A NOTE ON THE FAUNA OF ARTINSKIAN (LOWER PERMIAN) AFFINITY FROM GARHWAL SYNFORM, LESSER HIMALAYA

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ABSTRACT

A sample collection from the Boulder Slate Member, that forms lower part of the Bijni Unit in the Garhwal tectonic set-up, has revealed presence of Neospirifer fasciger (Keyserling), Linopodoceras cf. cora (d'Orbigny), Waagenoceras cf. gangetic (Diener), Cleithrydidina semioncava (Wagen) and some fenestellid bryozoa, indicative of a Lower Permian age. The paper describes and illustrates the fauna.

INTRODUCTION

Although the geology of the well described segment of the Lesser Himalayan terrain of Garhwal is well known through the publications of Medlicott (1864), Middlemis (1885 and 1887), Auden (1934 and 1937), Shanker and Ganesan (1973) and more recently, Dhoundiyal and Kumar (1976; in Kumar and Dhoundiyal, 1980), the interplay of field geology and paleontology has played a restricted role in the build-up of the local stratigraphy for the unfossiliferous nature of thick rock sequences. Only very few fossiliferous horizons are known from there and none them relates to the Permian period. The present paper describes some additional fossil elements from the Permian horizon and argues its biostratigraphy.

GEOLOGICAL SET-UP

In recent years the Garhwal Synform has been remapped in detail by Shanker, Dhoundiyal and Ganesan (in Ganesan, 1972), Shanker and Ganessan (1973) and more recently by Dhoundiyal and Kumar (1976; in Kumar and Dhoundiyal, 1980). As a sequel, two contrasting views have emerged. Shanker and Ganesan have suggested a four tier tectonic set-up, separated by thrusts (Table 1), which is a partially modified form of Auden's (1937) pioneering scheme.

Kumar and Dhoundiyal (1980), on the other hand, have concluded that the entire sequence, consisting of several formations ranging in age from Precambrian to Recent, if have unconformable junctions, are not thrust bound, as understood so far (see also Kumar, 1979).

In the scheme of the latter workers, the Upper Palaeozoic fossil yielding Boulder Slate sequence of the Lower Bijni Unit of Shanker and Ganessan (1973) has been proposed to be placed within the sequence of Blaini Formation—a possibility that was alluded to in the key paper of Auden (1937, p. 424).

Earlier Valdiya (1975) had shown the Boulder Slate sequence to be the lowest member (his Jogir Member of the Permian age) of Tal Formation, the latter manifesting, according to his proposal, the entire Permian. This hypothesis, which transgressed quite a bit from the accepted Mesozoic (Late ?) age for the Tal sequence, has not been accepted in later publications (Bhargava, 1979; Singh 1979a, 1979b; Bhatia, 1980; Singh 1980), most of whom relegated the Boulder Slate sequence as well as Table 1. Lithotectonic sequence of Garhwal Nappe (after Shanker and Ganesan, 1973).

<table>
<thead>
<tr>
<th>Lithology</th>
<th>Tectonic units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schistose phyllite with Lenses of Granite</td>
<td>Amri unit</td>
</tr>
<tr>
<td>Purple, green, white quartzite with subordinate green, gritty slate</td>
<td>Upper Bijni Unit</td>
</tr>
<tr>
<td>Sandy limestone</td>
<td>Lower Bijni unit</td>
</tr>
<tr>
<td>Grity quartzite</td>
<td>Boulder slate</td>
</tr>
<tr>
<td>Quartzite and phyllite</td>
<td>Garhwal Thrust</td>
</tr>
</tbody>
</table>

This paper was presented at the Seminar on Himalayan Geology and Palaeontology at Chandigarh in February, 1979,
the Tal Formation to their original positions in the accepted stratigraphic ladder, except for Singh (1979a, b) who regards the Boulder Slate sequence the remnant of a Carboniferous-Permian marine incursion in the area, independent of any stratigraphic implications, outlying over the Precambrian succession of the Krol Belt (including Tal Formation) in general, somewhat analogous to the Narmada valley sequence of the Peninsular India.

However, the fauna of the Boulder Slate sequence has been shown to be of only Lower Permian in the present paper as it does not reveal characteristic Carboniferous elements.

The Permian fossiliferous horizon in the Lesser Himalayan Carhwal has been variously referred to as "Volcanic Breccia", (Middlemiss, 1887), Sila Mudstone (Chaturvedi and Talent, 1971), Boulder Slate Sequence of the 'Lower Bhimi' unit (Shanker and Ganesan, 1973), Jogira Member (Valdiya, 1975) in the published literature. The present paper uses the terminology of Shanker and Ganesan (1973) for its more frequent current use.

**SYSTEMATIC PALAEONTOLOGY**

The fossil collection described here was collected from a greenish-grey shaly horizon of the Boulder slate sequence exposed about 0.80 km NW of Ghikdiyal village (29° 47' 00" : 78° 40' 15"), near a spring on Malethan-Konakhali foot track; this indicates the same sample location as one of the localities of Shanker et al., (1973). The fossils were collected in field by one of us (MPS) in collaboration with Ravi Shanker in 1973.

All the figured specimens are housed in the Museum, Geology Department, Lucknow University, Lucknow, under Catalogue Nos. GLUMF 1320 to 1327. Additional material exists in the personal collection of Dr. M. P. Singh.

**SYSTEMATIC DESCRIPTION**

<table>
<thead>
<tr>
<th>Phylum</th>
<th>Brachiopoda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>Articulata Huxley, 1869</td>
</tr>
<tr>
<td>Order</td>
<td>Spiriferida Waagen, 1883</td>
</tr>
<tr>
<td>Sub-order</td>
<td>Spiriferida Waagen, 1883</td>
</tr>
<tr>
<td>Superfamily</td>
<td>Spiriferacea King, 1846</td>
</tr>
<tr>
<td>Family</td>
<td>Spiriferidae King, 1846</td>
</tr>
<tr>
<td>Genus</td>
<td>Nespirifer fusciger (Kjeserling, 1846)</td>
</tr>
</tbody>
</table>

(Plate I-1)

1846 Sp. fusciger: Kjeserling, Reise in des Petschowland Taf. VIII, fig. 3.

**Material**: One nearly-complete, well preserved and the other well preserved but partial brachial valve and one or two fragmentary pieces.

**Remarks**: The two brachial valves in the collection resemble closely the figured specimens of Bion and Middlemiss (1928, pl. I, Fig. 5), with characteristic angular fasciculi. The ribs in the fasciculus, however, are only faintly observable because of the partially eroded surface wall of the shells. But the shell outline with the characteristic shape of the fasciculi undoubtedly place the forms under the species. Lack of any trace of concentric ornamentation differentiates the present forms from Brachythyrinella cf. warsaphenis (Reed, 1928).

**Dimensions in mm**:

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Valve</th>
<th>Length</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. GLUMF 1320</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>27.6</td>
<td>55.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Order</th>
<th>Productida Sarycheva, Likharev and Sokolayska, 1960</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-order</td>
<td>Productidina Waagen, 1885</td>
</tr>
<tr>
<td>Superfamily</td>
<td>Productacea Gray, 1840</td>
</tr>
<tr>
<td>Family</td>
<td>Linoprotistidae Stuhl, 1954</td>
</tr>
<tr>
<td>Subfamily</td>
<td>Linoprotistinae Stuhl, 1954</td>
</tr>
</tbody>
</table>

**Linoprotistus cf. corea** (d'Orbigny, 1842) (Pl. I-2)


**Material**: Two relatively well preserved pedicle valves and six additional fragmentary specimens.

**Remarks**: The specimens closely resemble the figured specimens of Diener (1911, Pl. III, Figs. 3-13) from Shan State of Burma. All the specimens are small in size and exhibit characteristic costellate ornamentation of the shell wall, interrupted with few transverse lamellae which become prominent on the sides of shell. The shells in the collection are generally slightly deformed by compression.

**Dimensions in mm**:

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Valve</th>
<th>Length</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. GLUMF 1321</td>
<td></td>
<td>17.2</td>
<td>20.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Family</th>
<th>Echinoconchidae Stuhl, 1954</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subfamily</td>
<td>Waagenoconchae Muir-Wood and Cooper, 1960</td>
</tr>
</tbody>
</table>

**Waagenoconcha cf. gangetica** (Diener, 1897) (Pl. I—3)

1897. Productus gangeticus Diener, Pol. Ind., Ser. 15, Vol. I, pt. 4 Pl. I, Figs. 1-4, 2 and 3, Pl. II, Fig. 3.

**Material**: One relatively well preserved specimen and three additional fragmentary specimens.

**Remarks**: The characteristic transversely oval shape of the pedicle valve with straight hinge line is clearly discernible. The shell-wall ornamentation is finely postulate.

**Dimensions in mm**:

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Valve</th>
<th>Length</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. GLUMF 1322</td>
<td></td>
<td>25</td>
<td>27.5</td>
</tr>
</tbody>
</table>
Order: Spiriferida Waagen, 1883
Suborder: Retziidina Boucot Johnson and Staton, 1964
Superfamily: Athyrisinaceae Grubau, 1931
Family: Athyrididae M'Coy, 1844
Subfamily: Athyrididae M'Coy, 1844

Cleiothyridina semiconcava (Waagen, 1883)


**Material:** One relatively better preserved pedicle valve and five additional specimens. Several fragmentary specimens.

**Remarks:** The general outline of the shell as more or less transversely oval with nearly flat brachial valve is characteristic of this species. The transverse growth lamellae are, however, only faintly visible because of the generally imperfect preservation.

**Dimensions in mm:**

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Valve Length</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. GLUM 1323</td>
<td>17.2</td>
<td>23.4</td>
</tr>
</tbody>
</table>

*Bryozoa*

**Family:** Fenestellidae King, 1950

**Fenestella sp.**

(Pl. I—5)

**Material:** All the samples are usually crowded with this genus.

**Remarks:** The zoarium is funnel or fan-shaped. The characters of zoecia and fenestrae nearly resemble the figured specimens of Ganesan (1972, Fig. 2).

*Polyvora* cf. *dieneri* Ganesan, 1972

172. *Polyvora* dieneri Ganesan, Hin. Geol. Vol. 2, Fig. 5.

**Material:** Five better preserved specimens and several fragmentary specimens.

**Remarks:** The specimen in the collection is nearly identical to the figured specimens of Ganesan (1972, Fig. 5). The fenestrae are oval to rectangularly oval and are of nearly uniform length, while their width varies considerably.

*Polyvora* sp.

(Pl. I—7 & 8)

**Material:** Several fragmentary specimens in the collection.

**Remarks:** The colony is irregularly shaped. The fenestrae are nearly rounded in outline. The characters of zoecia and dissepiments are not well preserved for precise identification.

**FAUNAL ASSEMBLAGE**

The brachiopod genera *Neospirifer fassicier*, *Waagenococha gangatica* and *Linoproductus cora* are known from strata ranging in age from Lower Carboniferous to Upper Permian (Diener, 1890, 1897, 1903, 1911 and 1915; Hayden, 1904; Bion and Middlemass, 1926; Reed, 1932; and Muirwood and Oakley, 1941).

Likewise the bryozoan genera being recorded here are also widely known from the Carboniferous and Permian sequences of the Tethyan basins of Himalaya and were first described from the present Lesser Himalayan area by Ganesan (1972). However, the present record of *Cleiothyridina semiconcava* (Waagen 1883) is significant from the point of view of giving a more or less precise age to the present fossil assemblage as being of Artinskian, as this species is known to be characteristic of the Amb formation of Salt Range which is indisputably assigned to Artinskian by all the workers (Waagen, 1883 and Waterhouse and Gupta, 1977). The authors are, therefore, of the view that the present assemblage is suggestive of the presence of Artinskian elements too in the fossiliferous Permian of Garhwal Synform.

*C. semiconcava* (Waagen 1883) has also been recorded recently from the Calcaeous sandstone (underlying the Productus Shale) of Spiti along with additional fossils favouring Artinskian age (Ishwart and Joshi, 1931).

**REMARKS ON THE AGE OF THE PERMIAN FOSSILIFEROUS HORIZON**

To date there are seven previous publications on palaeontological-palynological aspects of this important fossiliferous horizon.

Commencing with the significant discovery of fenestellid bryozoans by Ganesan (1971 and 1972) and of brachiopods and bivalves by Chaturvedi and Talent (1971), the scope of the palaeontological data was further broadened with the fossil records of Shanker et al., (1973), Waterhouse and Gupta (1978), Singh et al., (1979) and Gupta and Vischer (1980).

The assignment of age as Middle to Late Carboniferous by Ganesan (1972) on the basis of largely non-diagnostic fenestellids (*Fenestella, Polyvora* and a new genus *Dagadanella*), which are so very common in Carboniferous as well as Permian sequences in the northerly Tethyan basins, has to be relegated to the status of historical perspective, especially when evaluation of age on specific brachiopod and bivalve assemblage is now available (Waterhouse and Gupta, 1978). A general Permian age assigned by Chaturvedi and Talent (1971), who also collected species of the bivalve *Avinelopterus* and brachiopods *Spirifer* and *Sirocephalina* besides *Fenestella*, from the locality of Sila Gad valley, is however, more in line with the development of the idea of age with accumulating fossil evidences.

Assignment of Middle Carboniferous age to a conglomeration of fossils by Shanker et al., (1973), who collected from 20 different localities, is also not acceptable now with ever improving precision in the fossil data, as will be clear later. Moreover, Shanker and Ganesan (1973)
assigned the same horizon a Permocarboniferous to Permian age. According to H. M. Kapoor (in Vadiya, 1975) the assemblage of Shanker et al., (1973) contained elements of Lower Artinskian (or Sakmarian) age.

Waterhouse and Gupta (1978), who collected samples from Ganesan’s locality, showed the similarity of their brachiopod and bivalve fauna with the Umaria fauna of Peninsular India and considered it of Sakmarian. Though a definite age for the Umaria fauna is disputed (Waterhouse 1970; Dickins and Shah, 1977), yet its comparison with west Australian faunas favours a Sakmarian age (Dickins and Shah, 1977). Many workers regard the Umaria fauna to include Artinskian elements too (Sastry and Shah, 1964; Shah and Ghosh, 1977).

The brachiopod collection with us, however, does not reveal Sakmarian elements specifically.

Keeping the above in mind, we draw the conclusion that in the entire thickness of fossiliferous Permian horizon of Garhwal, whereas similar bryozoan genera may be occurring more or less throughout, the specific brachiopod and bivalve elements are likely to occur in different layers, most probably, vertically separated.

An important find fortifying the above contention, is the recent fossil record of Singh et al. (1979) from the Tal nadi section. It is exclusively a bivalve assemblage and has dominance of eurycerads in the fauna. It includes elements of Bren beds of Kashmir and Manendragarh fauna of the Peninsular India, indicative of a probable Asselian age (Acharyya and Shah, 1975; Kapoor and Shah, 1979).

A very recent record of palynomorphs from this horizon (Gupta and Visscher, 1980) shows a possibility of the occurrence of elements of Talchir, Karharbari and Barakar formations of the Lower Gondwana, which, in turn, would indicate Asselian to early Artinskian ages (Sastry et al., 1977).

CONCLUSION

Under the tentative proposals alluded to in the present paper it is clear that the Boulder Slate fauna of Garhwal is not older than Permian and includes the faunal elements of only Lower Permian, possibly of all its stages. As a further step in this regard it now becomes important in a future work to systematically collect samples along several measured profiles of the Permian fossiliferous horizon (=Boulder slate sequence) and study the fauna to establish if the fauna really occurs sequentially, from Asselian through Sakmarian to Artinskian, for which there exists a reasonable possibility with the more recent fossil records at hand.

ACKNOWLEDGEMENT

The kind permission of the Director General, Geological Survey of India for D. K. Bhatt to collaborate in the present study is thankfully acknowledged by one of us (MPS). The authors are thankful to Dr. I.B. Singh of Geology Department, Lucknow University, for fruitful discussions and helpful suggestions.

REFERENCES


EXPLANATION OF PLATE

PLATE I

1. Neslonifer fasciger (Keyserling), brachial valve, No. GLUMF 1320, x0.8.
2. Linoprotocystis cf. cora (d’Orbigny), pedicle valve, No. GLUMF 1321, x1.7.
3. Waagenoconcha cf. gametica (Diener), pedicle valve, No. GLUMF 1322, x1.
4. Cleithryridina seminicornuta (Waagen), pedicle valve, No. GLUMF 1323, x2.
6. Polyopora cf. dinieri Ganesan, No. GLUMF 1325, x2.
7. Polyopora Sp. No. GLUMF 1326, x2.2.