CHAPTER III

PREVIOUS WORK

With the establishment of the Geological Survey of India in the year 1851, geological work in this country had its humble start. Till the beginning of World War II, attention was largely concentrated on the regional stratigraphical aspects. It was only during the last two and a half decades that stratigraphy, minor structures and their bearing on the major structure, palaeogeography and palaeoecology have been worked out in greater details with reference to specific areas and formations. The Himalayan Geology, especially the Tertiary Geology owes its rapid development partly to the oil exploration programmes and partly to the modern techniques which have made the areas accessible during all weather conditions and the work much easier and more systematic.

Although the works of Major Vicary (1853) and d'Archiac and Haime (1853-54) remain the first to be quoted yet it is Medlicott (1864) to whom the credit goes for describing this area in a systematic and scientific manner. His monumental work, though a century old, still remains classic in the Indian Geology.
He postulated a three-fold classification for the Tertiary formations exposed between the rivers Ganges and Ravee. The stratigraphic succession as given by him is as follows:

**Sub-Himalayan Series:**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Formation</th>
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<tbody>
<tr>
<td>Upper</td>
<td>Sivalik Conglomerate, sandstone and clays.</td>
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<tr>
<td>Middle</td>
<td>Nahun Lignite, sandstone and clays.</td>
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<tr>
<td>Lower*</td>
<td>Subathu Kasaoli - grey and purple sandstones.</td>
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<td>Subathu - fine silty clays with limestone (Nummulites).</td>
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Dugshai - purple sandstone and red clays.

He was of the view that the Tertiary strata had originated from a common set of conditions. However, Nummulitic beds (Subathus) deviated locally from this rule. Deposition of the sediments took place in moderately deep to shallow water conditions. Sediments constituting the Subathus or the Nummulitic strata were deposited "upon a bottom of Infra-Krol rocks" and this marked the original limit of deposition. He observed the presence of semi-porcelain type of well indurated clay bed with large grains of pisolitic iron oxide at the base of the Subathus.

* Medlicott, later on, designated it as 'Sirmur Series'. 
According to him, sub-tropical climate prevailed during the time of deposition of the Kasaulis and cited the occurrence of leaf impressions in support of his contention. "The relative disposition of sea and land in the Subathu period was essentially the same as now or at least that the lower zone of the Himalayas was then, as now, open to the sea on the south". He further adds, "The Himalayan mountain area was defined before the deposition of the Subathu - Nummulitic rocks. Throughout all the succeeding sub-Himalayan period the same limit of deposition has maintained".

About the contact between the Nummulitic and the younger strata Medlicott (1868) recorded that the Subathus were "overlain transitionally by the sandstone of the regular molasse type, only thoroughly indurated like the flysch sandstone of Appenzell".

Fiestmantel (1882) sketched and described Sabal major from the Kasauli beds of the type area (Kasauli).

McMahon (1883) from the microscopic characters of the Kasauli and the Dagshai sandstones (Sirmur Series) concluded that the sediments were derived from "the sub-aerial waste of the Carbo-Triassic limestone, infra-Carboniferous slates, granitic rocks and probably to a small extent of traps". From the study of quartz
grains and other constituents such as schorl in the sandstones of the Sirmur Series, he believed that the sediments must have been derived from the Himalayan granites.

Oldham (1893) in his monumental work 'Manual of Geology of India' mentioned that the three units, i.e., Subathus, Dagshais and Kasaulis were perfectly conformable and the contact between Dagshais and Kasaulis was rather a gradational one. About the basin of deposition, he recorded that the Nummulitic Group was most probably marine whereas the Dagshai sediments were deposited in lagoons and saltwater lakes. A fresh water condition was suggested for the Kasaulis on the basis of the occurrence of fossil leaf impressions.

He expressed the views that the Dagshais and the Kasaulis could safely be correlated with the Murrees of the type area (Murree Hills, West Pakistan). Dealing with the age of these rocks, he put forward the view that the Subathus were of Nummulitic age whereas the Dagshai and the Kasauli Groups covered the Oligocene and Lower Miocene periods of European Geology.

Hayden (1933) assigned the Lutetian age to the Subathus. The Dagshais and the Kasaulis were put together as representatives of the Burdigalian and Helvetian age.
The collective term Sirmur Series was, however, retained by him. The Main Boundary Fault separating the Siwaliks from the Older Tertiaries was thought to be the original limit of deposition. Dealing with the depositional environments, he agreed with the views put forward by Oldham (op. cit.) that the Subathus were laid under the marine conditions, the Dagshais in lagoons and saltwater lakes, whereas the Kasaulis represented the freshwater deposits.

Auden (1934) held that the contact between the Tertiary and Pre-Tertiary rocks represented a major dislocation. The tectonic contact was referred to as the 'Krol Thrust'. He put on record the occurrence of glauconite from the Subathus. According to him, tourmaline, garnet, plagioclase, kyanite, zircon and derived glauconite were the minerals in the Dagshai Series. Garnet was reported to be in abundance in the Kasaulis.

Vokes (1937) described some pelycepods and gastropods from the Arki area. According to him the palaeontological studies did not disfavour the Lutetian age for the Subathus.

Singh (1952) on the basis of the occurrence of Nummulites atacicus, Assilina granulosa, etc., suggested the Middle Laki age for the Subathus.
Sahni (1953) described and figured some monocot. and dicot. leaf impressions from the Kasauli beds of the type area (Kasauli). Due to poor preservation the plant fossils did not afford any definite evidence as to the age of the Kasauli Series but from the geological setting Sahni concluded that the age of the Kasauli flora could be safely accepted as Lower Miocene.

Mandwal (1959) recorded twentyone species and varieties of smaller foraminifera from the Assilina granulosa bed of the Subathus exposed near Dharampur. From the palaeontological studies, he concluded "the Lower Bhadrar shales of the Panjab Salt Range, W. Pakistan, are the exact equivalents of the Dharampur shales".

Ganju and Srivastva (1961) suggested a multicyclc origin for the sediments constituting the Dagshai sandstones. According to them zircon, tourmaline, mica, chlorite, garnet and magnetite are the chief heavy minerals of the Dagshais.

Kharkwal (1964) described the shelly limestone from the Subathu Series of the type area (Subathu) and extended the term 'coquinite' to the shell limestone of the Subathus.

Raiverman (1964) studied the clay minerals and trace element components of clays and shales of the Subathu-Dharamshala Group. He suggested that the sediments
constituting these formations were deposited in marine conditions. For him, trace elements indicated the salinity of the environment from normal marine to brackish water.

Bhatia (1965) described the biostratigraphic succession of the Subathus in the type area (Subathu). He was of the opinion that the Simla Slates in the vicinity of Subathu might be Infra-Kroks.

Bhatia and Mathur (1965) recorded the occurrence of pulmonate gastropods (*Bullinus*, *Planorbis*) from the Tertiary rocks exposed near Dharampur. They preferred to call this horizon as the 'passage beds' between the Subathus and the Dagshais and expressed the opinion that the contact between the two series "is almost always a conformable one except, of course, in cases where the two are separated by a fault". They also suggested a gradual change from typical marine through brackish water to fresh water conditions from the time of deposition of the Subathus to the passage beds. A Laki age was assigned to the Subathus by them.

Datta *et. al.* (1965) studied the microfauna of the Subathu Series of the Simla Hills. They put forward a new biostratigraphy for the Subathus exposed in this area.
Raiverman and Seshvataram (1965) from the study of the sediments of Subathu-Dharamshala Group inferred that the Dharamshala sediments and the red facies of the Subathus were deposited by turbidity currents. The green facies of the Subathus resulted from deposition of sediments brought in pelagic suspension and its limestone from accumulation of organic debris. The rate of sinking of the basin was in harmony with that of deposition and the depth of deposition was epi-neritic. They opined that the whole of the Lower Tertiary strata formed a single conformation unit.

Bhandari and Aggarwal (1966) recorded the conformable nature of the contact between the Subathus and Murrees/Dharamshala/Dagshais. They have assigned an Upper Palaeocene - Upper Eocene age to the Subathus which are quoted to be equivalent of Upper Ranikot-Kirthar. About the depositional environments the authors remarked, "The sediments were deposited in a shallow elongated sea with a series of parallel to sub-parallel ridges and furrows". According to them the presence of red beds was indicative of oxidising conditions prevalent during the sedimentation of the Subathus. The green beds, however, were deposited in relatively deeper waters and indicated slightly euxenic conditions.
Chaudhri (1966) established a new order of superposition for the Lower Tertiary formations of the Simla Hills. According to his classification the Oldest Tertiary deposits are of Upper-Palaeocene age and have an unconformable contact with the Pre-Tertiaries. He further recorded "The Lower Tertiary sequence in the Simla Himalayas is complete and is represented by the Subathu, Dagshai and Kasauli formations which are of the Upper-Palaeocene -Eocene, Oligocene and Lower Miocene age, respectively". Moreover, "The contacts between the above three units are conformable and gradational".

Khan (1966) is of the view that the contact between the Subathus and the Dagshais "shows stratigraphical, faunal and tectonic break". To prove his contention, he cited such evidence as the occurrence of fragments of the Subathus in the Dagshais, absence of transitional beds (passage beds) from some places, the Lower Miocene age of the Dagshais which is supposed to be the equivalent of Fatehjang beds, faulted contacts between the Subathus and the Dagshais in Potwar region and east of Koshalia and highly disturbed nature of the Subathus in contrast to the overlying Dagshais. He remarked, "The Himalaya was slightly uplifted in the Middle Miocene and the maximum height was attained in the Middle Pleistocene upheaval".
Kharkwal (1966) reported the occurrence of glauconite (earlier recorded by Auden, 1934) from the Subathu Series. According to him, the mineral occurs in two forms, as filling in the foraminiferal chambers and as irregular grains in the matrix. The author proposed an early diagenetic autochthonous replacement origin for the mineral.

Sen (1966) recorded that the Subathu and the Dagshai sediments were laid in shallow marine and lagoonal environments. He referred to the occurrence of sub-greywackes and greywackes in the upper part of the Dagshais and concluded that these rocks represented coastal plain sediments. He remarked, "The Subathus and Dagshais together represent a complete range of sedimentation from shallow marine to epicontinental type".

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