

Environmental Problems
in the
HIMALAYA

Sharad Singh Negi

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SHARAD SINGH NEGI



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PREFACE

August 6, 1978 : Tragedy strikes the mountain hamlet of Gangnani, in the Bhagirathi valley of U.P. Himalaya. Located on the age old pilgrim route to Gangotri, in Uttarkashi district this ill fated valley is covered under six to ten metres of debris within a very short time. It seems as if mountains have moved. Scars mark the places where slope failure has occurred.

This is not an isolated occurrence. In the recent past such tragedies have visited almost all parts of the world's loftiest mountain system—the Himalaya. For one who has been brought up in the lap of the King of mountains, it is not only painful but also shocking to witness the wanton destruction of the Himalayan eco-system. Perhaps, never before has science been called upon to solve such intricate problems as restoring the ecological balance of a mountain system which has a direct impact on the well being of over 400 million people living in the Indian sub-continent.

Having being trained, first as a geologist and later as a forester and after having carried out research in both these fields in the Himalaya, I had ample opportunity to conduct studies on the Himalayan environment. In the initial stages, my aim was to collect material for a series of research papers, but as data piled up, my friends, particularly Sri P. Chowdry (Editor, Current Events) pressed on me to present the study in a book form. After submitting my doctoral thesis last year, I began to compile my own observations and that of others in real earnest. I found that my data was lacking in several fields and to supplement it, I have quoted the work of others. The present monograph is a result of these efforts. To sum it up all, the book is, at best, only a pioneering attempt to present in a scientific form, major problems of the Himalayan environment.

I express my deep sense of gratitude to the two doyens of environmental conservation Sri N. Baker and Sri Sunder Lal Bahuguna, with whom I had fruitful discussions during Sept.,

1980, at Dehra Dun. I am also thankful to my colleagues in the Indian Forest Service, specially Sri M.S. Singh for helping with the computation work. Thanks are also due to Prof. A.K. Sinha and Dr. R.S. Rawat of the Wadia Institute of Himalayan Geology, Dehra Dun for their help and constant encouragement during the writing of this book and to Sri G.S. Khatri for helping with the drawings. To Sri Harsh Upadhaya, I express my sincere thanks for providing free access to his vast collection of literature on environmental sciences. Last but not the least, I am indebted to Sri G.S. Gahlot, the publisher, for bringing out this publication in a short time. The reason for several printing errors that have crept in is haste.

During the writing of this book, my mother, Smt. Shakuntala Negi, who was a source of inspiration for me, left for her heavenly abode. I take this opportunity to dedicate this work to her everlasting memory.

1-10-1982
Dehra Dun

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CHAPTER ONE

INTRODUCTION

There is a mountain in the north, ensouled by Divinity named Himalaya, the king of all mountains. Stretching from east to west coasts, it is located on the earth as a measuring rod." Thus, the great poet Kalidas described the Himalaya. Stretching from the Indus gap in the northwest to the Brahmaputra gap in the southeast, the Himalaya form an arcuate shape, having a length of 2400 kms and extending in breadth varying from 150 kms to 300 kms.

For the king of mountains, sage Nagasena said, "The Himalaya, the king of the mountains, five and three thousand leagues in extent at the circumference, with its ranges of eight and forty thousand peaks, the source of five hundred rivers, the dwelling place of multitudes of mighty creatures, the producer of manifold perfumes, enriched with hundreds of magical drugs, is seen to rise aloft like a cloud, the centre (of the earth)". They are the Mecca of hundreds of adventurers, geologists, foresters, hydrologists, botanists, zoologists, conservationists, nature lovers and writers alike.

The Himalayas are the loftiest mountains in the world. They form the northern boundary of the Indian sub-continent. The Himalaya is said to be forming a part of the system of folded mountains, radiating from the Pamir Knot. The others are the Kun-Lun, Sayan and Ling Shan in the east, the Hindu-kush, Toros, Elburz, Dinarska, Alps, Pyrenes etc. in the west and Tien Shan, Altai, Stanovoy and Yabionoy lying in the northeast. Experts hold different opinions as to the exact boundaries of the Himalaya. Some consider that it extends from Nanga Parbat to Namche Barwa peaks. For all practical purposes, the present author has taken the Himalaya to extend from the Indus gap in the northwest to the Brahmaputra gap

in the southeast. (Though, there is not much of a difference). There are numerous peaks in this mountain chain which stand over 7500 mts above sea level.

External boundaries of eight countries touch or lie in this mountain chain. These countries are Afghanistan, Burma, Bhutan, China, India, Nepal, Pakistan and the U.S.S.R. The entire area is mostly barren with extremely rugged topography with a very sparse population. The Pakistan-China Karakoram highway passes through this area. To quote Bose (1972), "The rest of the northern frontier of India from Ladakh to Arunachal Pradesh more or less passes close to the northern face of the Himalaya. To the north of the border lie Sinkiang and Tibet in China. However, in the middle of this area lies the Himalayan kingdom of Nepal covering the central Himalayan ranges and some famous peaks such as Dhaulagiri, Annapurna and Sagarmatha or the Everest. At the eastern extremity lies Burma, beyond the syntaxial bend around the Namche Barwa peak."

Physical Features

The Himalaya constitutes one of the youngest mountain systems in the world: the youngest in India. "Whereas the mountains of Peninsular India such as the Aravalli, the Nilgiris and the Eastern Ghats are 1500 to 2500 million years old and the Vindhya-chals about 1000 m.y. old, the Himalaya date back only about 40 m. y.", wrote the late Dr. A.G. Jhingran (1980), founder of the Wadia Institute of Himalayan Geology.

Today, there is definite evidence to prove that the Himalaya rose from the sea. The rocks which constitute Mount Everest are limestone, a sedimentary rock. It is believed that a Tethys sea extended between two land masses, Angaraland to the north and Gondwana land to the south. Rivers from both these continents drained into this sea. Millions of tons of sediment was deposited into this water body which resulted in sagging of the ocean bottom (due to the enormous weight). In this manner huge forces of stress and strain came into play. During this time, the southern continent started moving northwards. Some volcanic activity also accompanied

this whereby, the partly folded sediments began to rise out of the sea. Slowly, the sea water was drained out. It has been opined that the Himalaya was formed due to a number of phases of uplift. These sediments were folded and faulted into a series of complex structures. The Himalayas are rising even today.

Due to later phases of tectonic activity, a younger fold mountain was formed south of the Himalaya. This is the Siwalik range. It runs parallel to the main range in the west but gradually merges with it in the eastern region. Geologically as well as geographically, the Himalaya can be divided into four distinct regions (south to north):

(a) *The Outer Himalaya or Siwalik Zone*: This comprises of the Siwalik range. The rocks here are mainly sandstone, claystone, siltstone, conglomerate, boulder beds etc. They are very weak in nature and are still in a formative stage. Fossils of mammals, reptiles, birds etc. have been found from this zone. They are the youngest part of the Himalaya.

(b) *The lesser Himalayan Zone*: The lesser Himalayan zone is separated from the rocks of the Siwalik zone by a deep seated tectonic lineament which runs from east to west—the main boundary thrust. In some places, these two zones are separated by long, narrow valleys—Dehra Dun valley etc. The rocks of this zone are mainly sedimentary, low grade metamorphosed (green schist facies) and of igneous origin. Mega fossils are by and large absent from this zone.

(c) *Higher Himalaya*: This zone is separated from the lesser Himalayan zone by a thrust known as the main central thrust. The rocks of this zone are highly metamorphosed (generally blue-schist facies) and are commonly referred to as the central crystallines by geologists. They are highly folded, deformed and are often intruded by granites associated with migmatites and pegmatites.

(d) *Tethyan Zone*: This zone is quite different from the other three zones. It is also known as the Tibetan zone. It is a rain deficient area. This zone has a variety of rocks ranging from Proterozoic to the Phanerozoic era. It is a paradise for

paleontologists as the area is full of fossils belonging to different ages. However, stromatolites, which are present in the lesser Himalaya are absent from the Tethyan Himalayan zone.

Drainage

Indus catchment: The river Indus rises near Lake Mansarovar in Tibet, flows along deep gorges through Ladakh and after making a right angle turn, enters the plains of west Pakistan. The Jhelum river is the most important tributary in Kashmir Himalaya. The Jhelum flows through the beautiful valley of Srinagar, along the Pir Panjal range.

Sutlej valley: The Sutlej river also rises from Lake Mansarovar and crosses into Indian territory near Shipki pass. The river Spiti and river Bapsa are its important tributaries. The Sutlej cuts across the great Himalayan range near Chini and Kalpa and the Dhaula Dhar range near Rampur. The Bhakra dam has been built across this river.

Yamuna Valley: The Yamuna river rises from the base of Bandarpunch peak. It has carved a deep V-shaped gorge. The Yamuna cuts across the Nag Tibba range and Mussoorie range near a place called Yamuna bridge. The rivers Tons, Pabar and Aglar are its important tributaries. It passes through the Dehra Dun valley.

Bhagirathi valley: This is one of the two rivers which join to form the river Ganga. It rises from Gaumukh in the snout of the Gangotri glacier, at the base of Chaukhamba peak. The Bhagirathi river has cut a deep gorge across the granitic rocks of higher Himalaya of Garhwal. Its main tributaries are the rivers Janhavi and the Bhilangana. The Tehri dam is being built across this river.

Alaknanda valley: This river joins the river Bhagirathi at Deoprayag to form the river Ganga. It rises from the eastern slopes of Chaukhamba—from the Bhagirathi kharak and Satopanth glaciers. The river flows past the Badrinath temple. Its main tributaries are the Khiraonganga, Pindar,

Dhauliganga, Birahi, Mandakini etc. It has formed a broad valley at Srinagar (Garhwal).

Mandakini valley : It rises from the Mandakini glacier near Kedarnath. It cuts through a gorge of glacial debris. The river has formed broad terraces at Agastmuni and Tilwara. At Tilwara it is joined by the river Lastar Gad. The river Mandakini joins the river Alaknanda at Rudraprayag.

Pindar valley : The river Pindar rises from the Pindari glacier which is located between Nanda Devi and Nandakot peaks. Sundardhuanga river joins the Pindar near Dhakuri. The Pindar joins the river Alaknanda near Karanprayag.

Kali valley : The river Kali forms the boundary between Kumaon (India) and Nepal. The towns of Champawat and Pithoragarh are situated along the Kali river. Its important tributaries are Darma and Sarju rivers.

Ghaghra valley : This river rises from near Mapcha Ghungo in Tibet. Its tributaries are the Karnali, Seti, Bhari rivers. The Ghaghra river drains western Nepal. It cuts across the Churia range near Gaianda Kanda.

Gandak valley : It rises near Manang Bhot and drains central Nepal. The river has cut a steep gorge across gneissic and granitic rocks. Important tributaries are the Marsiandi and Trisuli. The Gandak cuts across the Mahabharat range north of Chitwan.

Kosi valley : This river drains eastern Nepal. Seven rivers join to form the river Sapt (seven) Kosi or Kosi. They are Sun Kosi, Arun, Tamur, Indrawati, Bhola Kosi, Barun and Dudh Kosi. All these rivers are very voluminous. The Kosi river enters the plains near Hanuman Nagar.

Tista valley : The river Tista rises from Zemu glacier on the eastern slopes of Kanchenjunga peak in Sikkim. Some important tributaries are the Lhonak, Lachung, Talung and the Rangit rivers. The river Tista divides the hills of Darjeeling into two parts—Kallimpong (east) and Tiger hill (west).

Brahmaputra valley: Known as the Tsang-po in Tibet, the Brahmaputra river enters into India near Sadiya. Many rivers from Bhutan and Arunachal Pradesh drain into this river. They include the Manas, Amo Chho, Paro Chho, Kameng and Subansiri rivers.

Table 1.1. General Data

	Area (sq. km.)	Population	Population Density
J & K	363,361	4,616,632	33.42
H.P.	55,673	3,460,434	62.16
U.P. (hills)	51,100	3,821,960	74.79
Nepal	41,577	13,000,000	N.A.
W.B. (hills)	3,075	781,777	254.24
Sikkim	7,298	208,609	28.58
Bhutan	46,000	—	N.A.
Arunachal	83,578	467,511	5.59

Table 1.2. Population Data (1971)

	% of Rural—Urban	
	Rural	Urban
J & K	81.41	18.59
H.P.	93.01	6.99
U.P. (hills)	92.07	7.93
Sikkim	90.27	9.23
Arunachal	96.30	3.70

	% Religion						
	Hindu	Muslim	Christian	Budhist	Sikh	Jain	Others
J & K	30.42	68.85	0.16	1.26	2.29	0.02	N
H.P.	96.08	1.45	0.10	1.04	1.30	0.02	0.01
U.P. (hills)	83.76	15.48	0.15	0.05	0.42	0.14	N
Sikkim	68.88	0.16	0.79	29.84	0.05	0.09	0.19
Arunachal	21.99	0.18	0.29	0.04	0.29	0.01	63.63

	Schedule Caste as	Schedule Tribe as
	% of Total Population	% of Total Population
J.K.	8.26	N.A.
H.P.	22.24	4.09
Sikkim	4.53	—
Arunachal	0.07	79.02

	Literacy (% of Total Population)		
	Rural	Urban	Total
J & K	14.11	38.17	18.58
H.P.	29.81	60.54	31.96
U.P. (hills)	18.13	43.63	21.70
W.B. (, ,)	25.72	55.93	33.20
Sikkim	14.80	46.17	17.74
Arunachal	9.79	50.49	11.29

Climate

The climate of the Himalayas is extremely varied in nature. From the wettest spots of Arunachal Pradesh to the cold deserts of Leh and Ladakh, a marked change in climatic conditions are found.

Based on altitude the following climatic zones may be recognized :

Below 800 mts	—	warm tropical
800 to 1200 „	—	warm sub-tropical
1200 to 2400 „	—	cool temperate
2400 to 3600 „	—	cold temperate
above 3600 „	—	arctic

These belts may be divided into different zones such as western, central and eastern. The snow line is higher in the east and the eastern Himalaya are characterised by more rains. The latitude of the western part is higher, hence more snowfall occurs.

Main factors affecting climate are altitude, aspect, vegetation, latitude etc.

Cycle of Seasons : It becomes quite warm in most parts of the Himalaya in May and June. Snow melts at a very fast rate and hence water level in the rivers is quite high. Monsoon rains start from late June to September. On the south facing part of the Himalaya, there are very heavy rains. Sparse rains occur in the tethyan zone. The weather clears up in October. By late November, winter sets in and precipitation may occur

in the form of snow or winter rains. Winter continues upto mid-March, when the weather clears up. April is usually very sunny and fair.

Gravity winds are a very common feature in many parts of the Himalaya. At sunset, due to change in temperature and pressure conditions, there is a downward wind, which takes with it cloud — mist into the valley. During the monsoons, it is easy to catch sight of a cloud being rolled down into the valley. At daybreak and during the early part of the day there is a reverse wind, flowing from the valley to the top of the hills. Due to the warming effect of the sun, the mists warm up and ascend in altitude. Under certain conditions, these winds may attain very high speeds.

Table 1.3. Temperature ($^{\circ}\text{C}$) of some Himalayan Stations.

Station	Summer		Winter	
	Max.	Min.	Max.	Min.
Srinagar	31	11	3	-4
Leh	25	8	-1	-13
Simla	28	12	12	2
Mussoorie	32	17	13	2
Nainital	30	15	12	1
Kathmandu	25	15	10	3
Darjeeling	20	17	6	-1
Gangtok	13	7	-9	-2
Thimpu	23	10	3	-2

Natural Vegetation

Chiefly due to vast changes in climatic, altitudinal and aspect conditions that prevail in different parts of the Himalaya, a diverse nature of vegetation is found. The following are the vegetational belts in the Himalaya, arranged on basis of altitude (of Champion and Seth).

Sub-tropical semi-desert

This type is generally found in parts of Kashmir Himalaya where the area is barren with gravelly soil. This type of vegetation may also be found in the foothill tract of the Himalaya in river beds at lower altitudes etc. It consists of dry thorny

scrub type of vegetation. Babul, Khair, *Prosopis spicigera*, *Ziziphus jujuba* etc. are main species present.

Montane sub-tropical

This forest type occurs immediately above the sub-tropical semi-desert vegetation roughly between an altitude of 500 to 1500 mts. There are three sub divisions of this type – (i) Sub-tropical broad-leaved hill forests (8 A) in which the east Himalayan sub-tropical wet hill forest (8 B/C2) consisting of *Quercus*, *Alnus nepalensis*, *Betula cylindrostachys* etc. occur, (ii) Sub-tropical pine forests (9/C2) which is dominated by the lower Siwalik Chir Pine forest, upper or Himalayan Chir Pine forest and the Assam sub-tropical chir pine forest. Main species of this type is *Pinus roxburghii*, (iii) Sub-tropical dry evergreen forest which occurs in Bhabar, Siwalik hills and foothills of the Himalayas.

Montane wet temperate forest

The following types and sub types occur under this: Northern montane wet temperate forests (11 B) occur between 1800 mts. to 3000 mts. in West Bengal and Arunachal Pradesh. This can be divided into the east Himalayan wet temperate forest (11 B/C1) consisting of Lauraceous forest in which overwood consists of *Machilus*, *Cinnamomum angustifolium*, (11B/C1b) consisting of *Quercus lamellosa*, *Acer campbellii* etc. and high level oak forest (11B/C1c) consisting of *Q. pachyphylla*, *Q. lamellosa*, *Castanopsis* etc.

Himalayan moist temperate forest

This group is found well distributed all over the Himalaya. It generally occurs between 1500 mts and 3300 mts Under this the following types are present (i) *Lower western Himalayan temperate forest* (12/C1) – Under this there is the *Ban Oak forest* (12/C1a) in which *Q. incana* is the dominant species associated with *Q. dilatata*, Deodar, Rhododendron etc ; *Moru Oak Forest* (12/C1b) in which *Q. dilatata* is the dominant species associated with *Q. mcana*, *Q. semecarpifolia*, Fir, Spruce, Deodar, Blue pine, Rhododendron, Chestnut, Walnut, *Betula*, *Acer* etc. *Moist Deodar Forest* (12/C1c) occurs in the western Himalaya between

Kashmir and Garhwal. The natural limit of Deodar is the Dhaulī gāngā river, a tributary of the Alaknanda. *Western mixed coniferous forest* (12/C1d) consisting mainly of Fir, Spruce etc. *Moist temperate deciduous forest* (12/C1e) generally found in moist shady depressions consisting mainly of Acer, Carpinus, Betula, Fraxinus etc. *Low level Blue Pine forest* (12/C1f) in which pure patches of Blue pine occasionally mixed with Fir and Spruce dominate. (ii) *Upper Himalayan Temperate forest*—The following sub types may be present: *Kharsu Oak* (12/C2a), *Western Himalayan upper Oak Fir forest* (12 C2b), (iii) *East Himalayan mixed temperate forest*: The following sub types may be present—*East Himalayan mixed coniferous forest* (12/C3a) and *Abies delavayi forest* (12/C3b).

Himalayan Dry Temperate Forest

This forest group occurs mainly in the higher Himalayas, where there is little precipitation in the form of rain and major precipitation is in the form of snow. Under this the following types occur: (i) *Dry broad-leaved and coniferous forest* (13/C1)—*Pinus gerardiana* is dominating, (ii) *Dry temperate coniferous forest*—This is divided into the following sub types (i) *Neozoa pine forest* (13/C2a), (ii) *Dry deodar forest* (13/C2b), (iii) *West Himalayan dry temperate forest* 13/C3), (iv) *West Himalayan high level dry blue pine forest* (13/C4), (v) *West Himalayan dry Juniper forest* (13/C5), (vi) *East Himalayan dry temperate coniferous forest* (13/C6) and (vii) *East Himalayan dry Juniper forest* (13/C7).

Sub Alpine forest

This is the top most (altitude wise) tree forest in the Himalayas, lying between the alpine meadows and temperate forests. In this zone the temperatures go down to subzero during the winter months Betula, Birch, *Abies densa*, Junipers, *Abies spectabilis*. etc are the main species. The following sub types are present (i) *West Himalayan sub alpine birch/fir forest* (14/C1) and *East Himalayan sub alpine birch fir forest* (14/C2).

Moist alpine scrub

This consists of the (i) *Birch-Rhododendron scrub forest* (15/C1) usually above 3,500 mts generally consisting of Birch

and *Rhododendron*, (ii) *Deciduous alpine scrub* (15/C2) consisting of low alpine scrub usually present over 3,500 mts altitude and (iii) *Alpine pastures* (15/C3) consisting of mesophytic herbs like *Primula*, *Anemone*, *Iris*, *Gentiana* etc.

Dry alpine scrub

It occurs in parts of Kashmir, Uttar Pradesh and Himachal Pradesh Himalaya. Vegetation is generally xerophytic in which *Eurotia*, *Potentilla*, *Caragana*, *Artemisia* etc dominate.

People

The Himalaya is inhabited by a large diversity of people, belonging originally from a varied base of culture. In J&K state, there is a mixture of three types of people--In Kashmir, Muslim culture is prevalent, while in Ladakh, Buddhist culture is present and in Jammu area, Hindu culture is dominant. In Himachal Pradesh too, in Lahul and Spiti, Buddhist culture prevails, while the rest of the people are mainly of Hindu culture. About Ladakh to quote Bose (1972) once again, "the society is matriarchal. A woman may have a large number of husbands who work for her. In the great Dussehra festival at Kulu in the autumn, groups of gaily dressed Lahuli women come for fun and frolic but few Lahuli men visit the fair. One or two may come with groups of women as guards and workers".

Some people of the Himalaya are discussed below :

(i) *Gujars of Kashmir* : They are semi nomads. They live in huts made up of wood. Their main occupation is cattle rearing.

(ii) *Gaddis of Kulu valley* : They inhabit the slopes of Kulu area in Himachal Pradesh. They are semi nomadic in nature. They sell wool and woolen clothes.

(iii) *Kinnauris of Sutlej and Baspa* : These people generally grow fruits, grapes, nuts etc. and also rear sheep and goats.

(iv) *Jaunsaris* : These people inhabit the Jaunsar Bawar area of Debra Dun district. They claim to be the descendants of the Pandavas.

(v) *Jadhs of Nilang* : They live in the Janhavi valley. These people too are semi-nomadic and rear cattle.

(vi) *Marchas of Mana* : They live in Badrinath area. Some of these people were engaged in trade with Tibet before the Chinese invasion of 1962.

(vii) *Anwals of Pindar valley* : These people are very well organised. Often they live in stone huts built at high altitudes.

(viii) *Johris of Milam valley* : These people inhabit the Malla Johar area of Kumaon. They have two sets of homes, one at high altitude and the other at a lower altitude.

(ix) *Gorkhas of Nepal* : These are the people who have earned fame many a time on the battle fields all over the world. They inhabit western Nepal.

(x) *Sherpas of Nepal* : They have gained fame ever since the high altitude mountaineering expeditions have begun. They act as high altitude porters.

(xi) *Lepchas of east Himalaya* : They are thought to be the original people of Darjeeling hills.

The Himalaya can aptly be divided into 3 parts, viz. Western, Central and Eastern. Each of these parts are discussed below :

Western Himalaya

Three parts comprise this zone. They are J & K, H.P. and U.P. hills.

Jammu and Kashmir : This is the western most part of the Himalaya. It consists of a number of subdivisions. The great Himalayan range commences from Nanga Parbat and runs along a northwest to southeast direction in this region. The famous temple of Amarnath is located in this range. The route for Amarnath begins from Pahalgam via Chandanwari and Sheshnag. The river Sindhu is the most important river of this range. Pahalgam is situated at the junction of the rivers west Liddar and east Liddar. The famous peak of Nun Kun (7,135 m) is also situated in this range.

Zaskar and Ladakh are located in the tethyan Himalayan zone. Both these regions are extremely barren. The road linking Srinagar with Leh passes through two big centres of Dras and Kargil. Rupshu is located east of Zaskar. A big lake—Tso Morari is present here. The road joining Kulu valley in Himachal Pradesh passes through Rupshu. The people of this area are generally Buddhists. It is a common sight to see monasteries decorated with prayer flags. The broad Srinagar valley which has often been referred to as 'Heaven on Earth' lies between the great Himalayan range in the north and the Pir Panjal range in the south. It is a very broad valley, linked to the rest of the country by National highway 1A. It is drained by the river Jhelum. Numerous lakes are present, of which Dal lake is by far the biggest. Lake deposits are present in the entire valley and it is thought that at one time, the entire valley was a lake bottom. The valley is a very important centre of tourism and sports goods. It also has an airport. Srinagar, the capital of J & K is located here. Other important places are Pahalgam, Gulmarg, Anantnag etc. Agriculture is the chief occupation of the people in this valley.

The Pir Panjal range is another distinct subdivision of Kashmir Himalaya. It is thought to be younger in age to the Himalaya. It spans from the gorge of the river Kishan Ganga to Deo Tibba peak in Himachal Pradesh, where it appears to merge into the great Himalayan range. The road linking Srinagar and Jammu, passes through this range near Bannihal along a tunnel built in 1957 (Jawahar Tunnel). The rivers Chenab and Jhelum cut across this range at Kistwar and Uri respectively. The Chenab river has cut a deep gorge across this range. The Jammu-Srinagar road follows this river for a part of the route.

Jammu area is located in the Siwalik foothills of Kashmir Himalaya. Jammu town is situated on the banks of the Jammu Tawi river. The region has a typical Siwalik type topography.

Himachal Pradesh : At its northern border, Himachal Pradesh has Tibet (to its north), J & K to the west, Punjab to the south and U.P. to the east. The state can aptly be divided into four distinct zones :

The Dhaula Dhar range divides Himachal Pradesh into approximately two halves. It ends in the Indus-Ganga water divide near Baspa valley. The river Ravi flows between the Dhaula Dhar and Pir Panjal ranges. Chamba town is situated along the Ravi valley. Dharamsala, the headquarters of Kangra district is situated on the southern slopes of the Dhaula Dhar range. The townships of Palampur and Bajnath are famous for an ancient temple built by the Pandavas. A railway line and road follow the Beas valley upto Jogindernagar where a hydro-electric station has been set up to utilize the water of the Uhl river. The roads lead to Mandi and Kulu valley.

The Lahul-Spiti area lies in the trans Himalayan zone. They are extremely cold and rugged, resembling Ladakh area of Kashmir Himalaya. Lahul is drained by the Chandia and Bhaga rivers. To the south of Lahul is the Pir Panjal range. Lahulis are Budhists and by and large follow Lamaism. Their main occupation is cultivating crops and sheep rearing. Spiti is drained by the Spiti river, which is a tributary of the river Sutlej. Shilla (7030 m) is the highest peak in the area. The people of Spiti too are Budhists and follow Lamaism. The famous monastery of Dankar Gompa is located at Spiti. Kinnaur also resembles Lahul and Spiti to a great extent but some physical conditions are different.

Simla hills are the most populated part of Himachal Pradesh. They are a part of the lesser Himalayan range of Himachal Pradesh Himalaya. Simla, the capital of H.P. State, was once the summer capital of British India. Simla is very popular with tourists. It is linked by a railway line with Kalka located in the foothills. Chail, a small hill station near Simla was developed by the Maharaja of Patiala during the British rule. This town boasts of the highest cricket pitch in the world. It is also an important centre for the production of mushrooms. Other townships located in Simla hills are Solan, Kasumpti, Dharampur, Kotgarh, Sanawar, Dagshai, Subathu, Taradevi, Kasauli, etc.

Sirmur district of H.P. is located partly in the Siwalik hills. Its headquarters is Nahan. It is drained by the Giri

and Tons rivers. Poanta Sahib, a famous Sikh pilgrimage is located along the banks of the river Yamuna, is a Dun type valley.

Uttar Pradesh Himalaya : The U.P. Himalayas comprise of two administrative divisions of Garhwal and Kumaun. Garhwal consists of the districts of Chamoli, Dehra Dun, Pauri, Tehri, and Uttarkashi. Uttarkashi and Dehra Dun districts have their borders with Himachal Pradesh. The rivers Yamuna and Bhagirathi flow partly through Uttarkashi district. Uttarkashi township is situated along the Bhagirathi. It is famous for the Nehru Institute of Mountaineering. Dehra Dun city, the headquarters of Dehra Dun district is situated in a long, longitudinal narrow valley known as Doon Valley. Mussoorie, often called the queen of hill stations and Chakrata are two hill stations of this districts. Rishikesh located on the banks of the river Ganga is another small town in this district.

The headquarters of Tehri district is Narendranagar built by Narendra Shah, the former ruler of the erstwhile princely state of Tehri. A mammoth dam is being built at Tehri, whose waters will sink a part of this township. The Alaknanda and Bhagirathi rivers join together to form the river Ganga at Devprayag. Chamoli is by far the largest district of Garhwal division. It has the famous pilgrimage places of Badrinath, Kedarnath, Tungnath, Rudranath etc. The famed Valley of flowers and Hemkund Sahib are also situated in this district. Pauri district lies at the eastern end of Garhwal. Pauri, the headquarter town is situated at 2000 mts. altitude. It commands a picturesque view of the snow clad Himalayan peaks. Lansdowne and Kotdwar are two other important towns of this district.

Kumaon division consists of Almora, Naini Tal and Pithoragarh districts. Almora is a small town situated on the top of a ridge. It is the starting point for trekking expeditions to Rupkund, Pindari, Sundardungha and Milam glaciers. Ranikhet and Kausani are two picturesque places. Almora is famous for its production of fruits and vegetables. Bageshwar is fast coming up as an important trade centre.

Naini Tal is known for its lakes. The famous lakes situated in this district are Naini Tal, Khurpa Tal, Bhim Tal, Naukuchia Tal etc. Naini Tal is joined to the plains of India by a road through Kathgodam and Haldwani. Situated on limestone topography, Naini Tal town is a fashionable hill resort, situated around a lake of the name. Some popular picnic spots nearby are China (now Naini) peak, Lands end, Tiffin top, Bhowali, Sukha Tal, etc. The Uttar Pradesh state observatory is located here. Pithoragarh district forms the border between U.P. and Nepal. The pilgrim route to Mansarovar Lake in Tibet lies through this district. The main rivers that drain this district are the Darma, Goriganga and the Kaliganga. Important localities are Dharchula, Garbyang, Tawaghat, Ascote, besides Pithoragarh, the headquarters.

Central Himalaya

Nepal, the independent kingdom lying to the north of India lies in the central part of the Himalaya. From east to west, it is about 630 kms long and 200 kms from north to south, covering an area of 157,850 sq kms. Quite like its counterparts of western and eastern Himalaya, the central Himalaya too is marked by a number of longitudinal ranges. The lesser Himalaya is called the Mahabharat Lekh. Further south are some Dun type valleys, bounded by continuation of the Siwalik range called as Churia or Churia Muria in Nepal.

Ghaghra basin: The Ghaghra river drains most parts of western Nepal. This basin lies mainly to the west of Dhaulagiri (8172 m) peak. Its largest tributary, the river Karnali, rises near Mansarovar Lake. This river is thought to be antecedant. The Karnali river cuts a gorge in the Mahabharat range near Dailekh, a small mountain hamlet.

Waters from the western portion of this basin are brought by the river Seti. It rises from near Api (7132 m) and Nampa (7035 m) peaks. The big valleys of Thalara and Talkot are the most prominent settlements in Seti valley. The Seti river flows into the river Karnali below the Karnali gorge near Dailekh. West of the Seti basin, the area is drained by the river Kali.

The rivers Bhari, Rapti, and Babai form other important valleys of this basin.

Gandak Basin : The river Gandak drains a major portion of central Nepal. This river rises near Mustang Bhot very near to the Tibet-Nepal border. The river then flows through a deep and spectacular gorge between the towering peaks of Dhaulagiri and Annapurna (8078 m). The country here is typical of the Tethyan Himalayan zone. Muktinath is a pilgrimage place in this area. Some of the tributaries of the Gandak river are the Mirist Khola, Kali Gandaki, Andhi Khola etc. Some important settlements in this valley are Dana, Tukcha, Kagbri, Riri Bazar. The Gandak river cuts through the Mahabharat range near Riri Bazar

Kosi Basin : This river drains the eastern part of Nepal. It drains an area unique in character for in its basin lie the giant peaks like Mount Everest, Kanchanjunga, Makalu, Lhotse etc. Made up of limestone (known as Everest limestone) Mt. Everest lies on the border of Tibet and Nepal. Its southern face lies in Nepal whereas the northern face slopes towards Tibet. It is approached through an exhilarating trek past Namche Bazar. Khumbu glacier lies at the base of this peak. The area is supposed to be the habitat of the abominable snowman called Yeti. Ilam Bazar is the principal town of eastern Nepal.

Pokhra Valley : This beautiful valley lies in the lap of the higher central Nepal Himalaya. It is one of the most beautiful parts of the Himalaya. The valley lies almost at the base of the Annapurna range. Annapurna has four peaks— I, II, III and IV. The river Seti is joined by the river Mardi in Pokhra valley. The valley itself is marked by broad cultivated terraces made up of conglomerates and sandy soil. Lacustrine deposits are common in the valley and the valley appears to be an old lake bottom. Some remnants of this water body are still to be found in the form of small lakes at the periphery of the valley. These are Phewa Tal (which is the largest) Beguas Tal and Rupakot Tal. Pokhra town has rapidly come

up as a tourist centre particularly after the construction of an airport there.

Kathmandu valley : This is another exposed lake bottom. It is a very broad valley, marked by lacustrine sediments. Surrounding the valley are forest clad slopes. The valley has an altitude of about 1600 mts. with a mild climate. Some summer days may become dry and sultry with the mercury rising to between 35° to 40°C. The surrounding hills receive snow during winter. Bulk of the precipitation is in the form of monsoon rains.

The valley is drained by the river Bagmati. It is thought that the lake was produced by the damming of this river. In due course, this river cut across the mountains at Chhobar gorge and the lake waters drained out. Kathmandu the capital of Nepal is by far its largest city. It has an international airport. There are many temples and pagodas. The most famous being that of Pashupatinath. Other religious places are Hanuman Dhoka, Kal Bhairab etc. The city also has a modern University.

Eastern Himalaya

Sikkim : Having an area of about 7296 sq kms, Sikkim is surrounded by Tibet to the north and Nepal to the west. Singalia and Dongkya ranges lie to its west and east. It is drained by the river Tista. Lepchas, Bhutias, Limbus and Nepalis constitute the bulk of its population. They are generally followers of Hinduism and Buddhism. Lachen and Lachung are two highland communities which inhabit the upper reaches of Tista valley. Lachung is the main settlement of this area. While the people living at high altitudes are herdsmen, the people living in the valleys and at relatively lower altitudes are farmers. Lamastic Buddhism is a part of Sikkimese life. About this Neel (1971) writes "The monks of Sikkim are for the most part illiterate and have no desire to be enlightened even about the Buddhism, which they profess."

Gangtok, the capital of this state, situated at an altitude

of 1775 m, is by far the largest township. It is linked to Siliguri with a very good highway.

Darjeeling hills : Forming a part of West Bengal state, the Darjeeling hills are famous for its views of Everest and its tea gardens. A major portion of the district lies south of the Rangit river. It is an extension of the Singalia range. Tiger Hill (2567 m) occupies a vantage point in these hills. Ridges running from various directions merge at this place. Darjeeling township, founded by the British, is located on a spur of that name. A highway and an winding railway connect Darjeeling to Siliguri. If one is lucky enough, one may catch a glimpse of Everest at sunrise, atop Tiger Hill. Some of the other peaks seen at this hour are Kanchenjunga, Kabru, Pandim, Narsing etc. Darjeeling also houses the famous Himalayan Mountaineering Institute and the Padma Naidu Zoological Park for Himalayan fauna. Very near to Darjeeling is the hill station of Kurseong which houses the Eastern Forest Rangers College. Another hill resort, Kalimpong is situated east of the Tista river. It was a favourite with Rabindranath Tagore.

Bhutan : To quote the illustrious work of Bose (1972) once again, "The Bhutan Himalaya consists of a great arc of snowy ranges in the north from which descend snowfed rivers. The arc spreads from Chomo Lahari (7314 m) in the west to Kulha Kangri (7541 m) in the centre and to the east". Western Bhutan is drained by the Amo Chho river which rises in the Chumbi valley. The Paro Chho and Wong Chho drain a part of central Bhutan. On the banks of these rivers are located the towns of Paro and Thimpu. Eastern Bhutan is still trying to shed its garments of isolation. A number of small rivers drain this area and they flow into the Manas river.

Thimpu, the capital of Bhutan, is located on an exposed lake bottom. It is fast coming up as a big town with newly built hospitals, residential areas, schools, shopping complexes etc. Paro is the second biggest town. This too is situated on an exposed lake bottom. A number of hydroelectric projects have been completed in Bhutan.

Arunachal Pradesh : This is the eastern most portion of the mighty Himalayan range. The main Himalayan range is the most prominent feature of this area. It forms a small arc before it ends at the Brahmaputra gap. The river Brahmaputra (Tsang Po in Tibet) rises near Mansarovar lake and travels 1200 kms before entering into India. In the western portion of Arunachal Pradesh is the Kangto group of peaks. Before the Chinese invasion of 1962, Arunachal Pradesh Himalaya was not much developed. However in the years after this aggression, rapid development has taken place.

The famous Tawang monastery is situated on the banks of the river Twang, which drains the north western portion of Arunachal Pradesh. The river Subansiri is the main river of this state. The town of Zero, having an air landing strip is located on the banks of this river. Itanagar is fast coming up as a major town.
