CHAPTER II

PREVIOUS WORK AND REGIONAL GEOLOGY

1. Introduction

The geologists from various organisations and institutions have mapped and investigated the selected parts of the Himalaya. Thus a large tract of this region still remains virgin and a comprehensive account of the geology of the whole region remains incomplete. The lithological units of the investigated parts of the Himalaya show diverse facies changes in sedimentation under the geosynclinal conditions. They also show heterogeneities affected during the rock deformation. Yet to a great extent, the geology of certain parts of the Himalaya can tentatively be compared and correlated with those of the similarly situated regions. In the present chapter, a brief account of previous geological investigations has been given.

Geographically, the whole of the Himalayan range can be divided (from west to east, after Ganesser, 1964) into Panjab Himalaya (560 kms.), Kumaon Himalaya (320 kms.), Nepal Himalaya (800 kms.) and Assam Himalaya (720 kms.) including the Sikkim, Bhutan and Nefa Himalaya. Longitudinally, the Himalaya can be divided into sub-Himalaya bordering the alluvial plains, lower Himalaya, higher Himalaya and Tibetan Himalaya (Fig. 4).

The Halog area lies in lower Himalaya of the Panjab region and therefore, a resume of the geological divisions of the Panjab Himalaya
FIG. 4 - LOCATION OF HALOG IN THE STRUCTURAL MAP OF THE HIMALAYA

AFTER GANSSE1964
2. Previous Work

Gerard (1832), Hutton (1841), Win May (1850) and Stratchy (1851) are some of the earliest workers referred in the Himalayan literature. However, the most authentic work of the late nineteenth century is that of Medlicott (1864-1876). He classified the rocks into the following units:

Sub-Himalayan Series -

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<td>Nahan</td>
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<td>Lower</td>
<td>Subathu</td>
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<td>Kasauli</td>
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<td>Dagshai</td>
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<td>Subathu</td>
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Himalayan Series -

1. Unmetamorphics -
   - Krol
   - Infra-Krol
   - Blaini
   - Infra-Blaini

2. Metamorphics -
   - Crystalline and sub-crystalline rocks.

McMohan (1877), Oldham (1883-1917) and Middlemiss (1885-1913) have extended the work of Medlicott (op. cit.). Oldham (op. cit) suggested a glacial origin for Blaini conglomerate and assigned them the Upper Palaeozoic age. Holland (1907) also confirmed the glacial
origin of the boulder beds but assigned them a Purana age (Algonkian). However, the recent workers are more inclined to accept the earlier view of Oldham (op. cit.).

Middlemiss (op. cit.), while describing the geology of British Garhwal (now Pauri Garhwal) classified the rocks as follows:

1) Inner formations consisting of schistose series with intrusive gneissose granite.

ii) Outer formations with volcanic breccias, purple shales, massive limestone, Tals and nummulitics.

Pilgrim and West (1929) gave a classic account on 'The structure and correlation of the Simla Rocks' which became a valuable guide for future investigations. The thrusting hypothesis was for the first time applied to the rocks of Simla-Hills. They established the following stratigraphic units in the Simla-Hills:

**TABLE NO. I. - CLASSIFICATION OF THE SIMLA ROCKS**

**Dagshai Series** -

Purple sandstones and clays (brackish water deposits) ? Unconformity.

Uppermost Subathu Beds -

Purple sandstones and grits Unconformity.

Subathu Series -

Shales, Limestones, carbonaceous beds Basal pisolitic laterite. Unconformity.

Lower Miocene.

Upper Oligocene.

Middle Eocene.

continued.....
continued........

Krol Series -

1. Massive blue limestone.
2. Redshale.
3. Limestone and shale.
   Unconformity.

Krol Sandstone -

Sandstone, readily decomposing into dusty sand.

Infra-Krol Beds -

Shaly slates, with beds and lenticles of hard brown quartzitic grit

Blaini Limestone -

Pale pink magnesian limestone (=Mandhalis of Jaunsar)

Blaini Conglomerate -

Boulder beds; slates with pebbles (glacial)
   Unconformity.

Shali Limestone and Slates - (Position uncertain).

Simla Series (Infra-Blaini) -

1. Dark unaltered slates, and micaceous sandstones

2. Limestone with pseudo-organic structure
   (Kakazhatti and Naldera Limestones).
   (=Deoban Limestone)
   Unconformity.

Jaunsar Series -

1. Pale, sub-schistose slates
2. Much crushed micaceous slates and phyllites.
3. Purple phyllites and conglomerate.
4. Purplish, green and grey quartzites,
   pebbly in their upper portion.
5. Slates with slaty cleavage and vein quartz.
   Unconformity.

Lower Gondwana

Dogra Slates (Lower Palaeozoic).

Purana.

continued........
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Chail Series -

1. Light grey and brown schistose slates and quartz-schists.
2. Slightly talcose flaggy quartzites and quartz-schists.
3. Tale-schist bed (30 to 40 feet thick).
4. Slightly puckered grey phyllites.
5. Grey slates with interbedded banded crushed limestones.

Unconformity.

Intrusion of Chor granite accompanied by intense folding and high grade metamorphism.

Olivine dolerites are intruded both into the granite as well as into the Jutogh series.

Jutogh Series (Order of superposition uncertain) -

1. Quartzites and schists
2. Crushed and banded dolomitic limestone, generally carbonaceous and often containing actinolite.
3. Carbonaceous slates and phyllites (often gnamatiferous). (Jakko slates).
4. Quartzites and mica-schists. (Bileau-gunge beds). (Hornblende schists and gneisses are frequently intruded).

Archaean (?).

The following are thrust sheets according to their tectonic succession in the Simla-Hills (Pilgrim and West, op. cit.):

Jutogh-thrust
Chail-thrust
Jaunsar-thrust
Giri-thrust (?Shali-thrust in the north)
Kml-thrust
Main Boundary Fault in the south.

Pilgrim and West (op. cit.) concluded the following sequence of events as regards to the geological history of the Simla-Hills:
Wadia (1929-67) dealt in great detail the geology and structure of the Himalaya in general, with particular reference to Nanga Parbat, Chilas and Gilgit area in Kashmir. He established a tentative geological history of the Himalaya and explained the syntaxial bend of Kashmir.

Auden (1934-37) studied the rocks of the Simla-Hills and Garhwal regions and extended the work of Pilgrim and West (op. cit.) to include the 'Krol Belt'. He assigned the age of Krol and Garhwal-thrusts 'not older than Miocene' and described Jaunsars to be younger than Simlas, contrary to what Pilgrim and West (op. cit.) suggested.

Heim and Gansser (1939) and Gansser (1964) have compiled the geology of the Central Himalaya in particular and the Himalaya in general. The observations are mainly based on the Swiss expedition (1936).

Peter Misch (1949) has contributed valuable informations
regarding the granite and gneisses of Nanga Parbat (north-west Himalaya) and he suggested a metasomatic origin for the gneisses and granites from the metasediments of salkhalae (homotexial of Jotoghs, Wadia, op. cit.) during the Himalayan orogeny.

Pande (1950-68) discussed the geology of Kumaon Himalaya and he has described the Chandpurs as thrust over the Nagthats in Rangarh area. Pande (op. cit.) assigned the age of the migmatites of Kumaon to be Tertiary. Das and Pande (1964-65) have demonstrated the successive phases of metamorphic evolution which they classified into three episodes. Pande (1967) discussed the paleogeographical evolution of the Himalaya and Pande and Saxena (1968) have postulated the underthrusting of the Peninsular mass beneath the Himalayan rocks which caused the rise of the Himalaya.

Kanwar (1965) has discussed the regional metamorphism of the Jutogh formations and described the Chor granites as granitised products of the Jutogh metasediments. Gupta (1967) has worked out the geology of Dhauladhar range near Dharmsala and he concluded that the Dhauladhar granites are the result of migmatisation of the Chandpaur rocks.

Ehargava and Srikantia (1967) have reported from the area in the south-east of Gambhar that the Krol- and Giri-thrusts are in fact the two limbs of the folded Krol-thrust. Similarly the Blaini outcrops have been observed to be the most controversial lithological puzzle in the Simla-Hills (Pande and Kedar Narain, 1967).

So far, little attention has been paid to the deformation
history of the rocks of the Himalaya. Recent work in the Himalaya is aligned on these aspects and yet, any authoritative work has not been published. The mesoscopic structures from different regions have been discussed to relate them with the major orogenic phases (Pande and Das, 1965; Sarkar et al. 1965; Mishra, R.C. and Kumar, S., 1965; Saxena, 1966; Pande and Kumar, R., 1967 etc.)

3. Regional Geology

The Panjab Himalaya is formed of crystalline rocks, fossiliferous and unfossiliferous sediments and metasediments. These rocks show a complex and intricate system of folding and dislocation due to which the geology of the Himalaya has become difficult to decipher. The broad tectonic divisions of the Panjab Himalaya, which is very similar to those of the Himalayan range as a whole, are given below:

1) Autochthonous - The southern foothills of the Himalayas, Siwaliks and Lower Tertiary rocks of the lesser Himalaya in the south of Krol belt, form the autochthonous unit of the Panjab Himalaya. The base of this unit is probably Simla Series which is overlain by Subathus, Dagshais, Kasaulis and Siwaliks with an unconformity. The most important thrust of this unit is the Main Boundary Fault (high angle reverse fault) which separates the Siwaliks from the Lower Tertiary rocks.

2) Krol Nappe - The unfossiliferous Mesozoic rocks (Infra-Krols and Krols) are thrust over the Tertiary rocks in the south (Krol-thrust, Auden, 1934). This nappe forms a belt in a NW-SE direction.

3) Chail and Jutogh Nappes - The pre-Cambrian and older
formations are thrust over the Simla Series which is overlain in this region by Jaunsars, Blainis and Subathus. These nappe sheets also form a belt in NW-SE direction (Pilgrim and West, op. cit.).

iv) The main Himalayan Range and Granite Zone - The snowy ranges of the Himalaya are partly made of elements common to the Chail and Jutog nappe sheets and partly of distinct group of paragneisses. The gneisses and granites lie interbedded with the schists forming more or less regional belt throughout the Himalaya (Gansser, 1964).

v) Tibetan Zone - This zone shows a great contrast to the above described zones in lithology, stratigraphy and tectonics. The zone is composed of fossiliferous marine sediments ranging from Paleozoic to Eocene. The zone is, at times, characterised by ophiolites. The structure is comparatively simpler characterised by broad synforms and antiforms (Pascoe, 1965).

The most probable sequence of events in the geological history of the Himalaya has been summarised as below:

During the Dravadian era (Cambrian to Middle Carboniferous) there existed a northern or Redlichian sea which separated the land mass into northern and southern continents. As a result of the Caledonian orogeny this sea receded towards the north of the present main crystalline axis of the Himalaya where the fossiliferous beds from Cambrian to Ordovician were being deposited (Pascoe, op. cit.).

During the Hercynian orogeny (Upper Carboniferous) as a result of the uplift of the Chinese main-land, the sea receded towards the south. The sea became a narrow belt of regional extent which has
been referred as Tethyan geosyncline (Pande, 1967).

During this period, the emplacement of granitic batholith took place which resulted in the formation of a median ridge below the main crystalline axis (Pande, op. cit.). This median ridge divided the Tethys into northern geosyncline and southern geosyncline. The former was favourable to the sea life while the southern geosyncline is mostly devoid of fossil (Swaminath, 1961).

The close of Mesozoic era witnessed a major orogenic movement which extended into Tertiary period and finally resulted into the upheaval of the Himalaya. The Indian shield, which was being covered with lava flows, suffered a tension in a north-south direction and its northern part subsided to underthrust as wedge into the southern geosyncline (Pande, op. cit.).

De Terra (1936) postulated three phases of the Himalayan orogeny. The first phase probably resulted in narrowing of the Tethyan floor by warping movements during the Upper Cretaceous. This was followed by one of the most important upheaval in the post-Nummulitic time (Krishnan, 1961).

The second important tectonic movement took place during Middle Miocene. This phase of orogeny was rather strong resulting in thrusting of rocks (Auden, 1937). This phase also resulted in the formation of a series of interconnected basins fringing the southern part of the rising Himalaya which subsequently became the site for deposition of the Siwaliks.
GEOLOGICAL MAP OF THE PART OF SIMLA-HILLS FIG. 5

LEGEND

/ SHALE, LIMESTONE, LATERITIC BAUXITE ETC.
| CONGLOMERATE, SLATES LST. ETC.

NALDERA LIMESTONE.
SIMLA SLATES.

SCHISTOSE SLATES, FLAGGY QZITES.
CARBONACEOUS SCHIST,
CRYSTALLINE LIMESTONE ETC.
QUARTZITES & SCHISTS.

SCALE 1" = 2 MILES

AFTER PILGRIM & WEST 1928
During the Upper Pliocene times, the Himalaya was further uplifted with the Siwalik formations. This orogeny, though mild in nature, persisted for a long interval and it is believed that it came to an end at the Middle Pleistocene period. It is no wonder that this movement, though dormant in nature, is still continuing.

Regional mapping of the Simla-Hills has been done by Pilgrim and West (op. cit.) which was further modified by Auden (1934). A part of this geological map has been reproduced in Fig. 5 which also includes the Halog area (bounded by thick lines). This geological map incorporates the Krol-, the Chail- and the Jutogh-nappe sheets.

The exposure of the Chail- and the Jutogh-thrusts in Simla-Hills are traced towards Halog (Fig. 5) where they are observed to form a south-easterly plunging synform. The Chail-thrust is underlain by Simla Series, Blainis and Subathus. Thus the Halog area, wherein two tectonic units, viz. Para-autochthon (Simlas, Blainis and Subathus) and Allochthon (Chails and Jutoghs), are exposed, provide a unique opportunity for their critical study. It is also envisaged that the Halog area should represent the deep seated tectonic features of this plunging synform. Detailed observations to this effect, however, have been described in subsequent chapters.