

Neogene Pectinid Bivalves from Kolasib of Mizoram, Northeastern India

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Abstract

Neogene bivalve fauna from the Middle and Upper Bhuban units of Bhuban Formation of the Surma Group have been collected from stone quarries of Kolasib area of Mizoram (Northeastern India). These quarries are located along the sides of Silchar-Kolasib road section. Seven bivalve taxa of the family Pectinidae are identified. *Pecten (Pecten) kachharai* is recorded as the new species; *Chlamys (Argopecten) senatoria* (Gmelin) var. *kolasibensis* as a new variety and *Cyclopecten (Chlamydella) sp.*, *Parvamusium sp.* and *Pecten sp.* are kept in open nomenclature because of poor preservation. Most of the taxa are represented by a single valve or a few disarticulated valves. These pectinids form only a small part of the fossil groups present in the Bhuban Formation of Kolasib area. Though bivalves constitute main component of the fossil fauna, gastropods, echinoids, decapods, fish teeth, barnacles and scaphopods are also present in the study area.

Keywords: Neogene, Pectinid bivalves, Bhuban Formation, Surma Group, Kolasib, Mizoram.

Introduction

Invertebrate fauna are abundant in the Surma Group of Mizoram, both in number and diversity. These generally occur as disarticulated valves and their preservation is not very satisfactory. The specimens are mostly in the form of moulds or casts. Occasionally, external shells are encountered. Comparing to other taxa, pectinid bivalves are rather better preserved, though few are broken due to strong bottom currents and/or their predators.

Middle and Upper Bhuban units of Bhuban Formation of the Surma Group are exposed in the Kolasib area of Mizoram State. Middle Bhuban unit is argillaceous - consisting of shales, silty shales, sandy shales and alternations of siltstones/claystones with shales, whereas Upper Bhuban unit is mainly arenaceous - comprising sandstones with sizeable component of shales and siltstones-shales alternations. The whole sequence has been grouped into two biozones (Mazumder 2004, 2010): Zone I. *Nucula (Lamellinucula) aff. pulchra - Nuculana (Nuculana) virgo*, Zone II. *Chlamys (Argopecten) senatoria - Tellina (Tellinella) pseudohilli*. Rock succession of the Middle Bhuban unit fall within Zone I of Aquitanian age, and those of Upper Bhuban belong to Zone II of Aquitanian-Burdigalian to Burdigalian age.

Seven pectinid bivalves are identified from the Kolasib area of Mizoram with one new species and a new variety. These are *Parvamusium sp.*, *Cyclopecten (Chlamydella) sp.*, *Chlamys (Chlamys) prototranquebaricus* (Vredenburg), *Chlamys (Chlamys) quilonensis* Dey,

Chlamys (Argopecten) senatoria (Gmelin), *Chlamys (Argopecten) senatoria* (Gmelin) var. *kolasibensis* n.var., *Pecten (Pecten) kachharai* n.sp. and *Pecten* sp.

All the specimens are housed in the Palaeontology Section of the Department of Geology, Karimganj College, Karimganj, Assam.

[Abbreviations used here are l - length, h - height, t - inflation, v - valve, LV - left valve, and RV - right valve.]

Fossil Localities

Pectinid bivalves are collected from eight localities from the Kolasib area of Mizoram (Fig.1). Of these, locality number K13 only is in the Middle Bhuban unit and remaining localities marked as K2, K5, K7, K8, K10, K16 and K17 are in the Upper Bhuban unit. Lithostratigraphic sections of different localities are given in Fig. 2. Brief locality details are as follows:

Locality K2: It lies as a small exposure at T. Hall Veng on the left side road cutting of the Diakkawn - Electric Veng link road. The exposed thickness of grey sandstone bed = 6.7m, calcareous sandstone bed = 0.5m and brown silty-sandstone bed = 1.4m (Fig. 2a). Brown silty-sandstone bed is giving pectinid bivalves.

Locality K5: It lies in a large exposure at Quarry Veng in a big stone quarry situated near 2 km stone of the Kolasib - Silchar road and lies on the left side of the road section. The exposed thickness of grey sandstone bed = 14.6m, calcareous sandstone bed = 1.2m and brown silty-sandstone bed = 1.4m (Fig. 2b). Grey sandstone bed and the brown silty-sandstone bed yielded pectinid bivalves.

Locality K7: This locality is in the Oholeva Veng *nala*. Here the exposed thickness of brown silty-sandstone bed = 3.2m, silty-shale bed = 3.0m and conglomerate bed = 0.4m (Fig. 2c). Brown silty-sandstone bed is yielded pectinid bivalves.

Locality K8: It is located at about 4.5 km from Kolasib in the Kolasib - Silchar road. The exposed thickness of grey sandstone bed = 10.0m, calcareous sandstone bed = 0.4m, brown silty-sandstone bed = 1.0m and conglomerate bed = 0.25m (Fig. 2d). Brown silty-sandstone bed yielded pectinid bivalves.

Locality K10: It is near 92 km stone on the Silchar - Kolasib road. The exposed thickness of grey sandstone bed = 8.5m, calcareous sandstone bed = 0.8m and brown silty-sandstone bed = 1.2m (Fig. 2e). Here also brown silty-sandstone bed yielded pectinid bivalves.

Locality K13: It is in the form of a small exposure at right side of Kolasib - Aizawl road at about 1.3 km from Kolasib Town. The exposed thickness of crumpled shale bed = 4.4m and silty-shale bed = 0.8m (Fig. 2h). Silty-shale bed produces pectinid bivalves.

Locality K16: It is a small sandstone quarry, about 400m towards Kolasib from locality K8. The exposed thickness of jointed and bedded sandstone bed = 5.5m, grey sandstone bed = 2.7m, calcareous sandstone bed = 1.5m and brown silty-sandstone bed = 4.0m (Fig. 2f). Only the last bed is yielding pectinid bivalves.

Locality K17: It is a small stone quarry, left side of the Kolasib - Silchar road at about 1.7 km from Kolasib. The exposed thickness of grey sandstone bed = 8.4m, calcareous sandstone bed = 1.3m, brown silty-sandstone bed = 7.2m and silt-shale alternation bed = 1.8m (Fig. 2g). Here also the last bed is giving pectinid bivalves.

Systematic Paleontology

Phylum	Mollusca Linnaeus, 1758
Class	Bivalvia Linnaeus, 1758
Subclass	Pteriomorphia Beurlen, 1944
Order	Pterioida Newell, 1965
Suborder	Pteriina Newell, 1965
Superfamily	Pectinacea Rafinesque, 1815
Family	Pectinidae Wilkes, 1810 [emend. Waller, 1978]
Genus	<i>Parvamusium</i> Sacco, 1897

Type species: *Parvamusium duodecimlamellatum* Bronn, 1831; OD. Miocene; Italy.

Parvamusium sp.

(Pl. 1, fig. 15)

Material	: One partly broken right valve.
Dimension	: Sp. no. K5/B/47, l = 36.20 mm, h = 39.00 mm, t = 3.20 mm, h/l = 107.73% and t/l = 8.84%.
Horizon	: Upper Bhuban unit, Bhuban Formation, Surma Group. .
Locality	: K5.

Description and remarks: Valve large, seems to be orbicular and compressed with median and low umbo. Umbonal angle more than ninety degrees. The antero-dorsal, anterior and antero-ventral margins merge smoothly to form a broad curve; postero-dorsal, posterior, postero-ventral margins and the auricles are broken. The species occurred in association with oysters, anomiid bivalves and fish teeth.

Shell surface covered with about 30 radial ribs, which are flat, prominent and separated by much narrow and deep interspaces.

Since the specimen is incomplete and poorly preserved, its specific identification and comparison with other known forms is not possible.

Genus *Cyclopecten* Verrill, 1897

Type species: *Cyclopecten pustulosus* Verrill, 1893 (= *Pecten pustulosus* Verrill, 1893); SD Sykes, Smith, and Chick, 1898. Recent; N. Foundl.

Subgenus *Chlamydella* Iredale, 1929

Type species: *Chlamydella favus* Hedley, 1902; OD. Recent; Australia.

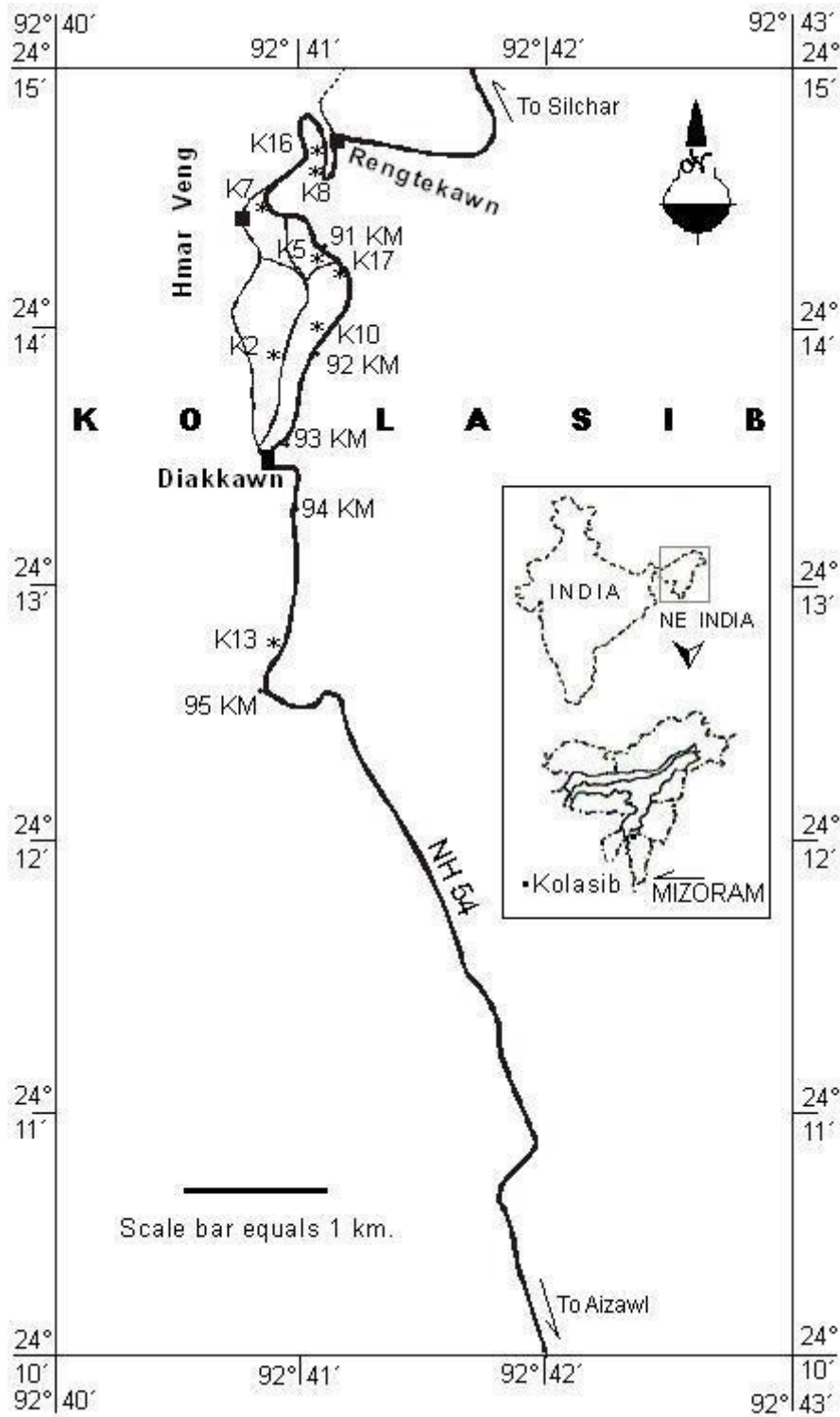


Fig. 1: Fossil localities in Kolasib, Mizoram.

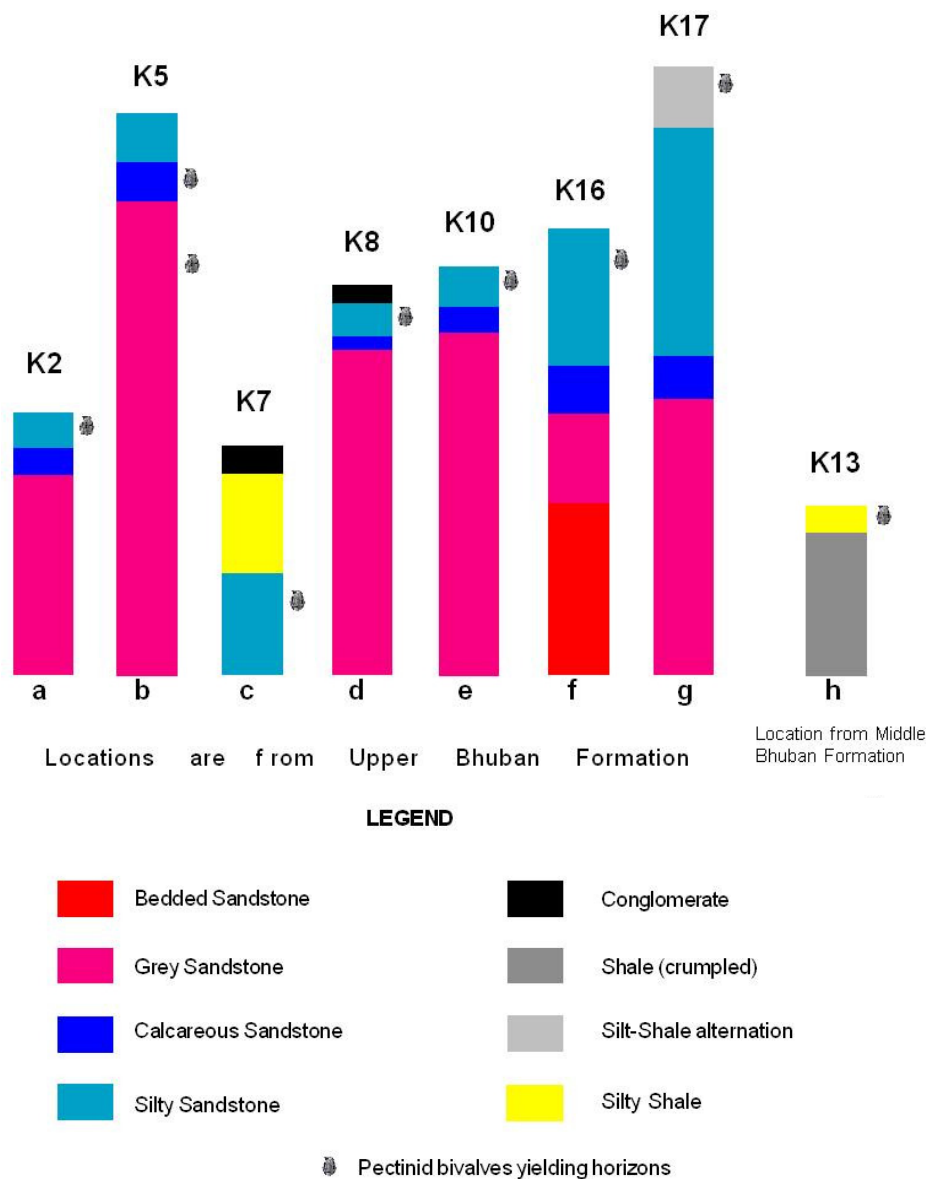


Fig. 2: Lithostratigraphic sections of the pectinid bivalves yielding localities in Kolasib, Mizoram.

Cyclopecten (Chlamydella) sp.
 (Pl. 1, fig. 8)

Material : One left valve only.
 Dimension : Sp. no. K13/B/5, l = 5.50 mm, h = 4.50 mm, t = 0.80 mm,
 h/l = 81.82% and t/l = 14.55%.
 Horizon : Middle Bhuban unit, Bhuban Formation, Surma Group. .
 Locality : K13.

Description and remarks: Valve small, sub-rounded and slightly inequilateral. Umbo pointed, sharp, sub-median; umbonal angle about 90°. Anterior, posterior and ventral margins are rounded. Surface ornamented with commarginal lamellae, which are flat towards ventral margin. Anterior auricle is triangular and is as long as the anterior margin, posterior one slit-like and long. Free margin of the anterior auricle is almost vertical and free margin of the posterior auricle is inclined and parallel to the postero-dorsal margin of the disc.

The Kolasib specimen can be compared with *Chlamydella* (*Chlamydella*) *favus* Hedley (Hertlein, 1969, in Moore, R.C. *et al.*, p. N353, fig. C75,4a); the sub-genotype species which is a Recent form reported from Australia by its small size, by fine concentric growth lines and by the nature of anterior auricle; but it is different from the Kolasib form for having antero-posterior elongation and triangular posterior auricle. Author has not come across any other comparable form of the present species. However, *Variamussium pumilum* (Lamarck) recorded from Middle Jurassic of Iran by Cox (1936, p. 19, Pl. I, fig. 18) is certainly different in possessing acute ventral margin and different style of auricles.

The specimen appears to be a new species, however, for the want of better preserved specimens, it has been provisionally described here as *Cyclopecten* (*Chlamydella*) sp.

Genus *Chlamys* Röding, 1798

Type species: *Pecten islandicus* Müller, 1776; SD Herrmannsen, 1847. Recent; North Atlantic.

Subgenus *Chlamys* (s.s.)

Chlamys (*Chlamys*) *prototranquebaricus* (Vredenburg)
(Pl. 1, figs.5,6,7)

1928. *Pecten* (*Chlamys*) *prototranquebaricus* Vredenburg, p. 433, Pl. XXV, figs. 7-12.

Material : Three isolated left valves.
Horizon : Upper Bhuban unit, Bhuban Formation, Surma Group.
Locality : K5 and K10.
Dimensions (mm):

Sp. no.	l	h	t	h/l%	t/l%	v
K10/B/3	9.20	9.20	1.80	100.00	19.57	LV
K5/B/27	23.20	23.20	3.50	100.00	15.09	LV
K5/B/28	23.00	24.00	3.80	104.35	16.52	LV

Remarks: Three isolated valves are characterized by small to medium size, flat to orbicular nature and equal or slightly more height than the length. Valves are decorated with 18-20 simple, prominent, semi-cylindrical ribs. The interspaces are almost equal or slightly wider than the ribs. All these characters tally well with the Mekran form *Pecten* (*Chlamys*) *prototranquebaricus* Vredenburg (1928, *op. cit.*). Hence, they are assigned to this species.

Chlamys is now considered as a separate genus (Newell, 1969, in Moore, R.C. *et al.*, p. N355). Therefore, this form has been re-designated as *Chlamys* (*Chlamys*) *prototranquebaricus* (Vredenburg).

***Chlamys (Chlamys) quilonensis* Dey**
 (Pl. 1, figs. 9,10,11)

1962. *Chlamys (Chlamys) quilonensis* Dey, p. 43, Pl. II, figs. 8, 9.
 1992. *Chlamys (Chlamys) quilonensis* Dey: Tiwari MS, p. 75, figs. 7, 8.

Material : Two left valves and a right valve.
 Horizon : Upper Bhuban unit, Bhuban Formation, Surma Group.
 Locality : K8.
 Dimensions (mm):

Sp. no.	l	h	t	h/l%	t/l%	v
K8/B/54	15.20	17.00	4.50	111.84	29.61	LV
K8/B/79	16.80	20.90	3.50	124.40	20.83	RV
K8/B/80	16.80	20.20	3.40	120.24	20.24	LV

Remarks: The valves are thin, feebly convex and oblique, more in height than length and covered with 16 rounded ribs, which are squamose near the margin. The interspaces have the same width as the ribs. Above description tallies well with the *Chlamys (Chlamys) quilonensis* Dey (1962, *op. cit.*), hence, the assignment.

The specimens are compared with GSI type nos. 16419-20 and noticed that the Kolasib examples are little more oblique and convexity of valves is slightly on a higher side.

Subgenus ***Argopecten*** Monterosato, 1899

Type species: *Pecten solidulus* Reeve, 1853; OD. Recent; Unknown locality.

***Chlamys (Argopecten) senatoria* (Gmelin)**
 (Pl. 1, figs. 1,2,4)

1791. *Ostrea senatoria* Gmelin, p. 3327.
 1840. *Pecten articulatus* J. de C. Sowerby, Pl. XXV, fig. 15.
 1853. *Pecten favrei* d'Archiac & Haime, p. 270, Pl. XXIV, fig. 5.
 1927. *Chlamys senatoria* (Gmelin): Cox, p. 45. Pl. VII, figs. 1-3; p. 75, Pl. XV, fig. 3; Pl. XXVII, fig. 10.
 1928. *Pecten (Chlamys) senatoria* var. *soomrowensis* Sowerby: Vredenburg, p. 434.
 1928. *Chlamys senatoria* (Gmelin): Douglas, p. 2, Pl. VIII, figs. 3-5.
 1929-30. *Chlamys senatoria* (Gmelin): Cox, p. 191.
 1930. *Chlamys senatoria* (Gmelin): Cox, p. 108, Pl. XIII, fig. 21.
 1936. *Chlamys senatoria* (Gmelin): Cox, p. 54, Pl. V, fig. 18; Pl. VI, fig. 9.
 1939. *Chlamys senatoria* (Gmelin): Mukerjee, p. 31, Pl. I, fig. 2; Pl. II, figs. 9, 10.
 1974. *Chlamys senatorius* (Gmelin): Dance, p. 234.
 1992. *Chlamys (Chlamys) senatoria* (Gmelin): Tiwari MS, p. 73, Pl. VII, figs. 10, 11; Pl. VIII, figs. 1-3.
 1997. *Chlamys (Argopecten) senatoria* (Gmelin): Jain MS, p. 72, Pl. XI, figs. 15-18.

Material : Two left valves and a right valve.
Horizon : Upper Bhuban unit, Bhuban Formation, Surma Group.
Locality : K5, K7, K8 and K16.
Dimensions (mm):

Sp. no.	l	h	t	h/l%	t/l%	v
K8/B/5	17.20	20.80	3.20	120.93	18.60	LV
K7/B/2	15.50	17.30	2.80	111.61	18.06	RV
K5/B/51	10.00	11.60	1.80	116.00	18.00	LV

Remarks: All the specimens are tall with an acute umbonal angle. Their surface covered with 21-24 narrow and prominent radial ribs that are undivided. The ribs have evenly spaced squamae, which are more distinct in specimen no. K8/B/5. Above characters of the specimens tally well with the tall variety of *Chlamys senatoria* (Gmelin), (Cox, 1936, p. 55, Pl. V, fig. 18) reported from the Burdigalian of Persia. Hence the specific assignment.

***Chlamys (Argopecten) senatoria* (Gmelin) var. *kolasibensis* n.var.**
(Pl. 1, fig. 3)

Material: One left valve, sp. no. K16/B/8, l = 13.80 mm, h = 18.50 mm, t = 3.00 mm, h/l = 134.06% and t/l = 21.74%.

Horizon: Upper Bhuban unit, Bhuban Formation, Surma Group.

Locality: K16.

Derivation of Name: Specific name is assigned after its occurrence in the Kolasib area, Mizoram.

Description: The specimen is small, compressed, sub-orbicular and symmetrical except the auricles. Valve slightly convex, the convexity is maximum about one-third of the valve height from the hinge. Surface of the valves ornamented with about 33 fine radial ribs separated by almost equal interspaces, which is clear towards the ventral half of the valve. Ornamentation on the rest of the valve including auricles is not clear due to worn-out nature of the valve. Umbonal angle 65 degrees. Hinge straight, hinge length 8.5 mm which is 62 percent of total length of valve. Auricles unequal in size, anterior auricle longer than the posterior one without any byssal notch, posterior auricle smaller and posterior margin of auricle is steeply sloping producing a blunt angle with the hinge whereas the anterior auricle makes an acute anterior end.

Remarks: Overall configuration of the solitary valve matches with *Chlamys senatoria* (Gmelin) (Cox, 1936, p. 55, Pl. V, fig. 18; also reported in this paper). But the present specimen have higher height-length ratio, number of ribs more and finer than the *Chlamys senatoria* (Gmelin). The species is also comparable to *Chlamys sentis* Reeve, a Caribbean form specially with the left valve, illustrated by Dance (1974, p. 234), for its size and nature of anterior and posterior auricles. However, the Caribbean *Chlamys sentis* Reeve has 50 fine radial ribs and is narrowly fan shaped.

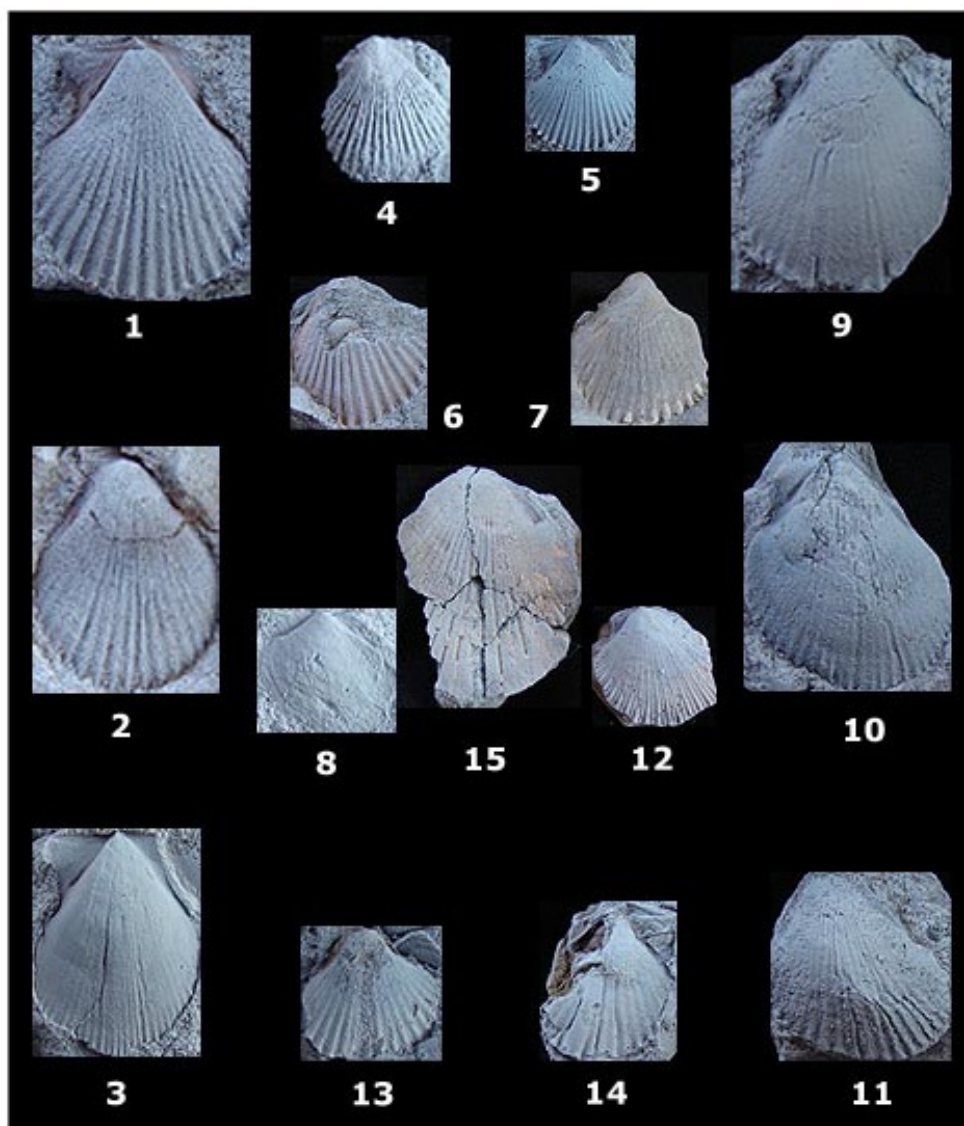


Plate-1: fig. 1, 2, 4. *Chlamys (Argopecten) senatoria* (Gmelin) - 1. Locality K8, Upper Bhuban unit, sp. no. K8/B/5, left valve, x2; 2. Locality K7, Upper Bhuban unit, sp. no. K7/B/2, right valve, x2; 4. Locality K5, Upper Bhuban unit, sp. no. K5/B/51, left valve, x2. **3. *Chlamys (Argopecten) senatoria* (Gmelin) var. *kolasibensis* n.var.** - Locality K16, Upper Bhuban unit, sp. no. K16/B/8, left valve, x2. **5, 6, 7. *Chlamys (Chlamys) prototranquebaricus* (Vredenburg)** - 5. Locality K10, Upper Bhuban unit, sp. no. K10/B/3, left valve, x2; 6. Locality K5, Upper Bhuban unit, sp. no. K5/B/28, left valve, x1; 7. Locality K5, Upper Bhuban unit, sp. no. K5/B/27, left valve, x1. **8. *Cyclopecten (Chlamydella)* sp.** - Locality K13, Middle Bhuban unit, sp. no. K13/B/5, left valve, x4. **9, 10, 11. *Chlamys (Chlamys) quilonensis* Dey** - 9. Locality K8, Upper Bhuban unit, sp. no. K8/B/79, right valve, x2; 10. Locality K8, Upper Bhuban unit, sp. no. K8/B/80, left valve, x2; 11. Locality K8, Upper Bhuban unit, sp. no. K8/B/54, left valve, x2. **12. *Pecten* sp.** - Locality K2, Upper Bhuban unit, sp. no. K2/B/15, left valve, x1. **13, 14. *Pecten (Pecten) kachharai* n.sp.** - 13. Locality K16, Upper Bhuban unit, sp. no. K16/B/22, right valve, x1; 14. Locality K17, Upper Bhuban unit, sp. no. K17/B/1, right valve, x1. ***Parvamusium* sp.** - Locality K5, Upper Bhuban unit, sp. no. K5/B/47, right valve, x1.

Genus *Pecten* Müller, 1776

Type species: *Ostrea maxima* Linné, 1758; SD Schmidt, 1818. Recent; English Channel.

Subgenus *Pecten* (s.s)

Pecten (Pecten) kachharai n.sp.

(Pl. 1, fig. 13,14)

Material : Two ill preserved right valves.
Horizon : Upper Bhuban unit, Bhuban Formation, Surma Group.
Locality : K16 and K17.
Dimensions (mm):

Sp. no.	l	h	t	h/l%	t/l%	v
K16/B/22	23.00	21.50	3.20	93.48	13.91	RV
K17/B/1	24.50	23.60	3.50	96.33	14.29	RV

Derivation of Name: The specific name is given after Prof. Rajendra P. Kachhara, retired professor in geology of Nagaland University, Kohima.

Diagnosis: Shell medium in size, slightly longer than its height with moderate inflation, umbonal angle 70-82 degrees. Extension of both the auricles are within their respective margins. Surface covered with 18-24 radial ribs with almost equal interspaces.

Description: Shell medium sized, attaining a height of 24 mm, longer than high with moderate inflation. Umbonal angle 70-82 degrees. Both the auricles are not preserved in any of these specimens. However, anterior auricle is present in sp. no. K17/B/1 and reveals that it is shorter than the anterior margin; posterior auricle is there in sp. no. K16/B/22 which seems to be smaller than the anterior auricle and shorter than the posterior margin. Free margin of the anterior auricle is convergent to the disc where as the free margin of the posterior auricle is inclined posteriorly. Byssal notch cannot be ascertained. Valves ornamented with 18-24 rounded, prominent radial ribs with almost equal interspaces.

Remarks: The Miocene species namely *Pecten protosenatorium* Noetling (1901, p. 115, Pl. III, Fig. 11; Pl. IV, figs. 1a-b) from Myanmar has similar outline as the Kolasib form but can be distinguished by its primary as well as secondary ornamentation.

Pecten nearchi Vredenburg (1928, p. 437, Pl. XV, figs. 5, 13) from Mekran Bed is known by a right valve has comparable inflation and height-length ratio but differs from the present species in respect of its large size and in having fine wide spread deep grooves all over the surface.

Pecten sp.

(Pl. 1, fig. 12)

Material : One ill preserved left valve.
Dimension : Sp. no. K2/B/15, l = 22.50 mm, h = 20.00 mm, t = 3.80 mm, h/l = 88.89% and t/l = 16.89%.
Horizon : Upper Bhuban unit, Bhuban Formation, Surma Group.
Locality : K2.

Description and remarks: Valve medium sized, orbicular, inequilateral, length slightly exceeding the height. The antero-dorsal margin concave, postero-dorsal one appears to be straight, other margins are broken. Auricles are not clear in the specimen, but the anterior auricle seems to be triangular in shape and separated from the disc by a deep channel. The free margin of the anterior auricle is vertical. Umbonal region shows only about 18 radials, which becomes broader and bifurcated towards the ventral margin, the interspaces of radials are narrow.

This may be a new species. But owing to its poor preservation and fragmentary nature, authors are refraining from erecting a new species.

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