

STUDIES ON THE JURASSIC OXYTOMIDS (BIVALVIA) FROM THE HABO HILL IN KUTCH, W. INDIA

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ABSTRACT

Five species of *Oxytoma* Meek (*O. inequivalve* (J. Sow.), *O. elongata* sp. nov. *O. pseudocensoriensis* sp. nov. *O. bhattacharyai* sp. nov. and *O. sp.*) and three of *Meleagrinnella* Whitfield, namely *M. echinata* (Smith), *M. cf. ovalis* (Phillips) and *M. cf. maltonensis* (Arkell), from the Upper Jurassic (Callovian and Oxfordian) rocks of the Habo Hill in district Kutch (Gujarat), are described and illustrated. The problem of the stratigraphic range of *O. inequivalve* and *M. echinata* has been discussed. These two species, in the present area, have been found to mark the Oxfordian and Callovian horizons respectively.

INTRODUCTION

Jurassic horizons of Kutch are famous for their rich molluscan assemblage, particularly the bivalvia and the cephalopoda. The cephalopods, specially the ammonoids, have been paid a greater attention apparently for their utility in correlation. Bivalves, on the contrary, are less useful due to their usually long stratigraphic ranges and as a result are less cared for in spite of their abundance in kind as well as number. However, at times they are indispensable for local correlation particularly in areas where the ammonoids are scarce, such as the 'island' exposures on the southern boundary of the Great Rann of Kutch. Even otherwise, in certain cases, they have been found to be capable of serving satisfactorily in the marking of a few horizons, though on a broader scale than the ammonoids do. Two such bivalve species, namely *C. inequivalve* (J. Sow.) and *M. echinata* (Smith), belonging to the family Oxytomidae Ichikawa, along with their kinds, have been illustrated and discussed from the Upper Jurassic (Callovian and Oxfordian) horizons of the Habo Hill in district Kutch (Gujarat), W. India.

FAMILY OXYTOMIDAE IN KUTCH

The Jurassic invertebrates of Kutch were mostly described by British palaeontologists who never visited the region themselves. The bivalves were for the first time described by Kitchin (1903) followed by Cox (1940, 1952). While the former dealt with only one group (the Trigoniids), the latter's work comprised several families including the present one. Agrawal, the worthy disciple of late Professor Rajnath, was the first ever Indian

palaeontologist who collected himself the fossils described by him (1956a, b, c).

The family Oxytomidae is represented in Kutch by two genera, namely *Oxytoma* Meek and *Meleagrinnella* Whitfield. The former had yielded two forms (*O. inequivalve* and *O. sp.*) while the latter only one (*M. echinata*), both recorded for the first time by Cox (1940). As per the published records, *O. inequivalve* is known in Kutch so far by merely seven specimens while *M. echinata* by more or less two dozens of individuals. Besides these, few specimens of each are preserved in the Department of Geology, Banaras Hindu University, collected by Singh (1961) and Rai (1972) respectively. The purpose of the present paper is to put on record various species, new or otherwise, of the two concerned genera and to test their merit for the purpose of biostratigraphy.

SYSTEMATIC DESCRIPTION

Individuals of all the species described below are lodged in the Department of Geology, Banaras Hindu University.

<i>Class</i>	Bivalvia LINNÉ, 1758
<i>Subclass</i>	Pteriomorpha BEURLÉN, 1944
<i>Order</i>	Pterioidea NEWELL, 1965
<i>Superfamily</i>	Pectinacea RAFINESQUE 1815
<i>Family</i>	Oxytomidae ICHIKAWA, 1958
<i>Genus</i>	<i>Oxytoma</i> MEEK, 1864

Types species: *Avicula muensteri* Bronn, 1830. Jurassic; cosmopolitan.

Oxytoma inequivalve (J. Sowerby)

Avicula inequivalvis J. Sowerby, 1819, p. 78, pl. 244, figs. 2-3.

Oxytoma inequivalvis (Sow.) : Arkell, 1933, p. 194, pl. 24, fig. 9.

Oxytoma inequivalve (J. Sow.) : Cox, 1935, p. 165, pl. 15, figs. 11-12.

Oxytoma inequivalve (J. Sow.) : Cox, 1940, p. 98, pl. 6, figs. 9-12.

Oxytoma inequivalve (J. Sow.) : Agrawal, 1956b, p. 62, pl. 8, fig. 9.

Oxytoma inequivalve (J. Sow.) : Cox, 1965, p. 47, pl. 5, fig. 7.

Material : Four left valves.

Remarks : The group of *O. inequivalve* has been discussed much in the past and different authors have interpreted it in different ways. Arkell (*loc. cit.*) seems to be inclined to regard each variation (mainly in ornamentation) restricted to a particular geological horizon as a distinct species, thereby considering 'inequivalve' to be restricted to Middle Lias only. Cox (1935, p. 166), on the other hand, maintains that 'a representative series of Liassic specimens will be found to include specimens agreeing in every character' with Arkell's definition of the Corallian species *O. expansum* (Phillips). He thinks 'it improbable that definite varieties of *O. inequivalve* will be found to characterise definite horizons, except locally', and fully agrees with Waagen (1901) and Gillet (1924), in conceiving this as 'a species ranging from the Rhaetic to Lower Cretaceous'. Further, records from the Divesian and Upper Argovian of Kutch as well as from the Callovian (?) and Upper Kimmeridgian of Tanganyika (Cox, 1940 and 1965 respectively) support this view.

The Kutch specimens (G.S.I. Nos. K40/576, 577) included in this species by Cox show much variation in ornamentation. Although the number of primary ribs in them remain fairly constant (about 14), their interspaces are either completely smooth or each of them bears only one secondary riblet in its middle. In some of the specimens both secondary and tertiary riblets ornament the interspaces.

The specimens now recorded bear 13 or 14 radial ribs with one secondary riblet in the middle of each, otherwise smooth, interspace. The present authors have identified them as *O. inequivalve* in view of their similarities in conchological characters with some of the Cox's specimens and those described by Agrawal (*loc. cit.*) and Singh (*op. cit.*) in spite of all the controversies regarding its geological range.

Remarkably salient umbones and short posterior wing with straight and vertical distal margin render it necessary to exclude the two Liassic specimens of '*Avicula inequivalve* Sow.' (Toni, 1912, p. 35, pl. 2, figs. 9-10). Neither the type specimens nor those cited in the synonymy show such characters. They possibly belong to a distinct form much resembling *Avicula subcostata* Roemer (Lycett, 1863, p. 36, pl. 40, fig. 24) from the British Great Oolite and *Oxytoma* sp. (Trechmann, 1923, p. 272, pl. 12, fig. 8) from the Hettangian of New Zealand, which also have distally truncated posterior wing. *O.* sp. (Trechmann, 1923, p. 273, pl. 13, fig. 10 ; also Marwick,

1953, p. 94, pl. 11, fig. 9) from the Bathonian-Callovian of New Zealand at first sight appears to be similar to *O. inequivalve*, from which, however, it can be distinguished by its fewer (11) primary ribs and more posteriorly situated umbo. The Divesian species *Avicula peralata* Greppin (Loriol, 1899, p. 168, pl. 10, figs. 34-35) from Switzerland differs in having beaded costae both on the flank as well as on the obtuse-angled posterior wing. *Pteria münsteri* (of Bronn, Meek & Hayded, 1865, p. 80) from Jurassic of Upper Missouri can be easily confounded with *inequivalve* but for its more posteriorly situated umbo and almost straight posterior margin.

This is the first record of the species from the present area.

Horizon and Localities: Bed No. 1 (Oxtordian)—South and Southwest of Lodai and South of Dharng.

Oxytoma elongata sp. nov.

(Pl. I—1)

Material : Three left valves.

Derivation of Name : The trivial name refers to the elongated shape of the species.

Description : Shell of moderate size for the genus, inequilateral, obliquely elongated, semielliptical in outline with length to height ratio being 3: 2. Umbo acute, prominent and level with the hinge-line. Hinge-line straight, more or less half the length of the shell. Anterior margin gently arched and merging with the strongly convex, asymmetrical, ventral margin in a smooth curve, so as to make an obtuse arc ; antero-dorsal angle about 90° or slightly more. Posterior margin of the body feebly concave and roughly parallel to the ventral margin. Posterior end bluntly acute showing a slight upturning. Anterior wing small ; posterior of moderate size, acute and terminating at about middle of the distance between the umbo and posterior extremity of the shell, having a deep auricular notch below. Surface of the main body of the shell steps down suddenly to demarcate the posterior wing, and also near the ventral margin.

Shell-surface ornamented with about 14 narrow but prominent rounded primary radial ribs. Each interspace bears one secondary riblet ; the secondaries are faint in the anterior half of the surface but prominent posteriorly. Faint tertiaries are also present and are distinctly seen near the ventral margin. Posterior auricle is almost smooth, probably due to erosion, but originally it might have had some weak radial threads which are still present here and there.

Dimensions :

Sp. No.	Length (mm)	Height (%)	Inflation (%)
Holotype .. H/16/18	36.0	66.7	18.6

Remarks : From *O. inequivalve* (J. Sowerby) it differs mainly by its greater elongation and a shorter posterior wing. Moreover, sudden steep fall of the surface to the ventral margin along ventral-quarter of the shell-height (as seen in the holotype) has not been observed in any of the figures of *inequivalve*. *Oxytoma* sp. indet. (Singh, 1961, p. 63 ; Sp. No. MF/1/30) from the Oxfordian of south of Bhuj (Kutch), approximates the present one in general configuration but is less elongate and has lesser number of primary ribs.

Horizon and Localities : Bed No. 1 (Oxfordian)—Southwest of Lodai and south of Dhrang.

Oxytoma pseudocensoriensis sp. nov.
(Pl. I—2)

Material : One left valve.

Derivation of Name : The specific name pertains to its apparent similarity with *Oxytoma censoriensis* (Cotteau).

Description : Shell of moderately large size for the genus, inequilateral, trigonally ovate with a posteriorly oblique elongation (obliquity—25°) and a length to height ratio of about 4 : 3. Umbo pointed, prominent, and placed at about the anterior-third of the shell-length. Anterior margin almost straight and vertical, merging with the gently arched ventral one in a broad curve ; posterior margin gently concave and meeting the ventral one in a rather flat curve. Anterior wing broken. Posterior wing partly preserved and appears to have been, when complete, very acute and terminating much before the posterior extremity of the shell ; a sudden step-down from the convex body of the shell to the flat posterior auricle clearly demarcates the latter from the former; auricular notch is deep.

Shell-surface ornamented with 11 strong, primary radial ribs, separated by interspaces of unequal width. The interspaces on the posterior-half surface bear secondary riblets but those on the anterior-half are covered with numerous very weak, tertiary threads. Besides, some comarginal delicate threads, whenever preserved, are seen to cross over the radials producing an obtuse-angled V-shaped structure on the ribs.

Dimensions :

	Sp. No.	Length (mm)	Height (%)	Inflation (%)
Holotype	.. H/90/5	52.5	78.9	21.7

Remarks : Perhaps the nearest ally of the present species is *O. censoriensis* (Cotteau) as figured and described by Arkell (1933, p. 195, pl. 24, figs. 6-7) from the Berkshire Oolite Series and Corallian of England. However, it can be distinguished from that by its more elongate outline, greater obliquity, and much lesser number of primaries which do not increase in number with ma-

turity. The English specimens of *O. expansa* (Phillips), described by Arkell (1933, p. 190, pl. 24, figs. 1-5) are much taller, less inflated, and with greater number of primaries which increase in number with growth. *Oxytoma* sp. from the Middle Jurassic of New Zealand (Trechmann, 1923, p. 273, pl. 13, fig. 10 ; also Marwick, 1953, p. 94, pl. 11, fig. 9) is yet another form which closely agrees with the present one in number of primary radials and length to height ratio but its posterior end is tapering, anterior and ventral margins markedly convex, and the posterior wing decidedly larger. *O. inequivalve* (J. Sowerby) from the Oxfordian of Kutch (Cox, 1940, p. 98, pl. 6, figs. 9-12) differs by its smaller size, more anteriorly placed umbo, and greater number of primary radials. *Oxytoma* sp. from the Oxfordian of Kutch (Cox, 1940, p. 101, pl. 6, fig. 13) has 10 primary ribs but more secondaries. Moreover, it is less elongated and more inflated.

Horizon and Locality : Bed No. 1 (Oxfordian)—South of Kunaria.

Oxytoma bhattacharyai sp. nov.
(Pl. I—3-4)

Material : Two left valves.

Derivation of Name : Named after Professor Dr. A. K. Bhattacharya of the Department of Geology, Banaras Hindu University.

Description : Shell of moderately large size for the genus, obliquely elongated posteriorly ; obliquity angle of about 35°. Height slightly less than the length. Umbo prominent, pointed and situated at about anterior-quarter of the shell-length. Anterior and ventral margins convex and together form a semicircular arch. Posterior margin of the body almost straight. Wings not preserved.

Shell-surface ornamented with seven wiry prominent, primary radial costae with an indication for the presence of one more costa near the antero-dorsal region. Interspaces are of irregular width, the middle two being the widest, and covered with numerous weak tertiary threads.

Dimensions :

	Sp. No.	Length (mm)	Height (%)	Inflation (%)
Holotype	: H/11/103	46.0	93.0	21.7

Remarks : This species' holotype is unfortunately broken in the postero-ventral region and the dorsal half of the surface has been eroded. But its outline and typical ornamentation readily distinguishes it from all the known Jurassic species of *Oxytoma*. Hence, in spite of its rather incomplete state, a new name has been given to it.

J. Sowerby (1819, p. 77, pl. 244, fig. 1) has figured *Avicula costata* from the 'Clay over the Upper Oolite' or Bathonian (Syn. : Smith's *A. costata*, 1819) which shows eight costae over the main surface of the shell. But

this, unlike the present form, has the primaries projected beyond the margins and the tertiaries are also probably absent. Morris & Lycett have also figured a left valve of *A. costata* Sow. (1853, p. 15, pl. 2, fig. 6) from the Great Oolite of England which is characterised by 18 primary costae separated by smooth interspaces.

From *O. pseudocensoriensis* sp. nov. described earlier, the present species differs by its less elongated outline, fewer primary radials, and absence of secondary riblets. *O. inequivalve* (J. Sowerby) has more anteriorly placed umbo and a greater number of primaries.

The other specimen, No. H/7/66 (from Bed No. 9), is rather imperfectly preserved, bearing 10 primary costae and several tertiary threads in the interspaces. It has been assigned to the present form in view of its similar outline and absence of secondary riblets.

Horizons and Locality : Bed No. 9 (Middle Callovian) and Bed No. 1 (Oxfordian)—Southwest of Lodai.

Oxytoma sp.

(Pl. I—5)

Material : One left valve.

Description : The specimen is broken postero-ventrally but would have been of moderate size for the genus when complete. The umbo is acute, projecting dorsal to the hinge-margin and placed slightly posterior to the anterior extremity of the shell. The anterior margin and available part of the posterior one are convex, the latter rather feebly. The shell-surface is evenly convex except near the posterior margin where it descends rapidly. Whole of the anterior wing and a major portion of the posterior one has been broken away.

Shell-surface bears about 12 sharp, prominent primary radial ribs, all of which are distinct even in the umbonal regions. The interspaces are sufficiently wide and, except a few, each has a prominent secondary riblet, and numerous tertiary threads. In one of the interspaces (sixth from the anterior), however, there are two secondaries. Several weak radial threads are present on the available portion of the posterior wing.

Remarks : The incomplete state of preservation of this specimen does not allow its precise identification. If complete it would be a specimen taller than most Jurassic representatives of *Oxytoma*. From *O. inequivalva* (J. Sowerby) it differs by its fewer primaries as well as its very sharp ornamentation. *O. expansa* (Phillips) and *O. censoriensis* (Cotteau) have comparatively more numerous primaries. Moreover, in the last two species the secondaries near the ventral margin in adult shell assume the prominence of primaries, which is not the case in the present specimen. *Oxytoma* sp. (Cox, 1940, p. 101, pl. 6, fig. 13) is similar in ornamentation but is rather orbicular in outline and has slightly lesser number of primary radials.

Horizon and Locality : Bed No. 1 (Oxfordian)—Southwest of Lodai.

Genus Meleagrinnella WHITFIELD, 1885

Type species : *Avicula curta* HALL, 1852 ; Cox, 1941.

Meleagrinnella echinata (SMITH)

(Pl. I—6-8)

Avicula echinata J. Sowerby, 1819, p. 75, pl. 243, fig. 1 (*non* fig. 2).

Avicula echinata Sow. : Morris Lycett, 1853, p. 16, pl. 2, figs. 7, 7a-b.

Pseudomonotis cf. *echinata* Sow. : Trechmann, 1923, p. 271, pl. 13, figs. 14-15.

Pseudomonotis echinata (Smith) : Douglas & Arkel, 1932, pl. 12, figs. 7, 7a.

Echinotis echinata (W. Smith) : Marwick, 1935, p. 301, pl. 35, figs. 7-8; pl. 36, figs. 25-27.

Echinotis echinata (Smith) : Cox, 1940, p. 92, pl. 6, figs. 2-7.

Meleagrinnella echinata (W. Smith) : Maithani, 1968, p. 503, pl. 30, fig. 2.

Eopecten tegulatus (Morris & Lycett) : Maithani, 1968, p. 506, p. 30, fig. 6 (*non* Morris & Lycett).

Material : Numerous specimens. One of them (No. H/99/13e) associated with *Palaeoneilo indicus* Cox, *Nuculana* (*Praesaccella*) *juriana* Cox, *Grammatodon jurianus* Cox and *Nanonavis* (*Indogrammatodon*) *virgatus* (J. de C. Sowerby). Another specimen (No. H/123/42a) is attached on a slab with *Palaeonucula kaoraensis* Cox and *Trigonia* (*Latitrigonia*) *kheraensis* Cox. A third specimen (No. H/123/43a) is associated with *P. kaoraensis* Cox, *Camptonectes* (*Indonectes*) *obscurus* (J. Sowerby) and *Spondylopecten* sp. indet. Yet another specimen (No. H/123/46b) is attached on a piece of rock with *C. (I.) obscurus* (J. Sowerby).

Description and Remarks : The present material has one bivalved specimen, a few right and several left valves. They are characterised by small- to medium-sized, inequivalved shells, orbicular to ovate in outline with much variation in length to height and length to inflation ratios as is clearly seen in the table of dimensions given below. As a rule, left valves are more convex than the right ones which may be occasionally almost flat. Nature of the umbones is also highly variable from narrow pointed to blunt and rounded as well as flush with the cardinal margin or projecting with incurving to a lesser or greater degree above it. A glance at the table of dimensions will also show that the number of primary radials on the left valve occasionally bifurcating, may be as low as 35 or as high as 55. The interspaces separating the radials are of variable width with, at times, intercalating secondaries. Some of the well preserved specimens show development of nodosites produced by the concentric threads at their intersections with the radials. The relationship between inflation and number of radials is not constant and it is not uncommon to find strongly inflated specimens with less numerous fine radials and weakly inflated ones with greater number of relatively thicker radials,

Some of the individuals agree perfectly well with the typical specimens of *M. echinata* (Smith) figured by authors quoted in the synonymy. There are several other specimens which present a mingling of characters of *M. echinata* and *M. braamburiensis* (Phillips) as figured by Douglas & Arkell (1932, p. 163, pl. 12, figs. 5, 5a, 6) who consider both the species to be distinctly separate, morphologically as well as stratigraphically. But in view of the Kutch examples now recorded the supposed conchological distinctions can not be maintained. Moreover, all the examples are from the Callovian and hence it is difficult to conceive the former as Cornbrash form and the latter as Divesian. Cox (1940, p. 95) also feels that 'the difference in stratigraphical position of the shells of the *echinata* and *braamburiensis* types observable in Great Britain does not apply to India'. It is thus clear that this species is extremely variable and it seems unnecessary to keep *braamburiensis* apart from it.

M. radiata (Trautschold), described from the Oxfordian and Kimmeridgian of Africa (Cox, 1965, p. 48, pl. 5, figs. 1-4) is said to differ from *echinata* in its less inflated left valves and more numerous but irregular and weaker radials. Although with the availability of convincing proof of highly variable nature of *echinata*, Trautschold's form does not seem to be morphologically distinct, it has been upheld for its different geological horizon.

The two figures of *M. echinata* given by Marwick (1953, p. 94, pl. 10, figs. 5, 6) bear such thick costae that their reference under the present species seems erroneous.

Pseudomonotis durangensis Imlay (1940, p. 404, pl. 53, figs. 1-4, 8-10) and *P. tamaulipana* Imlay (1940, p. 405, pl. 53, figs. 5-7, 11-15), from Oxfordian and Kimmeridgian of Mexico respectively, do not differ except their provenance from different areas and geological horizons.

The Great Oolite species *Avicula clathrata* Lycett (1863, p. 36, pl. 40, figs. 7, 7a, 7b) is closely comparable to the present form but can be distinguished by knotted radial riblets which are angular, widely spaced and neither bifurcate nor their interspaces contain free secondaries. In addition, the right valve of *clathrata* is smooth. Left valves of *Pseudomonotis ovalis* (Phillips), as described and illustrated by Arkell (1933, p. 198, pl. 27, figs. 5-11) from the British Corallian horizons, scarcely differ in dimensions and ornamentation from the present ones but the right valves bear more numerous and prominent radial costae crossed over by strong concentric threads producing a reticulate pattern.

Maithani has recorded a single specimen of this species from his 'Bed No. 21' (G.S.I. Type No. 17917) and designated it as 'Holotype' (*op. cit.*, p. 504)!

The species was so far unknown from the present area. Its present range up to Upper Callovian beds is of interest.

Dimensions :

Sp. No.	Length (mm)	Height (%)	Inflation (%)	No. of Primary radials
H/28/i/95	12.0	95.0	20.8—RV	about 12
H/28/i/94	12.0	98.3	15.0—RV	15
H/47/i/52	15.5	100.7	38.7—BV	35 on LV
H/28/i/86	21.5	106.0	20.5—LV	about 40
H/123/40	16.0	106.3	38.8—LV	about 40
H/32/109	20.5	107.3	27.8—LV	about 55
H/23/i/13	18.2	112.1	41.2—LV	about 55
H/123/43a	17.8	112.4	34.8—LV	—

Horizons and Localities : Bed No. 15 (Lower Callovian)—North of Boladi and south of Fulae and Dhrang ; Bed No. 13 (Lower Callovian)—South of Lodai, Kotai and Dhrang ; Bed No. 12 (Lower Callovian)—South of Kotai ; Bed No. 5 (Middle Callovian)—Southwest of Lodai ; Bed No. 2 (Upper Callovian)—East of Rudra Mata.

Meleagrinnella cf. ovalis (PHILLIPS)

(Pl. 1—9)

Material : One left valve associated on a slab with some fragmentary specimens of *Palaeonucula*, *Grammatodon*, *Dentalium*, etc.

Description : Shell small for the genus, almost equilateral, bialate, obliquely ovate, and strongly and uniformly convex. Umbo prominent, acute, opisthogyrous, salient dorsal to the hinge-line which is about two-thirds the length of the shell. Anterior margin strongly convex, merging imperceptibly into gently convex ventral one. Posterior margin feebly convex, meeting the ventral one in a rounded-off acute angle of slightly less than 90°. Antero-dorsal angle is obtuse while the postero-dorsal one is 90°. Wings small and equal.

Surface ornamented with about 55 primary radial riblets separated by interspaces, a few with secondary threads, of twice their width.

Dimensions :

Sp. No.	Length (mm)	Height (%)	Inflation (%)	No. of primary radials
H/99/7	8.00	100.0	43.8	55

Remarks : The present specimen very closely approximates the figures and especially no. 7 of *Pseudomonotis ovalis* (Phillips) given by Arkell (1933, p. 198, pl. 27, figs. 5-11) in its bialate shape, L/H ratio, strong inflation, nature of radial ornamentation, and acute, salient umbo. However, this example does not have the numerous

prominent concentrics, and comes from a slightly lower horizon. Another similar form from the English Corallian, *P. laevis* (Blake & Hudleston) described by Arkell (1933, p. 200, pl. 24, figs. 11, 11a, 12,) can be readily distinguished by its shorter hinge, more convex anterior margin, greater obliquity, an obtuse postero-dorsal angle, and absence of radials from the surface. The specimens of *M. echinata* just discussed can be distinguished by their different outline.

Horizon and Locality : Bed No. 2 (Upper Callovian)—East of Rudra Mata.

Meleagrinnella cf. *maltonensis* (ARKELL)
(Pl. I—10)

Material : One bivalved specimen.

Description : Shell of medium size for the genus, inequivalve, highly inequilateral, obliquely ovate and moderately inflated. Umbo prominent, pointed, placed at about anterior third of the shell-length ; umbo of the left valve slightly salient dorsal to the short and straight hinge-line, while that of the right one flush with it. Anterior margin strongly convex, merging with the convex and posteriorly deflected ventral one in a smooth curve ; posterior margin gently convex, and meeting the ventral one in a broad curve.

Surface of the left valve ornamented with about 40 low, radial riblets separated by interspaces of equal width ; the radials on the anterior and posterior sides weaker and slightly undulatory. A few of the radials bifurcate, such that their total number near the ventral margin is about 50. Surface of the right valve almost smooth ; about 10 faint, broad and flat radials can, however, be seen in grazing light.

Dimensions :

Sp. No.	Length (mm)	Height (%)	Inflation (%)
H/66/40	c. 16.0	86.3	43.8

Remarks : The present specimen resembles well with *Pseudomonotis maltonensis* Arkell (1933, p. 199, pl. 24, fig. 13), particularly its holotype, in outline and L/H ratio but it has fewer and coarser primaries with wider interspaces. In addition, the holotype of *maltonensis* is known from a horizon (Oxfordian) higher than that of this specimen (Callovian). *P. laevis* (Blake & Hudleston), described by Arkell (1953, p. 200, pl. 24, figs. 11, 11a, 12), has a similar outline but differs mainly by its taller and smooth shell.

Horizon and Locality : Bed No. 9 (Middle Callovian)—Southwest of Lodai.

DISCUSSION

Earlier, only two species of *Oxytoma* and one of *Meleagrinnella* were known in Kutch. To the existing list

has now been added four to the former and two to the latter respectively, of which three forms of *Oxytoma* are new. Since only *O. inequivalve* and *M. achinata* are recorded and studied previously, it would be proper only to discuss about the range of these species.

Considering *O. inequivalve* first we find that the species has a wide geographical and stratigraphical range. In India, however, it has been found, so far, restricted in the Oxfordian only which is perhaps absent in the 'islands' and is quite rich in its ammonoid content in the mainland of Kutch. It may be mentioned here that the lithological separation between the Oxfordian and the underlying Callovian shales is generally very difficult in Kutch. At some places the basal Oxfordian is rather poor in its ammonoid content and here *O. inequivalve* may be satisfactorily used for distinction between the Callovian and the Oxfordian horizon.

M. echinata is also a species of considerably long range but in Kutch is found restricted to a comparatively shorter time period. Here some specimens of *echinata* show conchological characters akin to *M. braamburiensis* which is a Divesian species from Yorkshire, Britain. However, in Kutch this species never occurred at that stage and has always been recorded from the Callovian ('macrocephalus' to 'athleta' beds) and the so-called Bathonian horizons. Here it may be recalled that Cox's (1940) recognition of Bathonian (particularly for the 'island' exposures) and other horizons is based upon Spath's (1927—33) ideas which have been considerably modified since then. In the 'islands' ammonoids are very scarce and it is very difficult to assign an age to rocks of this part of Kutch. In the western Bela Island *echinata* does not occur below the 'golden oolite' and associated conglomerate bed (no. 20) which according to Singh and Rai (1977) marks the Bathonian—Callovian junction. In the eastern Bela Island also this is true (Kacker, personal communication—1976). There is no record of its occurrence from other 'islands' as well. In the mainland *echinata* has not been found outside the Callovian horizon. However, *M. echinata* has been reported from the lowest bed (no. 21—dark limestone) of the Habo dome by Maithani (1968) who has assigned it a Bathonian age. An examination of the rock revealed that it is actually from some younger bed (Callovian) which might have been locally charred black by some nearby igneous intrusion.

Thus it can be concluded that in Kutch *inequivalve* marks the Oxfordian and *echinata* the Callovian, the latter being particularly useful in regions where ammonoids are scarce such as the 'islands'.

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EXPLANATION OF PLATE

PLATE I

1. *Oxytoma elongata* sp. nov.
Sp. No. H/16/18 (holotype), LV ext. (× 1) from Bed No. 1 (Oxfordian), S of Dhrang.
2. *Oxytoma pseudocensoriensis* sp. nov.
Sp. No. H/90/5 (holotype), LV ext. (× 1) from Bed No. 1 (Oxfordian), S of Kunaria.
- 3-4. *Oxytoma bhattacharyai* sp. nov.
3. Sp. No. H/7/66, LV ext. (× 1) from Bed No. 9 (M. Callovian), SW of Lodai.
4. Sp. No. H/11/103 (holotype), LV ext. (× 1) from Bed No. 1 (Oxfordian), SW of Lodai.
5. *Oxytoma* sp.
Sp. No. H/2/28, LV ext. (× 1) from Bed No. 1 (Oxfordian), SW of Lodai.
- 6-8. *Meleagrinnella echinata* (Smith)
6. RV ext. of the sp. no. H/28/i/94 from Bed No. 15 (L. Callovian), S of Fulae; a—(× 1), b—enlarged view (× 2) of the same to show the nature of the wings.
7. Sp. No. H 123/40 LV ext. (× 1) from Bed No. 13 (L. Callovian), S of Lodai
8. Sp. No. H/47/i/51 LV ext. (× 1) from Bed No. 15 (L. Callovian), N of Boladi
9. *Meleagrinnella* cf. *ovalis* (Phillips)
Sp. No. H/99/7, LV ext. (× 2.5) from Bed No. 2 (U. Callovian), E of Rudra Mata.
10. *Meleagrinnella* cf. *maltonensis* (Arkell)
Sp. No. H/66/40, LV ext. (× 1.6) from Bed No. 9 (M. Callovian), SW of Lodai.

