CHAPTER I

I N T R O D U C T I O N

General:

The ground with which this study is concerned lies to the south of Ranikhet (an important town of the Almora dist. of Uttar Pradesh), about 45 kms. west of Almora, and about 52 kms. north of the famous hill station of Nainital (Fig. 6). The rocks investigated occupy a more or less rectangular area of about 65 sq. kms. In the east, the area is flanked by a valley passing through the village known as Amiakande, while its northern border could be demarcated by an east-west imaginary line passing through

Ranikhet and Upat. The western side of the ground is bounded by a valley which enters from the north and finally meets the main Kuch-Gad valley in the south. The southern limit of the area extends upto village Chhera, Bamsyum and Amiakande.

Physiographically the present area which exhibits a typical rugged topography, forms a part of Nag-Tibba range of the lesser Himalayas. The main hill-range which runs continuously in NNW-SSE from Bamsyum to Pilkholi forms the principal water shed. Both the north eastern and south western slopes of the watershed are dissected by a number of small valleys formed by the various streams. To the NE beyond Pilkholi, the ground rises rather abruptly to a height of 6900 feet and ultimately forms a table land on which the Chaubatia camp is situated. This flat land gradually slopes down northward as well as southward. It slopes down to a height of 3500 feet. The narrow gorges are the result of the rapid and torrent flow in the past. The main summits are Chaubatia (6900'), Nagpani (6400'), and Kunellakhet (6000').

It is obvious that the drainage pattern of the area has been governed and controlled by the topography and the structural features. Kuch-Gad nala, a tributary of the river Kosi, flows due south in the SW portion of the area. In addition the area is drained by a number of streams, which flow from both the slopes of the watershed. The streams flowing southwestward finally meet Kuch-Gad to the south of the area, while those flowing from eastern slope of the shed flow generally to the SE of the area and meet big nala outside the area. Most of the streams remain dry during the summer being fed by monsoon water. In some cases streams have followed the path along dislocation planes developed during the later stage of Himalayan Orogeny.

The climate of the area is very pleasant, cool and invigourating. The seasonal variation in temperature is 27°C during summer (Mid- April-June) and 5°C during winter (November-January). The monsoon by westerly wind which breaks earlier than the plains commences from mid June and the area receives about 1500-1700 mms. of rainfall till the end of September. The area suffers occasional snowfalls in the month of January.

As regards the vegetation, it varies according to altitude. Sal (Shovea robusta), Sian (Terminoua tomentosa) etc. are found upto the elevation of 5000'. Beyond this altitude, higher up, the Chir (Pinus lonsitolla) and Oak (Quereus meanta) are common. Besides these the fruit trees of almost all description are noticed among which apple, apricot, citrous fruits, strawberry, black berry and oranges are very common. Among small shrubs "Vichhu" is the characteristic one, justifying its name by stinging like a scorpion on touching it.

Among the wild animals leopards (Felis jabuta), panther (Felis paradus) and black bears (Virsustov quatus) are common in forested area. The other animals are spotted deers (Carvus unicolar), jackals (Cavis qureus), pigs and langures are often met with. The domestic animals such as dogs (Canus jamilians), bullocks (Bos indicus), goats (Hemitragus himalayan) and ponies are very common. In addition to these, birds of various types, snakes and lizards are often seen.

Being mountainous, the terrian is thinly populated and not much organised. The main settlements are confined

to valley sides. The people belong to both Brahmin and non-Brahmin community of local stock, having a mixture of Aryan and Mongolian blood. The unfavourable geographical conditions of the area have stood in the way of any industrialization. The Departments of Forestry and Public Works who have their dist. offices at Ranikhet, provide employment to many in this region. One of the main source of livelihood is the army employment. Chaubatia is the headquarter for the Kumaon Regiment. Practically every family has its representative in the army. The reputation of Kumaonee as fighters, is second to none in the world. About, 80% of the population, however is engaged in agriculture. As little plain ground is available in such areas, the cultivation is done on the mountain slopes by preparing numerous narrow terraced fields. Rainwater is the only source for certain crops. Wheat, rice and 'madua' are among their major crops. Besides these, are grown fruits and vegetables.

Ranikhet is an important hill station and to many it is the best in the Kumaon Himalaya. The town is situated in the midst of majestic pine trees and the country around

Ranikhet is equally picturesque. It is connected with the nearest railway station Kathgodam in south by a 83 kms. long all-weather motorable road. Almora lies to the east, and is joined by a 48 kms. long motorable road. An important tourist centre, it attracts thousands of people every year who come to enjoy the scenic beauty of the Himalayas. Every Kumaonee, man or woman, has in him or her deeply embedded the colourful traditions of the past, and hospitality and friendliness comes natural to these Himalayan people.

Scope of the present work:

The author was introduced to this area by Dr.I.C.Pande in the year 1959 in connection with his M.Sc. Thesis work, when he conducted a preliminary survey of the area. But in the course of this investigation, it became very clear that a detailed study of the metamorphic rocks of Ranikhet area might not only reveal the complex structural and metamorphic history of the area in particular, but might also throw considerable light on the geology of this part of the Himalayas as a whole. Thus the author was encouraged to continue his work and expand the scope of his investigations

under the supervision and guidance of Prof. Merh.

The author spent an aggregate period of 30 weeks in field during the summer and winter months of the year 1962 and 1963. The area covers the part of the eastern side of the 2-Inch Survey of India Sheet No. $53\frac{O}{6}$ NS. The mapping was carried out on 6" = 1 mile map (enlarged from the original 2" = 1 mile sheet). The rock types encountered consist of pelitic and semipelitic schists, gneisses (migmatites), psammites and crystalline limestones belonging to different periods. A systematic study of every individual outcrop was made and the various observations were noted down either on the map or in the field note book. Lithology was carefully observed and distinctions based on field characters were recorded. Field evidence of metamorphic changes and degree of migmatisation were also noted. In addition to the bedding and foliation, various other structural elements such as minor folds, cleavages, lineations and joints were noted. Pattern of drag folds and mutual relationships of various structures were examined. A close look out for current bedding and graded bedding in psammitic rocks enabled to understand the true succession of the rocks.

All the data collected in the field was analysed in the Department of Geology, M.S.University of Baroda. About 150 thin sections were critically examined for petrographic study. To understand the structure of the area the structural data was analysed on a stereographic equal-area net.

The results of all these investigations conducted both in the field as well as in the laboratory, throw considerable light on the stratigraphy, structure and metamorphism of the Pilkholi area. A full account of all the relevant facts on these topics forms the subject matter of this thesis.

Brief Geology:

One comes across the following succession of the various rocktypes in the area. The succession is essentially a structural one:-

Chaubatia schists
Jhuladevi gneiss
Paniali schistose group

} Pilkholi Series: Crystalline rocks of Ranikhet-Almora Nappe of Heim & Gansser(1939) and Garhwal Nappe of Auden(1937)

---------- Upradi Thrust ------- South Almora Thrust (Heim & Gansser,1939)

Upradi-Bajina interbedded Quartzites and Phyllites Bamsyun limestone	Bajina Series: Krol Nappe of Auden(1937)

The names given to the various rock groups are based on the localities where the exposures are typically seen. The regional strike of the foliation, as well as the trend of the various lithological bands, generally run NW-SE with gentle to moderate (5° to 30°) dips due NE.

The Chaubatia schists constitute the uppermost formation of the succession, and occupy the tract from Chaubatia to Ranikhet and north of it. This formation can be divided into two groups - the upper pelitic and the lower semi-pelitic. The upper group is highly micaceous with varying garnet content. The lower semi-pelitic group shows interbedding of mica-schists and micaceous quartzites. Beneath this schistose formation is the Jhuladevi gneiss, exposed more or less as a continuous band extending NW-SE, and occupying the region immediately to the south of Ranikhet. It is obvious even in the field that the overlying schists gradually merge into gneisses

with increasing felspar content. The group can be classified into the following four types:-

1. Porphyroblastic gneiss,
2. Augen gneiss,
3. Permeation gneiss,
4. Felspathic schist.

The group of schistose rocks (Paniali schistose group) that underlies the Jhuladevi gneiss, occupies the area to the south of Ranikhet, and consists of the following varieties which occur as narrow bands:-

1. Biotite-muscovite-chlorite-garnet schists
2. Chlorite-muscovite-garnet schists
3. Sericite-chlorite-garnet-phyllites (Phyllonites)

The gradual downgrading of the metamorphism of these rocks from north to south is connected with the Upradi thrust (South Almora thrust). This thrust occurs near Upradi, about 8.5 air kms. south of Ranikhet.

Below the thrust, occur rocks of less metamorphosed Bajina Series (? Nagthat) as interbedded quartzites and phyllites. The quartzites and phyllites occupy a tract

extending from Upradi to Bamsyun where they are underlain by a grey dolomitic limestone (possibly equivalent to Deobans).

The rocks of the Pilkholi Series show the following three successive stages of regional metamorphism:-

1. Progressive regional metamorphism.
2. Migmatisation.
3. 'Retrogressive' metamorphism.

The rocks of the Bajina Series - the quartzites and slaty phyllites of Upradi-Bamsyun region, show a low grade metamorphism. The tendency of the phyllitic layers to become a little chloritic in the vicinity of the thrust suggests slight increase in the metamorphic grade.

The structure of the area has been worked out on the basis of the outcrop pattern and the study of the minor folds. It is suggested that the Ranikhet-Chaubatia area constitutes a reclined fold closing to the west. The migmatitic gneisses occupy the core of this fold. The axis of this regional fold plunges moderately to the NNE or NE. The metamorphic foliation of the area characterises the

axial-plane of the fold. It appears that the deformation of the area started with the development of this fold and ended up with the Upradi thrust (South Almora thrust).

Ample field evidence is there to suggest that the thrust at Upradi is the Heim and Gansser's South Almora thrust, and forms the southern flank of the Synform into which the Garhwal thrust has been folded. Last folding episode is recorded in a N-S folding causing gentle flexures of the thrust plane.