CHAPTER-4.5

PALEONTOLOGICAL STUDY OF BRACHIOPODS

INTRODUCTION

The creatures affiliated to the phylum Brachiopoda have certain specific features like a shell or test made of two unequal valves still extant in them. Within this shell, the soft parts of their body are sheathed. The larger one is explained to be the ventral valve, while the dorsal valve is the smaller one. The umbo or the tapering beak is present towards or the posterior end of any valve. The umbo on the ventral valve is usually more prominent and obvious. The class Inarticulata from which the Brachiopods hail, the two valves are clasped together by means of the muscles whereas in the class Articulata, the two valves clutched together at their posterior ends. A pair of teeth emerged on the ventral valve (close to the umbo) in such type of Brachiopods and these could fit into the two sockets which were near the beak of the dorsal valve. The hinge line or the cardinal margin where the teeth and sockets evolve is the posterior margin of the two valves. In few Brachiopods, between the umbo and the hinge line, a triangular portion is present. This portion is called as the hinge area or cardinal area and this is flat or a bit concave in appearance. The hinge area is more obvious and pronounced in the ventral valve, though it is existent in either of the two valves. An opening normally occurs on the ventral valve at the apex of the umbo or inside the hinge area. The accurate location on the shells of different genera is referred to as the pedicle or the peduncle foramen and the pedicle is seen with a variety of sizes and shapes. The pedicle opening is doled out by either of the valves in some Brachiopods. This subset exists however in most of the cases on the ventral valve exclusively. The pedicle opening in some cases is somewhat triangular in shape and occurs below the umbo of the ventral valve. This type of opening is known as delthyrium. By means of two plates, the delthyrium is somewhat closed and together constitute what is known as deltium. In these cases, the pedicle openings come into being, either in between the deltial plates or at the apex of the umbo of the ventral valve. The delthyrium is completely or intermittently shut by mode of a single plate forming the pseudodeltidium.
The muscles of the animal help in the opening and closure of two valves which represent the shell of the Brachiopods. Usually on the inner side of the valves the imprint or indentations are left. A frame work made of calcium carbonate is existent inside the shell of a few kinds of Brachiopods. The so called brachial skeleton is affixed to posterior end of the dorsal valve. It is found that brachial skeleton is bestowed got in almost all the articulate Brachiopods and missing in inarticulate types. The shells are found to be of various sizes between wide limits. The larger ones are about 12 inches in width, whence a few of these are just a fraction of an inch in length and breadth. Speaking about the shape, biconvex, plano-convex, concavo-convex, Brachiopods shell varieties are present. The upper ribs radiating away from the umbo in all directions, but it is noticed that however concentric ribs are existent surrounding the umbo region on either of the valves. There is a drastic difference seen in the beautification and adornment of the hinge area, usually from the rest of the shell. The Brachiopod shell is organized, well planned, and set up in the manner of three dissimilar, well defined layers and the material which they are generally made of is calcareous and chitinous. The two inner layers are calcareous in composition and are preserved in the fossil form while the outer most chitinous layer is not ordinarily preserved.

Brachiopod fossils are generally seen to be having a punctuated shell. Mostly, the Brachiopods have an equilateral shell with an absolute, exemplary, and flawless bilateral symmetry, displayed by the individual valve. Narrating in other words, if a shell is accommodated and adjusted in a proper manner i.e. with its ventral valve situated below the dorsal and its beak placed in a posterior position, the shell can be divided into two identically positioned halves by a vertical plane, which runs through the beaks and also the middle region of the anterior margin of the shell.
GEOLOGIC HISTORY

A long geologic history has been observed in Brachiopods. The most primitive forms of the Brachiopods are supposed to live in Pre-Cambrian Sea. So far, no clear fossil record has been put across in support of the view, but within the Lower-Cambrian age certain remains of Brachiopods are found. Though a few early articulates have been discovered which hail mostly from the class Inarticulata. Some Brachiopods like *Lingulella*, *Kutorgina*, *Obolella*, etc. hail from the Lower-Cambrian age. Both the Inarticulates and the Articulates developed to certain degree of the Cambrian. The Brachiopods became maximum in number in the Ordovician period and Articulates were vitally important. The zenith of their development was reached by the Brachiopods in the course of Ordovician, Silurian and Devonian periods. The Brachiopods become less important since the Devonian and there were only thirteen super families’ survivors, out of the nineteen super-families which emerged out during the Silurian period and they could continue to exist. Some of the commonest of Brachiopods of the Lower-Paleozoic were - *Lingulella*, *Kutorgina*, *Obolella*, *Leptaena*, *Strophomena*, *Rafinesquina*, etc. A reference can be made from the Upper-Paleozoic forms, of *Athyris*, *Atrypa*, *Spirifer*, *Syringothyris*, *Products*, *Stringocephalus*, etc. The Carboniferous and Permian age rocks are distinct and characterized by two predominant super families i.e. Productacea and Spiriferacea. Most of the super families vanished during the end of Palaeozoic era and among them only nine continued till the Triassic period. A new super family made its appearance when Jurassic period began, whereas three of these super-families ceased during the Mesozoic era. In the Mesozoic era *Terebratula* and *Rhynchochelus* are the two very important Brachiopods. There were some other Brachiopods like *Lingula*, *Discina*, *Crania*, *Terebratella*, *Terebratulina* etc. which were not very important. The mass extinction occurred at the end of Permian. Between the Permian and the Triassic the number of Brachiopods decreased rapidly. This drastic draw is known as Permo-Triassic mass extinction. In this largest extinction, nearly 90 percent of species of Brachiopods died. The Brachiopods were flourished during the Paleozoic era and afterwards they have never regained their abundance. They are reported as index fossils. As the Mesozoic was near to its end, the Brachiopods lost their importance. Sometimes only the Brachiopods are seen within the rocks of Tertiary age. The
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members of only six of the super families existed during the Tertiary era and they have continued to survive even up to the present day.

**DESCRIPTION OF BRACHIOPOD SPECIES**

The Brachiopod fauna of Bagh Beds was represented by only single genus *Malwirhynchia*. The genus comprises of three species viz., *Malwirhynchia transversalis*, *Malwirhynchia sub-pentagonalis*, and *Malwirhynchia trigonalis* which have been described by Chiplonkar (1938). During the course of present investigation, author has collected few well preserved Brachiopod specimens which belong to *Malwirhynchia* and *Acanthothyris* genus. The *Acanthothyris* genus is recorded from Bagh formation for the first time. All the specimens will be housed in the zoological museum of the MJB Govt. Girls P.G. College Moti Tabela, Indore.

The classification adopted by Moore (1965) in his “Treatise on invertebrate paleontology part- H” has been followed in the present work.

*Acanthothyris* sp.

**Systematic Paleontology**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Details</th>
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<tr>
<td>Phylum</td>
<td>Brachiopoda</td>
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<tr>
<td>Class</td>
<td>Articulata Huxley, 1869</td>
</tr>
<tr>
<td>Order</td>
<td>Rhynchonellida Kuhn, 1949</td>
</tr>
<tr>
<td>Super family</td>
<td>Rhynchonellacea Gray, 1848</td>
</tr>
<tr>
<td>Family</td>
<td>Rhynchonellidae Gray, 1848</td>
</tr>
<tr>
<td>Sub family</td>
<td>Acanthothyridinae Schuchert, 1913</td>
</tr>
<tr>
<td>Genus</td>
<td><em>Acanthothyris</em> Paetel, 1875</td>
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</tbody>
</table>

*Acanthothyris* sp.

(Fig. 7.1A-C)
**Material:** Four specimens well preserved. B. 1/1, 1/2, 1/3 and 1/4

**Dimensions:** B. 1/1

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<table>
<thead>
<tr>
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<tr>
<td>Length (L)</td>
<td>-</td>
<td>16 mm</td>
</tr>
<tr>
<td>Width (W)</td>
<td>-</td>
<td>18 mm</td>
</tr>
<tr>
<td>Thickness (T)</td>
<td>-</td>
<td>0.9 mm</td>
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</table>

**Description:** The genus *Acanthothyris* is characterized by rounded sub pentagonal shell outline. Wider (13-18 mm) than length (12-16 mm) with maximum thickness (0.7 to 0.9 mm). In smaller specimens, width is greater than length but comparatively in larger specimens length is more or less equal to its width. Shell is biconvex and ventral valve convexity increases with ontogeny. Maximum width of the test is at the middle. Gently arched to rectimarginate anterior commissure, no fold recognizable on the dorsal valve, short acute beak, numerous fine costae, sometimes irregularly branched. Brachial valve convexity is greater than pedicle valve and anterior commissure area is slightly flattened giving a resupinate shape in section. Pedicle valve is slightly depressed in the middle portion near the commissure, producing a furrow in the central region of the commissural line, flanked by two concomitant bulged portions in the side. Fine ridges radiating from the beak are present in both the valves. These ridges of both the valves give the anterior commissural line, a denticulate pattern with a ‘W’ shaped out line. Both the beaks are curved but P-valve beak is to some extent erect. Prominent pedicle opening is present in the P-valve.

**Remarks:** These specimens do not show close resemblance to already described species and are kept for open nomenclature.

**Locality:** Khandlai and Zirabad of district Dhar, Madhya Pradesh.

**Horizon:** Top most layer of Nodular limestone and Bryozoan limestone.
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**Malwirynchia subpentagonalis** Chiplonkar, 1938

**Systematic Paleontology**

Class : Articulata Huxley, 1869  
Order : Rhynchonellida Kuhn, 1949  
Super family : Rhynchonellacea Gray, 1848  
Family : Rhynchonellidae Gray, 1848  
Sub family : Cyclothyridinae Makridin, 1955  
Genus : *Malwirynchia* Chiplonkar, 1938  
Species : *subpentagonalis* Chiplonkar, 1938

*Malwirynchia subpentagonalis* Chiplonkar, 1938  
(Fig. 7.2A-B)

**Synonymy:**

1938 *Malwirynchia subpentagonalis* Chiplonkar; Chiplonkar, p.313.

**Material:** Three specimens, two well preserved, and one is partially preserved.  
B.2/1, 2/2, and 2/3

**Dimensions:** B.2/1  
Length (L) - 14 mm  
Width (W) - 14 mm  
Thickness (T) - 0.8 mm

**Description:** Shell is small, sub-pentagonal, sub medially widest and thickest, moderately tumid, rather coarsely ribbed with 30-35 ribs on the dorsal valve. Maximum width of test and also both of the valves are at the middle. After that B-valve becomes slightly flattened, producing depressed area in the commissure area in the P-valve. Shell varies from smooth to very fine radiating striations. The test is
ventrally biconvex. Prominent pedicle opening is there. Eight to eleven ribs on the protrusive, planoplicate 39 mesial fold. Commissure rather sharp; ventral umbo strong with a sub erect beak. Foramen hypothrid, tubular, large and sub circular. Dorsal septum usually very much reduced. Deltidial plates high, conjunct, and tetragonal.

Remarks: Malwirhynchia subpentagonalis has been originally described by Chiplonkar (1938) from the Bagh formation of central India. The collected specimens show close resemblance to Malwirhynchia subpentagonalis Chiplonkar in all morphological features of the shell. The present specimens differ from M. trigonalis described by Chiplonkar (1938) in being considerably small in size, stronger with fewer ribs, subpentagonal shell with sharp margins and strong ventral umbo.

Locality: Khandlai and Bagh of district Dhar, Madhya Pradesh.

Horizon: Bryozoan limestone.

DISCUSSION

The Rhynchonellid Brachiopod fossil fauna was found in different regions of the world. A large number of invertebrate fossils were explored including the Brachiopods from Bagh Beds. Their occurrence was scanty. Their rare availability might be due to the hard limestone in which the fossils were embedded.

Brachiopods were most abundant in the Paleozoic period. They possessed phosphatic or calcitic shells. Due to stable nature of calcite, the Brachiopod shells were preserved. Rhynchonellids Brachiopods were first noticed by Chipolonkar (1938) from Bagh Beds. He found only single genus Malwirhynchia. The author explored two endemic genus of Rhynchonellidae family, the Malwirhynchia and the Acanthothyris from the Bagh area. The only species collected from the Malwirhynchia subpentagonalis belongs to the Malwirhynchia genus. They were found in Bryozoan Limestone. The anterior margin of M. transversalis has fine ribbing while it is coarse in M. subpentagonolis Chiplonkar. The degree of coarseness indicates that the coarseness is developed from a smooth one. The ventral valve is shallower than the dorsal one. The prominent ventral sinus is present and towards the anterior margin it is identified by lateral slopes.
It is probable that *Malwirhynchia* originated from Jurassic genus, *Kallirhynchia* as they have moderately divergent dental plates and the hook like calcarifer. The shallow ventral valve with its sinus can be seen clearly than the dorsal fold. The *Malwirhynchia* is a modified form obtained by muscle area expansion of *Kallirhynchia* (Buckman, 1918). His observation revealed that the muscle area and dental plates resemble with their ancestor *Sphenorhynchia*. He also noticed the resemblance of musculature with *Burmirhynchia*, but the widely divergent dental plates, drawn out beak, convex dorsal umbo, curving grooves separating the pairs of dorsal adductor scars and incomplete foramen in the former genus separate it from the later while *Burmirhynchia* possessed from widely divergent dental plates and produced beak (Buckman, 1918). The brachial valve in *Bihendulirhynchia* is posteriorly smooth while the ventral valve is shallow and trigoniform dorsal muscle area resembles with *Malwirhynchia*. A different branch from *Kallirhynchia* has evolved having an incurved beak, conspicuous mesial fold, long dental plates, half moon shaped dorsal anterior scars known as *Kutchirhynchia* (Buckman, 1918). This branch is different from the one which laid to *Malwirhynchia*.

Stoliczka (1873) worked on the Cretaceous fauna of South India. He found *Rhynchonella plicatiloides* from the Turonian and Senonian of South India. The internal characters of these South Indian specimens were probably different from *Malwirhynchia*. *Rhynchonella plicatiloides* had more rounded ribs, shallower ventral umbo with a lower beak and more adavanced mesial fold than those of *Malwirhynchia* species. Chiplonkar (1938) recorded three species of *Malwirhynchia* with wide range in variation in their dimensions and morphological characters. The author explored only one species viz. *Malwirhynchia subpentagonalis*. It has well developed mesial fold while in *M. transversalis* moderately developed mesial fold and *M. trigonalis* poorly developed mesial fold were documented. Among the above three species *M. subpentagonalis* had subcircular foramen and tetragonal deltidial plates which indicates it to be most abundant species (Chiplonkar, 1938).

*Acanthothyris* genus is first time reported by the present author from Bagh Beds. The genus is characterized by having a subpentagonal shell boundary. The plane anterior commissure of shell is slightly curved. On the dorsal valve no fold is recognized. They possessed short acute beak with abundant fine costae, which are sometimes branched and arranged irregularly. With a broad similarity in external
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morphological characters of this genus found in Lower Jurassic – Upper Jurassic period, it is somewhat tentatively referred as genus *Acanthothyris*. Serial sectioning of the specimens would be needed to determine, if the specimens represent a new genus.

However the rarities of described fauna leave little doubt but they belong to undescribed species or new genera from Bagh Beds. The data about Cretaceous Rhynchonellids fauna from Bagh Beds is very scanty, so the age of these Brachiopods fauna is difficult to access. However the genus is compared with the rhynchonellids from others parts of the world, where on the basis of other fossils their stratigraphical position is already fixed. Very probable age indicated by these Brachiopod species is ranging from Lower Gault-Cenomanian (Chiplonkar, 1938). The genus *Malwirhynchia* shows its stratigraphical position ranging from Albian (Lower Gault)-Cenomanian (Chiplonkar, 1977).

Comparable material and literature of this genus is lacking on the Bagh Beds area. So species reorganization is difficult to access at present, but it may be well explained by collecting more specimens. It will be more fruitful, if more data of Cretaceous Brachiopods could be collected from all of the Gondwana continents so that a connectivity of fauna can be established between the Antarctica and Northern hemisphere. Due to scarcity of available evidences and lack of number of collected specimens at present it is not possible to date these Brachiopod fauna more precisely.

The present Rhynchonellid Brachiopod fauna offers an important contribution to our knowledge of the group in Bagh Beds.