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ON SOME MEGAINVERTEBRATE (MOLLUSCA, ECHINODERMATA AND BRACHIOPODA) FOSSILS FROM BAGH BEDS, MADHYA PRADESH

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INTRODUCTION

Marine Cretaceous deposits have been recorded in large part of the Extra-peninsular belt of the Indian Subcontinent. A condensed sequence form of this type of deposit has also been recognised in the Narmada Valley of Central India. Less thick marine Cretaceous deposits came up in the vicinity of Bagh, a township in Dhar District of Madhya Pradesh, on the western portion of the Narmada Valley. The Bagh beds, in fact stretch from Rajpipla about 35 miles (56 km.) west of Gulf of Cambay in Gujarat eastwards as far as Barwaha, about 240 miles (386 km.) from the coast of Gulf (Pascoe,1959). The Bagh beds though contain comparatively thin sedimentary strata but possess substantive diversity of faunal elements. Eventually, the beds have long been an important focus of attention of the geologists and palaeontologists for their rich fossil faunal martial. Dangerfield (1818) pioneered the detailed geological investigation on a regional scale of the Bagh beds. Later, Carter (1854), Keatinge (1856) and Oldham (1858) commented upon the age of the Formations in Bagh beds. Carter (*loc. cit.*) assigned a Neocomian age of the Formation but Oldham (*loc. cit.*) had certain disagreement with the view of Carter. Keatinge (*loc. cit.*) however, assigned a general Cretaceous age for the fossiliferous beds. Bose (1884) assigned an Albian toTuronian age for the nodular limestones on the basis of recovered molluscs and echinoderm material, and a Campanian to Maestrichtian age for coralline limestone on the basis of recovered echinoids, brachiopods, gastropods and lamellibranch material. Fourteau (1918) assigned upper Albian age of the beds on the basis of recovered echinoid fauna of the beds. Mukherjee (1935, 1936, 1938) opined that the Bagh beds range in age from the Cenomanian to the upper Senonian. Spath (1927-33) was of opinion that the Bagh ammonites belong to Turonian age. Chiplonkar (1939) on the basis of bivalves of the beds assigned an age from Albian to Senonian, with Cenomanian as the more dominant aspect. Roychaudhur & Sastri (1962) proposed a stratigraphic classification of the Bagh beds. Dassarma & Sinha (1966) recorded shark teeth and other marine animal forms of Cretaceous affinity in the Nimar Sandstone horizon of the Bagh beds. Pal (1970) made a review of the fossil forms explored from the Bagh beds of the Man river section. Chiplonkar & Badve (1973) made taxonomic assessment of an extensive collection of bivalve molluscs of Bagh beds including several new forms. This fauna demonstrated an affinity to the fauna of the Mediterranean palaeozoogeographic province and assigned an age from Cenomanian to Turonian. Subsequently, Chiplonkar & Badve (1976) and Chiplonkar & Ghare (1977) worked out the ammonoid fossils, and trace fossils and palaeoecological conditions of the Bagh beds. In the background of the potentiality of Bagh beds as a fossil storehouse; it was thought that a lot more interesting forms could be recovered from the area. Hence, the field works were carried out recently by the ZSI in this

Table 1 : Stratigraphic succession of Bagh beds: Development of concepts

Stratigraphic Units (after Rode & Chiplonkar, 1935)	**Stratigraphic Units** (after Chiplonkar, Badve & Ghare1975
Upper coralline limestone	Upper coralline limestone with oyster bed at top
Deola and Chirakhan Marl	Upper *Inoceramus* bed Deola & Chirakhan Marl with *Hemiaster*
Lower coralline limestone (c. 1.0 m.)	Lower Coralline Limestone
Nodular limestone	Lower *Inoceramus* bed Nodular Limestone
Nimar Sandstone	*Astarte-Turritella* bed Oyster bed with shark teeth Trace fossil horizon Lower portion of Nimar sandstone with oyester bed

area for exploration of the nature of the fossil faunal content, especially the megainvertebrats. The collection made during the field works has been worked out and the result of the study is presented here in the background of the lithostratigraphy of the Bagh beds.

STRATIGRAPHY

The Bagh beds comprised depositional strata of relatively small depth but contain heterogeneous composition. This heterogeneous nature within short depth point out to rapidly changing depositional conditions. Accession and recession of the transgressing waters of the marine regime were the frequent occurrences and the phenomena influenced substantially over the times which thrived in the Narmada basin during the depositional phases. Rode & Chiplonkar (1935) proposed a stratigraphical sequence which was modified later on by Chiplonkar *et al*., (1973) with incorporation of some more details *viz*., Oyester beds, *Inoceramus* beds, *Astarte-Turritella* beds, etc., (see Table-1).

Stratigraphically, the layer containing oyesters becomes the lowest horizon, and which is encountered in the ferrugenous shaly band of the Nimar sandstone. It ranges in thickness from about 0.5 to 1.0 meter and is situated slightly above the local base of the section, or otherwise the actual base of the Nimar sandstone which is not exposed. Another oyester bed of about 1.5 meter thickness was recognised to the west of Bagh cave over an interval of about 15 meter above the lowest oyster-bearing horizon. Subsequently, gradual decline in oyster shells and appearance of *Astrate*-shells give rise to *Astrate*-bed. Sandstone horizon succeeds in a gradual manner into the Nodular limestone. *Astrate*-bed bears representatives of *Turritella* spp. It has been shown by Chiplonkar & Badve (1980) that setting of immature stages was induced by dense population of sessile epifauna like, *Ostrea*. Other species of oysters also flourished well. Infrequent occurrences of oysters shells were recorded in the lower and upper coralline horizons. Near the top of the upper coralline limestone layer dense population of oysters further point out to another distinct oyster bed. The two *Inoceramus* bearing horizons had similar lithic characteristics, *viz*, marly limestone, but were well separated from one another (Chiplonkar & Badve, 1976).

It has been apparent that the Bagh Formation contains at least two major depositional hiatuses. Kennedy *et.al.* (2003) assigned a late Turonian age to the Bagh Formation on the basis of findings of ammonite from the upper Nodular limestone, several kilometres to the west of Man River section. While on the basis of findings of inoceramid bivalves Gangopadhyay & Bardhan (2000) claimed to support a Conaician age. As the late Turonian ammonite dating comes from high in the succession, it is perceived that the lower beds in the Formation might extend down to the Cenomanian.

SYSTEMATIC PALAEONTOLOGY

Phylum MOLLUSCA
Class CEPHALOPODA
Order AMMONOIDEA
Suborder AMMONITINA
Family ASPIDOCERATIDAE Zittle 1895

Genus ***Paraspideceras*** Spath, 1925

1. ***Paraspideceras*** sp.

Diagnosis: Whorls very depressed, coronate and spinous from early stage, outer row of spines more or less clavate, inner row recessive or absent.

Material: 1 example

Locality: Awlda, (Seetapur) village, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Genus ***Peltoecras*** Waagen, 1871

2.***Peltoceras*** sp.

Diagnosis: Evolute whorls hardly overlapping ; ribs strong bifurcating and trifurcating on ventral margin. Venter nearly flat, outer row with 2 rows of massive lateral, tubercles, outer row developing first.

Material: 1 example

Locality: Awlda, (Seetapur) village, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Genus ***Metapeltoceras*** Spath, 1931

3. ***Metapeltoceras*** sp.

Diagnosis: Differs from Peltoceras in developing inner lateral tubercles before outer.

Material: 1 example

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Genus ***Peltomorphites*** Buckman, 1925

4. ***Peltomorphite***s sp.

Diagnosis: Inner whorls as in Peltocerotides; outer whorls became tritubarculate and spinous with ventral as well as lateral tubercles . Comprises "eugenii group"

Material: 1 example

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Family: PLACENTIRCERATIDAE Hyath, 1900

1. Genus ***Placenticerus*** Minitoi,

Diagnosis : Very involute, with slightly convex sides and very narrow venter with faith falcoid ribs umbilical tubercles of early whorls move upto mid sides on lateral whorls normally with lower and fine upper ventra-lateral clavi, ornamental weakens in adult and last whorls may be smooth and with narrowly rounded Venrer. Suture with many auxiliaries.

Material: 12 examples

Locality: Bariha village, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Genus ***Placenticerus*** Kaffrorium

2. ***Placenticerus*** sp.

Diagnosis : Rare kind of ornament that is seldom seen because it is apparently confined to the structure of the inner shell layers occurs on all of the whorl sides, chiefly in oxycones, the consist of a band of delicate, forwardly directed chevrons, standing in scarcely perceptible relief and thus generally visible only by low angle lighting. It has been figured in some cretaceous pseudocertites and main species is Placenticeras kaffrorium. Radial strips have been noticed other bolder size pattern occur in Palacozoic Straight.

Material: 35 examples

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Class GASTROPODA
Order ARCHAEOGASTROPODA
Family PLETHOSPIRIDAE

Genus ***Gyrodoma*** Etheridge, 1898

1. ***Gyrodoma*** sp.

Diagnosis: Relatively high spired, with rounded whorls and deep sutures; selenizone

broad, flat, ornament numerous spiral threads except on Selenizone little is known apertureal margin.

Material: 1 example

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Class BIVALVIA
Order OSTRAEACEA
Family OSTREIDAE

Genus ***Turkostrea*** Vyalov, 1936

1. ***Turkostrea*** sp.

Diagnosis: Having strong chomata and many strong continuous, fairly narrow radial ribs on LV and tendency of ligmantal area to turn in posthogyral spiral fashion.

Material: 3 examples

Locality: Bariha village, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Order PTERIOIDA
Family LIMIDAE

Genus: Aviculolima, E. Philippi, 1900

1. ***Aviculolima*** sp.

Diagnosis: Body of shell recalling that of Pteria, but obliquely elongated in anterior instead of posterior direction, posterior wing acutely pointed, anterior wing rounded, cardinal area wide, with broad posteriously directed ligament pit.

Material: 6 examples

Locality: Bariha village, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Genus ***Limatulella*** Sacco, 1898

2. ***Limatulella*** sp.

Diagnosis: Without appreciable gaps ornament of weak unequal radial riblets. Posterior view bivalve shells.

Material: 4 example

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Genus ***Regalilima*** Cox, 1943

3. ***Regalilima*** sp.

Diagnosis: Large traplzifrom, unequilateral, without anterior auricle, anterior umboral ridge well developed and extended, with flattened area in front of it. Cardinal area broad, anterior gap wide, ornament of broad flat ribs, obscure in some specimens.

Material: 3 example

Locality: Seetapuri, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous

Order UNIONODA
Family ARCHNODONTIDAE

Genus ***Anthracosphaerium*** Trueman & Weir, 1946

1. ***Anthracosphaerium*** sp.

Diagnosis: Subovate inflated equivalved with gibbons contiguous umbones, internal characters unknown.

Material: 16 examples

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous

Order UNIONIDA
Family ACTINODONTOPHORIDAE

Genus ***Actinodontophora*** Ichikawa, 1951

1. ***Actinodontophora*** sp.

Diagnosis: With several radial cardinals anterior elements of which are relatively long and massive, garding posteriorly to short and thin, anterior tooth of cardinal series occurring RV.

Material: 3 examples

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous

COORDINATES OF THE FOSSIL LOCALITIES:

Places	Latitude (North)			Langitude)East)		
AmbaDongar	21˚	59'	00"	74˚	04'	00"
Badia	22˚	21'	50"	75˚	04'	00"
Bagh	22˚	21'	30"	74˚	47'	30"
Barwah	22˚	15'	30"	76˚	02'	00"
Mongra	22˚	00'	30"	74˚	02'	30"
Motichikli	22˚	01'	00"	74˚	05'	00"
Phata	22˚	15'	00"	74˚	37'	00"
Mathsar	21˚	46'	30"	73˚	33'	30"
Sitapuri	22˚	21'	50"	75˚	04'	30"

Order OSTRECEA
Family OSTREIDAE Rafineque, 1815

Genus ***Flemingostrea*** Vredenburg, 1916

1. ***Flemingostrea*** sp.

Diagnosis: Medium size to large; overall shape flattised, valves subequal, neither highly convex norcompresed in antero-posterior direction. LV umbo not prominent or hook shaped, terebratuloid fold broad and gentle arising gradually at later growth stage than roof like fold does in Odonatograyphaea. No radial sulcus delimiting fold on its posterior flank which has gradually slope. Calcite prisms long and well developed in prismatic shell layertop. Many species with regularly spaced concentric imbrications on RV recallygryphaeostrea, imbrications composed of prismatic shell layers and separated from each other by smooth concentric bands with sigmoidial profiles. Chomata may be present. Ligament growing rapidly in length, but not in height in earlier resulting in some what shouldered appearance of RV with shoulders at ends ofligamental area approaching rectangular shape. It has several features and it distinguished from other genera e.g. i) LV umbo not prominentand not beaked. ii) Shell not as highly convex. iii) Shell shape less globose, tending to be flattish. iv) Valves more nearly equal in size. v) Terebratuloid fold appearing later and very gradually lower down.These features are more primitive than corresponding ones in other genera of theribs, because they more nearly approach those of the normal, overage ostreime prototype.

Material: 6 examples

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous

Phylum BRACHIOPODA
Class ARTICULATA
Order RHYNCHONELLIDA
Family RHYNCHONELLIDAE

Genus ***Burmirhynchia*** Buckman, 1918

1. ***Burmirhynchia*** sp.

Diagnosis: Large sized shell, globose, with many rounded costae, flabellate; beak massive, gibbons incurved, with a long apex, overhanging a small foramen that hardly touches umbo; ventralsuleus less marked than dorsal fold, fold highest along middle and anteriorly protruding.

Material: 94 examples

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous

Genus: ***Gibbirhynchia*** Buckman, 1917

2. ***Gibbirhynchia*** sp.

Diagnosis: Shell large, roundly triangular with very high valve thickness; Incurved beak; costal strong, angular.

Material: 15 examples

Locality: Bariha village, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous

Family WELLERELLIDAE
Genus ***Kallirhynchia*** Buckman, 1917

1. ***Kallirhynchia*** sp.

Diagnosis : Shell medium sized, almost convex planate, well developed uniplication, multicostate; beak stout, rather flattened, sub erect, rarely incurving, apex short with distinct foramen, elliptical; slightly trilobite median flat fold more or less angulated, dental plates strong and divergent.

Material: 35 examples

Locality: Awalda, Thana-Manawar, District: Dhar, M.P.

Geological age: Middle Jurassic

Phylum ECHINODERMATA
Class ECHINODEA
Order SPATANGOIDA
Family HEMIASTERINA Clarke, 1917

Genus***Hemiaster***

1. ***Hemiaster*** sp.

Diagnosis: Star fish like structure, apparel rib sutures pointed ends in each finger rays, edging roundly, central point round with circle, upper part star fish like, beak portion plane round shape, solid and medium in size.

Material: 580 examples

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous

DISCUSSION

During the current study the stratighaphic set up of the Bagh beds, worked out by earlier workers, was testified and realized. The author also made a substantive collection of fossil faunal forms. A systematic analysis of these faunal material enabled the author to understand the biozonations and age of the beds.

It was realized during the present investigation that the fossils were not distributed evenly in all beds and hence well organized biozonations become an inconvenient task. Different forms of ammonites demarcate to some extent finer zones as Nodular limestone, Marl and Coralline limestones etc. The upper part of upper coralline limestone showed presence of plenty of brachiopods. Different forms of *Hemiasters* showed differential distribution in different beds. Eventually, the understanding of the study may be summarized as follows:

I. The fossiliferous strata of the Bagh beds range tentatively in age from Aptian to Maestrichtian; the Nimar rocks range down to Neocomian or further little more.

II. Unique biozonations of the Bagh beds are not ascertained without the thorough analysis of fauna of different invertebrate groups encountered in the beds.

III. The faunal similarity vis-a-vis distribution in geological time scale point out to some correlation with the Cretaceous Formations of south India. This was envisaged long back by Bose (1884).

IV. The close similarity between the echinoid forms of the Bagh Formation and the echinoid fauna of the late Turonian of Madagascar provides convincing evidence that the bulk of Bagh Formation was deposited during the Turonian (Smith, 2010)

SUMMARY

The Bagh beds in the Narmada Valley of Madhya Pradesh, India yielded a rich and varied invertebrate fossil fauna. During the mid Cretaceous Period Marine conditions intruded far into the Indian cratun, and the techtonic breakup of the greater Gondwana super continent gave rise to limar intracratonic basinal belts across the region. The lower Narmada basin is one Cretaceous seaway along the Narmada-son graben. The Bagh Group comprises a series of limestone and Marls deposited in Shallow marine environment that have become richly fossiliferous in places. The recent collection of fossils from Bagh beds have yielded 6 species of Ammonoidea, 7 species of Bivalvia, 1 species of Gastropoda, 2 species of Brachiopoda, 1 species of Echinoida. A few species show affinities to the forms ranging up in the Senonian while some species bear affinities to forms ranging down into

Aptian. However, majority of the recovered fauna demonstrated an age from Cenonian to Turonian.

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