CHAPTER II

PREVIOUS WORK

Kashmir, Kishtwar and Ladakh provide well developed sequences of Palaeozoic rocks from where the fossils belonging to different groups, which is the subject matter of the thesis, were collected. These regions encompass one of the best fossiliferous sequences and offer immense opportunity for palaeontological and biostratigraphical investigations.

The earliest reference to the geology of the Kashmir Valley is by Hugh Falconer (1837-1838) who reported the occurrence of the Carboniferous limestone. Vigne (1842) made the first correct determination of the rocks around Srinagar which consisted of "amygdaloidal traps". Thomson (1852) on the basis of his observations, made some suggestions on the origin of the "Panjal Traps" exposed in different parts of Kashmir.

Godwin Austen (1861&66) worked on the geology of Kashmir and classified the rocks exposed in different parts of the Kashmir valley on the basis of brachiopod fauna collected by him from different stratigraphic horizons.
The first reference to the geology of Ladakh is made by Stoliczka (1866b) who worked in the region around Tso-Morari in Rupshu region. He described gneisses from this area and considered these gneisses to be the representative of "Central Gneisses".

Verchere (1866) assigned Carboniferous age to the lower part of the limestone which lies above amygdaloidal and slaty rocks. Stoliczka (1866a) considered the trap rocks underlying the Carboniferous succession of the Kashmir valley to be probably altered Silurians.

Bellow (1875) took some traverses along the route from Kashmir to Yarkand and published his observations on the geology of Kashmir and Ladakh.

Lydekker (1883) carried out the first systematic investigations on the geology of Kashmir and neighbouring Chamba and Khagan regions. He proposed the following classification for the rocks exposed in these regions.

<table>
<thead>
<tr>
<th>Alluvial System</th>
<th>Tertiary System</th>
<th>Zanskar System</th>
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<tbody>
<tr>
<td>Siwalik Series</td>
<td>Sirmur Series</td>
<td>Chikkim Series (Cretaceous)</td>
</tr>
<tr>
<td>Upper Kuling Series (Jurassic and Triassic)</td>
<td>Kuling Series (Carboniferous)</td>
<td></td>
</tr>
</tbody>
</table>
Lydekker (1883) believed that the rocks belonging to his Panjal and Zanskar Systems are repeated many times in the section from Eishmakum to Pahalgam of Anantnag District due to synclinal folding. He also declared the whole Panjal System to be totally devoid of organic remains with the possible exception of some obscure impressions from one locality which might be grapolites (P.212).

Hayden (1904) recorded the occurrence of Lower and Middle Carboniferous rocks exposed between Budhil Pass in Ladakh District and Banihal Pass in Kashmir valley and described fossils (Fenestella, Productus, Spirifer and Pecten) from the beds overlaying the Syringothyris Limestone.

Oldham (1904) published a detailed account of the "Zewan Beds" in Anantnag District of Kashmir. It was followed by a paper by Hayden (1907) on "Stratigraphic position of Gangamopteris Beds of Kashmir". He found the
plant bearing beds interbedded with the Zewan Beds which belong to the same series. He assigned Permian age to the Zewan and Gangamopteris Beds.

Middlemiss (1910) studied the rocks exposed in Anantnag District of the southeastern part of Kashmir valley and classified these into different stratigraphic units. He wrote a detailed paper entitled "The Silurian-Trias sequence of Kashmir". He recorded the occurrence of Gangamopteris Beds lying above the Panjal Traps and collected Upper Silurian fossils from four main localities of Kashmir. These fossil collections were submitted to Cowper Reed for identification and their detailed description was published in his paper (1912) on "Silurian fossils from Kashmir". The fossil collection made by Middlemiss from Carboniferous rocks was described by Diener (1915) in his memoir entitled "The Anthracolithic Fauna of Kashmir and Spiti".

The classification of Silurian-Trias sequence of southeastern Kashmir based on fossil evidence as worked out by Middlemiss (1910) is as follows:

<table>
<thead>
<tr>
<th>Division</th>
<th>11. Upper Triassic</th>
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<tbody>
<tr>
<td>B</td>
<td>10. Muschelkalk</td>
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<tr>
<td></td>
<td>9. Lower Triassic</td>
</tr>
</tbody>
</table>
8. Zewan
7. Gangamopteris Beds (Lower Gondwana)
   Panjal Volcanic Flow
   Agglomeratic Slate
Division (Below the Panjal Volcanics)
A 6. Fenestella Series (? Middle Carboniferous)
5. Passage Beds
4. Syringothyris Limestone Series (Lower Carboniferous)
3. Muth Quartzite
2. Upper Silurian
1. Lower Silurian and Cambrian (?)

Diener (1915) made some observations on the fossils from the Fenestella Shales to be definitely older than Permian in age. However, he could not assign any precise age to this horizon. In addition, Diener (1915) studied the fauna from the Zewan Beds of Kashmir. On the basis of fossils collected from these beds, he concluded that the various fossiliferous zones are closely related to one another and as such he concluded that these may belong to one stratigraphic unit.

& Middlemiss Bion/(1928) described in detail the geology of the beds yielding fossils from the Agglomeratic Slate Succession.
Important contributions on the geology of Kashmir region were made by Wadia (1920-1937) through his various publications. The publications are as follows:

i) The Geology of Poonch (1920)

ii) The Syntaxis of N-W Himalayas (1931-1932)

iii) The notes on the Geology of Nanga-Parbat and adjoining portion of chillas in Gilgit District, Kashmir (1932-1933).

iv) The Cambrian-Triassic sequence of North Western Kashmir (1933-1935) and on


The theory of the Hazara-Kashmir syntaxis put forward by him has become a landmark in the elucidation of geological structure of Kashmir Himalaya.

Das Gupta (1929) in his presidential address at the Indian Science Congress reviewed "A record of fifty years progress in Indian Pre-Mesozoic stratigraphy." He also made some remarks on the Palaeozoic fossils of the Kashmir Himalayas.

Hazara and Parsad (1962) carried out the geological investigations around Banihal and Doda Districts and classified the rocks as follows:
Sahni and Gupta (1964 a,b) recorded the occurrence of graptolites from the Naubug Beds and fossils from the Muth Quartzite. The Muth Quartzite had been considered to be unfossiliferous for more than a century since its first description by Stoliczka (1866a). Subsequently Gupta (1970, 1973b) described rich fauna from the Muth Quartzite succession exposed in parts of Kashmir and Ladakh in a series of research papers.

Gupta (1967) reported few new species of trilobites from Naubug Beds and recorded rich fauna from
different stratigraphic horizons of the Palaeozoic rocks exposed in different parts of Anantnag District, Kashmir and Luneak valley of Ladakh. All these contributions are synthesized by Gupta (1973a) in his book entitled "Indian Palaeozoic Stratigraphy".

Gupta et al. (1970) mapped along the Manali-Leh road and collected fossils from different stratigraphic horizons of Ladakh. The fossils recorded from this region are poorly preserved as compared to rich fossiliferous sequence in Kashmir.

Gupta and Webster (1979) described two complete specimens of crinoid Proampelocrinus himalayensis from the Lower Carboniferous of Surichun-La, Ladakh. This limestone succession has also yielded well preserved conodonts, ostracods, bryozoans, fish scales and brachiopods.

Gupta and Kumar (1975) have discussed in detail the geology of Ladakh, Lahaul and Spiti regions of Himalayas. Das (1976) published the results of his observations in part of the Luneak valley and reported the occurrence of trilobites (Ptychoparia, Asaphus sp.) and a few primitive brachiopods from the Kurgiakh nala and assigned them Cambrian age. Srikantia et al. (1978) have used the term "Phe Volcanics" for the volcanic succession in the Zanskar
basin of Ladakh and correlated these volcanics with the Panjal Volcanic succession of Kashmir. This succession was subsequently classified as part of "Ralakung Volcanic Succession".

Nanda and Singh (1976) have recorded a complete sequence of Precambrian to Tertiary rocks in the Zanskar area and adjoining parts of the Ladakh region. Waterhouse and Gupta (1977a) carried out the detailed study of fossils from the Fenestella Shales exposed in different parts of Kashmir and their equivalents in other parts of Himalayas. The brachiopod fauna was described in detail on the basis of modern classification and nomenclature.

Gupta (1978) described the Palaeozoic stratigraphy of the Luneak valley and recorded a new species of Retichonetes from the Lower Carboniferous Limestone of this area. Gupta and Waterhouse (1978) revised the stratigraphic position of the Malung Shales and assigned Early Permian age on the basis of new fossil finds.

Waterhouse and Gupta (1979, 1983a,b) described Permian fossils from the Marbal Pass of Kashmir and Shyok area of Karakorum, Ladakh. Thakur and Gupta (1982) have discussed in detail the geology of the Zanskar region of Ladakh.
Waterhouse and Gupta (1977, 1986) have proposed biostratigraphic classification of the Permian rocks exposed in different parts of Himalayas on the basis of brachiopods and bivalves.

Waterhouse (1985) has described two new brachiopod genera *Sandrella* and *Himathyris* from the Permian *Lamimargus himalayensis* Zone of Zanskar region, Ladakh.

In addition to the above, several papers on different aspects of the geology of the region forming the subject matter of the present thesis have been published from time to time. However, only important papers connected directly with the present investigation have been listed. Some of the additional contributions on different parts of Himalaya shall be referred to at the appropriate places in the text of the present thesis.