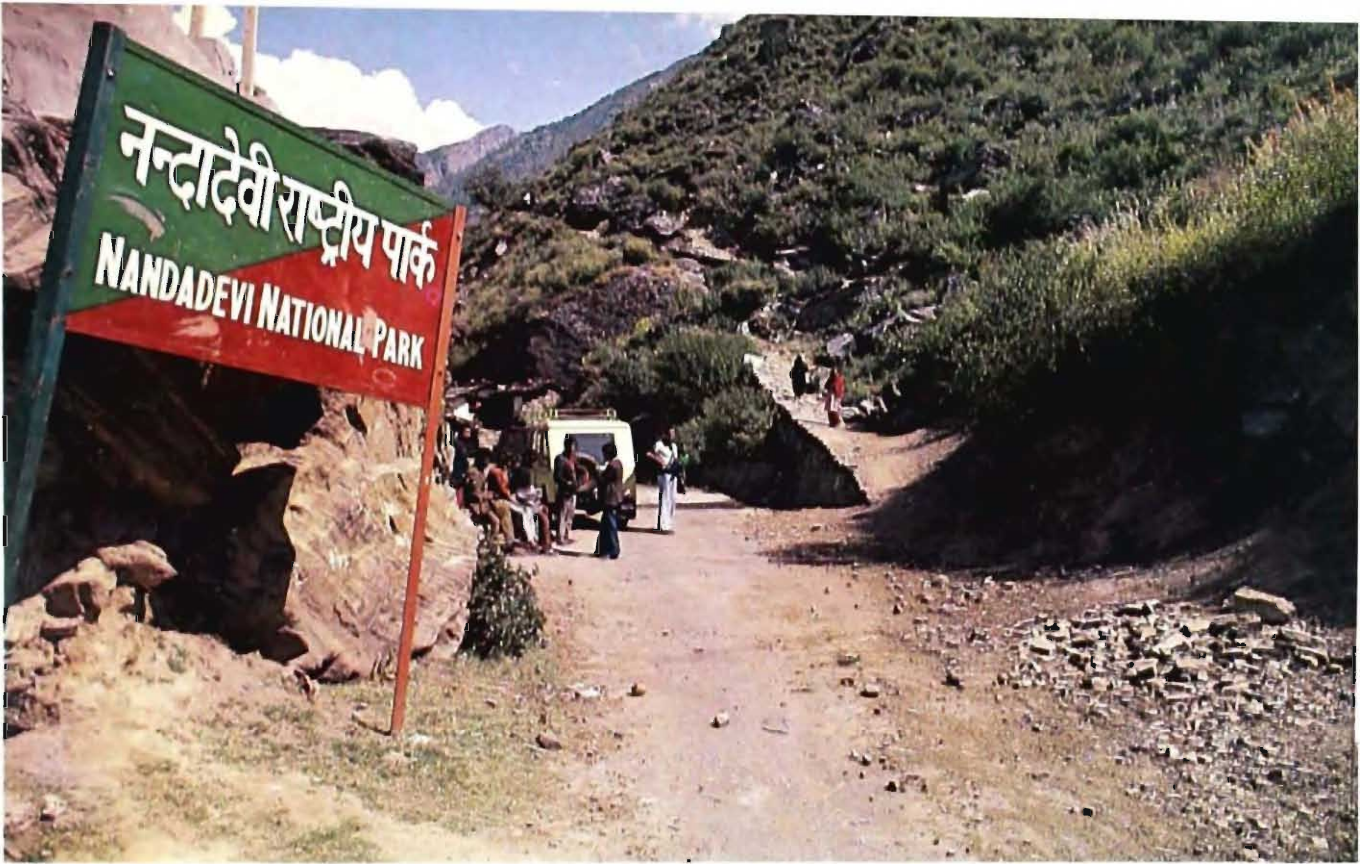
Family : FRINGILLIDAE (Finches)

76. **Mycerobas affinis** (Blyth). Allied Grosbeak.
Salim Ali and Ripley (1974), H. B. No. 1983, vol. 10 : 126.
Baker (1926), FBI No. 1040, vol. 3 : 103.
Distribution : Mostly between 3000 and 4000 m.
77. **Carpodacus rhodochrous** (Vigors), Finkbrowed Rosefinch,
Salim Ali and Ripley (1974), H. B. No. 2017, vol. 10 : 171.
Baker (1926), FBI No. 1062, vol. 3 : 129.
Distribution : Usually between 2800 and 4600 m.
78. **Pyrrhula erythrocephala** Vigors, Redheaded Bullfinch.
Salim Ali and Ripley (1974), H. B. No. 2039, vol. 10 : 201.
Baker (1926), FBI No. 1044, vol. 3 : 110.
Distribution : Mostly between 3400 and 4300 m.
79. **Pyrrhula aurantiaca** Gould, Orange Bullfinch.
Salim Ali and Ripley (1974), H. B. No. 2040, vol. 10 : 202.
Baker (1926), FBI No. 1043, vol. 3 : 109.
Distribution : Normally between 2700 and 3300 m.

Family : EMBERIZIDAE (Buntings)

80. **Emberiza leucocephala leucocephala** S.G. Gmelin, Pine Bunting.
Salim Ali and Ripley (1974), H. B. No. 2042, vol. 10 : 206.
Baker (1926), FBI No. 1123, vol. 3 : 202.
Distribution : Normally upto c. 2700 m.

PLATES



Lata Trek

PLATE I

Camp site at Belta Kharak.



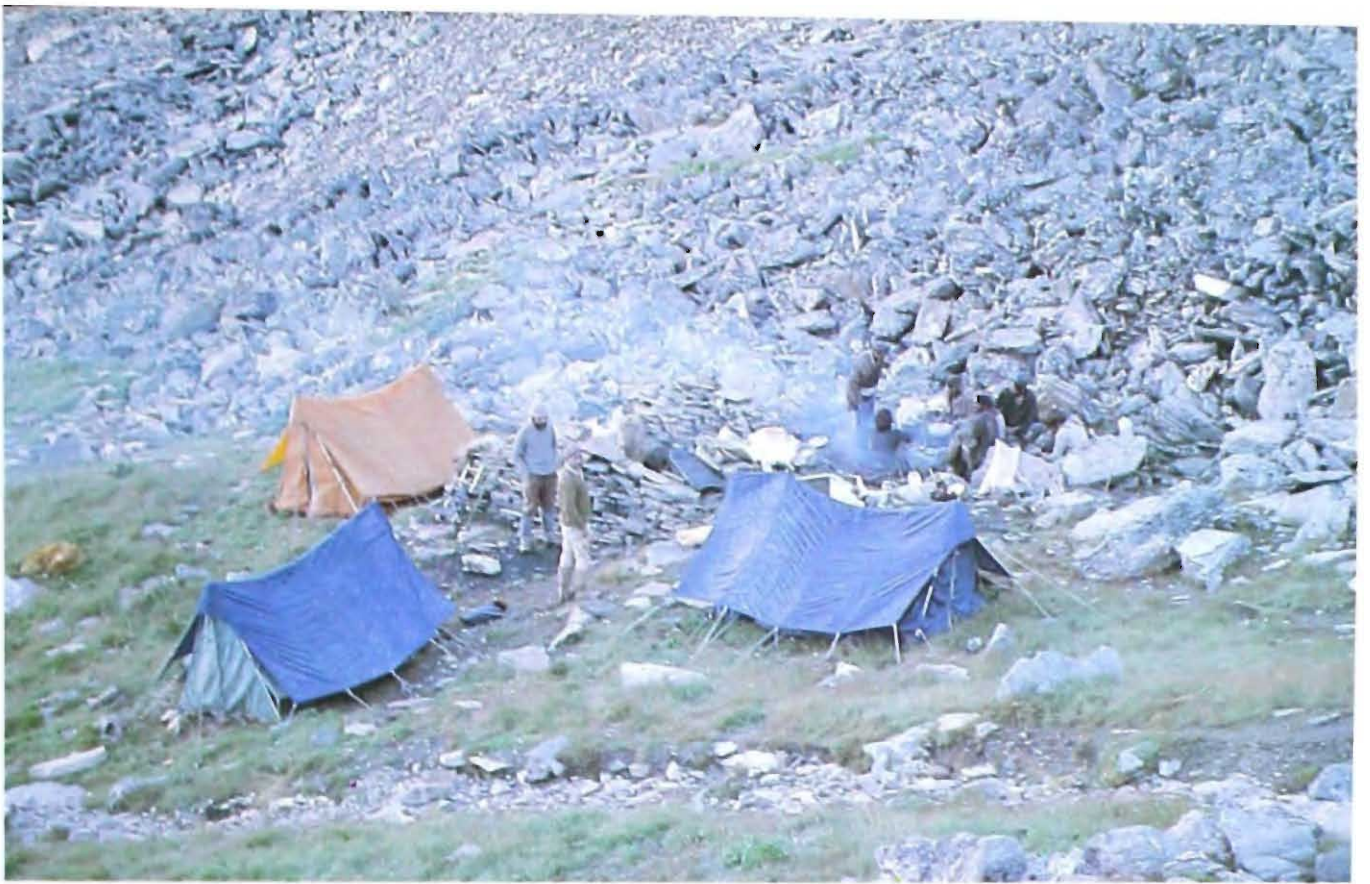


Camp site at Belta.

PLATE II

A difficult portion of the track being negotiated with the help of fixed ropes.





Camp site at Dharansi.

PLATE III

Log bridge : An improvised log bridge to cross the glacial streamlet.





Nanda Devi Base Camp.

PLATE IV

Glacial Debris.

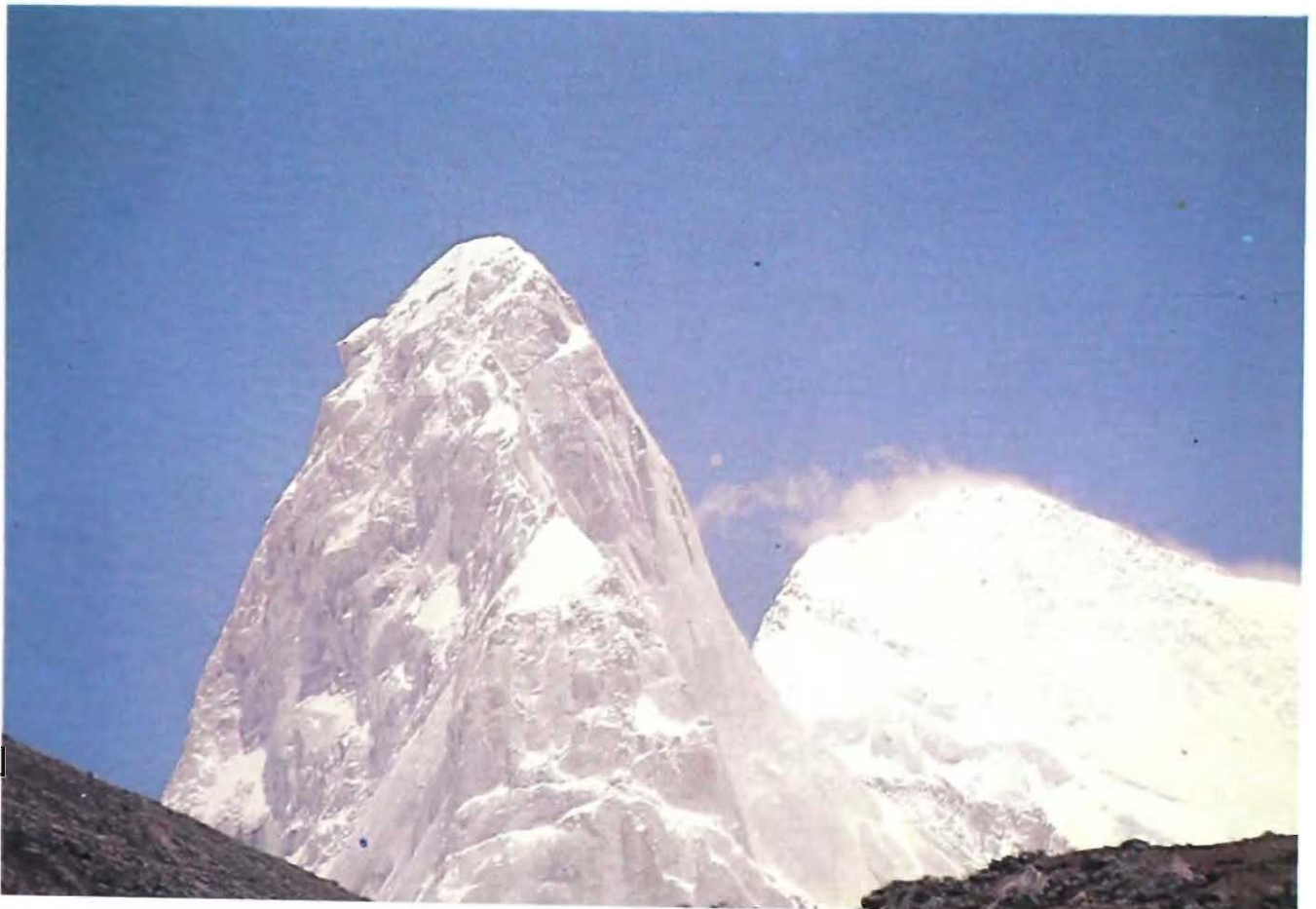


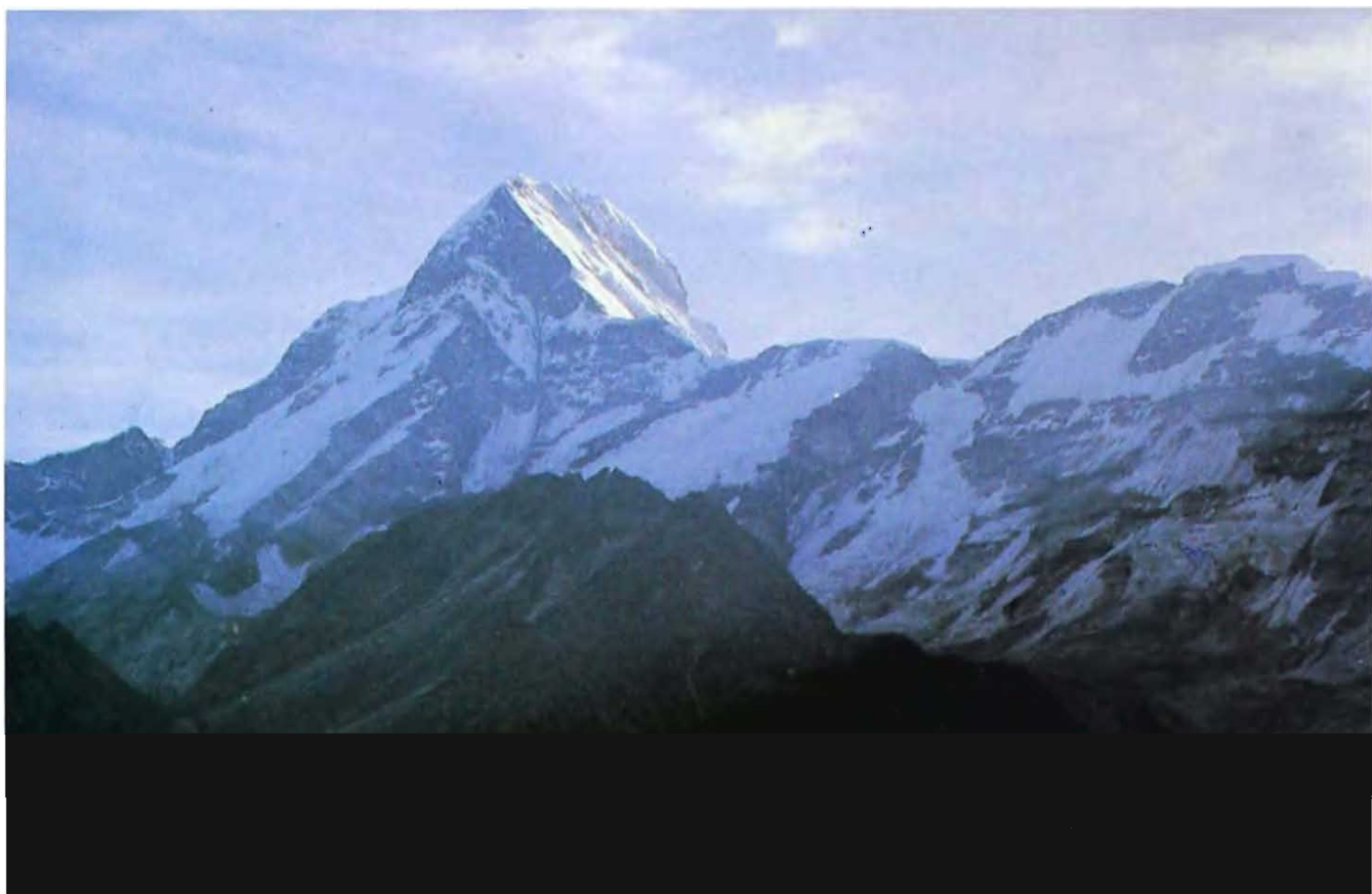


A view of the Rishi Kot Peak.

PLATE V

A view of the Kalinka Peak.

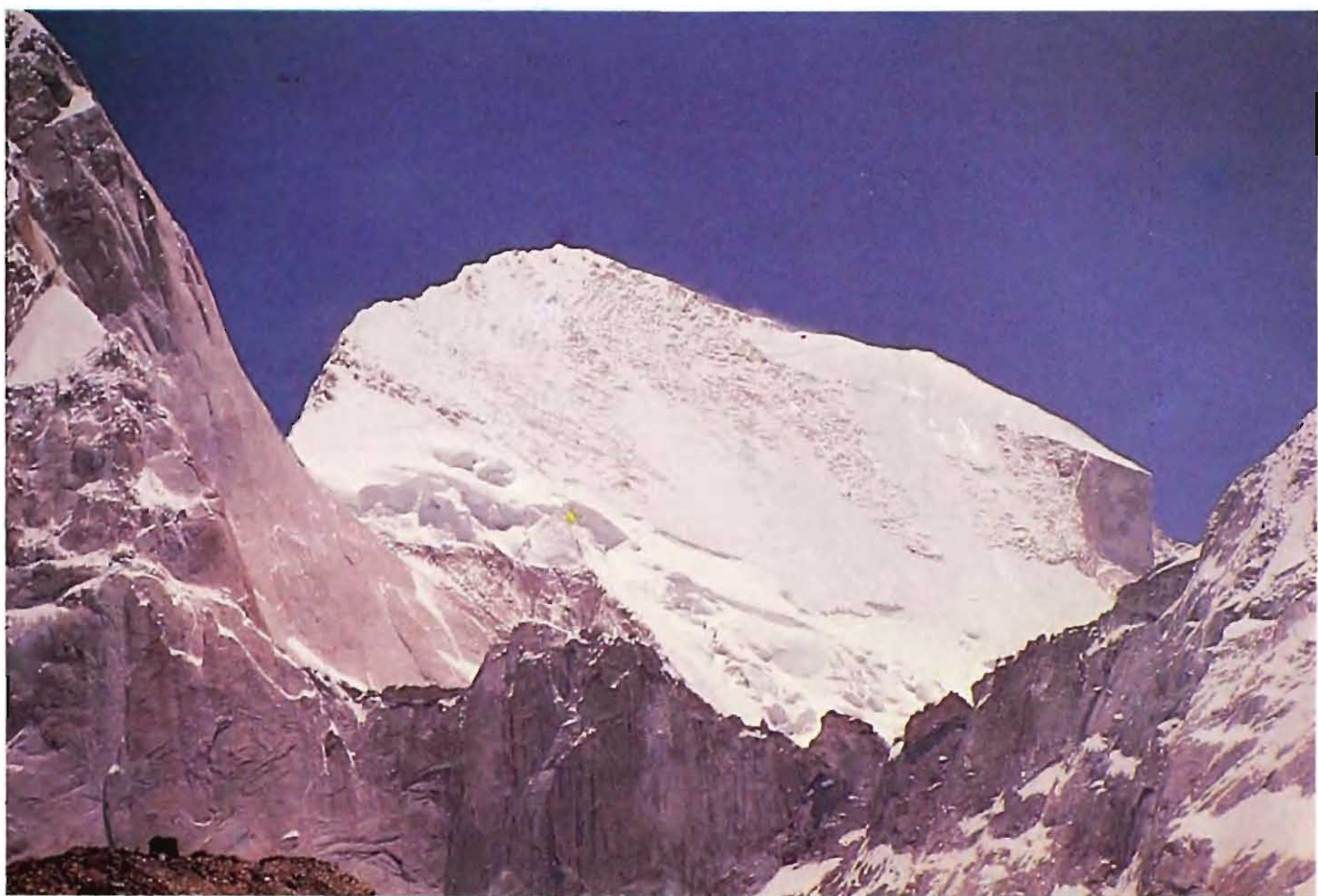


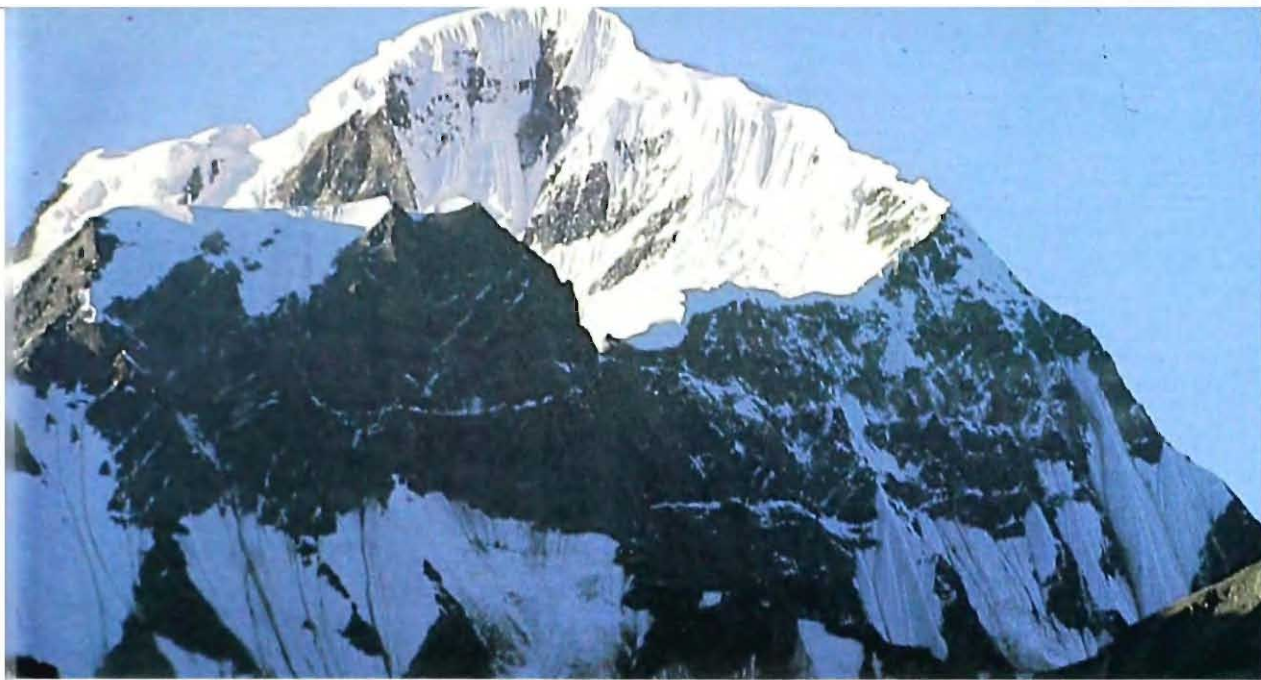


A view of the Dunagiri Peak.

PLATE VI

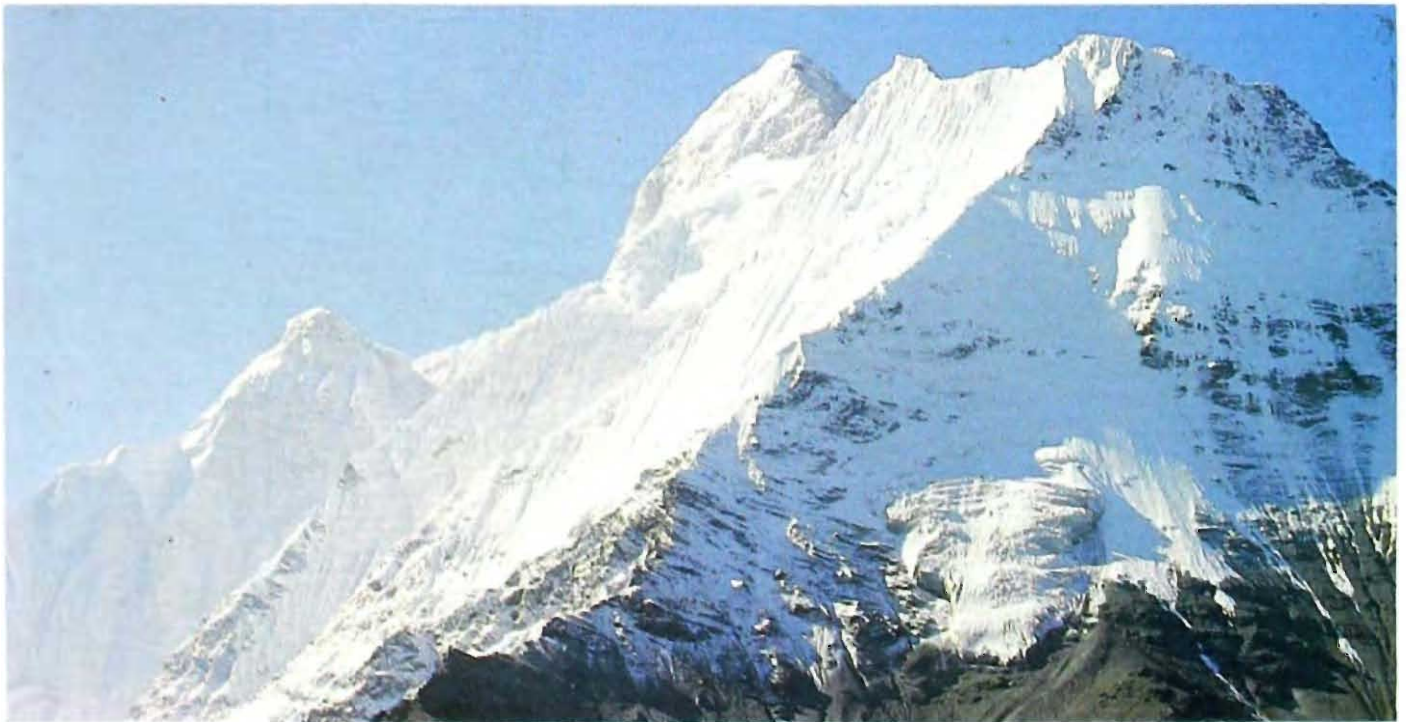
A view of the Changbang Peak.





A view of the Trisul Peak.

A view of the Nanda Devi East & West.



Alpine meadow.





Another view of the Alpine meadow.

A view of the Sub-Alpine forest.



The Brahm Kamal, *Sisona* sp.



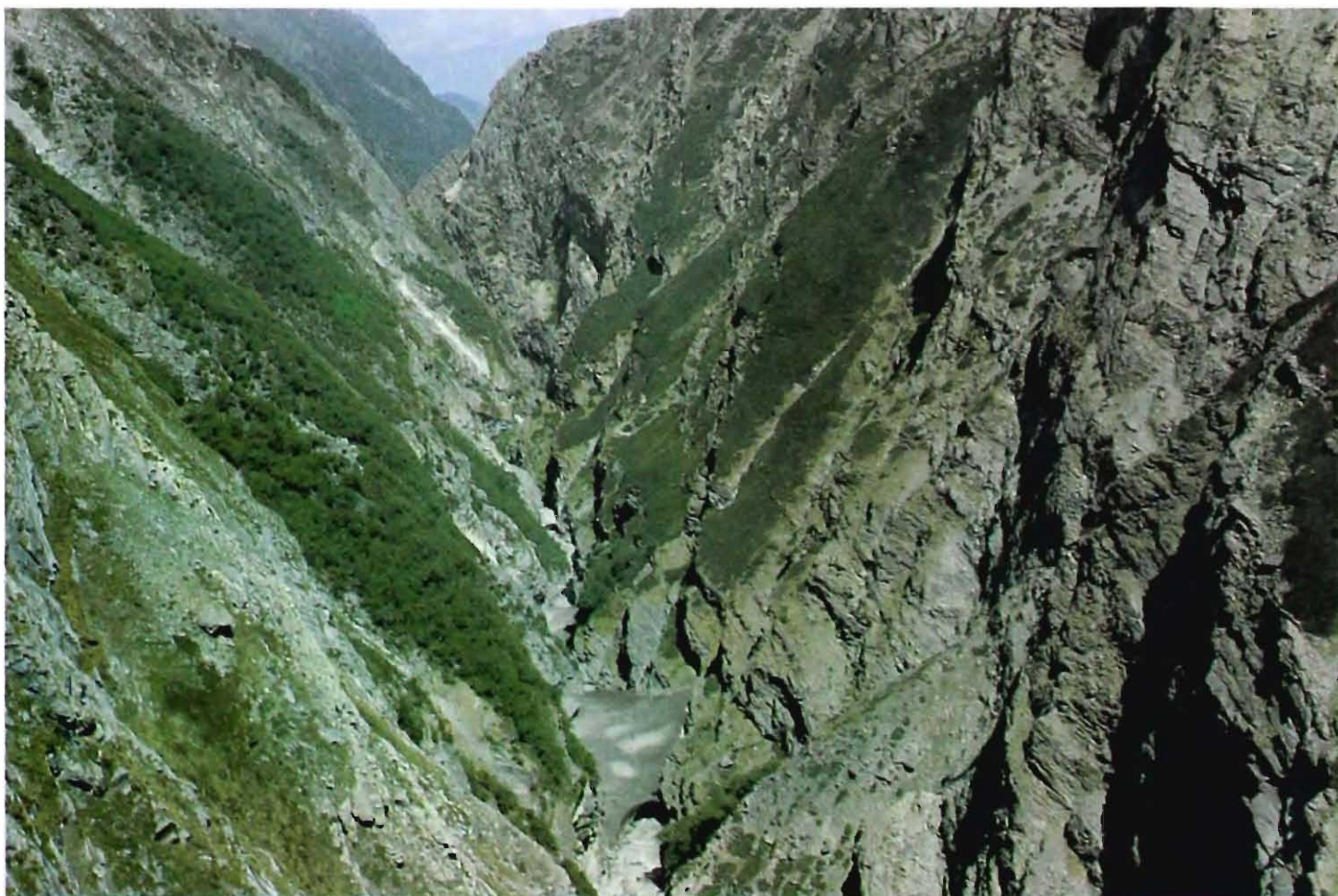


PLATE IX

A view of the Inner Sanctuary

PLATE X

A view of the Outer Sanctuary.





Goral

PLATE XI



Musk Deer

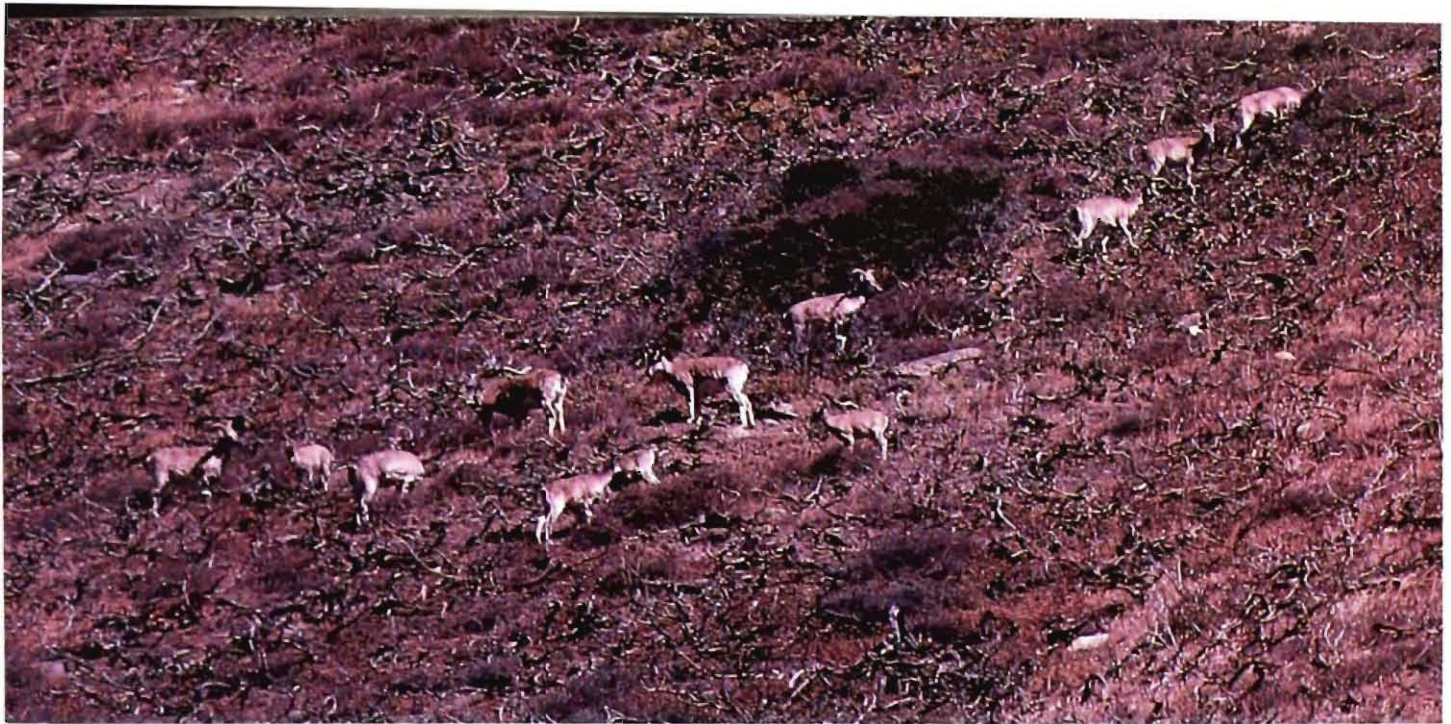


Yellow throated Martin

PLATE XII

Young of Musk Deer





A herd of Blue Sheep or Bharal

PLATE XIII



Bearded Vulture in flight.

Himalayan Tahr





Eagle

PLATE XIV

Red billed Chough.

