CHAPTER 2

P R E V I O U S W O R K

The geological investigations of the Himalayas have been divided into following three periods:

(1) The first period of sixty years, beginning with 1860 was instrumental in laying the foundations of Himalayan stratigraphy.

(2) The second period between 1920 and 1939 saw a special emphasis being laid on the structural studies of the Himalayas. The development of the concepts of great thrusts in Europe had a clear impact on the Himalayan studies during this period.

(3) The third and the most recent period from 1939 to this date has witnessed the beginning of intensive areal studies of structures and their regional correlation.

A number of agencies, foremost among them the G.S.I., have been paying attention to the study of Himalayan geology recently and the various major engineering projects, expedition traverses and academic research have given added impetus to a gradual clarification of concepts about the stratigraphy, structure and metamorphism of the Himalayas.

A chronological account of the growth and development of the geological knowledge of the Himalayas is summarised in the following table (Table 2.1, 2.2, 2.3 and 2.4).

PREVIOUS WORK IN THE KUMAON REGION

Auden (1937) working in Garhwal, improved upon the work of Middlemiss (1887) and suggested the existence of great thrusts. He divided the Garhwal area into three tectonic units - the Garhwal nappe, the Krol nappe and the Autocthonous zone - separated respectively by the Garhwal thrust and the Krol thrust.

Heim and Gansser (1939) extended Auden's concepts eastward into Kumaon, and named the crystalline thrust unit corresponding to the Garhwal nappe as 'Almora nappe'. They suggested that the Almora nappe was a huge syncline

TABLE 2.1

PREVIOUS WORK IN THE HIMALAYAS

YEAR	NAME	AREA INVESTIGATED	CONCEPTS DEVELOPED
1851	Strachey	-	Published the first sections across Himalayas.
1854	Hooker	-	Gave the first geological account of the Nepal Himalayas.
1864	Medlicott	Simla area and Kumaon (See Table 2.2)	Gave the first connected account of the geology of the lower Kumaon Himalayas. Laid the foundation for the correlation and nomenclature of the rocks of Simla. Classified the rocks into Himalayan and Sub-Himalayan series.
1880	Middlemiss	-	Gave the structural interpretation and correlation of the Himalayan rocks. Assigned two ages to the Himalayan granitic rocks. viz. Tertiary and Pre-Triassic.
1883	Oldtham	Traverse from Almora to Mussoorie	Gave a general description of the rock types.
1887	Macmahon	Chor area	Gave a detailed account of the gneissic granites of the Chor area. Proved late intrusive origin of Chor Granites.
1887	Middlemiss	Lower Himalayas	Published work on the crystalline and metamorphic rocks of the Lower Himalayas.
1890	Middlemiss	Nainital area	Discussed geology of the Nainital area with a special reference to its lakes.
1891	Griesbach	Spiti area	Correlated rocks of the 'inner formations' of Middlemiss with similar rocks of Spiti and called them the Vaikrita System.

1907	Loczy	-	Gave the first modern section of thrust folding over the entire Himalays.
1926	Pilgrim & West	Chor area	Gave a general account of the Chor Granites.
1928	Pilgrim & West	Simla area (See Table 2.3)	Gave a complete account of the structure, stratigraphy and metamorphism of the Simla area.
1931	Wadia	-	Discussed the tectonics and orogeny of the NW Himalayas. Established the syntaxial bend in the Himalayan chain between Kashmir and Hazara and suggested a single movement from the north.
1932	Burrard & Hayden	-	A book on geography and geology of Himalayas.
1933	Auden	-	Suggested the age of some Himalayan rocks to be Pre-Triassic.
1934	Auden	The Krol Belt of Simla	Discussed the geology of the Krol Belt and described the rock types.
1935	Auden	Garhwal, Nepal and Sikkim	Gave a detailed account of traverses in these regions.
1937	Auden	Garhwal Himalayas (See Table 2.4)	Established the structure of Himalayas in Garhwal.
1939	West	Simla area	Developed the stratigraphy of the Shali Window in Simla and discussed the structure.
1949	Misch	Nanga Parbat region	Discussed granitisation of batholithic dimensions in the area.

TABLE 2.1 (Continued)

YEAR	NAME	AREA INVESTIGATED	CONCEPTS DEVELOPED
1949-50	Pande	Ramgarh area (Nainital)	Discussed the general geology.
1952	Hagen & Hunger	Central Nepal Himalayas	Gave a detailed geological account of the region.
1953	Berthelsen	N.W. Himalayas	Gave a general account of the Geology of the Rupshu District.
1956	Ghose	Darjeeling area	Suggested rise of isotherms in the subsiding Daling Geosyncline to be responsible for the development of metamorphic minerals.
1956	Pande	Ramgarh area (Nainital)	Proved Ramgarh porphyries to be migmatites.
1958	Hagen	Nepal Himalayas	Summarised and discussed the geological investigations in the Nepal Himalayas.
1961	Ganju & Srivastava	Simla area	Established petrology of the Dagshai area.
1961	Bordet	Eastern Nepal Himalayas	Established the stratigraphy and structure of the region.
1962	Valdiya	Southern Pithoragarh area	Established stratigraphy and structure of the southern Pithoragarh, gave an account of Champawat granodiorites and suggested them to be batholothic.
1963	Valdiya	Lohaghat region of Almora district	Described the stratigraphy and the structure of the region.

1963	Pande	The Kumaon Himalayas	For the first time suggested a migmatitic origin for the gneissic rocks of the region. Established four distinct episodes of metamorphism for the Kumaon Himalayas.
1964	Valdiya	-	Divided Lesser Himalayan unfossiliferous formations (Sedimentary) into argillo-calcareous and arenaceous groups.
1964	Gansser	-	Published a modern and synthesised account of the geology of the Himalayas.
1964	Nautiyal et al.	The Bhutan Himalayas	Gave a preliminary account of the geology of the Bhutan Himalayas.
1965	Krishnaswami & Swaminath	-	Divided the Himalayas into tectonic zones and compared them to those of the Alps.
1967	Fuchs	-	Gave a general account of geological investigations in the Himalayas.
1968	Merh	The Central Kumaon Himalayas	Developed the preliminary concepts about the tectonic pattern of the central Kumaon region.
1968	Pande & Saxena	-	Critically discussed the birth and development of the Himalayas.
1970	Frank & Fuchs	Western Nepal	Gave an account of the investigations and discussed their significance for the geology of the Himalayas.

TABLE 2.2

MEDLICOTT'S CLASSIFICATION (1864)

SUB HIMALAYAN SERIES	Upper Siwaliks		
	Middle Nahan	Kasauli	
	Lower Subathu	Dagshai	

HIMALAYAN SERIES

A. Unmetamorphosed

Krol - Limestones

Infrakrol - Carbonaceous shale

Blaini - Conglomerate

Infra Blaini - Slates.

B. Metamorphics

Crystalline and
Sub-crystalline rocks

TABLE 2.3

CLASSIFICATION OF SIMLA ROCKS BY PILGRIM AND WEST (1928)

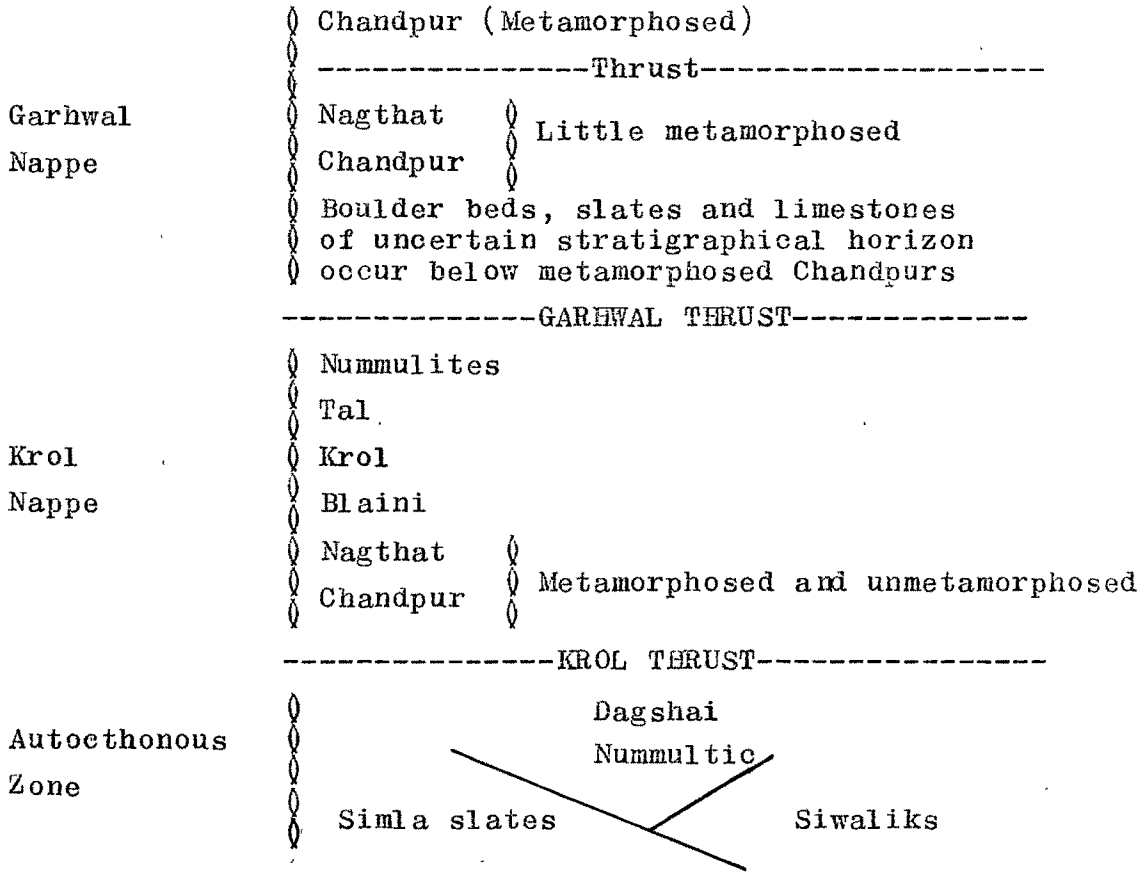
Dagshai Series	Lower Miocene
----------Unconformity----------	
Uppermost Subathu Beds	Upper Oligocene
----------Unconformity----------	
Subathu Series	Middle Eocene
----------Unconformity----------	
Krol Series Infra Krol Beds Blaini Beds	Lower Gondwana
----------Unconformity----------	
Shali Limestones & Slates Simla Series (Infra Blaini)	?
----------Unconformity----------	
Jaunsar Series	Purana
----------Unconformity----------	
Chail Series	Purana
Jutogh Series	Archeans (?)

TABLE 2.4

AUDEN'S SEQUENCE OF ROCKS IN GARHWAL (1937)

Formation	Thickness	Probable Age
Siwaliks	4864 m	Upper Miocene to Pleistocene
Nummulites	-	Eocene
Tal	1976 m	Upper Cretaceious
Krol	1216 m	Permian to Triassic
Blaini	608 m	Talchir (Uralian)
Nagthat	912 m	Devonian
Chandpurs	1216 m	Lower Palaeozoic or Pre-Cambrian

AUDEN'S STRUCTURAL SUCCESSION IN GARHWAL



bounded by thrusts on either side called by them the North Almora thrust and the South Almora thrust respectively.

Heim and Gansser were however, not clear about the exact location of the South Almora thrust. They have shown two thrusts dipping to NE between Bhowali and Ranikhet and they thought that the thrust near Ramgarh possibly joins up with the North Almora thrust. The other thrust further NE, running along Upradi, Peora and Mukteshwar has been called by them as the South Almora thrust. They have suggested (1939, p.28) that the region between Bhowali and the South Almora thrust forms a recumbent syncline.

After Heim and Gansser, the Kumaon Himalayas received little attention from geologists till Pande (1949, 1950, 1956, 1963) started his investigations, and who devoted a great deal of his time in unravelling the complexities of the structure and metamorphism. It is due to him that valuable data on Kumaon are available. He and his associates have worked in various areas of Kumaon and have published a number of papers. The author has included here only a few important works which have a direct bearing on the area of the present study.

Pande (1963), summarising the results of his investigations established four general metamorphic episodes in Kumaon, viz. load metamorphism, progressive regional metamorphism, dislocation and retrogressive metamorphism, and granitisation - in that order. Pande for the first time unequivocally suggested a migmatitic origin of the gneissic rocks of Kumaon. Later on, Sarkar et al. (1965), working in the Almora area, also suggested the granitic rocks of the area to be a product of granitisation. They investigated the structural geology of the Almora town and identified three S-planes and four types of linear structures related to them. Sarkar considered the age of regional metamorphism and granitisation in this part of the Himalayas as lower Oligocene. Powar (1965) and Das (1966), working under the guidance of Pande, worked out the details of the metamorphism and granitisation process at Almora and Chaukhutia respectively.

Important contributions to the Kumaon geology have come from Merh and his associates (Merh and Vashi, 1965, Desai and Merh, 1965, Merh,1968). These workers have studied the structural and metamorphic aspects of the Almora nappe rocks in a great detail. Merh and Vashi (1965) and Desai (1968) who investigated the Ranikhet and Majhkhali areas respectively, worked out, on the basis of minor structures, a complete sequence of structural events and correlated them

with the metamorphic history. These workers have ideally shown the different stages of migmatisation in Kumaon.

A short note recently published by Merh (1968) on the structural and metamorphic aspects of the Central Kumaon gives a clear picture of the geological evolution of the Kumaon region. Merh has come to the conclusion that some of the structural observations of Heim and Gansser are not valid and according tonhim, the thrust at Upradi is in fact, the southern limb of the Almora thrust, which joins up synformally with the North Almora thrust in the north. He has completely ruled out the possibility of the existence of a nappe at Ramgarh and has shown the regional structure between Bhowali and Mukteshwar as an uninverted succession. According to him, the Ramgarh thrust is younger to the Almora thrust, and possibly originated during the synformal folding of the latter.

In the same paper Merh has suggested that the Central Kumaon region has been affected by three deformational episodes. The earliest deformation appears to have folded the geosynclinal sediments into several large reclined isoclinal structures. The folding synchronised with the progressive phase of the regional metamorphism. Later, these overfolded rocks ruptured and this resulted in the

Almora thrust. The superimposed second folding gave rise to the major structures like the synform at Almora and the anticlines at Bhowali and Someshwar. The third major folding has been along a NNW-SSE to N-S axis.

Very recently, J.P. Patel (one of the research workers under Merh) has established that the Ramgarh thrust is not connected with the folding of the Almora thrust, but is a very late structure (Personal Communication).

PREVIOUS WORK AROUND SOMESHWAR

A number of geologists have visited the Someshwar area in the past, but none has studied its complex geology in detail. The first mention of this locality is due to Heim and Gansser (1939) who visited the area during their traverse from Almora northwards. The word 'anticline' was never emphatically used for the regional structure at Someshwar before Heim and Gansser who (1939, p. 43) wrote, "... obviously, the anticline, or false anticline of Someshwar with its dolomites and limestones corresponds to the crumpled sedimentary zone of Badolisera. - Kanarichhina-Batari....."

Elsewhere, (p. 30) they have described the Badolisera-Kanarichhina-Batari structures as an open fan fold with

limbs which do not correspond. The apparent dissimilarity of the limbs at Someshwar is obviously, the reason which prompted Heim and Gansser to describe it as a 'false' anticline.

The next work on Someshwar is a paper by Pande and Seth (1967) who gave a preliminary account of the geology of Someshwar and its vicinity.

An attempt to explain the structural complexity of the Someshwar anticline was made by Merh (Merh, 1968; Shah and Merh, 1968). He found the structure to be a sharp anticline and correlated it with the anticlines at Dudatoli-Chaukhutia region in the west, and the Pithoragarh region in the east. He further suggested that the anticlines at Someshwar and Bhowali together with the Almora nappe synform, are all genetically related to the second major episode of folding in the Kumaon. Merh postulated the existence of an ESE-WNW major reverse fault to explain the absence of the southern limb of the Someshwar anticline.