

Apertural modifications and jaw structures of placenticeratid ammonites from the Upper Cretaceous Bagh Group, central India

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With 3 figures

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Abstract: Sexual dimorphs among Cretaceous ammonites are mainly distinguished by the differences in relative adult size and strength of ornamentation. Microconchs of the Cretaceous family Placenticeratidae are characterised by a terminal constriction and a ventral rostrum which are unique in Cretaceous ammonites while macroconchs show a simple apertural contraction. Jaws are, in general, extremely rare in Cretaceous ammonites. Two species of *Placenticeras* reported here have jaw structures.

Zusammenfassung: Bei kretazischen Ammoniten läßt sich Sexualdimorphismus hauptsächlich durch unterschiedliche Adultgröße und die Stärke der Skulptur identifizieren. Es wird gezeigt, daß bei der kretazischen Familie Placenticeratidae auch Modifikationen der Apertur vorkommen. Die Mikrokonche haben eine terminale Einschnürung und ein ventrales Rostrum, die sonst bei kretazischen Ammoniten nicht vorkommen, während die Makrokonche eine Verengung der Apertur aufweisen. Kiefer sind generell sehr selten bei kretazischen Ammoniten und waren bisher bei den Placenticeratiden nicht bekannt. Wir beschreiben die Kiefer von zwei Arten von *Placenticeras*.

Introduction

Abundant individuals and diverse forms of the family Placenticeratidae (Albian to Maastrichtian) are reported from many places of the world and they are considered biostratigraphically very important. The family includes many species which show extreme intraspecific variations ranging from smooth to strongly ornamented forms. Recently dimorphism has been established in different species of the family including those of the type



Genus *Placenticer* (SUMMESBERGER 1979, KENNEDY & WRIGHT 1983, KLINGER & KENNEDY 1989, GANGULY & BARDHAN 1993) and it is shown that sexual variants differ mainly in relative adult size and strength of ornamentation. However, very little is known about the nature of their apertural modifications which otherwise characterise many microconchs of Jurassic ammonites (MAKOWSKI 1963, CALLOMON 1963, 1981), because of extreme rarity of specimens with completely preserved body chamber. As far as we know, VREDENBURG (1907) recorded a specimen with complete aperture from the Bagh Group, India. Recently KLINGER & KENNEDY (1989) illustrated a nearly complete specimen from Zululand, S. Africa. These two specimens in fact belong to the same species *Placenticer* *kaffrarium*. *Placenticer* is extremely thin-shelled and lived in the shallowest part of the marine environment (WESTERMANN 1990, BATT 1991). These two factors perhaps led to a taphonomic bias of incomplete preservation. Besides, predation on placenticeratid ammonites (KAUFFMAN & KESLING 1960; pers. observation) might have contributed to the partial preservation of shells with the aperture missing.

The present paper addresses apertural modifications in several specimens of both macro- and microconchs belonging to two different species of *Placenticer*. It appears that the microconchs like those of the Jurassic had apertural modifications. All the specimens have been collected from the Late Cretaceous Nodular Limestone Formation in the river Man sections in Madhya Pradesh, central India (for details see GANGULY & BARDHAN 1993). Besides these, we inspected the specimen (G. S. I. type No. 8682) with complete aperture that was collected by VREDENBURG (1907). It is now kept in the Repository section, Geological Survey of India, Calcutta and is re-figured here (Figs. 1A, B, 3A). VREDENBURG grouped it in his comprehensive species, *Placenticer* *mintoi* and included it in his type 'series', but closer examination reveals that it is in fact *P. kaffrarium* ETHERIDGE which is still unknown in Bagh. Recently, we collected a good number of specimens that show striking similarities with the *P. kaffrarium* population of Zululand, S. Africa (KLINGER & KENNEDY 1989). Detailed taxonomy will be published elsewhere.

Fig. 1. Adult apertures in *Placenticer* *kaffrarium* ♂; lateral views. **a, b:** *kaffrarium* variant (Geological Survey of India Type 8682). Note the well preserved ventral rostrum and the gradual attenuation of both lateral tubercles and ventral clavi towards the aperture. **c:** *kaffrarium* type, JBN-27, specimen slightly deformed. **d:** *subkaffrarium* type, JBN-28, note ventral rostrum and persistence of lateral tubercles and ventral clavi to the end. **e:** close up view of D.

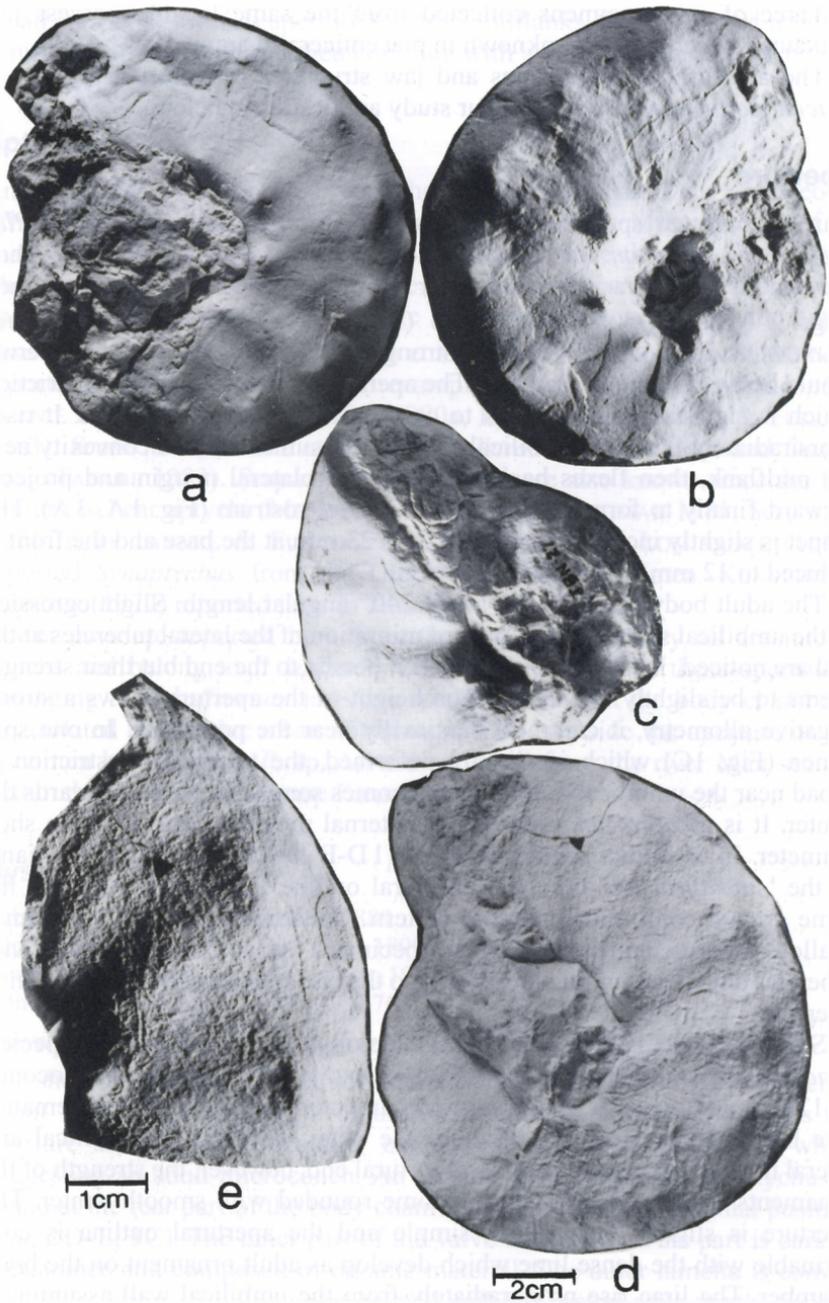


Fig. 1 (Legend see p. 194)

Three of our specimens collected from the same locality possess jaw structures which are still unknown in placenticeratid ammonites.

The apertural characteristics and jaw structures of different species of *Placenticeras* as revealed from our study are described below.

Aperture

Four microconch specimens with complete peristome belonging to *Placenticeras kaffrarium* are described here (Figs. 1A-E, 2A-C & 3A). They show intraspecific variation and differ in adult diameter. The type specimen (Figs. 1A-B, 3A) of VREDENBURG (1907) is a *kaffrarium* type (sensu KLINGER & KENNEDY 1989) with strong lateral tubercles. It is an internal mould being 128 mm in diameter. The aperture shows a terminal constriction which is sigmoidal and appears to conform with the growth lirae. It rises prorsiradiately from the umbilical seam and assumes a broad convexity near the midflank, then flexes back near the ventrolateral margin and projects forward finally to form a well defined ventral rostrum (Fig. 1A, 3A). The lappet is slightly inclined downward. It is 23 mm at the base and the front is reduced to 12 mm with a rounded margin.

The adult body chamber has about 240° angular length. Slight egression of the umbilical seam and an outward migration of the lateral tubercles at the end are noticed. Both tubercles and clavi persist to the end but their strength seems to be slightly attenuated. The height of the aperture shows a strong negative allometry, it contracts maximally near the peristome. In one specimen (Fig. 1C) which is slightly deformed, the terminal constriction is broad near the umbilical margin and becomes somewhat narrow towards the venter. It is a *kaffrarium* type and an internal mould having 124 mm shell diameter. In two other specimens (Figs. 1D-E & 2A-B) which are variants of the '*subkaffrarium*' type, the apertural outline follows more or less the same growth conformable falcooid pattern. Constriction gradually becomes shallow towards the rostrum. These specimens are adult microconchs with tubercles and their ventral clavi persist to the end with no sign of reduction in strength.

Specimen No. JBN - 29 (Fig. 2C) belongs to the other Bagh species, *Placenticeras mintoi* (see GANGULY & BARDHAN, 1993) and is a macroconch of 129 mm diameter. It is a strongly ornamented variant with shell remains. The body chamber occupies half of the outer whorl. Both umbilical and lateral tubercles continue up to the apertural end, however, the strength of the ornaments attenuates and whorl become rounded with smooth venter. The aperture is slightly constricted, simple and the apertural outline is conformable with the dense lirae which develop as adult ornament on the body chamber. The lirae rise prorsiradiately from the umbilical wall assuming a

broad convexity towards aperture near the midflanks, flex backward near the ventrolateral tubercles and then continue with a slight forward projection at the venter.

Aptychi

Ammonite jaws are reported from the Palaeozoic to the Late Cretaceous. While the lower jaws of the Palaeozoic and the Early Mesozoic are of an anptychus type, they were replaced by aptychi since the Middle Jurassic. The upper jaws, on the other hand, are very poorly known and it appears that upper jaws showed very little change and resemble very closely the upper jaws of Recent cephalopods (DAGYS et al. 1989). Cretaceous jaws have been reported from various taxa, for example *Gaudryceras* and *Tetragonites* (KANIE et al. 1978, TANABE et al. 1980a, KANIE 1982, TANABE & FUKUDA 1983), *Scalarites* (TANABE et al. 1980b), *Tetradesmoceratoides* and *Damesites* (TANABE 1983). *Scaphites* and *Baculites* are also known since the last century to bear aptychi (MEEK & HAYDEN 1864 in LEHMAN 1981, SCHLITZER 1971-76 in TANABE & FUKUDA 1987). ZAKHAROV & LOMINADZE (1983) reported *Synaptychus* from the Late Cretaceous of Crimea. KENNEDY & KLINGER (1972) reported jaws in *Texanites*.

Lower jaws are reported here from three specimens. They all are microconchs and belong to *P. kaffrarium* and *P. sp.* In two of these specimens belonging to *P. kaffrarium* jaws are found well within the body chambers. An isolated right valve of an aptychus is found outside the aperture of the specimen belonging to *P. sp.* All are collected from the river Man section within the Nodular Limestone Formation.

Systematics

- Suborder Ammonitina HYATT, 1889
Super family Hoplitaceae DOUVILLE, 1890
Family Placenticeratidae HYATT, 1900
Genus *Placenticeras* MEEK, 1876

Lower jaw of *Placenticeras kaffrarium* ETHERIDGE, 1904

Fig. 2D

The shell (JBN-30) is an internal mould having a reconstructed diameter of about 102 mm. The strength of the ornamentation attenuates towards the aperture and the body chamber occupies about 3/4th of the last whorl suggesting an adult microconch. An isolated right valve of the aptychus is found at the rear part of the body chamber perhaps near its original position (Fig. 2D-E, 3C). The inner part of the valve is exposed. This part is dark in appearance and composed of organic material. The outer lamella is convex and wide. The rostrum is less projected with the rostral edge gently curved.

Very fine dense concentric striations are found. The aptychus is similar to the lower jaw of *Scaphites* in outline and ornamentation (see LEHMANN 1981, fig. 81). In specimen JBN-27, only the part of the outer surface of the jaw is seen (Fig. 2F-G). The rest is concealed under the matrix. A calcareous covering is thin, now restricted to near the periphery. The internal mould is convex with distant, regularly spaced parallel indentations.

The basic terminologies followed here are after CLARKE (1962).

Measurements are in millimeters:

MW	DW	HH	HH:DW
15	14	8	0.56

Lower jaw of *Placenticerus* sp.

Figs. 2H-I, 3B

The shell (JBN-31), having a reconstructed diameter of about 63 mm, is a strongly sculpted form with strong umbilical tubercles and distinct ventral clavi. Most of the body chamber is not preserved. It is very tumid, depressed and evolute. It appears to be a small microconchiate variant. A right valve of an aptychus is found on one of the lateral sides. The similarity in composition of the internal mould of the jaw and the body chamber matrix speak for their close association. Besides, the width of the outer whorl exceeds the size of jaw, thus could easily accommodate it. The jaw is characterised by a strongly convex wide outer lamella, shorter hood and strongly projected rostral edge. The inner lamella is not exposed. The surface of the outer lamella with a partially preserved thin aptychus shows a fine densely spaced concentric undulation. The posterior part is broken.

We are aware of only one other example which shows some similarity with the present specimen. One of the authors (S. B.) along with others found

Fig. 2. *Placenticerus* spp. **a:** *P. kaffrarium* ♂, *subkaffrarium* type, JBN-32, larger variant with aperture preserved, lateral view. **b:** close up view of A. **c:** *P. mintoi* ♀, JBN-29, adult, broken body chamber with completely preserved aperture. Note simple, slightly contracted aperture conformable with growth lirae, lateral view. **d:** *P. kaffrarium* ♂, *subkaffrarium* type, JBN-30, lateral view showing an isolated lower jaw preserved within the body chamber perhaps in its original position. **e:** close-up view of the jaw. **f:** *P. kaffrarium*, *kaffrarium* type, JBN-27, ventral view, broken body chamber showing partly exposed jaw. Note convex internal mould with distinct regularly spaced parallel undulations. **g:** close-up view of the jaw; note thin calcareous outer layer broken during development, now restricted near the exposed periphery. **h:** *Placenticerus* sp., ♂, JBN-31, an isolated lower jaw on the lateral side of the specimen; oblique lateral view. **i:** close-up view of the jaw.

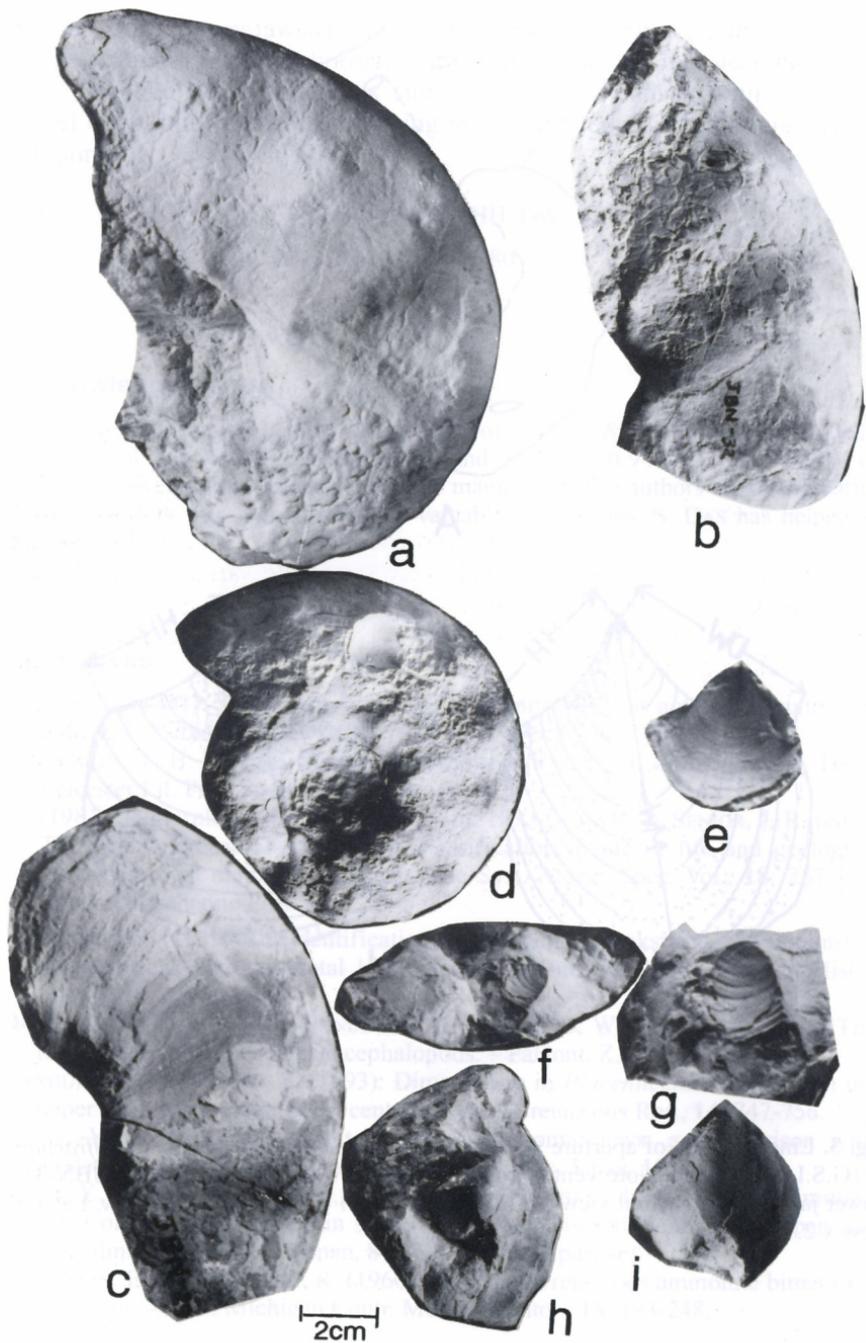


Fig. 2 (Legend see p. 198)

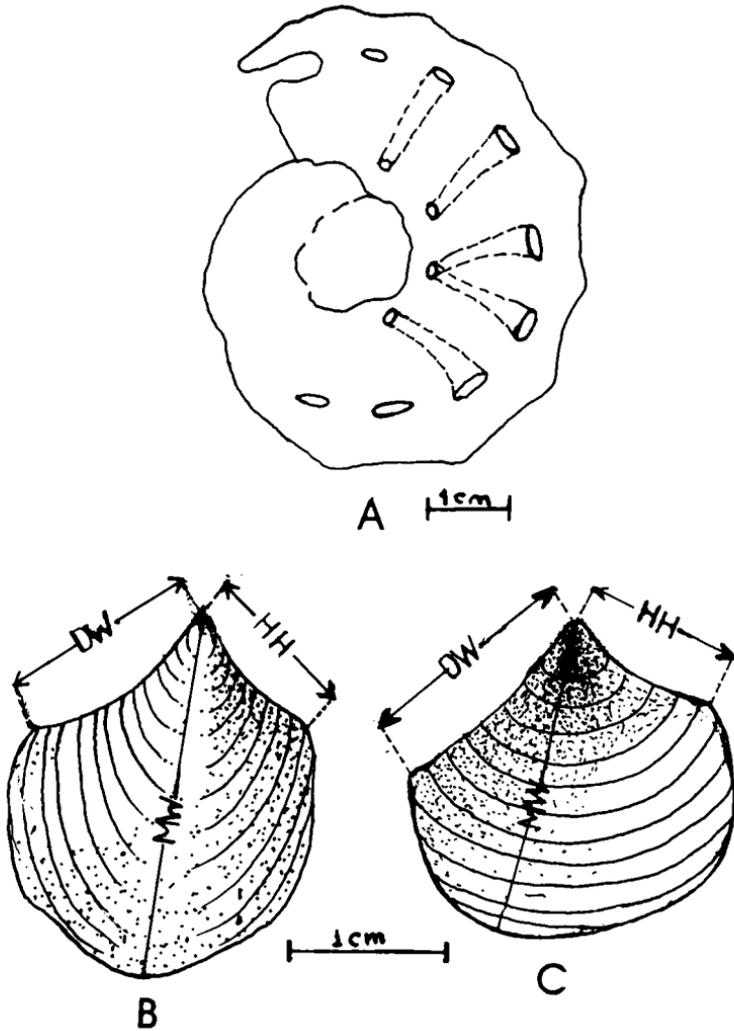


Fig. 3. Linedrawings of aperture and aptychi of *Placenticerus* spp. A: *P. kaffrarium* ♂ (G.S.I type 8682). Note ventral rostrum. Lateral view x 1. B: *P. sp* ♂ JBN-31. Lower jaw. Oblique lateral view x 2. C: *P. kaffrarium* ♂ JBN-30. Lower jaw. Lateral view x 2.

similar isolated lower jaws closely associated with acanthoceratid ammonites in the Albian 'Uttatur' Formation, south India. In the acanthoceratid lower jaw, the outer lamella is similarly strongly convex with projected rostral edge, but it differs in having strong concentric undulations on the exterior.

MW	DW	HH	HH:DW
23	15	c.0.12	0.80

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