A first step in the revision of the genus *Cretirhynchia* PETTITT, 1950

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**Abstract**

The rhynchonellid brachiopod genus *Cretirhynchia* PETTITT, 1950 was in need of revision. Representatives of this genus together with the original material studied by PETTITT in 1950 and 1954 were reviewed. Transverse serial sections were made and the internal structures observed in this study allow us to remove some species from the genus *Cretirhynchia* and to split the genus into four subgenera. A new species and a new subspecies of *Cretirhynchia* are described here. In addition a new genus, related to the genus Cyclothyris M'Coy, 1844 has been erected.

**Key-words:** Brachiopods, *Cretirhynchia*, Revision, Cretaceous, Europe.

**Résumé**


**Mots-clés:** Brachiopodes, *Cretirhynchia*, Révision, Cretacé, Europe.

**Introduction**

A persistent problem for establishing distinct species among Upper Chalk rhynchonellid brachiopods has been observed, since the publication, in 1816, of the second volume of “The Mineral Conchology of Great Britain” by J. SOWERBY. Abundant comments and erroneous applications, concerning *Terebratula plicatilis* J. SOWERBY, 1816 and *Terebratula octoplicata* J. SOWERBY, 1816 have been published for more than a century.

**Davidson** tried to distinguish valid species among the numerous specimens collected from Great Britain. In his monograph of the British Fossil Brachiopoda (1855, Part II, The Cretaceous Brachiopods) several species from the Upper Chalk were discussed and illustrated. The material collected from Britain has been compared with other European rhynchonellid brachiopods. Observations made by other palaeontologists as, for instance, the remarks of Woodward (1833), were reported in this work which remains a masterpiece on the subject.

However, as these studies were based only on the external characters of the shell, problems subsided for erecting valid species. **Davidson** (1855, p. 75) clearly described this problem in one sentence: “...it is often almost impossible to draw up a diagnosis embodying the character of every variety.” Great confusion in this subject was thus maintained for several decades.

In 1950, PETTITT, using transverse serial sections, erected the genus *Cretirhynchia* and established the distinction between this genus and the genus *Cyclothyris* M’Coy, 1844. He also erected, in 1954, the genus *Orbirhynchia* represented by numerous species collected from the European Upper Cretaceous chalk.

Species included by PETTITT in the genus *Cretirhynchia* were presented in three series. The first (*Cretirhynchia plicatilis* series) deals with ribbed species, showing a reduced number of costae near the commissure. The second (*Cretirhynchia exsculpta* series) includes ribbed species, exhibiting incipient splitting of the costae near the commissure. The third series (*Cretirhynchia limbata* series) is not accurately defined but includes all species with a “smooth shell”.

The series of PETTITT are mainly based on external characters and no taxonomic relationships have been drawn by this author. These series do not represent taxonomic units. However, PETTITT carefully described a lot of different species, collected from Great Britain and the stratigraphy of these species was indicated (PETTITT, 1950, tables 1-3, pp. 3-5). The work of PETTITT was a major step in improving the knowledge of Upper Cretaceous rhynchonellid brachiopods. However, this work was not immediately acknowledged by palaeontologists in Western Europe. The new species erected by PETTITT were sharply criticized. For instance, **Steinich** (1965, p. 23) thought that the variability inside a species was often larger than the variation of the characters chosen by PETTITT for separating his species. The need of revision and of subdivision of the genus *Cretirhynchia* was already expressed by **Ager** (1965) and **Ager et al.** (1972). **Popiel-Barczyk** (1988, p. 5) and **Johansen & Surlwyk** (1990, p. 838) also suggested the necessity of a revision of the genus *Cretirhynchia* and its possible subdivision. The doubt, concerning the species of PETTITT,
partly results from the lack of knowledge of the whole morphological variation inside the representatives of the genus *Cretirhynchia* and of their precise and complete geographical and stratigraphical distributions. Moreover, it is rather difficult to recognize the different species, without a direct and concrete comparison with the original type specimens. This introduced erroneous identifications of species into the literature (see the taxonomic part of this paper).

Relationships between the genus *Cretirhynchia* and other rhychnonellid genera have been studied by Owen (1962). He stressed that the genus *Cretirhynchia* probably arose from the Aptian genus *Burrirhynchia* (Owen, 1962, p. 58) and not from the genus *Cyclothyris* M'Coy, 1844. *Burrirhynchia* and *Cretirhynchia* representatives have much in common. Both do not have a pedicle collar and they possess narrow, thickened hinge-plates. The median septum present in the dorsal valve persists for well over one half the length of the shell. The raduliform crura are given off dorsally from subquadrate basal plates (Owen, 1962, p. 61).

The present paper is a first step in the revision of the genus *Cretirhynchia*. The species erected by Pettitt (1950) are reviewed and serial sections of the original material have been completed. The validity of Pettitt's species diagnoses and series is discussed. Tentatively, a new light is thrown on the affinities existing between Upper Chalk rhychnonellid brachiopods. Several species have been removed from the genus *Cretirhynchia* and lastly, the genus *Cretirhynchia* has been split into four subgenera. Their diagnoses are sustained by both external and internal morphological characters.

**Material and methods**

The material used by Pettitt in 1950 constitutes the largest part of the rhychnonellid brachiopods studied in this paper. Only two species could not be investigated due to the lack of material: *Cretirhynchia lenticularis* Pettitt, 1950 and *C. magna* Pettitt, 1950. The collections, preserved in the Natural History Museum in London (NHM), and some type specimens of Pettitt, preserved in the British Geological Survey, are taken into account. Large numbers of *Cretirhynchia* specimens, preserved in the Institut royal des Sciences naturelles de Belgique in Brussels (IRScNB) are included in this study. Specimens from Poland are also considered here, and their specific attribution is discussed. They have been studied previously by Popiel-Barczyk in 1988. This Polish material is preserved in the Museum of the Earth in Warsaw (Muzeum Ziemi PAN). Rhychnonellid brachiopods, collected by von Hanstein (1879) from Ciply (Hainaut, Belgium) and preserved in the Geological and Palaeontological Institute of the University of Bonn are reviewed. Upper Cretaceous specimens more recently collected in Belgium (Mons basin and Maasstricht area), France (Seine-maritime), Germany (Ahlten near Hanover), and Danmark (Møns Klint and Stevns Klint) are added to our study.

Transverse serial sections were made by the method described by Ager (1965, pp. 212-218) and peels were taken on cellulose acetate following the method of Sternberg & Belding (1942). In some cases, the matrix of the specimens sectioned consisted of very soft white chalk. With such a material, the use of acetic acid is not possible and peels of the serial sections cannot be made. In this case, macrophotographs of the sections were taken and enlargements used to draw the serial sections for these specimens. Peels or photographs of the serial sections made from British specimens are preserved in the NHM, whereas those made on specimens from the other European countries are kept in the IRScNB.

**A sharper concept of the genus *Cretirhynchia* Pettitt, 1950**

*Terebratula plicatilis* J. Sowerby, 1816 is the type species of the genus *Cretirhynchia*. Pettitt (1950, text-fig. 4, p. 11) published transverse serial sections of a specimen of *Cretirhynchia plicatilis* collected from the Corangium Zone of Northfleet (Kent, England). All the important elements of the generic diagnosis are visible on this figure which can be consulted.

No pedicle collar is observed. The dental plates are ventrally convergent. The hinge plates are short and subtriangular. The septum in the dorsal valve is well developed and persistent. Crural bases are subquadrate and raduliform crura remain close together. All these characters, considered as a whole, are the most essential for assigning a rhychnonellid brachiopod to the genus *Cretirhynchia*. They also allowed Owen (1962, p. 59) to propose the Aptian genus *Burrirhynchia* Owen, 1962 as potential ancestor to the genus *Cretirhynchia*. Although dental plates are less convergent, and the dorsal septum is less developed in *Burrirhynchia* than in *Cretirhynchia*, there is a structural similarity between these two types of rhychnonellid brachiopods. Hinge plates are very similar and crural bases, given off dorsally, are subquadrate in both genera. Another important feature clearly visible in *Burrirhynchia*, is the fact that raduliform crura remain close together. The slight concavity of the crura is similar in *Burrirhynchia* and *Cretirhynchia*: they are inwardly concave. They are never dorsally concave as in the representatives of the genus *Cyclothyris* M'Coy, 1844. This proposition, considering...
Burrirhynchia as potential ancestor of Cretirhynchia is thus confirmed here.

In 1994, Motchurova-Dekova emended the diagnosis of the genus Cretirhynchia. She pointed out that the shell microstructure of Cretirhynchia is characterized by three calcitic layers: primary, secondary and prismatic. The secondary layer is fibrous. The fibres are diamond-shaped to square in cross section (Motchurova-Dekova, 1994, p. 88).

Among the species included by Pettitt (1950) in the genus Cretirhynchia, only three species simultaneously exhibit the external and internal features described in the diagnosis. This group includes Cretirhynchia plicatilis (J. Sowerby, 1816), C. norvicensis Pettitt, 1950 and C. triminghamensis Pettitt, 1950 which is a junior synonym of C. retracta (Roemer, 1841). These species illustrate a restricted concept of the genus Cretirhynchia. Other species, previously included by Pettitt in the genus Cretirhynchia, show the essential features of this genus. They have no pedicle collar, their dental plates are clearly convergent, the hinge plates are small and subtriangular, the raduliform crura are given off dorsally from more or less subquadrangular bases and a dorsal septum is present. They can be considered as representatives of the genus Cretirhynchia. But, in these species, some secondary characters, which are absent in C. plicatilis, C. retracta and in C. norvicensis, become evident in transverse serial sections. These secondary characters allow the erection of distinct subgenera within the genus Cretirhynchia. These characters mainly affect the aspect of the hinge plates and the development of the crura, but some external features are also taken into account. This splitting of the genus Cretirhynchia into four subgenera, is developed further. The diagnoses of these subgenera can be found in the taxonomic part of this paper. Proposed relationships between Upper Chalk rhynchoenolid brachiopod species are illustrated in Figure 1.

The internal features observed in “Cretirhynchia” cuneiformis Pettitt, 1950 and in “C.” woodwardi (Davidson, 1855) indicate a close relationship with the genus Cyclothyris McCoy, 1844. These rhynchoenolid species are now removed from the genus Cretirhynchia and a new genus is erected for them (see taxonomic part of this paper).

Cretirhynchia bohemica (Schloenbach, 1868) and C. aff. cuneiformis Pettitt, 1950 are Turonian rhynchoenolid brachiopods. They have several features in common with representatives of the genus Cretirhynchia: no well-developed pedicle collar, convergent dental plates (rarely subparallel), presence of a coherent persistent dorsal septum, subquadrangular bases and raduliform crura remaining close together. But the hinge plates are much wider, often slightly forked (Nekvasilova, 1974, text-figs. 5–6, 9). Moreover the hinge plates are nearly parallel to the hinge axis or are even dorsally deflected. We consider that these species constitute a homogenous group distinct from the typical Cretirhynchia. As similar internal features are observed in Cretirhynchia minor Pettitt, 1950 this Upper Turonian species is removed from the genus Cretirhynchia and is placed in this group, near “C.” bohemica and “C.” aff. cuneiformis. Further studies are necessary to decide if these species should be placed together in one new genus or in two new genera. For this reason, it is better to allow them to remain for the present with uncertain generic affinity.

The Cenomanian rhynchoenolid brachiopod Bohemirhynchia soukupi Nekvasilova, 1973 (pp. 78–84, text-figs. 1–3, pl. 1, figs. 1–4, pl. 5, fig. 4, pl. 7, figs. 1–2) has several characters in common with Burrirhynchia and Cretirhynchia. In this species, a pedicle collar is not developed, dental plates are ventrally convergent and a persistent septum is developed on the dorsal valve floor. The hinge plates are much narrow than those observed in “C.” bohemica and are subtriangular in outline. The raduliform crura, which remain close together, are given off from more or less subquadrangular bases. But, the crura in Bohemirhynchia soukupi are dorsally concave and this specific character is never observed in representatives of Cretirhynchia or Burrirhynchia. The genus Bohemirhynchia Nekvasilova, 1973 is herein considered to be related to Burrirhynchia but remains distinct from the genus Cretirhynchia.

About the series proposed by Pettitt (1950)

Species included in the genus Cretirhynchia were arranged by Pettitt (1950, p. 2) in three distinct series. In the light of present knowledge, these series are no longer tenable. Some examples are presented here to justify this position.

The serial sections of C. octoplicata (J. Sowerby, 1816) are identical to the sections of C. exsculpta Pettitt, 1950 (Figs. 11–12). In Pettitt, C. octoplicata was placed in the first series (“plicatilis series”) and C. exsculpta was placed in the second series (“exsculpta series”). Obviously, the first series of Pettitt is not homogenous and in the present paper, C. octoplicata and C. exsculpta have been placed in a new subgenus within the genus Cretirhynchia.

The second series, the “exsculpta series” as described by Pettitt (1950, p. 2), which was based on the tendency towards incipient splitting of the costae in the latest stages of growth, is not acceptable. The species included in the “exsculpta” series are C. minor Pettitt, 1950, C. exsculpta Pettitt, 1950, C. woodwardi (Davidson, 1855) and C. magna Pettitt, 1950. When the internal features of these species are analyzed, it appears that they have little in common and it can now be demonstrated that the second series of Pettitt (1950) included several species which do not belong to the same genus.

The third series of Pettitt (1950, p. 2) which seems more homogenous, includes all the “smooth” species. Cretirhynchia limbata (von Schlotheim, 1813) has been chosen as “typical representative” of this series. Pettitt (1950, p. 2) considered that this group had special features which might be held to justify the generic segregation of the series.

Transverse serial sections made of species of this series confirm that a segregation can easily be considered. But, an astonishing internal structure was discovered for “Cretirhynchia” subplicata (Mantell, 1822). This species was considered by Davidson (1855, pp. 79–80) as a junior synonym of C. limbata (von Schlotheim, 1813) because of the superficial similarity affecting the external outline of both brachiopod species. Pettitt (1950, pp. 23–24) pointed out constant differences
between these two species and gave a very accurate
description for "C.‖ subplicata. Our serial sections (Fig.
7) of "C.‖ subplicata confirm the opinions of MANTELL
(1822) and PETITT (1950). This rhynchonellid brachiopod
must be considered as a valid species, absolutely dis-
tinct from C. limbata. The internal aspect of "C.‖ sub-
plicata is different from the typical structure of the genus
Cretirhynchia. The dental plates are not convergent ven-
trally but parallel to subparallel. The hinge plates are rel-
atively wide and forked. Although the crural bases are
subquadrate, the crura are strongly concave and they do
not remain very close together. These serial sections of
"C.‖ subplicata are closer to the Cyclothyris structures
than to the Burrirhynchia structures. "C.‖ subplicata is
thus removed from the genus Cretirhynchia and tenta-
tively placed near the genus Cyclothyris (Fig. 1). But, as
no other "smooth‖ species, exhibiting cyclothyridid
internal structures are known, "C.‖ subplicata remains
of uncertain generic affinity.

About the "Passage forms‖ described by PETITT
(1950)
In his monograph, PETITT often described "passage
forms‖ between two species of Cretirhynchia. He recog-
nized such "passage forms‖ between "Cretirhynchia",
cuneiformis and C. octoplicata (J. SOWERBY, 1816), and
between C. plicatilis (J. SOWERBY, 1816) and C. lenticu-
laris PETITT, 1950 (p. 7, 9, 12). Other "passage forms‖
between C. intermedia PETITT, 1950 and C. norvicensis
PETITT, 1950 are pointed out (PETITT, 1950, p. 15, 17).
Concerning the species included in his second series,
"passage forms‖ between Cretirhynchia Woodwardi
(DAVIDSON, 1855) and C. exculpta PETITT, 1950 are
described. For species included in the third series, no
"passage forms‖ were observed.

In the light of present knowledge, these passage forms of
PETITT are not acceptable. The internal structures observed
by serial sections demonstrate that passage forms between "Cretirhynchia",
cuneiformis and C. octoplicata are related to the genus Cyclothyris M'Coy,
1844, and Cretirhynchia plicatilis (J. SOWERBY, 1816)
cannot be taken into account. For the same reasons, pas-
sage forms between "C.‖ cuneiformis and Cretirhynchia
octoplicata are not possible. A similar remark can be
stressed for passage forms between "Cretirhynchia",
woodwardi (DAVIDSON, 1855) and Cretirhynchia exculpta
PETITT, 1950 which are now rhynchonellid species placed in two different genera (see taxonomic part of this paper).

These "passage forms‖ were only described on the basis of their external characters and they represent only
intraspecific or taphonomical variations. These morpho-
logical variations or taphonomical distinctive aspects
can sometimes be important. Some individuals are so dif-
ferent from the type specimen, that they could easily be
considered as candidates to a new specific designation.
In this case, the serial sections which are much less vari-
able than the external characters, make it possible to
assign this "intermediate form‖ to an already described
species. An example is given, with the specimens of
"Cretirhynchia‖ cuneiformis collected from Bardouville
(Rouen, France) which have been sectioned for the pres-
ent paper.

On the other hand, it has never been demonstrated that
the evolutionary process in the Upper Chalk rhynchonellid
brachiopods is a progressive and continuous process.
Further studies are needed to more accurately establish
this evolutionary process.

Taxonomic descriptions
Phylum Brachiopoda DUMÉRIL, 1806
Subphylum Rhynchonelloidea WILLIAMS et al., 1996
Class Rhynchonellata WILLIAMS et al., 1996
Order Rhynchonellida KÜHN, 1949
Superfamily Rhynchonelloidea D’ORBIGNY, 1847
Family Rhynchonellidae D’ORBIGNY, 1847

Nomenclative note: the family-group names based on
Rhynchonella should be attributed to D’ORBIGNY, 1847
and not to GRAY, 1848 (MANCEÑIDO, OWEN & MORRIS,

Subfamily Cyclothyridinae MAKRINID, 1955 emended
OWEN, 1962

Genus Woodwardirhynchia gen. n.

Type species: Cretirhynchia cuneiformis PETITT, 1950
Derivatio nominis: in honour of S.P. WOODWARD and
from the greek Ruggos meaning beak.

Diagnosis of the genus
Costate rhynchonellid brachiopod with a cyclothyridid
outline. Shell slightly wider than long. Beak short and
curved. Beak ridges distinct. Extensive interarea.
Hypothyridid, auriculate foramen. Well developed pedi-
cle collar. Dental plates divergent ventrally in their early
stages and subparallel to slightly convergent anteriorly.
Forked hinge plates, generally short, triangular in outline
with a ventral concave surface. Raduliform crura, inward-
ly concave and becoming straight in transverse section
near distal end. Crura diverging laterally. Septum persist-
ent on dorsal valve floor.

Comparison with other genera
Woodwardirhynchia gen. n. has several features in com-
mon with the genus Cyclothyris M'Coy, 1844 as the
development of a pedicle collar, subparallel thin dental
plates and forked hinge plates. But, in Cyclothyris, the
hinge plates are more parallel to the hinge axis whereas in
Woodwardirhynchia gen. n. they are ventrally oriented
and ventrally concave. The crura in Cyclothyris are dor-
sally concave whereas they are inwardly concave in
Woodwardirhynchia gen. n. In Parthirhynchia Titova,
1980 (Basillolidae COOPER, 1959) a pedicle collar is pres-
ent, ventrally concave and forked hinge plates are devel-
oped, and the subacute crura are inwardly concave.
The dental plates are ventrally divergent, the hinge plates
are deflected dorsally and the dorsal septum is weakly
developed. In Woodwardirhynchia gen. n. the dental
plates are never ventrally divergent in their medium or
anteriour part. The hinge plates are not deflected dorsally
and the crura are raduliform. The dorsal septum is more
persistent.
Woodwardirhynchia cuneiformis (Pettitt, 1950)  
Text-Figures 2-3, Plate 8, Figures 1a-d, 2a-c.

* 1950 Cretirhynchia cuneiformis, sp. nov. - Pettitt, pp. 2, 6-7, table 1, text-fig. 3, pl. 2, figs. 4a-c.
. 1974 Cretirhynchia cuneiformis Pettitt - Bignot, p. 5.
non 1974 Cretirhynchia aff. cuneiformis Pettitt, 1950 - Nekvasilova, pp. 45-49, text-figs. 8-9, pl. 3, figs. 1-4, pl. 4, fig. 3, pl. 7, figs. 3-4.
. 1997 Cretirhynchia cuneiformis (Pettitt) - Mortimore, pp. 37, 93.

Stratigraphical range: Upper Turonian, Holaster planus Zone.

Type specimen: holotype from the Upper Turonian (H. planus Zone) of Aston Hill, Aston Rowant, near Stockenchurch, England. Illustrated in Pettitt (1950, pl. 2, figs. 4a-c). Preserved in the NHM under the reference BB. 9990.

Material preserved in the NHM.

The holotype cited above.

Two specimens from Santon Downham (Suffolk), H. planus Zone (B. 40863-64).

One specimen from Gillingham (Kent), H. planus Zone (B. 97336).

Two specimens from Bridgwick Pit, South Malling, Lewes (Sussex), H. planus Zone (B. 55846-47).

Material preserved in the IRScnB in Brussels.

42 complete, bivalved specimens collected from the Hayez quarry in “Hameau de Beaulieu”, Bardouville, (near Rouen, Seine-Maritime, France). Hardground, Upper Turonian, H. planus Zone.

Original diagnosis in Pettitt (1950, pp. 2, 6).

"Cretirhynchia, about 20 mm long, 24 mm wide and 16 mm thick, subtriangular to subpentagonal in outline, domical (sic) to oval in anterior contour and cuneiform in lateral profile. Brachial valve of considerable convexity, but medianly flattened, with broad, somewhat faint median fold on the anterior commissure. Pedicle valve less convex, with broad median sinus and large linguiform extension. Linguiform extension broad, finely long, arcuate, turning almost at right angles to the line of junction of the valves. Umbo short, erect; umbonal slopes straight, long. Foramen moderately large, circular; deltidial plates slightly produced around foramen. Beak-ridges distinct, only slightly curved. Ornament of about 50 fine depressed costae, becoming subangular and reduced in number to about 35 near the commissure; the intervening sulci are narrow. Concentric ornament of very fine growth-lines and a few laminae, especially near the commissure. Apical angle 109°."

Comments

Externally, the outline and the ornamentation of the shell of this rhynchonellid brachiopod have much in common with the representatives of the genus Cyclothyris M'Coy, 1844. This is the first rhynchonellid brachiopod species described in the work of Pettitt (1950) as representative of the genus Cretirhynchia. In his diagnosis, Pettitt did not mention any internal characters, but he illustrated transverse serial sections for this species (1950, fig. 3 p. 7). A very short description of the internal characters (1950, p. 7) stressed “the presence of a median septum and raduliform crura in the brachial valve”. Although the diagnosis of the genus Cretirhynchia given by Pettitt (1950, p. 1) is accurate, this author did not strictly apply the criteria of this diagnosis to each species described in his monograph. In fact, Pettitt was often satisfied with the presence of a dorsal septum and of raduliform crura for including a species in the genus Cretirhynchia.

The serial sections made by Pettitt (1950, fig. 3 p. 7) show several characters which are quite different from the specific characters seen in the type species Cretirhynchia plicatilis (see Pettitt, 1950, text-fig. 4, p. 11 and this paper Figs. 2-3). The dental plates are slightly divergent during young stages of growth, they become subparallel and lastly, are slightly convergent. The dental plates are especially thin, a character which is not observed in the type species of Cretirhynchia. A well developed pedicle collar is visible. The hinge plates are forked, thin and nearly parallel to the hinge line. Crural bases are concave. The crura are slightly divergent. Specimens collected by the first author in Bardouville (Seine-maritime, Rouen, France) from the H. planus Zone were sectioned (Figs. 2-3). These sections are virtually identical to those of Pettitt for a specimen from Aston Hill.

In Cretirhynchia plicatilis, there are strong and thick convergent dental plates, short triangular hinge plates and subquadrate crural bases. The anterior parts of the crura remain close together. "C." cuneiformis cannot, therefore, be maintained in the genus Cretirhynchia. The internal structures observed, mainly the forked hinge plates which are subparallel to the hinge line and the subparallel dental plates, indicate that "C." cuneiformis probably arose from the genus Cyclothyris and not from the genus Burritirhynchia (Owen, 1962, pp. 58-60) justifying the erection of the genus Woodwardirhynchia gen. n.

Cretirhynchia aff. cuneiformis Pettitt, 1950 described by Nekvasilova (1974, pp. 45-49, text-figs. 8-9) is a rhynchonellid brachiopod collected from the Upper Turonian of North-West Bohemia. Compared with Woodwardirhynchia cuneiformis from England or France, this material exhibits narrower hinge plates which are slightly forked but the dental plates are thick and clearly convergent. The crural bases are more or less subquadrate. Cretirhynchia aff. cuneiformis sensu Nek-
Vasilova (1974) is distinct from Woodwardirhynchia cuneiformis (Pettitt, 1950) but has much in common with other Turonian brachiopods such as “Cretirhynchia” bohemica (Schloenbach, 1868).

**Woodwardirhynchia woodwardi** (Davidson, 1855)

Text-Figures 4-5, Plate 8, Figures 3a-e, 4a-d.

1833 *Terebratula gallina* - Woodward, p. 49, pl. 6, fig. 12. (non Brongniart, 1822)

1855 *Rhynchonella plicatilis var. woodwardi* - Davidson, pp. 77-78, pl. 10, figs. 43, 44 (non figs. 45, 46).


? 1871 *Terebratula plicatilis* Sw. - Quenstedt, p. 167, pl. 41, fig. 57.

1879 *Rhynchonella plicatilis* Sow. sp. - Ubaghs, pp. 128, 217.


1874 *Rhynchonella plicatilis* var. *woodwardi* Div. - Požarysky, p. 20.

1950 *Cretirhynchia woodwardi* (Davidson) - Pettitt, pp. 1, 4, 16, 21-22, table 2, pl. 1, figs. 4a-c, pl. 2, figs. 5a-c.

1954 *Cretirhynchia woodwardi* (Davidson) - Pettitt, pp. 48, 49.

1961 *Cretirhynchia woodwardi* (Davidson) - Peake & Hancock, p. 320.

1968 *Cretirhynchia woodwardi* - Leeder, pp. 6-7, tables 1-2, text-fig. 2, p. 10.

1983 *Cretirhynchia woodwardi* - Bailey et al., text-fig. 3.


1990 *Cretirhynchia woodwardi* (Davidson) - Johansen & Sürlyk, p. 838.

1992 *Cretirhynchia woodwardi* (Davidson) - Popiel-Barczyk, p. 15.

1995 *Cretirhynchia woodwardi* (Davidson) - Simon in Jagt et al., p. 11.

2000 *Cretirhynchia woodwardi* (Davidson, 1855) - Simon, p. 139, text-fig. 3, pl. 5, figs 4a-e.

Stratigraphical range: Upper Campanian, from Blt. mucronata Zone to Blt. woodi Zone.

Type specimen: lectotype from the Upper Chalk of Norwich, Norfolk, Norwich Castle Museum (Fitch Collection), N° 2069. Specimen figured by Davidson (1855, pl. 10, figs. 43-44) and also illustrated by Pettitt (1950, pl. 1, figs. 4a-c).

Material

Material preserved in the NHM.

Five specimens from the Blt. mucronata Zone in Norwich (Norfolk, England).

B. 10069: this specimen is a toplotype illustrated by Pettitt (1950, pl. 2, figs. 5a-c).

B. 11928-1: one specimen (a second specimen, B. 11928-2 is from Brighton and it is considered here as specimen of *Cretirhynchia excuplta* Pettitt, 1950).


Material preserved in the IRScNB in Brussels.

Specimens collected from the Mons basin (Hainault, Belgium):

From the “Craie de Trivières”, Blt. mucronata Zone 43 bivalved specimens and several fragments from the “Craie de Trivières”, collected by the first author in Cuesmes, Craibel quarry.

From the “Craie d’Obourg”, Blt. mucronata/Blt. woodi Zones 58 bivalved specimens collected from Cuesmes, 472 bivalved specimens collected from Harmignies, 23 bivalved specimens from Ciply and seven bivalved specimens from Ninny.

From the “Craie de Nouvelles”, Blt. woodi Zone Eight bivalved specimens from Nouvelles and 47 bivalved specimens from Harmignies.

Material preserved in the Museum of the Earth in Warsaw (PAN Muzeum Ziemi).

Two Maastrichtian specimens from Nasifow (MZ VIII Bra-1466 and MZ VIII Bra-1466a) which should be studied for their internal characters. Their description as *Cretirhynchia woodwardi* is doubtful. This material has been illustrated by Popiel-Barczyk (1988, pl. 3, figs. 5-6).

Original diagnosis in Davidson (1855, p. 77).

“Shell transversely oval: valves moderately convex, with a shallow sinus in the ventral, and slightly produced ntesial fold in the opposite one. Externally each valve is ornamented by from 24 to 44 simple plaits, often split close to the margin”.

Emended description in Pettitt (1950, p. 21).

Pettitt placed *Cretirhynchia woodwardi* in his second series because he recognized that the costae show incipient splitting near the commissure.

“*Cretirhynchia*, about 17 mm long, 21 mm wide, and 12 mm thick, transversely oval in outline, lenticular to oval in anterior contour. Brachial valve convex with broad, anterior median fold. Pedicle valve slightly less convex, with broad, shallow sinus. Linguliform extension broad, arcuate. Umbo erect. Ornamentation with 30 low costae, with narrow intervening sulci. Apical angle 106°.”

Comments

In a further description concerning the internal characters
of this species, PettiTT (1950, p. 21) wrote: “The dental lamellae can be seen through the test in the lectotype; they are distant and divergent. The median septum can also be seen through the test.”

Transverse serial sections were made on specimens collected from the “Craie d’Obourg” (Upper Campanian, Blt. mucronata/Blt. woodi Zones) in Harmignies (Mons basin, Hainaut, Belgium). It is seen (Fig. 4-5) that thin dental plates, ventrally divergent in the posterior part of the shell, become anteriorly subparallel or slightly convergent. A pedicle collar is observed. In the dorsal valve, a septum is present on the valve floor, but it is rather short. The hinge plates, relatively narrow and thin in section, are typically forked. The crural bases are not sub-quadrate but concave. The raduliform crura which are laterally diverging, are inwardly concave but they become straight in transverse section near their distal end. All those cyclothyrid characters are consistent with the diagnosis of the genus Woodwardirhynchia gen. n.

Externally, Woodwardirhynchia woodwardi is an Upper Chalk rhynchonellid brachiopod resembling the representatives of the genus Orbiirhynchia PETTIT, 1954. But the well developed beak ridges and the internal characters observed in the serial sections avoid any confusion with this genus.

The Polish Maastrichtian specimens of “Cretirhynchia woodwardi” (DAVIDSON, 1852) from Nasirow studied and illustrated by Popiel-Barczyk (1988, p. 15, pl. 3, figs. 5-6) are in need of revision. The very small size and general outline of the shell, the sharp angular “roof shaped” costae present in these specimens are quite different from the characters observed in the typical Woodwardirhynchia woodwardi. In W. woodwardi, the costae are relatively flat near the commissure. Serial sections should be made for these specimens.

On the other hand, Campanian specimens determined and illustrated by Popiel-Barczyk (1988, pp. 16-17, text-fig. 18, pl. 3, figs. 7-8) as Cyclothyrhis sp., exhibit a similarity with W. woodwardi. The specimen sectioned on her text-fig. 18 shows subparallel dental plates, a pedicle collar and narrow, forked hinge plates.

W. woodwardi is fairly common in the West European Upper Campanian white chalks. It seems to be limited to the Belemnitella mucronata - Blt. woodi Zones and could provide a good stratigraphical marker for these zones.

Woodwardirhynchia tenuicostata (VON HANSTEIN, 1879)

Text-Figure 6, Plate 8, Figures 5a-e.

1879 Rhynchonella tenuicostata sp. n. - VON HANSTEIN, p. 42.

1996 Cretirhynchia tenuicostata (von Hanstein, 1879) - SIMON, pp. 102-104, tables 3-4, text-fig. 2, pl. 2, figs. 1-6.

Stratigraphical range: Lower Maastrichtian, Belemnitella obtusa Zone.

Type specimen: lectotype from the phosphatic chalk of Ciply (Hainaut, Belgium) chosen among the four specimens of the type series of von Hanstein, preserved in the Geological and Palaeontological Institute of the University of Bonn and registered under the number G.P.I.B.O.-HANSTEIN-5. The lectotype is illustrated in SIMON (1996, pl. 2, figs. 2a-e).

Material

Material from Ciply (Mons basin, Hainaut, Belgium) preserved in the IRScNB in Brussels: 30 specimens.


Emended description in SIMON (1996, p. 103). It can be consulted mainly for the description of the internal characters. Transverse serial sections are also illustrated in SIMON (1996, text-fig. 2).

Comments

This species was included by SIMON (1996, p. 102) in the genus Cretirhynchia PETIT, 1950 mainly because a persistent septum on the dorsal valve floor, simple hinge plates, raduliform crura, anteriorly convergent dental plates were observed in transverse serial sections.

However, the dental plates which are relatively thin, are
slightly divergent posteriorly and they are mainly subparallel in their median parts. They are only convergent at their distal end (Simon, 1996, text-fig. 2). The hinge plates are wider than the hinge plates usually found in the representatives of the genus Cretirhynchia. The crural bases are not subquadrate and the crura appear clearly concave. For these reasons, new serial sections were made on four specimens collected from the phosphatic chalk of Ciply. These specimens were chosen for their relatively large size (fully adult specimens). An illustration of these results is given in Fig. 6.

A new observation was the presence of a short pedicle collar which was overlooked in the sections made by Simon (1996, text-fig. 2). Dental plates are ventrally divergent in the first stage of growth, becoming parallel and slightly convergent anteriorly. Dental plates are relatively thin and their development resembles those observed in Woodwardirhynchia cuneiformis and W. woodwardi. In the dorsal valve, a persistent, low septum is observed. The hinge plates appear variable in serial sections but in some specimens (Fig. 6) they are typically forked. Crural bases are inwardly concave and the raduliform crura which are posteriorly concave become clearly visible.

Observations lead us to include this species in the genus Cretirhynchia. The crural character is variable, the crura are divergent. These new observations make on four specimens collected from the phosphatic chalk of Ciply. These specimens were chosen for their relatively large size (fully adult specimens). An illustration of these results is given in Fig. 6.

Species removed from the genus Cretirhynchia Pettitt, 1950 and placed in open nomenclature near the "Cyclothyris" group"

**"Cretirhynchia" subplicata** (Mantell, 1822)
Text-Figure 7, Plate 8, Figures 6a-e, 7a-e.

* 1822 *Terebratula subplicata* - Mantell, p. 211, pl. 26, figs. 5, 6, 11.


non 1846 *Terebratula subplicata* Mantell - Boli, p. 209 (= C. limbata).

non 1847 *Rhynchonella subplicata* d'Orb., 1847 - D'Orbigny, p. 48, pl. 499, figs. 13-17.

Fig. 5 — Serial transverse sections through the umbonal part of Woodwardirhynchia woodwardi (Davidson, 1855) collected from the Upper Campanian (Belemnitella woodi Zone), "Craie d'Ombourg", Cuesmes (Mons basin, Hainaut, Belgium). Length of the specimen: 15.5 mm. IRSNB. - IST. N° 10835.

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**Revision of the genus Cretirhynchia**

Type specimen

The specimen figured by Mantell (1822, pl. 26, figs. 5, 6, 11) has not been found (Pettitt, 1950, p. 23). A neotype has been chosen by Pettitt (1950, p. 23) from the Cortestudinarium Zone of Offham Hill, near Lewes, Sussex, England. This type specimen is preserved in the NHM under the reference B. 47876 (See Pettitt 1950, pl. 2, figs. 2a-c).

Material

Material preserved in the NHM.


One specimen collected from the Cortestudinarium Zone in Holmes Lane, Rustington near Littlehampton, Sussex, England, reference B. 81425.


Eleven specimens from the Cortestudinarium Zone in Chalk Pitton, Offham Hill, Lewes, reference B. 47876-86.


Six specimens from the Cortestudinarium Zone in Beachy Head, Sussex, England, reference B. 97171-76.

Original diagnosis in Mantell (1822, p. 211) "Transversely ovate, gibbous, nearly smooth; lower valve depressed, upper valve convex; margin serrated; front sinuate, with three or four sharp plicae; heel slightly produced. This is
a small species, well characterized by its smooth surface, and elevated plicated front."

Emended diagnosis in Pettitt (1950, p. 23)
"Cretirhynchia, about 11 mm long, 11 mm wide and 8.0 mm thick, subpentagonal to oval in outline; anterior contour domical, lateral profile cuneiform.
Brachial valve depressed at first, convex later, especially on lateral slopes; with faint median fold.

Pedicle valve less convex, with shallow sinus; linguiform extension fairly broad, subarcuate to U-shaped, turns at 90°. Umbo broad. Foramen small, circular.
Ornament of about 15 low costae, near commissure only. Concentric growth-lines fine, distinct. Apical angle 117°."

Comments
Concerning the internal characters, Pettitt (1950, p. 24) pointed out that "a median septum and raduliform crura are present in the brachial valve. The inner socket-ridges are well developed". He did not published any serial sections for this species, but exhaustively described the external characters (Pettitt, 1950, pp. 23-24) and this description should be consulted. Its comparison between "C." subplicata (Mantell, 1822) and C. limbata (von Schlotheim, 1813) is noteworthy (Pettitt, 1950, p. 24).
"... There are, however, several differences between the two forms. The lateral profile in C. limbata is depressed, but becomes cuneiform in the adult stage
owing to elevation of the median fold; the lateral parts of the brachial valve remain low and the lateral slopes are not steep. In C. subplicata the lateral profile is cuneiform, but the median fold is barely perceptible, and the lateral slopes are steep. The posterior part of the brachial valve is nearly flat, not convex as in C. limbata. The linguiform extension quickly reaches an angle of 90°; in C. limbata it turns at a smaller angle and is V-shaped. The umbo is short in C. subplicata, and not incurved as in C. limbata."

We agree with these distinctions which have been observed in all the specimens investigated in our study. In addition, it can be stated that in C. limbata the antero-lateral parts of the ventral valve are nearly flat, whereas in "C." subplicata they are obviously convex.

Transverse serial sections (Fig. 7) were made from a specimen from the Cortestudinarium Zone of Dover, Kent, England (B. 79974). The sections made from a second specimen (B. 47876) from the Cortestudinarium Zone of Offham Hill, Lewes (Sussex, England) offered similar structures. The dental plates are slightly divergent to subparallel posteriorly and they are parallel anteriorly. The anterior parts of the dental plates are relatively thin in section. The hinge structures of "C." subplicata are totally different from the typical hinge structures described for the representatives of the subgenus in which C. limbata has now been placed. In the dorsal valve, the hinge plates are nearly flat and forked. The crural bases are strongly concave and the crura remain inwardly concave. They are only straight in section near their distal ends. Crura are also slightly divergent. All these observations show that a possible synonymy between "C." subplicata and C. limbata must be excluded. Moreover the cyclothyrid aspect of the internal characters, i. e. subparallel dental plates and forked hinge plates, lead us to remove this species from the genus Cretirhynchia Pettitt, 1950 and to place it much nearer the representatives of the "Cyclothyris group". As "C." subplicata (Mantell, 1822) is the only smooth rhynchonellid brachiopod in this taxonomic position, it remains of uncertain generic affinity.

Genus Cretirhynchia Pettitt, 1950

Type species: Terebratula plicatilis J. Sowerby, 1816

Original diagnosis in Pettitt (1950, p. 1)

"Shell biconvex, symmetrical; brachial valve convex, with median fold on anterior part of the valve; pedicle valve less convex, with anterior median sinus; linguiform extension arcuate - V-shaped.

Hypothyrid; umbo short, erect to slightly incurved; foramen small; deltidial plates small, conjunct, produced; beak ridges distinct; interarea well defined.

Revision of the genus Cretirhynchia

Type species: Terebratula plicatilis J. Sowerby, 1816

Text-Figures 8, Plate 1, Figures 1a-e, 2a-e, 3a-e, 4a-e.

Shell multicostate (or smooth, owing to costae becoming obsolete); costae low, rounded, faint near umbo, becoming elevated and more subangular and either sharply reduced in number near the commissure. Thick-shelled, umbo thickened with secondary callosite material. Pedicle collar absent. Thick dental plates, convergent ventrally. Hinge plates ventrally deflected, simple, subtriangular, never forked. Crural bases subquadrate. Raduliform crura straight or moderately concave in section and remaining close together. Crura ventrally deflected but not steeply.

Cretirhynchia (Cretirhynchia) plicatilis (J. Sowerby, 1816)

Text-Figures 8, Plate 1, Figures 1a-e, 2a-e, 3a-e, 4a-e.

* vv 1816 Terebratula plicatilis - Sowerby, J., ii, p. 37, pl. 118, fig. 1.

non 1822 Terebratula plicatilis - Bronn, pl. 4, figs. 5a-c.

pp. 1822 Terebratula plicatilis. - Mantell, pl. 20, n°81, var. a.

1828 Terebratula plicatilis, Sov. - Defrance, fig. 3, p. 159 (considered as a variety of T. octoplicata, Sov.).

non 1833 Terebratula plicatilis - Woodward, p. 49.

- 1836 Terebratula plicatilis - Deshayes, 7, p. 357, n°77.

- 1838 Terebratula plicatilis - von Buch, pl. 15, fig. 24.


non 1842 Terebratula plicatilis Sov. - Hagenow, p. 534, n°2 (= C. retracta).

non 1846 Terebratula plicatilis - Geinitz, H.B., pl. 21, figs. 9 a-b.


? 1846 Terebratula plicatilis - Reuss, p. 47, n°6, pl. 25, figs. 10-13.

non 1848 Terebratula plicatilis (Sow.) Br. - Bronn, pl. 1246 (except the type of Sowerby cited in the synonymy).

non 1851-52 Rhynchonella plicatilis Br. - Bronn & Roemer, F., pl. 30, fig. 9.

non 1852 Terebratula plicatilis (Sow.) Bronn - Pug-gaard, p. 14, fig. 19, p. 17 (= C. retracta).

pp. 1854 Terebratula plicatilis, Sov. - Morris, p. 150.
pp. 1855 *Rhynchonella plicatilis* J. Sowerby - Davidson, pp. 75-77, pl. 10, fig 40 (non figs. 37-39, 41-42).

non 1866 *Rhynchonella plicatilis*, Sow. - Cornet & Briart, p. 189.


non 1871 *Terebratula plicatilis* Sw. - Quenstedt, p. 167, figs. 55-57.

non 1877 *Rhynchonella plicatilis* Sow. sp. - Frich, ii, p. 144, fig. 147.

non 1879 *Rhynchonella plicatilis* Sow. sp. - von Hanstein, pp. 38-40.

non 1879 *Rhynchonella plicatilis* Sow. sp. - Ubaghs, pp. 128, 217.


non 1888 *Rhynchonella plicatilis* Sow. - Geinitz, F.E., p. 742 (= C. retracta).


non 1895 *Rhynchonella plicatilis* Sow. - Geinitz, H.B., pp. 6-7 (= C. retracta).


non 1921 *Rhynchonella plicatilis* Sow. - Cornet, J., p. 21.

non 1925 *Cretirhynchia plicatilis* (J. Sowerby) - Pettitt, pp. 9-12, text-fig. 4, p. 11, text-fig. 5, p. 12, pl. 1, figs. 9 a-c, 10, 11, pl. 2, figs. 8 a-b.

1962 *Cretirhynchia plicatilis* (J. Sowerby) - Owen, p. 60.

1965 *Cretirhynchia plicatilis* (J. Sowerby) - Ager, p. 166.

1965 *Cretirhynchia plicatilis* (Sow.) - Steinic, p. 17.

1965 *Cretirhynchia plicatilis* (J. Sowerby) - Bignot, p. 5.

1968 *Cretirhynchia plicatilis* Pettit - Leeder, p. 6.


1974 *Cretirhynchia plicatilis* (Sowerby) - Kaeuer et al., p. 107, pl. 1, figs. 7 a-c.

1974 *Cretirhynchia plicatilis* (Sow.) - Pajaud, pp. 24-25.


1983 *Cretirhynchia plicatilis* (J. Sowerby) - Bailey et al., text-fig. 2, p. 33, pp. 36-37.

1987 *Cretirhynchia plicatilis* (J. Sowerby) - Owen, p. 57, pl. 11, figs. 8 a-c.

1988 *Cretirhynchia plicatilis* (Sowerby, 1816) - Aliev & Titova, p. 228, text-fig. 66, pl. 5, figs. 1-5.

1988 *Cretirhynchia plicatilis* (J. Sowerby) - Poojel-Barczyk, p. 16.

1997 *Cretirhynchia plicatilis* - Mortimore, p. 130.

Stratigraphical range: Santonian, Coranguinum and Testudinarius Zones.

Type specimen

Holotype from the Upper Chalk, Northfleet, near Gravesend, Kent, England. NHM, Sowerby Collection, B. 61513. Figured by J. Sowerby, 1816, pl. 118, fig. 1. Illustrated by Pettitt (1950), pl. 1, figs 9 a-c.

Material

Material preserved in the NHM.

From Upper Chalk, Northfleet, Kent

The holotype cited above.

Topotype. B. 79813, Coranguinum Zone. Figured by Pettitt (1950, pl. 1, fig. 11, interior of brachial valve).

Topotype. B. 79814, Coranguinum Zone. Figured by Pettitt (1950, pl. 1, fig. 10, lateral view). One complete adult specimen.

Topotype. B. 79815, Coranguinum Zone. Figured in this study, Pl. 1, Figs. 1a-e, sectioned (Fig. 8).

Topotype. B. 79809, Coranguinum Zone. Sectioned and illustrated by Pettitt (1950, text-fig. 4, p. 11).

Topotype. B.44664, Dibley Coll. (oct. 1922): 1 adult complete specimen. Figured in this study Pl. 1, Figs. 2a-e.

B.79811, an altered adult specimen.

B.79808, an adult complete specimen with a more trapezoidal linguiform extension which is slightly wider than in the type specimen.

B.79810, one ventral valve with an internal mould.

From the Snowdown Colliery, Kent, England.

B. 93648, Coranguinum Zone. Younger complete specimen figured in this study, Pl. 1, Figs. 4a-e.

From the Upper Chalk, Grays, Essex.

B.44662, Coranguinum Zone. One complete, adult specimen which is opened. Its internal structure fits perfectly with the type specimen.

B. 44663, Coranguinum Zone. One complete adult specimen similar to the type.

From Amesbury near Salisbury, Wiltshire.

B. 94062, a complete adult shell which exhibits finer costae than the type.

From Devizes Road, W. of Salisbury, Wiltshire.

B. 91832, Uintacrinus Zone. One complete adult specimen with slightly coarser costae. Figured in this study, Pl. 1, Figs. 3a-e.

From Thanet Coast

B. 79820, Uintacrinus Zone. One complete adult specimen.

B. 79821, Uintacrinus Zone. One complete adult specimen.

B. 79822, Uintacrinus Zone. One ventral valve.

From unknown origin

B. 9036-37. Two specimens transferred from the Zoological Department in February 1896 determined erroneously as *Cretirhynchia triminghamensis* Pettitt, 1950. B.79816. Young specimen of *Cretirhynchia plicatilis*.

Specimens originally determined as *Cretirhynchia plicatilis* (J. Sowerby, 1816) and not accepted as representatives of this species in this study.
In most cases, they can be attributed to other species of *Cretirhynchia*, mainly *Cretirhynchia exsulpata*, *C. intermediata* or *C. norvicensis*. Their references in the NHM collection are: B. 4809, B. 8380, B. 10677, B. 11724, B. 19868, B. 19869, B. 19870, B. 19871, B. 22886, B. 25068, B. 79818, B. 79852, B. 79883., BB. 922 and BB. 76525.

Material preserved in the Geological and Palaeontological Institute of the University of Bonn.

Three specimens of *Rhynchonella plicatilis* Sow. sp. sensu von Hanstein (1879, pp. 38-40) from the chalk of Ciply, Hainaut, Belgium (G.P.I.B.O.- Hanstein: 6). These specimens cannot be accepted as *Cretirhynchia plicatilis* (J. Sowerby, 1816). Such material has not been found by Simon (1998) in the phosphatic chalk of Ciply, despite extensive research. A specimen, extremely similar in character was collected in the Chalk of Vijlen, in Altembroeck (Maastrichtian, Belemnella sumensis Zone). This isolated specimen was determined as *Cretirhynchia gr. exsulpata* Pettitt, 1950 by Simon (1995, p. 11).


"Gibbose, transversely ovate, finely and obscurely plaited; middle elevated by twelve plaits; fifteen or more plaits on each side; beak slightly projecting."

Emended diagnosis in Pettitt, 1950, pp. 9-10.

"*Cretirhynchia*, about 22 mm. long, 28 mm. wide and 19 mm. thick, transversely oval to subpentagonal in outline, oval in anterior contour, subcircular in lateral profile.

Brachial valve of considerable convexity, with slight, broad, flattened fold on anterior part. Pedicle valve less convex, with broad, flat, shallow sinus on anterior part. Linguiform extension broad, trapezoidal, nearly rectangular, turning sharply in the dorsal direction until at right angles to the plane of junction of the valves.

Umbo small, erect; umbonal slopes concave. Deltidial plates small, just conjunct. Foramen small, circular to longitudinally oval. Beak-ridges distinct, curved.

Ornament of about 70 or more depressed, rounded costae, about 11 on fold and 10 in sinus, and about three on each flank of the fold, with shallow subangular intervening sulci. Many closely set and very fine concentric growth-lines with several laminae near the commissure. Apical angle 105-120°."

Comments

Special attention must be paid to the wide place occupied by *Cretirhynchia plicatilis* in the literature. Since the description of *Terebratula plicatilis* appeared in the Mineral Conchology of Great-Britain (J. Sowerby, 1816, p. 37), this name has been widely used by numerous authors for describing many rhynchonellid brachiopods from the European chalk facies. The concise description given by Sowerby was very freely interpreted by several palaeontologists. The binomen *Terebratula* (or *Rhynchonella*) *plicatilis* was applied to several distinct species collected from the Cenomanian to the uppermost Maastrichtian. *Terebratula* (or *Rhynchonella*) *plicatilis* became an abstract concept applied to nearly all ribbed rhynchonellid brachiopods from the Chalk. Most of the distinctive characters which allow us to recognize different species in the genus *Cretirhynchia* Pettitt (1950) have been considered as "variations". These variations were never measured or demonstrated and an extraordinary confusion was installed. Some examples illustrate this problem.

Steinich (1965) stressed the fact that the Maastrichtian *Cretirhynchia retracta* (Roemer, 1841) had been confused with *C. plicatilis* (J. Sowerby) by Hagenow (1842), Boll (1846), Bronn (1848), Puggaard (1852), Quenstedt (1871), Geinitz, F.E. (1888), Posselt (1894), Geinitz, H.B. (1895) and by Deecke (1895).

*Cretirhynchia plicatilis* (J. Sowerby, 1816) had been confused with *C. octoplicata* (J. Sowerby, 1816). The latter species was often considered as a variety of the former. These confusions are discussed further when dealing with *Cretirhynchia octoplicata*.

The Campanian *Rhynchonella plicatilis* var. woodwardi Davidson, 1855 has been confused with *Cretirhynchia plicatilis* (J. Sowerby) by Cornet & Briart (1866 and 1874), Quenstedt (1871), Ubachs (1879), and by Rutot & Van den Broeck (1887).

Even "smooth" species such as *Cretirhynchia limbata* (von Schlotheim, 1813) and *C. subplicata* (Mantell, 1822) were included as varieties of the true *C. plicatilis* by several authors as Bronn (1851), Quenstedt (1871) and also by D'Orbigny (1847, pp. 46, 47, 48) who included *Terebratula subplicata* Mantell, 1822 in his *Rhynchonella octoplicata* D'Orbigny (non *Terebratula octoplicata* J. Sowerby, 1816), together with the true *T. plicatilis* (J. Sowerby).

Davidson (1855, pp. 75-79) repeated D'Orbigny's opinion (1847) namely that "Sowerby's descriptions of *Terebratula plicatilis* and *Terebratula octoplicata* are so entirely similar, that no one is able to perceive in them distinguishing features". Davidson, admitting D'Orbigny's point of view, interpreted *Terebratula plicatilis* in a very wide sense. But, he reported the opinion of Woodward (1833) who considered *Terebratula plicatilis* and *T. octoplicata* as distinct species. Moreover, Davidson (1855, p. 77) created a variety (var. woodwardi) for separating the Campanian rhynchonellid brachiopod designated here as *Woodwardirhynchia woodwardi* (Davidson, 1855) from *Terebratula plicatilis* (Sowerby, 1816). Pettitt (1950, p. 9), pointed out that only the fig. 40, pl. 10 in Davidson's monograph is a true *Cretirhynchia plicatilis*.

Some authors however restricted the use of the specific name *plicatilis* to the true *Terebratula plicatilis* J. Sowerby, 1816: see Defrance (1828, p. 159) in his "Dictionnaire des Sciences naturelles" and Deshayes (1836, p. 357) who insisted on a possible confusion in literature between *Terebratula plicatilis* and some Cenomanian rhynchonellid species placed today in the genus *Cyclothyris* McCoy, 1844. Pettitt (1950, pp. 9-12) has accurately reviewed the whole material available and his detailed description restricts this species to a very distinct *Cretirhynchia* found in precise stratigraphical levels of the British Chalk; the Coranguinum and Testudinarius Zones. For Pettitt, *Cretirhynchia plicatilis* is distinct from *C. octoplicata* and also from all other ribbed rhynchonellid brachiopods from the Chalk.

Recent works (Owen, 1962 and 1987; Ager, 1965; Steinich, 1965 and Bailey et al., 1983) generally admit and confirm the point of view of Pettitt.

However, Käever et al. (1974, p. 107, pl. 1, figs. 7a-c) continue to apply the binomen *Cretirhynchia plicatilis* to...
German material which appears different from the English species.

**Alev & Titova** (1988, text-fig. 67, pl. 5, figs. 1-5) illustrated and published serial sections of a Coniacian-Santonian rynchonellid brachiopod which they described as *Cretirhynchia plicatilis*. However, the general outline of their sections is different from the outline seen in sections of *C. plicatilis*. The dental plates are thinner and the dorsal septum is weakly developed. Externally this material exhibits a different type of ribbing and an anterior contour which is oval-lenticular. In *C. plicatilis* the anterior contour is more oval, never lenticular and the costae are much finer. Differences in the linguiform extension are also observed. Moreover the specimen illustrated on pl. 5, figs.1a-d appears fairly distinct from the specimen figured pl. 5, figs. 5a-d.

Observations made on the reviewed material

The specimen chosen by J. Sowerby in 1816 is a perfectly preserved specimen from Northfleet, Kent. It is a gerontic representative of the species. The whole material examined by Pettitt (1950) consists in fully adult, often gerontic, specimens. Younger specimens are nearly absent from the collections investigated. The whole variability and the ontogeny of the species is not well known. Pettitt (1950, p. 10) indicated that the convexity of the shell increases in the dorsal valve during growth. This increase of convexity is “accompanied by increased growth along the posterior and lateral margins, tending to the formation of a depression on either side of the dorsal umbo”. This has been deduced from the observation of the shape of concentric laminae present on the surface of a specimen. A younger shell is illustrated here (Pl. 1, Figs. 4a-e) which shows a reduced convexity. Its other external characters, such as the shape of its linguiform extension, the structure of its costae, the shape of its beak and the size and shape of its foramen, fit within the limit of the description given by Pettitt. As the original material mainly consists of gerontic specimens, new material is needed for describing the ontogenic process.

Pettitt (1950, p. 10) studied “numerous specimens from the Upper Chalk”. In the collections reviewed in the Natural History Museum, 19 specimens are considered here as true representatives of the species. Many other specimens, labelled *Cretirhynchia plicatilis* (see above for references) must be discarded.

The fact that most European, non-British, specimens attributed to *Cretirhynchia plicatilis* (J. Sowerby, 1816) are misidentified, restricts *C. plicatilis* to its original geographic area. It is not excluded, a priori, that *C. plicatilis* could be present elsewhere in Europe, but material, candidate to this determination, should be imperatively confronted with the original English material for avoiding new taxonomical errors.

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**Fig. 9** — Serial transverse sections through the umbonal part of *Cretirhynchia (Cretirhynchia) retracta* (Roemer, 1841) collected from the Lower Maas-trichtian, Trimingham (Norfolk, England). Length of the specimen: 22.2 mm. NHM. BB. 43335.

The specimen sectioned and illustrated in Pettitt (1950, text-fig. 4, p. 11) shows the important internal characters of the genus and subgenus *Cretirhynchia* Pettitt, 1950.

New serial sections were made on another specimen from Northfleet, Kent, England (Fig. 8). These sections confirm the internal structures observed by Pettitt (1950, text-fig. 4, p. 11). The dental plates are thick and ventrally convergent. The hinge plates are very small and triangular whereas the crural bases are subquadrate. The raduliform crura which remain close together are slightly and inwardly concave in their posterior part. The sections illustrated here (Fig. 8) and the sections illustrated by Pettitt (1950, text-fig. 4, p. 11) distinguish *Cretirhynchia* (Cretirhynchia) plicatilis from *C. octoplicata* (J. Sowerby, 1816).
non 1974 *Cretirhynchia reta*ctra* (Roemer, 1842) - KATZ*, p. 251, pl. 83, figs. 10a-c.

. 1982 *Cretirhynchia triminghamensis* Pettitt - NECHRIKOVA, table 2, pp. 39-40, pl. 2, figs. 8-11.

? 1984 *Cretirhynchia retracta* (Roemer, 1841) - POPIEL-BARCYZK, p. 350, pl. 151, fig. 2.


. 1988 *Cretirhynchia ex gr. limbata retracta* - JOHANSEN, text-fig. 2.

. 1989a *Cretirhynchia ex gr. limbata* (Schlotheim 1813) retracta (Roemer 1841) - JOHANSEN, text-fig. 2.

. 1989b *Cretirhynchia ex gr. limbata retracta* - JOHANSEN, text-fig. 2.

non 1992 *Cretirhynchia retracta* (Roemer, 1841) - POPIEL-BARCYZK, p.15.

Stratigraphical range: Lower Maastrichtian

Type specimen

Specimen from the Lower Maastrichtian of Rügen (Germany), illustrated by ROEMER, F.A. (1841, pl. 7, fig. 2) not traced, but it could be useful to check the collection of Roemer preserved in the Pelizaeus Museum in Hildesheim.

STEINICH (1965) illustrated three specimens from Rügen (1965, pl. 2, figs. 1a-d, 2a-d, 3a-d) but he did not designated a lectotype for this species.

Material

Material preserved in the NHM.

Material collected from Trimingham (Norfolk, England).

One specimen which is the holotype of *Cretirhynchia triminghamensis* PETTITT, 1950, illustrated by PETTITT (1950, pl. 2, figs. 7a-c). Reference B. 52635.

Eleven specimens labelled as *Cretirhynchia triminghamensis* PETTITT, 1950 with the following references: B. 96744-45, B. 96961 and BB. 43329-36. The specimen BB. 43335 has been sectioned (Fig. 9).

Material preserved in the Geologisk Museum in Copenhagen.

One complete specimen labelled as *Cretirhynchia retracta* (Roemer, 1841) from Stevns under reference n° 1918.95. Lower Maastrichtian.

Material preserved in the IRScNB in Brussels.

Three specimens of *Cretirhynchia retracta* (Roemer, 1841) collected from Mons Klint, Denmark. Lower Maastrichtian.

One specimen of *Cretirhynchia retracta* (Roemer, 1841) collected from Kronsmoor, Schleswig-Holstein, Germany. Lower Maastrichtian. Illustrated on Pl. 3, Figs. 5a-c.

Two specimens of *Cretirhynchia retracta* (Roemer, 1841) collected from Lägerdorf, Germany. Lower Maastrichtian.

Original diagnosis of Roemer (1841, p. 38)

"*Cretirhynchia* ist etwas breiter als lang, breit quer oval, wenig dreiseitig und hat 27 einfache, flache, erst seit der Mitte sichtbare Falten, von denen drei in dem tiefen, glattseitigen, nach dem Buckel der Bauchschale zurückgebogenen Sinus liegen; Bauschale vor der Stirn am höchsten; sie steigt am Buckel anfangs senkrecht, dann sehr allmählich in die Höhe."

Emended diagnosis in STEINICH (1965, pp. 16-17)

"*Cretirhynchia* about 20 mm long, 23 mm wide and 15 mm thick, subpentagonal to oval in outline, oval to domical in anterior contour, lateral profile oval to subcircular. Brachial valve convex, with moderately elevated median fold, rather flattened. Pedicle valve les convex, with rather deep, rounded median sinus; linguiform extension trapezoidal to U-shaped, turning at 45° to 60° to lateral commissure. Umbo short, erect to slightly incurved; foramen minute, circular. Ornament of numerous fine, very low costae, becoming more elevated and reduced in number near the commissure; about seven on fold. Apical angle 120°."

Original diagnosis of *Cretirhynchia triminghamensis* in PETTITT (1950, p. 17).

"*Cretirhynchia*, about 20 mm long, 23 mm wide and 15 mm thick, subpentagonal to oval in outline, oval to domical in anterior contour, lateral profile oval to subcircular. Brachial valve convex, with moderately elevated median fold, rather flattened. Pedicle valve les convex, with rather deep, rounded median sinus; linguiform extension trapezoidal to U-shaped, turning at 45° to 60° to lateral commissure. Umbo short, erect to slightly incurved; foramen minute, circular. Ornament of numerous fine, very low costae, becoming more elevated and reduced in number near the commissure; about seven on fold. Apical angle 120°."

Comments

An exhaustive description of *Cretirhynchia retracta* (Roemer, 1841) was published by STEINICH (1965, pp. 16-23). The ontogenetic development of this species (STEINICH, 1965, fig. 7, p. 20) and the detailed structure of the brachidium (STEINICH, 1965, fig. 5, p. 18) are fully illustrated. Transverse serial sections of *C. retracta* from Rügen are also figured (STEINICH, 1965, fig. 6, p. 19). All the internal characters of the subgenus *Cretirhynchia* PETTITT, 1950 are visible on these serial sections.

The extended description of *Cretirhynchia triminghamensis* given by PETTITT (1950, pp. 17-18) is very similar to the description of *C. retracta* reproduced above. PETTITT (1950, p. 17) did not investigate the internal characters of *C. triminghamensis* owing to lack of material.

STEINICH (1965, pp. 23-24) pointed out that *C. triminghamensis* could be a junior synonym of *C. retracta*. The material from Trimingham, from Lägerdorf and Kronsmoor (Germany) and the Danish specimens from Stevns and Mons Klint were compared. As already suggested by STEINICH, it is rather difficult to separate the English "*triminghamensis*" specimens from the German and Danish individuals of *C. retracta*. The beak structure and the interarea, especially, are strictly identical for the

Fig. 10 — Serial transverse sections through the umbonal part of *Cretirhynchia* (Cretirhynchia) norvicensis PETTITT, 1950 collected from the Upper Campanian (Belemnitella mucronata Zone), Norwich (Norfolk, England). Length of the specimen: 26.1 mm. NHM. B. 24902.
Revision of the genus *Cretirhynchia*
specimens investigated. These characters are fairly important as it has been demonstrated that *C. retracta* is a secondary free living brachiopod.

Transverse serial sections of a specimen of *C. triminghamensis* were made and the results are illustrated in Fig. 9. These sections can be compared with the results published by STEINICH (1965, text-fig. 6, p. 19) and it is difficult to point out any significant differences between them. The posterior part of the shell is thickened and ventrally convergent, thick dental plates are observed. They are rather short. The hinge plates are very small and subtriangular in section. Crural bases are more or less subtrally convergent, thick dental plates are observed. They

Among the specimens investigated, some exhibit a trans-

Material preserved in the IRScNB in Brussels.

One specimen from Wansin (Brabant, Belgium) and one specimen from Waremmne (Liège, Belgium) incidentally collected during waterworks.

Original diagnosis in *PETTITT* (1950, p. 15) "**Cretirhynchia, about 25 mm long, 27 mm wide and 18 mm thick, triangular to subpentagonal in outline, oval in anterior contour, depressed oval in lateral profile. Brachial valve moderately convex, with broad, flattened fold on the anterior third of the valve. Pedicle valve less convex, with broad, moderately deep but somewhat flattened median sinus. Linguiform extension trapezoidal. Umbo short, erect to slightly incurved, beakridges distinct. Foramen small, auriculate; deltidial plates slightly produced.

Ornament of about 50 fine depressed costae, reduced in number to about 20 near the commissure, with about 7 on fold and 6 in sinus; the intervening sulci are narrow but are wider and deeper near the commissure. There are fine concentric growth-lines and occasional laminae; they are particularly well developed near the commissure. Apical angle 99°.""

Comments

The external characters of this species have been exhaustively described by *PETTITT* (1950, pp. 16-17) and his accurate description can be consulted. The external distinctions between *C. norvicensis* *PETTITT*, 1950, *C. plicatilis* (J. SOWERBY, 1816), *C. octoplicata* (J. SOWERBY, 1816), *C. intermedia* *PETTITT*, 1950, Woodwardirhynchia cuneiformis (*PETTITT*, 1950) and Woodwardirhynchia woodwardi (*DAVIDSON*, 1855) are exposed in this text.

For the internal characters of *C. norvicensis*, *PETTITT* (1950, p. 16) indicated that "the teeth are large, but the dental lamellae are considerably reduced. In the brachial valve the hinge plate is wide and thickened and the dental sockets are large; a median septum and raduliform crura are present". No transverse serial sections were illustrated by *PETTITT*, *OWEN* (1962, text-fig. 9, p. 58) figured serial sections for this species. From these sections it can be seen that the umbo is strongly thickened and dental plates are not as reduced as indicated by *PETTITT*. They are very thick and ventrally convergent. The hinge plates are small, subtriangular in section and the crural bases are subquadrate. The crura are a little more laterally divergent than in the type species *C. plicatilis*.

Another specimen from the *Blt. mucronata* Zone of Norwich (B. 24902) was used for serial sections (Fig. 10). The shell is thickened in its posterior part. The thick and ventrally convergent dental plates, are shorter in this specimen. Hinge plates are small and subtriangular and crural bases are subquadrate. The crura remain close together but they are slightly more divergent than in *C. plicatilis*.

Usually, *C. norvicensis* has a clear triangular outline. Among the specimens investigated, some exhibit a trans-

### Stratigraphical range: Upper Campanian, *Belemnitella mucronata* Zone

**Type specimen**

Holotype (in *PETTITT*, 1950, p. 16) from the *Blt. mucronata* Zone, Mousehold pit, Norwich, Norfolk, England, preserved in the NHM; reference B. 93138 and figured by *PETTITT* (1950, pl. 2, figs. 6a-c).

Material preserved in the NHM.

From Norwich, Norfolk, England.

The holotype cited above.

- B. 477 (young individual), B. 9638-40 (from Mousehold pit), B. 10681 (3 specimens), B. 22033, B. 24902 (29 specimens), B. 25078, B. 31340 (3 specimens), B. 44192-94 (from Mousehold pit), B. 45244-45 (from Harford Bridge), B. 47580-86 and B. 47588-93, B. 70201, B. 93354-56 (from Mousehold pit), B. 97815-26 (several specimens from this collection figured in this paper on Plate 2, 3).

- B. 83341, B. 83344 and B. 83348 are three representatives of *C. norvicensis* although they were originally determined as *C. cuneiformis* *PETTITT*, 1950.

From Trimingham, Norfolk, England.

One specimen: B. 29731.
versely oval outline. These specimens can be confused with *Woodwardirhynchia tenuicostata* (von Hanstein, 1879). Serial sections will help to dispell confusion between these two rhynchonellid brachiopods. It is probable that these transversely oval specimens were considered by *Pettitt* as passage forms between *C. norvicensis* and *C. intermedia* *Pettitt*, 1950 (another species with a transversely oval outline). However, such passage forms are doubtful. The internal features observed in serial sections for both species indicate that *C. intermedia* has little in common with *C. norvicensis*.

*C. norvicensis* preserves a primitive crural structure which is not very distinct from the crural structure observed in the genus *Burrirhynchia* *Owen*, 1962. *C. intermedia* *Pettitt*, 1950 which is now placed in the subgenus *Harmignirhynchia* *subgen.* *n.*, strongly exhibits con cave crural structures which are steeper than the crura observed in *C. norvicensis*. It is difficult to imagine a passage from the elaborate crural structure of *C. intermedia* to a more ancestral aspect observed in *C. norvicensis*.

The similarity proposed by Steinich (1965, p. 24) between *C. retracta* and *C. norvicensis* *Pettitt*, 1950 is not confirmed here and *C. norvicensis* remains a distinct and valid species.

*C. norvicensis* which occurs commonly in the Campanian chalk of Norwich (Norfolk, England) is a large rhynchonellid species which is rarely found outside England. In Belgium, only two specimens are present in the collections of the IRScNB in Brussels and they were incidentally collected during waterworks in the area of Liège. In Norfolk, *C. norvicensis* is found together with *C. arcuata* *Pettitt*, 1950 in the Beeston Chalk (Wood, 1988, p. 36). This stratigraphical level is rarely exposed in Belgium resulting in the absence of these two species in the Belgian material.

Subgenus *Lewesirhynchia* *subgen.* *n.*

*Derivatio nominis:* from the name of the town of Lewes (Sussex, England) and from the Greek "*Puyxoa*" meaning beak.

Diagnosis of the subgenus

Multicostate rhynchonellid brachiopods with a biconvex, symmetrical shell. Numerous costae, generally faint near umbo, becoming elevated near the commissure. Costae may be reduced in number near the commissure. Incipient splitting of the costae near the commissure is observed in some species. Thick-shelled, umbo filled with callus. No pedicle collar. Thick dental plates, convergent ventrally. Inner socket ridges extending anteriorly. Hinge plates very small, triangular becoming anteriorly indistinct. Crural base inwardly concave, developing dental plates, convergent ventrally. Inner socket ridges extending anteriorly. Hinge plates very small, triangular becoming elevated near the commissure. Costae may be reduced in number near the commissure. Incipient splitting of the costae near the commissure is observed in some species. Thick-shelled, umbo filled with callus. No pedicle collar. Thick dental plates, convergent ventrally. Inner socket ridges extending anteriorly. Hinge plates very small, triangular becoming anteriorly indistinct. Crural base inwardly concave, developing with the hinge plate and the anterior part of the inner socket ridge, an original hook structure, visible in transverse section. Crura raduliform, slightly diverging.

Type species: *Terebratula octoplicata* *J. Sowerby*, 1816.

**Cretirhynchia (Lewesirhynchia) octoplicata**

*(J. Sowerby, 1816)*

Text-Figure 11, Plate 4, Figures 1a-c.

* 1816 *Terebratula octo-plicata* - *J. Sowerby*, ii, pp. 37-38, pl. 118, fig. 2 (left-hand figure only).

non 1822 *Terebratula octoplicata* - *Bronn* et *art.*, pl. 4, figs. 8 a-c.


? 1827 *Terebratula octoplicata* - *Nelson*, p. 36.

non 1833 *Terebratula octoplicata* - *Woodward*, p. 49.

non 1837 *Terebratula octoplicata* - *Hisinger*, pl. 22, fig. 12.

1838 *Terebratula octoplicata* *Sow.* - *von Buch*, pl. 15, fig. 18 (opened specimen).

pp. 1838 *Terebratula octoplicata* *Sow.* - *von Buch*, pp. 147-148 (cit. the type specimen of *Sowerby*).

non 1842 *Terebratula octoplicata* *Sow.* - *Hagenow*, p. 534, n°3. (= *C. retracta*).

non 1845 *Terebratula octoplicata* *Sow.* - *D’Orbigny*, ii, pt. 3, pl. 43, figs. 15-17.

non 1846 *Terebratula octoplicata* *Sow.* - *Boll*, pp. 148, 209 (= *C. retracta*).


? 1846 *Terebratula plicatilis* var. *octoplicata* *Sow.* - *Geinitz*, H.B., pl. 16, fig. 16.

non 1851 *Terebratula octoplicata* *Sow.* - *Boll*, p. 446 (= *C. retracta*).

non 1852 *Terebratula octoplicata* *Sow.* - *Boll*, p. 62 (= *C. retracta*).

non 1852 *Terebratula octoplicata* *(Sow.)* *Bronn* - *Puggard*, fig. 14, pl. 19, p. 17 (= *C. retracta*).

non 1855 *Rhynchonella plicatilis* var. *octoplicata* *Sow.* - *Davidson*, i, pl. 77, pl. 10, figs. 1-17 (= *C. norvicensis*).

non 1856 *Terebratula octoplicata* - *Boll*, p. 46 (= *C. retracta*).

non 1860 *Rhynchonella plicatilis* Sp. var. *octoplicata* *Sow.* - *Bosquet*, N° 586.


non 1866 *Rhynchonella octoplicata*, *d’Orb.* - *Cornet & Briart*, pl. 189.

non 1870 *Rhynchonella octoplicata*, *d’Orb.* - *Cornet & Briart*, pp. 7, 8, 9.

non 1871 *Terebratula octoplicata* *subplicata* - *Quen- stedt*, pp. 168-169, pl. 4 1 , figs. 58, 60-62 (= *C. retracta*), pl. 41, figs. 59, 63-64 (= *C. limbata*).

non 1871 *Terebratula octoplicata* - *Quenstedt*, pl. 41, figs. 534, n°3. (= *C. retracta*).

non 1889 *Rhynchonella plicatilis* var. *octoplicata* *Fröü*, fig. 91.

pp. 1894 *Rhynchonella octoplicata* *(Sow.)* *Davidson* - *Pospel*, pp. 28-29, n°4 (pro partim), non pl. 2, figs. 17-18. (= *C. retracta*).

non 1895 *Rhynchonella octoplicata* *Sow.* - *Geinitz*, H.B., pp. 6, 7 (= *C. retracta*).

non 1895 *Rhynchonella octoplicata* *Sow.* - *Debcke*, pp. 55,73,74,87. (= *pp. C. retracta, pp. limbata*).

non 1907 *Rhynchonella octoplicata* *Lam.* - *Debcke*, pp. 105,108, 109, 112. (= *C. norvicensis*).

1950 *Cretirhynchia octoplicata* *(J. Sowerby)* - *Pettitt*, pp. 8-9, pl. 1, figs 12 a-c.

1965 *Cretirhynchia octoplicata* *(Sow.)* - *Bignot*, p. 5.

1965 *Cretirhynchia octoplicata* *(Sow.)* - *Steinich*, p. 17.

1974 *Cretirhynchia octoplicata* *(Sowerby)* - *Kaevery et al.*, p. 107, pl. 1, figs. 8 a-c.

1892 *Cretirhynchia octoplicata* *(Sowerby)* - *Nechrikoova*, p. 38.
Fig. 11 — Serial transverse sections through the umbonal part of *Cretirhynchia (Lewesirhynchia) octoplicata* (J. Sowerby, 1816) collected from the Coniacian (Cortestudinarium Zone), Lewes (Sussex, England). Length of the specimen: 19.2 mm. NHM. B. 8379-1.
to the expanded anterior parts of the inner socket ridges. They build a pair of symmetrical "hook structures". This structure which is easily seen in serial sections, is observed in all the species of the subgenus *Lewesirhynchia* subgen. n., and is a distinctive character. A tendency to produce such a "hook" structure is observed in serial sections of *C. norvicensis* (Fig. 10) but it is not fully realized.

Undoubtedly, *C. octoplicata* is a distinct species from *C. plicatilis*. New material from Lewes and other places in England should be collected in order to improve the knowledge of this species and for establishing its potential of variation.

The "passage forms" between *C. octoplicata* and *C. cuneiformis* proposed by Pettitt (1950, p. 9) cannot be taken into account as the internal structures of the second species, placed here in the genus *Woodwardirhynchia* gen. n. (Figs. 2-3, show that it arose from the *Cyclothyris* stock.

*Fig. 12* — Serial transverse sections through the umbonal part of *Cretirhynchia (Lewesirhynchia) exsculpta* Pettitt, 1950 collected from the Santonian (Marsupites testudinarium Zone), Brighton (Sussex, England). Length of the specimen: 21.1 mm. NHM. B. 9464.

*Cretirhynchia (Lewesirhynchia) exsculpta* Pettitt, 1950.

Text-Figure 12, Plate 4, Figures 3a-e, 4a-e.

* 1950 *Cretirhynchia exsculpta*, sp. nov. - Pettitt, pp. 19-21, text-fig. 6. pl. 1, figs. 6a-c.

? 1965 *Cretirhynchia exsculpta* Pettitt, 1950 - Bignot, p. 6, pl. 1, figs. 6a-c, 8a-e.

. 1968 *Cretirhynchia exsculpta* Pettitt - Leeder, p. 6.

. 1974 *Cretirhynchia exsculpta* - Pajaud, p. 25.


. 1983 *Cretirhynchia exsculpta* - Bailey et al., text-fig. 3, p. 36.


Material

Material preserved in the NHM.


Material from Dorset, England.

One specimen from the *Uintacrinus* Zone in White Nothe (B. 79819). Two specimens (*Marsupites* Zone) from the Dorset coast (B. 79834-35).


10 specimens from the lower part of the *Gonioteuthis quadrata* Zone (B. 79776-85).

Original diagnosis in Pettitt (1950, p. 19)

"*Cretirhynchia*, about 19 mm long, 20 mm wide, and 16 mm thick, subpentagonal in outline, domical (sic) in anterior contour, and subdomical in lateral profile. Brachial valve convex, with slight, fairly broad and flat median fold on the anterior part. Pedicle valve less convex, with shallow to moderately deep median sinus. Linguiform extension trapezoidal, almost rectangular. Umbo erect. Ornament of about 40 rounded, clearly defined costae, with incipient splitting near the commissure and with moderately deep intervening sulci. Concentric growth-lines, with occasional laminae, especially near the anterior and lateral commissures. Apical angle 100°."

Comments

*Cretirhynchia (Lewesirhynchia) exsculpta* Pettitt, 1950 is a fairly abundant species in the Santonian and the Lower Campanian of England. It has never been collected, with certainty, outside England. The external morphological characters were exhaustively described by Pettitt (1950, pp. 19-20). For the internal characters, Pettitt (1950, p. 20) pointed to the existence of a dorsal septum and of ruduliform crura only. Despite the large amount of material available, no transverse serial sections were illustrated.

Sections made for the present paper (Fig. 12) show that the posterior part of the shell is greatly thickened. In the ventral valve, the dental plates are thick and strongly convergent. They are fused with the lateral walls of the shell, a character already observed by Pettitt (1950, text-fig. 6, p. 20). Robust teeth are present. In the dorsal valve, a persistent septum is present on the valve floor. The outer socket-ridges are very low in transverse section whereas the very high, robust inner socket-ridges are much more developed. The hinge plates are small and subtriangular. The structure built by the anterior parts of the inner socket ridges and the hinge plates, is strikingly similar, in transverse sections, to the structures observed in *C.
(Lewesirhynchia) octoplicata (Fig. 11). Crural bases are inwardly concave forming, with the hinge plates and the anterior parts of the inner socket ridges, symmetrical hook-like figures. In C. excsculpta, this hook-like structure is a little thicker than those observed in C. octoplicata and in C. protoexsculpta.

Cretirhynchia (Lewesirhynchia) protoexsculpta sp. n.

Text-Figure 13, Plate 4, Figures 2a-e, Plate 6, Figures 1a-e.

Diagnosis
Medium-sized, multicoastate, rhynchorhynchellid brachiopod, subpentagonal to transversely oval in outline, lenticular, dome-shaped in anterior contour and lenticular in lateral profile. Dorsal valve regularly convex with slight, fairly broad and flat median fold on the anterior part. Ventral valve less convex with a very broad, shallow sinus. Linguiform extension trapezoidal. Beak strong, curved, pointed and erect. About 40 costae, clearly defined, not reduced in number near the commissure and showing faint incipient splitting. Inner socket ridges, hinge plates and crural bases associated in very slender hook structures.

Derivatio nominis: from "προτεω", greek prefix indicating that this species is a potential ancestor of C. excsculpta.


Stratum typicum: Coniacian, Cortestudinarium Zone.

Holotype
Cretirhynchia (Lewesirhynchia) protoexsculpta sp. n.

Text-Figure 13, Plate 4, Figures 2a-e. The holotype is a prepared specimen for transverse serial sections (Fig. 13). The cast, peels and photographs of the serial sections are preserved in the NHM. B. 8379-2.

Dimensions of holotype: 19.8 mm long, 22.3 mm wide and 13.6 mm thick.

Paratype
One specimen collected from Lewes, illustrated Pl. 6, Figs. 1a-e, and preserved in the Natural History Museum in London under reference B. 8379-3.

Description
The shell is relatively depressed, transversely oval in outline (dorsal view) and subpentagonal in ventral view. The convexity of the dorsal valve is moderate and regular, the lateral part of the shell remaining gently convex. The short, median fold occurs on the anterior part of the valve and it is limited by relatively sharp ridges. The ventral valve is slightly convex mainly in its posterior part and the sulcus is more clearly developed than the corresponding fold on the dorsal valve. The sinus is much wider than the corresponding fold. The linguiform extension is wide and sharply trapezoidal. It turns at an angle of about 60°-70° to the plane of junction of the valves. The beak is slightly curved and erect. The beak-ridges are sharply defined. The hypothyrid foramen is very small and perfectly circular. The deltidial plates are conjunct and produced.

The costae (± 40), relatively flat and rounded, are well defined, very faint near umbo and widening towards the commissure. The costae on the lateral parts of the shell are finer near the commissure than the costae ornamenting the ventral sulcus (± 9) or the dorsal fold (± 8). The deep, intervening sulci, are extremely narrow. Incipient splitting is observed for several costae near the commissure. On the specimens investigated, no growth-lines or growth laminae are detected.

Internal characters (Fig. 13)
The posterior parts of the shell are fairly thickened. In the ventral valve, no pedicle collar has been observed in serial sections. The dental plates are subparallel posteriorly and they become anteriorly convergent. The outer socket-ridges are rather low whereas the inner socket-ridges are very thick in section and quite elevated. Teeth are strong. The hinge plates are small, subtriangular posteriorly, but they become indistinct anteriorly and develop, with the distal parts of the inner socket-ridges and the crural bases, symmetrical hook-like structures. These structures are especially thin and slender in transverse sections. The raduliform crura are slightly concave in their anterior part and are slightly divergent laterally. A persistent septum is present on the dorsal valve floor.

Comparison with other species
Cretirhynchia (Lewesirhynchia) protoexsculpta sp. n. must be compared with C. (Lewesirhynchia) excsculpta PETTITT, 1950. Generally, the dorsal valve of C. excsculpta is much more convex and the lateral flanges are much steeper in C. excsculpta. The beak is a little more curved in C. excsculpta but the beak of C. protoexsculpta sp. n. appears wider in dorsal view. The interarea is much more reduced in C. excsculpta. In C. protoexsculpta sp. n. the interarea is fairly wide. The linguiform extension of C. excsculpta, which turns at an angle of 90° to the plane of the commissure, is often rectangular, although a trapezoidal linguiform is more rarely observed. In C. protoexsculpta, the linguiform extension turns rarely above an angle of 70° and in the specimens investigated, it is widely trapezoidal. These two species exhibit a similar number of costae showing incipient splitting near the commissure. But, in C. excsculpta, the costae ornamenting the anterolateral zone of the dorsal valve, are slightly wider than the costae situated on the fold and in the sulcus. On the contrary, in C. protoexsculpta sp. n., the costae present on the fold and in the sulcus are slightly wider than the costae present on the anterolateral parts of the dorsal valve.

Concerning the internal characters, it is observed that the dental plates are more convergent ventrally in C. excsculpta than in C. protoexsculpta sp. n. The hook-like
structure seen in transverse sections is much more slender in *C. protoexsculpta* sp. n. than in *C. exsculpta*.

Confusion can also be made between *C. protoexsculpta* sp. n. and some flat or depressed specimens of *Woodwardirhynchia cuneiformis* (Pettitt, 1950). In *W. cuneiformis*, incipient splitting of the costae near the commissure never occurs. The number of costae is generally reduced near the commissure in *W. cuneiformis* but some specimens do not exhibit this reduction of the number of costae. The structure of dental plates, hinge plates and crural bases is totally different in *W. cuneiformis* and transverse serial sections avoid any confusion.

As the incipient splitting of the costae is not always clearly present in the specimens of *C. protoexsculpta* sp. n., it is possible that the passage forms between *W. cuneiformis* and *C. octoplicata* (J. Sowerby, 1816) described by Pettitt (1950, p. 9) were in fact specimen of *Cretirhynchia (Lewesirhynchia) protoexsculpta* sp. n.

**Subgenus Harmignirhynchia** subgen. n.

*Derivatio nominis:* from the name of the village of Harmignies (Mons basin, Hainaut, Belgium) and from the Greek "πνεύμα" meaning beak.

**Diagnosis of the subgenus**

Multicostate rhyynchonellid brachiopods with a slightly biconvex, symmetrical shell. Shell transversely oval in outline, always wider than long. Anterior contour and lateral profile lenticular. Numerous faint costae reduced or not reduced in number near the commissure. No incipient splitting of the costae near the commissure. Dental plates convergent ventrally. Hinge plates relatively wide and crural bases subquadrate but often inwardly concave. Posterior part of the crura strongly concave. Crura steep, deflected ventrally, remaining close together or slightly diverging laterally. Angle formed by the posterior parts of the crura widely obtuse in transverse section.

**Type species:** *Cretirhynchia intermedia* Pettitt, 1950
**Cretirhynchia (Harmignyrhynchia) intermedia**

PETITT, 1950

Text-Figures 14-16, Plate 5, Figures 1a-e, 2a-e, 3a-e.

1950 *Cretirhynchia intermedia* sp. nov. - PETITT, pp. 14-15, pl. 1, figs. 5a-c, 8a.

Stratigraphical range: Lower Campanian, *Offiaster pilula* and *Gonioteuthis quadrata* Zones.

Type specimen

Holotype from the *O. pilula* Zone of East Harnham, Wiltshire, England, illustrated by PETITT (1950, pl. 1, figs. 5a-c) and preserved in the NHM under the reference B. 92723.

Material

Material preserved in the NHM.

Specimens from the *O. pilula* Zone of East Harnham, Wiltshire, England.

The holotype cited above. 74 topotypes [B. 92705-19, B. 92742 (24 specimens), B. 92743-44, B. 92746-63, B. 92764-73, BB. 43306-11].

Specimens from the *O. pilula* and/or *G. quadrata* Zones of Whaddon near Salisbury, Wiltshire, England.


Specimens from the *O. pilula* Zone of Harnham Hill, Salisbury, Wiltshire, England.

Three specimens (B. 25068-70).

Original Diagnosis in Pettitt (1950, p. 14)

"*Cretirhynchia*, about 19 mm long, 22 mm wide and 14 mm thick, subpentagonal to oval in outline, oval in lateral profile, lenticular, thick in anterior contour. Brachial valve convex, with low median fold on anterior part; pedicle valve slightly less convex, with moderately deep median sinus; linguiform extension U-shaped, turns at 45° to 60°. Umbo short, thick; foramen small, circular. Costae numerous, low and fine; sulci shallow".

Comments

*Cretirhynchia intermedia* has never been collected outside England. However, the material preserved in London is quite abundant and relatively homogenous. Numerous specimens available, mostly collected in East Harnham, fit the description given by PETITT.

*Cretirhynchia intermedia* is a species with numerous (up to 50 in large specimens) very low and faint costae. However, in some specimens, the costae can be more acutely developed. The shell is transversely oval in outline with very rounded lateral parts. A flat median fold, which is fairly broad and moderately elevated, corresponds to a relatively wide sinus which is moderately deep. PETITT stressed the evolution of the linguiform extension in this species: arcuate in early stages of growth and U-shaped in later stages. In some larger specimens, the linguiform extension can be subrectangular. Another typical feature is the very narrow interarea which is curved. The apical, hypothyridid, foramen is oval and the deltoidal plates are produced, forming a well developed tube. The beak ridges are acutely distinct in this species. Transverse serial sections were made on two specimens collected from the type area (Figs. 14, 16). The dental plates, convergent ventrally, are thick in the umbo but relatively thin anteriorly. No pedicle collar has been observed in transverse section. A dorsal septum is present in the dorsal valve but it is rather short and very low. The hinge plates are small and subtriangular. The crural bases are fairly coarse and inwardly concave. They are not strictly subquadrate. They remain associated with the internal side of the anterior portion of the inner socket ridges, below their ventral edge. This gives, in transverse section, a very peculiar image resembling a "cockfighting" situation (Fig. 15). In their posterior part, the crura are thick and deeply concave. They become wider, up to the middle of their length. In the anterior part, they become narrower again, appearing straight in transverse sections. An obtuse, wide angle is formed by the distal parts of the crura. The crura are steep and ventrally oriented.

*Cretirhynchia intermedia* represents a special lineage among the species of the genus *Cretirhynchia*. Its shape and external ornamentation suggest that *C. intermedia* was a deep water species. Among the internal characters, the convergent dental plates, the small subtriangular hinge plates and the anterior parts of the crura which are close together, are all typical characters for representatives of the genus *Cretirhynchia*. The dorsal septum which is relatively short and poorly developed, the sharply concave crural bases and posterior parts of the crura, and the wide obtuse angle formed by the distal parts of the crura, are original features of the subgenus Harmignyrhynchia subgen. n.

PETITT (1950) named this species "intermedia" because its shape was a kind of "go-between" form among several species of *Cretirhynchia*. He described passage forms between *C. intermedia* and *C. norvicensis*. These forms are not considered here as passage forms. They are only more subtriangular than the usual transversely oval specimens. The serial sections easily distinguish *C. norvicensis* from *C. intermedia*.

**Cretirhynchia (Harmignyrhynchia) obourgensis** sp. n.

Text-Figures 17-18, Plate 5, Figures 4a-e, 5a-e, Plate 6, Figures 2a-e.

2000 *Cretirhynchia sp. - SIMON, pp. 139-140, text-fig. 3, pl. 5, figs. 5a-e, 6a-e.

Stratigraphical range: Upper Campanian, from uppermost part of the *Bit. mucronata* Zone to the *Bit. woodi* Zone.

Diagnosis

Medium-sized, multicostate rhychoonellid brachiopod, transversely oval in outline, always wider than long,
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lenticular in anterior contour and lenticular in lateral profile. Dorsal valve slightly more convex than the ventral valve. Slight, relatively broad and flat median fold limited to the anterior part of the dorsal valve. Ventral valve with a very broad, shallow sulcus with very sharp lateral limits. Linguiform extension trapezoidal. Beak small, curved and pointed, erect. About 50 costae, clearly defined, slightly reduced in number near the commissure. No incipient splitting of the costae. Dental plates subparallel in the posterior part of the ventral valve, becoming ventrally convergent in their anterior part. No pedicle collar. Persistent, low dorsal septum. Hinge plates simple, subtriangular. Crural bases inwardly concave. Crura very steep, laterally diverging. Wide, obtuse angle formed by the anterior parts of the crura.

**Derivatio nominis:** The species name is derived from the name of the village of Obourg near Mons (Mons Basin, Hainaut, Belgium) and refers also to the "Craie d’Obourg" from which the species has been collected.

**Locus typicus:** Harmignies near Mons, C.C.C. (Crayères, Cimenteries et Chaux) quarry.

**Stratum typicum:** "Craie d’Obourg-Nouvelles", Upper Campanian, *Bit. woodi* Zone.

**Holotype**

*Cretirhynchia* (Harmignirhynchia) *obourgensis* sp. n. Text-Figure 17, Plate 6, Figures 2a-e. The holotype is a prepared specimen for transverse serial sections. The cast, peels off and photographs of the serial sections are preserved in the IRScNB in Brussels under the reference IRScNB - IST n° 10847.

Dimensions of holotype: 15.7 mm long, 17.9 mm wide and 10.2 mm thick.

**Paratypes**

*C. (Harmignirhynchia) obourgensis* sp. n. Plate 5, Figures 4a-e. IRScNB - IST n° 10844. Complete bivalved specimen collected from the "Craie de Nouvelles", Upper Campanian (*Bit. woodi* Zone) in Harmignies near Mons (Hainaut, Belgium).

*C. (Harmignirhynchia) obourgensis* sp. n. Plate 5, Figures 5a-e. IRScNB - IST n° 10846. Complete bivalved specimen collected from the "Craie de Nouvelles" (*Bit. woodi* Zone) in Harmignies near Mons (Hainaut, Belgium).

*C. (Harmignirhynchia) obourgensis* sp. n. Slightly damaged, bivalved specimen collected from the top of the "Craie de Trivières", Upper Campanian (*Bit. mucronata Zone*) in Cuesmes near Mons (Hainaut, Belgium). Specimen described and illustrated in Simon (2000, pp. 139-140, pl. 5, figs. 5a-e). IRScNB - IST n° 10830.

*C. (Harmignirhynchia) obourgensis* sp. n. Slightly damaged, bivalved specimen collected from the top of the "Craie de Trivières", Upper Campanian (*Bit. mucronata Zone*) in Cuesmes near Mons (Hainaut, Belgium). Specimen described and illustrated in Simon (2000, pp. 139-140, pl. 5, figs. 6a-e). IRScNB - IST n° 10824.

**Material**

Material from the Mons basin (Hainaut, Belgium) preserved in the IRScNB in Brussels.

Specimens collected from the "Craie de Trivières", Upper Campanian, *Bit. mucronata Zone*.

12 complete, bivalved specimens collected from the Craibel quarry in Cuesmes.

Specimens collected from the "Craie d’Obourg", Upper Campanian, uppermost part of the *Bit. mucronata* and *Bit. woodi* Zones.

Two specimens from Cuesmes, one from the base of the "Craie d’Obourg" in the Craibel quarry (see Simon, 2000, pl. 5, figs. 5a-e, 6a-e) and one specimen without precise locality (Collection Cornet).

48 specimens from Harmignies. Three specimens from Cipy. Seven specimens without precise locality.

Specimens collected from the "Craie de Nouvelles", Upper Campanian, *Bit. woodi* Zone (Mons basin, Hainaut, Belgium).

One specimen from Harmignies and one specimen from Nouvelles.

**Description**

**External characters**

Medium sized rhynchonellid brachiopod, about 14.0 / 19.5 mm long, 14.5 / 21.2 wide and 7.3 / 11.5 mm thick, transversely oval in outline, oval-lenticular in lateral profile and lenticular in anterior view. Young specimens are more subtriangular in outline. The dorsal valve is slightly more convex than the ventral valve. The maximum convexity is situated in the middle of the dorsal valve. A very low dorsal median fold is only developed on its anterior part and is bounded by sharp edges. The ventral valve shows a maximal posterior convexity near the umbo and its sulcus is low, flattened but slightly wider than the corresponding dorsal fold. The sulcus is restricted to the anterior part of the ventral valve and it is limited by sharp edges. The broad linguiform extension is sharply trapezoidal. The relative width of the linguiform extension is variable. The beak is very short, curved and erect with a pointed tip. The beak ridges are very distinct. The hypothyridid foramen is circular with conjunct, protruding deltidial plates. The interareas are slightly curved but the posterior commissure is nearly straight. Numerous costae are visible (38 to 53). They are low, very faint in the posterior part of the shell but wider anteriorly. The costae are slightly reduced in number near the anterior part of the shell, but in some specimens, reduction of the number of costae does not occur. Incipient splitting is never observed. Eight to ten costae are visible in the bottom of the sulcus at the anterior commissure whereas seven to nine costae are present on the dorsal fold. Fine
concentric growth lines are perceptible on the shell surface and sometimes, a few laminae are developed near the commissure. A major growth line is often perceptible in the anterior part of the shell.

**Internal characters**

In transverse serial sections (Figs. 17-18), dental plates are subparallel in the posterior part of the umbo and they become anteriorly convergent. No pedicle collar is observed. Outer socket ridges are extremely low and the sockets, in this species, are fairly wide in transverse section. Inner socket ridges are much more elevated. The hinge plates are simple and subtriangular. Crural bases subquadrate but slightly concave inwardly. Very steep, ventrally directed, raduliform crura are observed. In transverse section, they are nearly vertical in their anterior part. A persistent, low dorsal septum is developed on the dorsal valve floor.

**Comparison with other species**

The general outline of large shells of *C. (Harmignyynchia) obourgensis* sp. n. is quite similar to the shell outline of *C. (Harmignyynchia) intermedia* PETTITT, 1950. But, the latter species is relatively thicker in anterior contour and the maximum convexity of its dorsal valve is situated near the umbo. Reduction of the number of costae near the anterior commissure is stronger in *C. intermedia*. Moreover, the linguiform extension of *C. intermedia* is generally U-shaped or arcuate, it is sharply trapezoidal in *C. obourgensis* sp. n. However, in the collections of the NHM, specimens of *C. intermedia*, from East Harnham near Salisbury, have a more trapezoidal linguiform extension.

The smaller specimens of *C. obourgensis* sp. n. have a subtriangular outline similar to those of *C. norvicensis* PETTITT, 1950. In the latter species the linguiform expansion is trapezoidal but a strong reduction of the number of costae limit to the antero-lateral commissure. Beak small, pointed and generally curved. Beak ridges well developed. Hypothyrid foramen with conjunct, protruding deltoidal plates.

Ventrally convergent dental plates. Pedicle collar rarely developed. Very strong hinge structure, with ventrally expanded inner socket ridges. Crural bases subquadrate. raduliform crura slightly concave in their posterior part, remaining close together.

**Type species**: *Terebratulites limbatus* VON SCHLOTHEIM, 1813.

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**Cretirhynchia (Homaletarhynchia) limbata**

*(VON SCHLOTHEIM, 1813)*

Text-Figure 19, Plate 7, Figures 1a-e, 2a-e.

(1803?) *Terebratules fossiles* - FAUJAS DE SAINT-FOND, pl. 26, fig. 4.

* 1813 *Terebratulites limbatus* - VON SCHLOTHEIM, p. 113 (cit. FAUJAS, 1803?)

* 1820 *Terebratulit. Limbatus* - VON SCHLOTHEIM, p. 286.


* 1842 *Terebratula subplicata* Mant. - VON HAGENOW, p. 534, Nr. 4.


* 1848 *Terebratula limbata* - BRONN, p. 1240.

* 1852 *Terebratula subplicata* Mant. - PUGGAARD, p. 16.

* 1856 *Rynchonella limbata* v. Sch. sp. - BOLL, p. 47.

* 1860 *Rynchonella limbata* v. Sch. sp. - BOSQUET, N° 585.

* 1866 *Rynchonella subplicata* d'Orb. - CORNET & BRIARD, pp. 150, 159 (= C. limbata).

* 1870 *Rynchonella subplicata* d'Orb. - CORNET & BRIARD, pp. 8, 9 (= C. limbata)

* 1871 *Terebratula octoplicata subplicata* - QUENSTEDT, p. 169, pl. 41, fig. 59 (d, f, non fig. 58, 60-62 = C. retracta).


* 1888 *Rynchonella limbata* Schl. - GEINZITZ, F.E., p. 742.

* 1894 *Rynchonella limbata*, Schlotheim - POSSELT, p. 27, fig. 16.


* pp 1909 *Rynchonella limbata* Schlatheim (Sic) - BRÖNNICH NIELSEN, p. 157, N° 17, pl. 1, fig. 26 (non Figs. 24-25).

* v 1938 *Rynchonella limbata* Schlot. - POJARYNSKI, p. 20.

* 1954 *Cretirhynchia limbata* (Schlotheim): - PETTITT, p. 27, pl. 1, fig. 1a-c, pl. 2, fig.12 a-c, text-fig. 7a-c, 8, 9.

* 1961 *Cretirhynchia limbata* (Schlot.). - KOVALEVA, p. 66, 70.

* 1965 *Cretirhynchia limbata* (Schlotheim, 1813) - STEINICH, p. 24, pl. 2, fig. 4a-d, text-fig. 13.

* 1966 *Cretirhynchia limbata* limbata (Schloth.) - MALKIN & KATZ, p.191, pl. 1, fig. 6.

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Subgenus *Homaletarhynchia* subgen. n.

Derivatio nominis: from the greek "Homailes" (Ωμαο¬λεοσ) meaning "flat", "without relief" and "Φω/φεαος" meaning beak.

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Fig. 18 — Serial transverse sections through the umbonal part of *Cretirhynchia (Harmignyynchia) obourgensis* sp. n. collected from the Upper Campanian *(Bolennnillia mucronata* Zone), Cuesmes ( Mons basin, Hainaut, Belgium). Holotype. Length of the specimen: 19.1 mm. IRScNB. - IST. N° 10849.
Material preserved in the Museum of the Earth in Warsaw (Museum Ziemi PAN).

One Lower Maastrichtian specimen collected from Kamien, "horizon u", middle Vistula river, Poland (MZ VIII Bra 1516a).

143 specimens determined as *Cretirhynchia limbata* (Schlotheim, 1813) in *Popiel-Barczyk* (1988, pp. 6-8) which must be removed from this species.

Diagnosis in Faujas (1803?): none (parôt être inédite).

Original diagnosis in *von Schlotheim* (1813, p. 113): none.

Diagnosis in *von Hanstein* (1879, p. 37):


Emended diagnosis in *Petitt* (1954, p. 27):

"*Cretirhynchia*, about 12 mm long, 15 mm wide and 7 mm thick, oval in outline, low domical in anterior contour, depressed cuneiform in lateral profile. Brachial valve modestly convex, with sharp, elevated median fold. Pedicle valve less convex, with deep, narrow, rounded sinus. Umbro slightly incurved. Surface of shell nearly smooth, with a few costae developed near the commissure".

Emended diagnosis in *Steinich* (1965, p. 24):

"Relativ klein; stets deutlich breiter als lang, oval bis subtrian-

gular, Stirnrand oft leicht eingebuchtet; Dorsalklappe kräftig konvex, am Wirbel steil ansteigend; Ventralklappe sehr niedrig, am Wirbel schwach gewölbt, sonst plan; etwa ab Schalenmitte erscheint ein kräftiger Ventral sinus, der v-förmig bis trapézoidal, bemerkliche Wölbung der durchbohrten Klappe und die steile Area sie von derselben unterscheiden, ich habe sie daher von ihr getrennt gelassen. Während die Klappen bis zu dem der Stirnrande nächsten Anwachstreffen keinerlei Spur von radialer Sculptur erkennen lassen, treten die Rippen nun plötzlich sehr stark hervor, etwa 12 an der Zahl, davon 3-4 im Sinus der grossen Klappe liegen".

Comments

*Cretirhynchia* (*Homaletarhynchia*) *limbata* (*von Schlotheim*, 1813) is a species which was often confused with other rhychnonellid brachiopods in the past but which is now accurately described. The descriptions in *Petitt* (1953, pp. 27-29) and in *Steinich* (1965, pp. 24-26) avoid any possible confusion with other *Cretirhynchia* species. *Simon* (1993, p. 83) pointed out the essential differences between *C. limbata* and *C. undulata* (*Pusch*, 1837). The same author (1998, pp. 183-184, text-fig. 3) discussed the palaeoecology of *C. limbata*, a species thought to have been fixed directly in the sediment by means of its pedicle. It was probably living with its dorsal fold down, partly inserted in the sediment (*Simon*, 1998, text-fig. 3).

Transverse serial sections of an original specimen, col-
lected from the phosphatic chalk of Ciply (Lower Maas-
trichtian, Blm. obtusa Zone) were illustrated by Popiel-
Barczyk (1988, text-fig.9) under the name Cretirhynchia
subplicata (MANTELL). A specimen from Rügen, Germa-
nny (Lower Maastrichtian) was prepared for serial sections
and the results were illustrated in Steinich (1965, text-
fig. 13). Serial sections of a specimen collected from the
Vijlen chalk in the CPL quarry in Hallembaye, near
Liège, Belgium (Upper Maastrichtian, B. junior Zone)
were illustrated by Simon (1993, text-fig. 8). In this
paper, serial sections of a specimen from Jandrain,
Brabant, Belgium (Upper Maastrichtian) are presented in
Fig. 19. Serial sections show the typical features of the
genus Cretirhynchia: convergent dental plates, persistent
dorsal septum, simple and subtriangular hinge plates,
subquadrate crural bases and raduliform crura remaining
close together. The strong hinge associated with expanded
inner socket ridges is an important character of the
subgenus Homaletarhynchia subgen. n.
Cretirhynchia (Homaletarhynchia) limbata is a vari¬
able species for its size. Campanian representatives are
rather small and thin-shelled. Lower Maastrichtian speci-
mens (Pl. 7, Figs. 2a-e) are larger and their shell is much
thicker. Specimens from Jandrain (Pl. 7, Figs. 1a-e) are st
ill larger and they are slightly different in outline from the
type material. They seem adapted to a higher rate of sedi-
mentation inducing a larger development of their dorsal
fold.

On the contrary, other characters are very stable in this
species. The clearly cuneiform aspect of the shell in lat-
éral view, the very thin and pointed beak which is only
suberect, the v-shaped linguiform extension and the
antero-lateral parts of the ventral valve which are always
flat, are specific characters for C. limbata.

The Upper Maastrichtian material from the middle
Vistula River studied and illustrated by Popiel-Barc-
zyk (1988, pp. 6-8, pl. 1, figs. 1-6) is removed from
Cretirhynchia limbata. These specimens are very larges-
sized Cretirhynchia which are clearly biconvex. Even
if some specimens are cuneiform in lateral profile,
most of them are oval lenticular (Popiel-Barczyk,
1988, pl. 1, fig. 2a). The beak is much thicker and more

![Fig. 20 — Serial transverse sections through the umbonal part of Cretirhynchia (Homaletarhynchia) lentiformis (Woodward,
1833) collected from the Upper Campanian (Blechnitella mucronata Zone), Cuesmes (Mons basin, Hainaut,
Belgium). Length of the specimen: 9.2 mm. IRScNB. - IST. N° 10821.](image-url)
Fig. 21 — Serial transverse sections through the umbonal part of *Cretirhynchia (Homaletarhynchia) robusta* (Tate, 1865) collected from the Santonian, Woodburn, Northern Ireland. Length of the specimen 13.5 mm. NHM. B. 25152.

curved and erect. The antero-lateral parts of the ventral valve are always convex, never flat. These specimens are related to the *limbata* - group but the erection of a new species in the *Homaletarhynchia* subgen. n. is suggested.

In 1965, BIGNOT (p. 6, pl. 1, figs. 7-8) described some rhynchonellid brachiopods as *Cretirhynchia gr. limbata* (V. SCHLOTHEIM) from the Lower Senonian of Ballastière d’Etran and Arques-la Bataille (Area of Dieppe, Normandy, France). Although no transverse serial sections are available for this material, the illustrations given by BIGNOT suggest a close relationship between this material and *C. (Homaletarhynchia) limbata*. This material is considered as a potential ancestor (Fig. 1) for the "*limbata-undulata* group" included in *Homaletarhynchia* subgen. n. but it should be reviewed for further information.

*Cretirhynchia (Homaletarhynchia) lentiformis*  
(WOODWARD, 1833)  
Text-Figure 20, Plate 7, Figures 5a-e.

* 1833  
Terebratula lentiformis - WOODWARD, S., p. 49, pl. 6, fig. 11.

pp. 1855  
Rhynchonella limbata - SCHLOTHEIM - DAVIDSON, pp. 79-80, pl. 12, figs. 4-5.

1950 *Cretirhynchia lentiformis* (S. Woodward) - PETTITT, pp. 1, 26-27, 29, table 3, pl. 2, figs. 1a-e.

1961 *Cretirhynchia lentiformis* (S. Woodward) - PEAKE & HANCOCK, p. 320.

1968 *Cretirhynchia lentiformis* Woodward - LEEDER, pp. 6-7, 9, tables 1-2, text-fig. 1, p. 8.

1988 *Rhynchonella lentiformis* - ROWE in WOOD, pp. 10, 21, 58, 59, 86.


1988 *Cretirhynchia lentiformis* - Woodward, 1833) - POPIEL-BARCZYK, pp. 11-12, text-fig. 11, non text-fig. 10, pl. 2, figs. 7-9 (= *C. arcuata* PETTITT, 1950).

1990 *Cretirhynchia arcuata* Pettitt, 1950 - POPIEL-BARCZYK, pl. 2, fig. 10.


2000 *Cretirhynchia lentiformis* (Woodward, 1833) - SIMON, pp. 138-139, table 1, text-fig. 3, pl. 5, figs. 2a-e, 3a-e.
Stratigraphical range: lower to middle Upper Campanian.

Type specimen
Holotype, the original of Woodward (1833, pl. 6, fig. 11) from the Upper of Norwich, Norfolk, England, not traced. Pettitt (1950, p. 26) designated and figured a topotype as neotype from the Upper Chalk (Blt. mucronata Zone) of Hartford Bridge, Norwich, Norfolk.

Material
Material preserved in the NHM.

The neotype cited above. 49 specimens from the Blt. mucronata Zone in Norwich, under the reference B. 93067-110. 41 specimens (topotypes) from the Blt. mucronata Zone in Hartford Bridge, Norwich, Norfolk (B. 25067-107). Four specimens, from Norwich without precise locality (B. 24900-3). Five specimens from the Blt. mucronata Zone of Ballard Head and Studland Bay, Dorset, England (B. 79946-50).

Material preserved in the IRSnFB in Brussels.

Specimens collected from the Mons Basin (Hainaut, Belgium).

From the “Craie de Trivières”, Blt. mucronata Zone: 230 complete bivalved specimens collected from the Craibel quarry in Cuesmes.

From the “Craie d’Obourg”, Blt. mucronata- Blt. woodi Zones: 30 complete bivalved specimens collected from Harmignies.

Original diagnosis in Woodward (1833, p. 49)
None.

Diagnosis in Pettitt (1950, p. 26)
"Cretirhynchia; about 10 mm in length, 9 mm in width, 5 mm in thickness, subcircular in outline, lenticular to oval in antero- or contour and lateral profile. Brachial valve moderately convex, with slight median fold on anterior margin; pedicle valve equally convex, with shallow and narrow median sinus; or fold and sinus may be absent. Linguiform extension very small, arcuate, or anterior commissure may be rectimarginate. Surface nearly smooth."

Comments
Cretirhynchia lentiformis held a juvenile structure throughout its whole life and specimens with a more adult internal aspect are rarely collected. However, the hinge and crural structures are very similar to the structures observed in C. arcuata and in C. limbata and they are typical for the subgenus Homaletarhynchia subgen. n.

The numerous specimens investigated are relatively small, about 10 mm long, 9-10 mm wide and 5-7 mm thick. Valves are equally convex with a slight median fold on the dorsal valve corresponding to a narrow and shallow sulcus on the ventral valve. The linguiform extension is small, but clearly trapezoidal in most studied specimens. More rarely, some flat specimens exhibit a slightly arcuate linguiform extension. The umbo is fairly broad. The beak is thin and the hypothyridid foramen is extremely small. At first glance, the shell surface seems nearly smooth, except for faint growth-lines. But, careful study of a large sample, observed under good light condition, show numerous faint costae which are constantly present on the anterior part of the shell. The posterior part and in some cases, the middle part of the shell remain smooth. Only very young specimens are totally smooth. This character distinguishes Cretirhynchia lentiformis from C. arcuata Pettitt, 1950. In C. arcuata, the shell is smooth on its whole surface and "costae" are only developed on large specimens near the antero-lateral commissure.

Pettitt (1950, p. 26, pl. 2, figs. 1a-c) based his description on a poorly developed specimen. He stated in his diagnosis: "linguiform extension very small, arcuate, or anterior commissure may be rectimarginate". This diagnosis was the subject of confusion between C. lentiformis and C. arcuata. In most specimens of C. lentiformis investigated, we observed a small but clearly trapezoidal linguiform extension. Confusion arose over the material collected from the middle Vistula river valley in Poland (Popiel-Barczyk, 1988, pp. 11-13, pl. 2, Figs. 7-10). In that paper, Popiel-Barczyk describes some specimens of C. lentiformis (pl. 2, fig. 10) under the name C. arcuata. Specimens presented as C. lentiformis (pl. 2, figs. 7-9) must be interpreted as the real C. arcuata. The serial sections presented in Popiel-Barczyk (1988, text-fig. 10) under the name C. lentiformis, are typical of C. arcuata. The dorsal septum is very thick and high, a character not observed in C. lentiformis. The sections presented in Popiel-Barczyk (1988, text-fig. 11) are consistent with our sections obtained on specimens of C. lentiformis (Fig. 20) but those presented in her text-fig. 12 must be considered as C. lentiformis and not as C. arcuata.

The material collected from Norfolk is identical to the material collected from Cuesmes. However, two forms α and β, have been described by Leeder (1968, p. 9, text-fig. 1ac, 1d-f) and they have a stratigraphical value. The form α has a broad trapezoidal linguiform extension and up to nine small costae near the anterior commissure. It ranges from the top of the Basal Mucronata Chalk to the middle of the Weybourne Chalk. The form β has only four broad costae and its linguiform extension is much narrower and tends to a V-shaped. It occurs from the middle of the Weybourne Chalk to the Paramoudra Chalk.

Transverse serial sections of specimens of C. lentiformis collected from Cuesmes (Fig. 20) show that no pedicle collar is observed and that dental plates are ventrally convergent. The strong hinge structure, with its ventrally expanded inner socket ridges, is typical of the subgenus Homaletarhynchia subgen. n. Crural bases are inwardly concave as are the crura in their posterior part. The dorsal septum is present but it is relatively low.
**Cretirhynchia (Homaletarhynchia) undulata**  
(Pusch, 1837)  
Plate 7, Figures 6a-e.

* 1837 Terebratula undulata m. - Pusch, p. 20, pl. 4, figs. 4a-c.  
1838 Rhynchonella limbata v. undulata Pus. - Pożar- 
yski, p. 20.  
1842 Rhynchonella limbata Schl. var. undulata Pusch 
- Putzer, p. 373.  
1958 Cretirhynchia limbata (Schlotheim, 1813) - Fe-
dorowski, p. 9, pl. 1, figs. b, d.  
1966 Cretirhynchia limbata undulata (Pusch) - Ma-
kradin & Katz, p. 101, pl. 1, figs. 7-8.  
1984 Cretirhynchia limbata undulata (Pusch) - Po-
piel-Barczyk, p. 349 pl. 151, figs. 7-8.  
1988 Cretirhynchia undulata (Pusch, 1837) - Po-
piel-Barczyk, p. 8, text-figs. 5-7, pl. 1, figs. 7-12. 
1989 Cretirhynchia limbata undulata (Pusch, 1837) 
- Popiel-Barczyk, p. 245, pl. 152, figs. 7-8.  
1992 Cretirhynchia undulata (Pusch, 1837) - Po-
piel-Barczyk, p. 15.  
1993 Cretirhynchia undulata (Pusch, 1837) - Simon, 
pp. 78-86, text-figs. 4-7, pl. 1, figs. 1-5, pl. 2, 
figs. 1-5, pl. 3, figs. 1-3, pl. 4, figs. 2-4, pl. 5, 
figs. 1-4.

**Stratigraphical range:** Upper Maastrichtian

**Type specimen**

Holotype not designated by Pusch (1837). Pusch’s col-
lection has been destroyed (Kiepura, 1984), a neotype 
form the Upper Maastrichtian of Kazimierz (Poland) has 
been designated by Popiel-Barczyk (1988, p. 8, pl. 1, 
fig. 11). The neotype is preserved in the Museum of the 
Earth (Muzeum Ziemi PAN) in Warsaw under the refer-
ence MZ VIII Bra-943, 33.

**Comments**

*Cretirhynchia undulata* (Pusch, 1837) has been studied 
by Popiel-Barczyk (1988) and more recently by Simon 
(1993). Numerous illustrations have been published in 
these two papers concerning the Polish and the Belgian 
material of *C. undulata*. The external characters and the 
internal characters, presented in the transverse serial sec-
tions published by Popiel-Barczyk (1988, text-figs. 5-7) 
and by Simon (1993, text-figs. 4-5), are consistent with 
the diagnosis of *Homaletarhynchia* subgen. n.

A pedicle collar has been observed in one Belgian 
specimen from Hallembeaye by Motchurova-Dekova & 
Bittner (Personal communication, 1998). This species has 
a fairly strong hinge structure with very low outer socket 
ridges and extremely elevated, expanded, inner socket-
ridges. Subquadrate crural bases and concave raduliform 
crura which remain close together are observed. *C. un-
dulata* developed small umbonal chambers in the dorsal 
valves.

It is proposed here to erect two subspecies, one for the 
original Polish material and one for the Belgian material 
collected in the area of Maastricht.

**Cretirhynchia (Homaletarhynchia) undulata** 
(Pusch, 1837) subsp. *undulata*

This is the original Polish material described by Pusch 
(1837) and by Popiel-Barczyk (1988). At adult growth 
stage, *C. undulata undulata* is a large shell, triangular in 
outline and with distinct sharper cardinal margin. In the 
Polish subspecies, adult and gerontic specimens exhibit a 
large trapezoidal linguiform extension. Weak folds (4-10) 
are visible on the anterior margin.

**Cretirhynchia (Homaletarhynchia) undulata**  
(Pusch, 1837) subsp. *maastrichtiensis* subsp. n.

This subspecies is erected for the material collected from 
the Vijlen chalk (Upper Maastrichtian, *B. junior Zone*) in 
the CPL quarry in Hallembeaye and the CBR quarry in 
Lixhe (Liège, Belgium), studied and illustrated by Simon 
in 1993 (pp. 78-83, pl. 1, figs. 1-5, pl. 2, figs. 1-5, pl. 3, 
figs. 1-3).

**Type specimen of the subspecies**

*Cretirhynchia (Homaletarhynchia) undulata* (Pusch, 1837) 
subsp. *maastrichtiensis* subsp. n. collected at the 
basis of the Lixhe chalk (Upper Maastrichtian, *Bl. junior 
Zone*) from the CBR quarry in Lixhe (Liège, Belgium) 
and illustrated in Simon (1993, pl. 2, figs. 5a-d). The type 
specimen is preserved in the IRScNB in Brussels under the 
reference IRScNB - IST n° 10842.

**Morphological measurements of the type specimen:**

length of the shell 17.7 mm, width of the shell 20.4 mm 
and thickness of the shell 11.4 mm.

**Diagnosis of the subspecies**

Shell small to medium-sized, subtriangular in outline, 
lenticular to oval-lenticular in anterior contour, oval-
rectangular to slightly cuneiform in lateral profile. The 
maximum width of the shell is observed just below the 
middle of the valves. Ventral valve less convex than the 
dorsal valve but a strong convexity takes place at the base 
of the beak.

Beak short, erect, thick in lateral profile and curved. 
Beak ridges distinct. Hypothyridid small foramen, circu-
lar. Flat ventral median sulcus and relatively narrow, flat 
dorsal fold. Linguiform extension arcuate in young 
specimens becoming trapezoidal in gerontic specimens. 
Absence of large weak folds on the top of the lin-
guiform extension, anterior commissure slightly plicate.

Ornamentation of the shell consisting of numerous 
regular, faint and extremely narrow grooves. Dental 
plates convergent. Pedicle collar sometimes developed. 
Umbonal chambers in the umbo of the dorsal valve. 
Strong hinge with ventrally expanded, elevated inner 
socket ridges, simple hinge plates, crural bases inwardly 
concave, crura concave posteriorly and remaining close 
together.

**Comments**

Juvenile or young specimens of both subspecies of *C. 
undulata* are not distinguishable. The adult specimens 
of the subspecies *maastrichtiensis* subsp. n. are much 
smaller and the dorsal valve is less convex than in the 
representatives of the subspecies undulata. The sulci-
plicate anterior commissure of gerontic Polish specimens 
referred to the subspecies *undulata* is the most obvious 
external difference from the Belgian specimens. Anterior 
commissure of the specimens referred to the sub-

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This is a sample text for a scientific paper. The content is organized to show how a scientific paper might present a description of a biological species, including its morphology, stratigraphical range, and diagnostic features. The text is well-structured, with clear sections for type specimens, comments, and diagnostic information. The use of scientific names and references is consistent with the conventions of biological nomenclature. The text is written in a formal scientific style, typical of academic publications in the field of geology or paleontology.
species *maastrichtiensis* subsp. *n.* is always simply pli- cated.

**Cretirhynchia (Homaleatarhynchia) robusta**  
*(Tate, 1865)*  
Text-Figure 21, Plate 6, Figures 6a-e.

* 1865 *Rhynchonella limbata* Schlotheim var. *robusta* - *Tate, p. 42, pl. 5, figs. 2a-c.*  
. 1950 *Cretirhynchia robusta* (Tate) - *PETTITT, pp. 24-25, pl. 2, figs. 3a-c.*  
. 1988 *Cretirhynchia robusta* (Tate) - *POPIEL-BARCZYK, p. 10.*

Stratigraphical range: Santonian.

Type specimen  
Specimen illustrated in *Tate* (1865, pl. 5, figs. 2a-c) not traced. Lectotype in *PETTITT* (1950, p. 24, pl. 2, figs. 3a-c) from the Santonian but originally considered from "the Zone of *Inoceramus crispus*" (sic) of Carrickfergus, North-East Ireland. The lectotype is preserved in the Museum of the British Geological Survey, under the reference GSM. 83078.

Material  
The lectotype chosen by *PETTITT*, cited above.

Ten specimens from Woodburn, Northern Ireland, preserved in the NHM (unregistered specimens). On the original label, the mention "chotic sand, *Inoceramus crispus* Zone? (sic)" is indicated. One specimen (B. 25152) has been chosen for transverse serial sections (Text-Fig. 21, PI 6, Figs 6a-e).

Original diagnosis in *Tate* (1865, p. 42)  
"This well marked variety of *R. limbata* is very distinct on account of the exceeding gibbosity of the shell; it is moreover of larger dimensions than specimens of *R. limbata* usually are. It is exceedingly common in the Zone of *Inoceramus crispus*, [sic] at Carrickfergus, North-East Ireland. The lectotype is preserved in the Museum of the British Geological Survey, under the reference GSM. 83078."

Emended diagnosis in *PETTITT* (1950, p. 24)  
"*Cretirhynchia*, about 16 mm long, 17 mm wide and 12 mm thick, subtriangular to subpentagonal in outline, domical in anterior contour, cuneiform in lateral profile. Brachial valve convex; pedicle valve less convex, with rounded median sinus. Linguiform extension arcuate to V-shaped. Umbo short, broad, erect. A few low and broad costae near the anterior commissure. Concentric ornament of fine growth-lines; a few laminae near the anterior and lateral commissure. Apical angle 120°."

Comments  
Among the species of *Cretirhynchia* included here in the subgenus *Homaleatarhynchia* subgen. *n.*, *C. robusta* (Tate, 1865) is a species which has most characters in common with *C. limbata*, and it is important to point out the differences between these two species. Externally, the shell of *C. robusta* is dome-shaped in anterior contour and its dorsal valve is more convex than the dorsal valve of *C. limbata*. The lateral parts of the shell are steeper in *C. robusta*. The ratio thickness (in mm)/width (in mm) has a mean value of 0.7 in *C. robusta* and of 0.6 in *C. limbata*. The antero-lateral parts of the ventral valve are slightly convex in *C. robusta* and always flat in *C. limbata*. But some specimens of *C. robusta* exhibit a so weak convexity of the anterior part of the ventral valve that this difference can be difficult to appreciate. The linguiform extension is U-shaped or sometimes narrowly trapezoidal in *C. robusta* whereas it is V-shaped in *C. limbata*. Very young specimens of *C. limbata* have an arcuate linguiform extension but it is never U-shaped. The beak is much shorter in *C. robusta* and less curved than in *C. limbata*.

*PETTITT* (1950, p. 25) made transverse serial sections (not illustrated) from a specimen of *C. robusta*, and he observed that "...the shell showed the presence of a medi- an septum and raduliform crura in the brachial valve. No cardinal process or septalium were seen. Of particular interest are the inner socket-ridges, which are considerably elevated, the remainder of the hinge plate being much reduced".

The sections presented in the present paper (Fig. 21) and made on a specimen from Woodburn (Northern Ireland) confirm the remarks of *PETTITT*, especially that inner socket ridges are considerably elevated. All the external characters and this internal character, associated with the small subtriangular hinge plates, the sub-quadrate crural bases and the raduliform crura which remain close together, places *C. robusta* in *Homaleatar- hynchia* subgen. *n*.

Compared with *C. limbata* for its internal features, *C. robusta* has a shorter dorsal septum. *C. robusta* possesses more expanded inner socket ridges and narrower crura which are less concave in their posterior part.

At first glance, *Cretirhynchia (Homaleatarhynchia) arcuata* PETTITT, 1950 can be rather difficult to distinguish from *C. robusta*. Specimens of both species exhibit the same ratio T/W; a similar narrow interarea and extremely short costae near the antero-lateral commis- sure. Generally, *C. arcuata* is more biconvex than *C. robusta*. A clear difference between these species concerns the anterior part of the dorsal fold. In *C. robusta*, the anterior part of the dorsal fold is elevated and nearly parallel to the plane of the ventral valve. In *C. arcuata*, the fold is less elevated and slopes towards the anterior commis- sure. When seen in lateral profile, the beak is more curved in *C. arcuata*. The apical angle is narrower in *C. arcuata*. The linguiform extension is generally arcuate in *C. arcuata* and U-shaped in *C. robusta*, but some gonero- tic specimens of *C. arcuata* can exhibit a more trapae- zoidal linguiform extension and confusion with *C. robus- ta* is possible. Serial sections will avoid all possible con- fusion because *C. arcuata* is distinguished by its thick, elevated and long dorsal septum. In *C. robusta*, the sep- tum is much weaker, lower and shorter.

"*Rhynchonella* subplicata* MANTELL, 1822 is much smaller than *C. robusta* and its cyclothyridid internal structures cannot be confused with the internal characters of *C. robusta*.

**Cretirhynchia (Homaleatarhynchia) arcuata**  
*PETTITT, 1950*  
Text-Figure 22, Plate 7, Figures 3a-e, 4a-e.

* 1950 *Cretirhynchia arcuata*, sp. nov. - *PETTITT, pp. 25-26, pl. 1, figs. c 3a-c pl. 2, fig. 13.*
Stratigraphical range: Upper Campanian, Blt. mucronata Zone.

Type specimen

Holotype designated and illustrated by Pettitt (1950, p. 25, pl. 1, figs. 3a-c) from the Upper Chalk (B. "mucronata" Zone) of Mousehold Pit, Norwich, Norfolk, England. This holotype was preserved in the NHM under the reference BB. 9991, but it has been recently lost.

A paratype from Mousehold has been illustrated by Pettitt, pl. 2, fig. 13 (BB. 9989).

Material

Material preserved in the NHM.

Material from Norwich, Norfolk (Blt. mucronata Zone)

The paratype cited above.

Six large specimens originally labelled as Cretirhynchia limbata (B. 25066-71). 24 topotypes from Mousehold Pit n°160 (B. 93163-76).

Material preserved in the IRScNB in Brussels.

Six specimens collected from the uppermost part of the Upper Campanian at Ahlten near Hanover, Germany (ex collection Leiptnitz, Uelzen, Germany).

Original diagnosis in Pettitt (1950, p. 25)

"Cretirhynchia, about 13 mm long, 14 mm wide and 9 mm
thick, subcircular to subtriangular in outline, anterior contour oval to lenticular. Brachial valve convex, with low median fold on anterior part; pedicle valve less convex, with shallow to moderately deep sinus on anterior part; linguiform extension short, arcuate to trapezoidal. Umbo thin, long, slightly incurved. Costae only developed along antero-lateral commissure (in late stages of growth); about 14, with 3 to 4 on fold; low, broad, subrounded to subangular.

Comments
PETIT (1950, p. 26) observed a fairly strong median septum in the dorsal valve and raduliform crura. He indicated that "the adductor muscle-scar are posterior to the pedicles, and only partly surrounded by them".

The transverse serial sections made from a type specimen collected from Mousehold Pit (Fig. 22) show coarse dental plates, strongly convergent. No pedicle collar is observed. The hinge structure is very strong and typical of Homaletarhynchia subgen. n. The outer socket ridges are very low whereas thick inner socket ridges are ventrally expanded. The dorsal septum seen on the valve floor, is extremely thick, elevated and rather long. The hinge plates are very small. Crural bases are subquadrate and raduliform crura are inwardly concave. The crura remain close together.

C. arcuata has an absolutely smooth shell. Ribs only occur along the commissure. This is a difference with C. lentiformis which possesses very faint costae on the anterior part of the shell.

C. arcuata, a species of possible stratigraphical value, is an abundant brachiopod in the Bit. mucronata Zone of Northern Germany. In Belgium, C. arcuata has never been collected and C. norvicensis is a very exceptional species. On the contrary, C. arcuata seems well present in Northern Germany.

A phylogenetical relation, between Homaletarhynchia subgen. n. and Harmignirhynchia subgen. n., is suggested by a closer examination of the serial sections (Fig. 1). In the sections of the posterior part of C. arcuata and C. limbata, the juvenile crura are embedded in the material constituting the adult hinge plates. These juvenile crura are very concave and obviously similar to the adult crura observed in the representatives of Harmignirhynchia subgen. n. A common ancestor to these two subgenera is plausible (Mancenido, personal communication, July, 2000).

Species removed from the genus Cretirhynchia
PETIT (1950)

"Cretirhynchia" minor PETIT, 1950
Text-Figures 23-24, Plate 6, Figures 3a-d, 4a-e, 5a-d.

1873 Rhynchomella plicatilis Sow. - GEINZIT, H.B., pl. 7, figs. 9, 10, 12, 13.
* 1950 Cretirhynchia minor, sp. nov. - PETIT, pp. 18-19, pl. 1, figs. 2a-c.
. 1961 Cretirhynchia minor PETIT - PEAKE & HANCOCK, p. 309.
. 1974 Cretirhynchia minor PETIT, 1950 - NEKVASLOVA, pp. 48-53, 61-62, table 1, text-figs. 7, 10-14, pl. 4, figs. 1-6, pl. 7, figs. 1-2, pl. 8, fig. 3.

1997 Cretirhynchia minor - MORTIMORE, pp. 36, 93.

Stratigraphical range: Upper Turonian, H. planus Zone.

Type specimen
Holotype designated and illustrated by PETIT (1950, p. 18, pl. 1, figs. 2a-c) from the base of the H. planus Zone, New Pit, Lewes, Sussex, England. The holotype is preserved in the Museum of the British Geological Survey, under the reference GSM. 88778.

Material
Material preserved in the NHM.

Six specimens from the H. planus Zone, Firle Chalk, West Firle, Sussex (DB. 73-9). One specimen has been chosen for transverse serial sections (Fig. 23).

Material preserved in the Museum of the Earth in Warsaw (Muzeum Ziemi PAN).

30 specimens from the Upper Turonian of Cizkovicke in North-West Bohemia, under the reference MZ VIII bra-1498. This is a part of the material studied by NEKVASLOVA, 1974.

Material preserved in IRScNB in Brussels.

Three specimens collected by the first author in Barczyk near Rouen (Seine-Maritime, France) from the Upper Turonian, H. planus Zone. One specimen has been sectioned for the present study (Fig. 24).

Original diagnosis in PETIT (1950, p. 18) "Cretirhynchia, about 12 mm long, 12 mm wide and 9 mm thick, subcircular to subpentagonal in outline, oval to subcircular in lateral profile; anterior contour domical. Brachial valve of considerable convexity, with flattened, barely perceptible fold on the anterior commissure. Pedicle valve less convex, with broad, shallow, median sinus. Linguiform extension trapezoidal, long (in adult forms) and fairly broad. Hypothyridid; umbo short, erect, extremity pointed. Foramen moderate in size, tubular. Deltidial plates conjunct, produced (alar). Beak-ridges distinct; interarea well defined. Ornament of about 36 rounded to subangular costae, with angular intervening sulci; 8 costae on fold and 7 in sinus. Concentric ornament faint; fine growth-lines and a few growth laminae. Apical angle 105°."

Comments
PETIT (1950, p. 19) did not illustrate his serial sections made on Cretirhynchia minor. He merely pointed out the presence of a dorsal septum and raduliform crura and considered (1950, p. 21) C. minor as a small Cretirhynchia species very similar to C. exsculpta PETIT, 1950. The external similarities between both species, including incipient splitting of the costae, lead PETIT to assign to C. minor a taxonomic position close to C. exsculpta in his "second series".

NEKVASLOVA (1974, pp. 49-57) published an exhaustive study of C. minor collected for North-West Bohemia. This material from North-West Bohemia was compared to the original material of PETIT preserved in the Natural History Museum and in the Geological Survey in
Fig. 24 — Serial transverse sections through the umbonal part of *C.* minor. A study of the Upper Campanian brachiopods (Belemnitella mucronata Zone and Belemnitella woodi Zone) from the Mons basin (Simon, 2000) indicates that stratigraphical correlations can be established between the “Craie de Trivières” (Mons basin, Belgium) and the Weybourne′ faunal belt described by Wood (1988). *C.* minor forms, with other Turonian brachiopods such as *C.* aff. *cuneiformis* sensu *Nekvasilova* (1974) and *C.* bohemica (Schloenbach, 1868), an homogenous group of *C.* minor, *C.* bohemica and *C.* aff. *cuneiformis*, a relationship between these species and the genus *Bohemirhynchia* seems probable. It must be noted that *Bohemirhynchia* soukupi exhibits intermediate internal structural similarities to *Burrirhynchia* and *Cretirhynchia* representatives. Bohemirhynchia soukupi has many characters in common with *Cretirhynchia* but it has dorsally concave crura subparallel to the hinge-axis, a character which has never been observed in *Cretirhynchia* representatives. In the group of *C.* minor, *C.* bohemica and *C.* aff. *cuneiformis* sensu *Nekvasilova* (1974) the crura are not really facing each other, as in most representatives of the genus *Cretirhynchia*, but they have a concavity which is more dorsally oriented. A revision of this material is suggested before a new genus could be erected for it. This is the reason why, it seems preferable to leave “C.” minor and other members of this group without precise generic attribution.

**Stratigraphical interest of Upper Chalk rhynchonellid brachiopods**

Rynchonellid brachiopods have been successfully used for establishing stratigraphical correlations between English Chalk deposits (Peake & Hancock, 1961, Bailey et al., 1987, Leeder, 1968, Wood, 1988). Using rhynchonellid brachiopods, stratigraphical correlations were established between the British, French and Belgian Cenomanian deposits (Owen, 1988).

These stratigraphical results are consistent with the correlations obtained with the ammonites (Kennedy, 1971, Wright & Kennedy, 1981). The Upper Turonian material collected from Bardouville near Rouen (Seine-Maritime, France) and presented in this paper show that an excellent stratigraphical correlation can be demonstrated between this French area and the Turonian Chalk Rock of England. These areas are from the *H. planus* Zone and ammonites such as *Lesvesiceras mantelli* (Wright & Wright, 1951) and *Subprionocyclus neptuni* (Geinitz) have been collected from both areas. The rhynchonellid brachiopod *Woodwardirhynchia cuneiformis* (Pettitt, 1950) is relatively abundant in these French and English chalk deposits.

A study of the Upper Campanian brachiopods (Belemnitella mucronata Zone and Belemnitella woodi Zone) from the Mons basin (Simon, 2000) indicates that stratigraphical correlations can be established between the “Craie de Trivières” (Mons basin, Belgium) and the Weybourne′ faunal belt described by Wood (1988). *C.* minor is the most striking rhynchonellid brachiopod species present in both places. On the other hand, misidentifications of rhynchonellid brachiopod species produce wrong stratigraphical results or simply mask possible correlations. *Cretirhynchia plicatilis* (J. Sowerby, 1816) and *C.* octoplicata (J. Sowerby, 1816) are extreme examples of this type of
misidentification but confusion between C. (Homaletarhynchia) lentiformis (WOODWARD, 1833) and C. (Homaletarhynchia) arcuata PETITTT, 1950 are also seen in the literature. The latter species is of special interest because it is often associated with C. (Cretirhynchia) norvicensis PETITTT, 1950 in a restricted Upper Campanian stratigraphical level. This level is well exposed in Norfolk and near Ahlten (Hanover, Germany) but it is not visible in Belgium.

Cretirhynchia (Cretirhynchia) plicatilis and C. (Lewesirhynchia) octoplicata must be considered as English endemic species since they were never collected with certainty outside England. They are respectively good markers for the Cœstusdinarium- and Coronguinum-Marsupiates Zones of Sussex and Kent (PEAKE & HANCOCK, 1961, BAILEY et al., 1987, MORTIMORE, 1997). This suggests that English Coniacian and Santonian deposits could represent special facies which are not similar to the Coniacian-Santonian facies exposed on the continent.

The Lower Campanian Cretirhynchia (Harmignirhynchia) intermedia PETITTT, 1950 from the Offsofter pilula Zone is actually known from Wiltshire and Hampshire, England. In Belgium, Lower Campanian white chalk is not exposed, resulting in the absence of C. intermedia. This species, which has a restricted stratigraphical range, should be searched for elsewhere in Europe as it is now better described and could be more easily recognized.

Conclusions
The proposed revision of the genus Cretirhynchia PETITTT, 1950 throws a new light on this interesting problem. The original material used by PETITTT in 1950-1954 for his monograph was accurately reviewed and the large amount of European material used in this study have afforded a sharper concept of the genus Cretirhynchia.

After this revision, “Cretirhynchia” cuneiformis PETITTT, 1950, “C.” woodwardi (DAVIDSON, 1855) and “C.” teniacostata (VON HANSTEIN, 1879) are removed from the genus Cretirhynchia. The new genus Woodwardirhynchia gen. n. is erected for these species exhibiting numerous distinct characters which indicate that it probably arose from the Cyclothyris rhynchonellid stock.

For specific reasons, “Cretirhynchia” minor PETITTT, 1950 and “C. subplicata (MANTELL, 1822) are removed from the genus Cretirhynchia and left with uncertain generic affinity. “C.” subplicata exhibits internal features more resembling the structure of the genus Cyclothyris M’COY, 1844. “C.” minor is a species related to “C.” bohemica (SCHILDENBACH, 1868). Further studies are necessary to assign a more precise taxonomic position to these rhynchonellid species.

The genus Cretirhynchia has been split into four subgenera. Three new subgenera based on typical external and mainly internal features have been erected: Lewesirhynchia subgen. n., Harmignirhynchia subgen. n. and Homalearthynchia subgen. n.

The species erected by PETITTT in 1950 and revised in this work are valid and distinct species, except Cretirhynchia triminghamensis which is a junior synonym of C. retracta (ROEMER, 1841). Further studies are necessary to assign a correct taxonomic position to C. lenticularis PETITTT, 1950 and C. magna PETITTT, 1950 which were not considered here due to lack of material.

The series of PETITTT (1950) are no more tenable, and this system must be discarded.

The passage forms described by PETITTT were discussed and cannot be taken into account.

The taxonomical relationships between the Upper Chalk rhynchonellid brachiopods proposed in this paper are a first step in the revision of the genus Cretirhynchia. The numerous species from Eastern Europe and from Western and Central Asia should be now revised in the light of present knowledge.

Most species of Cretirhynchia have, without doubt, restricted stratigraphical ranges. But the stratigraphical use of such brachiopods is sometimes restricted to a regional scale, such as several English species, mainly those collected from the Coniacian to the lowermost Campanian, appear endemic or extremely rare outside England. On the contrary, good stratigraphical correlations can be made between other English and some Western European chalk. This is especially true for the Cenomanian, Turonian, Upper Campanian and Lower Maastrichtian white chalks.

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PLATE 1

_Cretirhynchia (Cretirhynchia) plicatilis_ (J. Sowerby, 1816)

a: ventral view, b: dorsal view, c: lateral view, d: anterior view, e: posterior view

All the specimens are preserved in the Natural History Museum in London (NHM)

Magnification: x 1.76

Fig. 1 — Specimen from the _Coranguinum_ Zone in Northfleet, Kent (England) used for serial transverse sections (Figure 8). B. 79815.

Fig. 2 — Specimen from the _Coranguinum_ Zone in Northfleet, Kent (England). B. 44664.

Fig. 3 — Specimen from the _Uintacrinus_ band, Devices Road, West of Salisbury, Wiltshire (England). B. 91832.

Fig. 4 — Younger specimen from the _Coranguinum_ Zone, Snowdown Colliery, Kent (England). B. 93648.

PLATE 2

_Cretirhynchia (Cretirhynchia) norvicensis_ Pettitt, 1950

a: ventral view, b: dorsal view, c: lateral view, d: anterior view, e: posterior view

All the specimens are preserved in the Natural History Museum in London (NHM)

Specimens collected from the Upper Campanian (_Belemnella mucronata_ Zone) of Norwich, Norfolk, England. Variations of shape and size, observed among individuals from a same locality.

Fig. 1 — Small-sized specimen illustrating the possible homeomorphy between _C. (Cretirhynchia) norvicensis_ Pettitt, 1950 and _Woodwardirhynchia tenuicostata_ (von Hanstein, 1879) a Lower Maastrichtian rhynchonellid brachiopod from the phosphatic chalk of Ciply (Hainaut, Belgium). B. 97815-1. (Magnification: x 1.85).

Fig. 2 — Small-sized specimen with a typical triangular outline. B. 97815-2. (Magnification: x 1.85).

Fig. 3 — The smallest specimen observed in this study. B. 97815-3. (Magnification: x 1.78).

Fig. 4 — Medium-sized specimen with a typical triangular outline. B. 97815-4. (Magnification: x 1.78).

Fig. 5 — Medium-sized specimen exhibiting a more transversely-oval outline. Such specimens can be confused with _Woodwardirhynchia tenuicostata_ (von Hanstein, 1879) or with _Cretirhynchia (Harmignirhynchia) intermedius_ Pettitt, 1950. B. 97815-5. (Magnification: x 1.78).

PLATE 3

a: ventral view, b: dorsal view, c: lateral view, d: anterior view, e: posterior view

Fig. 1 — Fully adult specimen of _Cretirhynchia (Cretirhynchia) norvicensis_ Pettitt, 1950 with an oval outline collected from Norwich, Norfolk, England. Upper Campanian (_Belemnella mucronata_ Zone). Specimen preserved in the NHM. B. 97815-6. (Magnification: x 1.80).

Fig. 2 — Small, adult specimen of _Cretirhynchia (Cretirhynchia) triminghamensis_ Pettitt, 1950 from S. Bluff, Trimingham, Norfolk, England. Lower Maastrichtian. _C. (Cretirhynchia) triminghamensis_ is a junior synonym of _Cretirhynchia (Cretirhynchia) retracta_ (Roemer, 1841). Specimen preserved in the NHM. B. 96961. (Magnification: x 2.84).

Fig. 3 — Gerontic specimen of _Cretirhynchia (Cretirhynchia) triminghamensis_ Pettitt, 1950 from Trimingham, Norfolk, England. Lower Maastrichtian. _C. (Cretirhynchia) triminghamensis_ is a junior synonym of _Cretirhynchia (Cretirhynchia) retracta_ (Roemer, 1841). Specimen prepared for serial sections (Figure 9) and preserved in the NHM. BB. 43335. (Magnification: x 1.81).

Fig. 4 — Adult specimen of _Cretirhynchia (Cretirhynchia) triminghamensis_ Pettitt, 1950 from Trimingham, Norfolk, England. Lower Maastrichtian. _C. (Cretirhynchia) triminghamensis_ is a synonym of _Cretirhynchia (Cretirhynchia) retracta_ (Roemer, 1841). Specimen preserved in the NHM. BB. 43333. (Magnification: x 1.81).

Fig. 5 — _Cretirhynchia (Cretirhynchia) retracta_ (Roemer, 1841) collected from Kronsmoor, Schleswig-Holstein, Germany. Lower Maastrichtian. Specimen preserved in the IRSNB, IST. n° 10840. (Magnification: x 1.78).
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**Plate 4**

*Cretirhynchia* *PETTITT*, 1950 - Subgenus *Lewesirhvnchia* subgen. n.


All this material is preserved in the Natural History Museum, London (NHM).

Fig. 1 — Gerontic specimen of *Cretirhynchia* (*Lewesirhvnchia*) *octoplicata* (J. SOWERBY, 1816) from the chalk of Lewes (*Cortestudinarium* Zone), Lewes, Sussex, England. B. 8379-1. This specimen has been sectionned (Figure 11). (Magnification: x 1.77).

Fig. 2 — Holotype of *Cretirhynchia* (*Lewesirhvnchia*) *protoexsculpta* sp. n. from the chalk of Lewes (*Cortestudinarium* Zone), Lewes, Sussex, England. B. 8379-2. This specimen has been sectionned (Figure 13). (Magnification: x 1.60).

Fig. 3 — Fully adult specimen of *Cretirhynchia* (*Lewesirhvnchia*) *exsculpta* *PETTITT*, 1950 collected from the Santonian (*Marsupites testudinarius* Zone) in Brighton, Sussex, England. B. 9464. (Magnification: x 1.9).

Fig. 4 — Smaller specimen of *Cretirhynchia* (*Lewesirhvnchia*) *exsculpta* *PETTITT*, 1950 collected from the “Senonian” chalk of Elmer, Middleton, Sussex. BB. 76525. (Magnification: x 1.9).

**Plate 5**

*Cretirhynchia* *PETTITT*, 1950 - Subgenus *Harmignirhynchia* subgen. n.


Fig. 1 — Gerontic specimen of *Cretirhynchia* (*Harmignirhynchia*) *intermedia* *PETTITT*, 1950 from East Harnham, Wiltshire, England. Lower Campanian (*Offaster pilula* Zone). The numerous faint costae, reduced in number near the commissure are well preserved. Specimen preserved in the NHM. B. 92742-2. This specimen has been sectionned (Figure 16). (Magnification: x 2.4).

Fig. 2 — Adult specimen of *Cretirhynchia* (*Harmignirhynchia*) *intermedia* *PETTITT*, 1950 from East Harnham, Wiltshire, England. Lower Campanian (*Offaster pilula* Zone). Specimen preserved in the NHM. B. 92742-3. (Magnification: x 1.94).

Fig. 3 — Adult specimen of *Cretirhynchia* (*Harmignirhynchia*) *intermedia* *PETTITT*, 1950 from East Harnham, Wiltshire, England. Lower Campanian (*Offaster pilula* Zone). Specimen preserved in the NHM. B. 92742-4. (Magnification: x 2.5).

Fig. 4 — Paratype of *Cretirhynchia* (*Harmignirhynchia*) *obourgensis* sp. n. from Harmignies, Mons basin, Hainaut, Belgium. Upper Campanian, “Craie de Nouvelles” (*Belemnitella woodi* Zone). Specimen preserved in the IRScNB - IST n° 10844. (Magnification: x 2.27).

Fig. 5 — Paratype of *Cretirhynchia* (*Harmignirhynchia*) *obourgensis* sp. n. from Harmignies, Mons basin, Hainaut, Belgium. Upper Campanian, “Craie de Nouvelles” (*Belemnitella woodi* Zone). Specimen preserved in the IRScNB - IST n° 10846. (Magnification: x 1.60).

**Plate 6**

*a: ventral view, b: dorsal view, c: lateral view, d: anterior view, e: posterior view.*

Fig. 1 — Paratype of *Cretirhynchia* (*Lewesirhvnchia*) *protoexsculpta* sp. n. from the chalk of Lewes (*Cortestudinarium* Zone), Lewes, Sussex, England. Specimen preserved in the NHM. B. 8379-3. (Magnification: x 1.5).

Fig. 2 — Holotype of *Cretirhynchia* (*Harmignirhynchia*) *obourgensis* sp. n. collected from Harmignies, Mons basin, Hainaut, Belgium. Upper Campanian, “Craie de Nouvelles”. (*Belemnitella woodi* Zone). Specimen preserved in the IRScNB - IST n° 10847. (Magnification: x 2.1).

Fig. 3 — Adult specimen of ex *"Cretirhynchia" minor* *PETTITT*, 1950 collected from Bardouville, hameau de Beauleau, Seine Maritime, France. Upper Turonian (*Holaster planus* Zone). This specimen has been sectionned (Figure 24). Specimen preserved in the IRScNB. IST- n° 10843. (Magnification: x 3.1).

Fig. 4 — Adult specimen of ex *"Cretirhynchia" minor* *PETTITT*, 1950 collected from West Firle, Firle Chalk, Sussex. Upper Turonian (*Holaster planus* Zone). This specimen has been sectionned (Figure 23). Specimen preserved in the NHM. B. 73. (Magnification: x 4.3).

Fig. 5 — Adult specimen of ex *"Cretirhynchia" minor* *PETTITT*, 1950 collected from Cizkovice, North-West Bohemia. Upper Turonian. Specimen preserved in the IRScNB. IST n° 10844. (Magnification: x 3.7).

Fig. 6 — Adult specimen of *Cretirhynchia* (*Homaleotarhynchia*) *robusta* (TATE, 1865) collected from Woodburn, Northern Ireland. Santonian. This specimen has been sectionned (Figure 21). Specimen preserved in the NHM. B. 25152. (Magnification: x 2.3).
Plate 7

Cretirhynchia Pettitt, 1950 - Subgenus Homaletarhynchia subgen. n.

Fig. 1 — Adult specimen of Cretirhynchia (Homaletarhynchia) limbata (von Schlotheim, 1813) from Jandrain, Brabant, Belgium. Upper Maastrichtian. Specimen preserved in the IRScNB. IST n° 10838. This specimen has been sectionned (Figure 19). (Magnification: x 1.87).

Fig. 2 — Adult specimen of Cretirhynchia (Homaletarhynchia) limbata (von Schlotheim, 1813) from Ciply, Mons basin, Hainaut, Belgium. Lower Maastrichtian (B. obtusa Zone). Specimen preserved in the IRScNB. IST n° 10839. (Magnification: x 1.84).

Fig. 3 — Gerontic specimen of Cretirhynchia (Homaletarhynchia) arcuata Pettitt, 1950 from Ahlten, Germany. Upper Campanian. Ex collection Leipnitz, Uelzen, Germany. Specimen preserved in the IRScNB. IST n° 10841. (Magnification: x 2.0).

Fig. 4 — Adult specimen (paratype) of Cretirhynchia (Homaletarhynchia) arcuata Pettitt, 1950 from Mousehold Pit, Norwich, Norfolk, England. Upper Campanian. Specimen preserved in the NHM. B. 93163. This specimen has been sectionned (Figure 22). (Magnification: x 3.0).

Fig. 5 — Adult specimen of Cretirhynchia (Homaletarhynchia) lentiformis (Woodward, 1833) from Cuesmes, Mons basin, Hainaut, Belgium. Upper Campanian. “Craie de Trivières” (Belemniella mucronata Zone). Specimen preserved in the IRScNB. IST n° 10821. This specimen has been sectionned (Figure 20). (Magnification: x 2.74).

Fig. 6 — Type specimen of Cretirhynchia (Homaletarhynchia) undulata (Pusch, 1837) subsp. maastrichtiensis n. subsp. collected from C.P.L. quarry in Hallembeaye, Liège, Belgium. Upper Maastrichtian, Vijlen Chalk (B. junior Zone). Specimen preserved in the IRScNB. IST n° 10842. (Magnification: x 2.0).

Plate 8

Woodwardirhynchia gen. n.

Fig. 1 — Fully adult specimen of Woodwardirhynchia (Homaletarhynchia) cuneiformis (Pettitt, 1950) collected from Bardouville near Rouen, Seine Maritime, France. Upper Turonian (Holaster planus Zone). IRScNB. IST n° 10831. This specimen has been sectionned (Figure 2). (Magnification: x 1.7).

Fig. 2 — Fully adult specimen of Woodwardirhynchia cuneiformis (Pettitt, 1950) collected from Bardouville near Rouen, Seine Maritime, France. Upper Turonian (Holaster planus Zone). The numerous costae are better preserved in this specimen. Specimen preserved in the IRScNB. IST n° 10832. This specimen has been sectionned (Figure 3). (Magnification: x 1.7).

Fig. 3 — Large adult specimen of Woodwardirhynchia woodwardi (Davidson, 1855) collected from Harmignies, Mons basin, Hainaut, Belgium. Upper Campanian, top of the “Craie de Trivières” (Belemniella mucronata Zone). Specimen preserved in the IRScNB. IST n° 10834. This specimen has been sectionned (Figure 3). (Magnification: x 1.7).

Fig. 4 — Smaller adult specimen of Woodwardirhynchia woodwardi (Davidson, 1855) collected from Harmignies, Mons basin, Hainaut, Belgium. Upper Campanian, top of the “Craie de Trivières” (Belemniella mucronata Zone). Specimen preserved in the IRScNB. IST n° 10837. (Magnification: x 1.6).u

Fig. 5 — Adult specimen of Woodwardirhynchia tenuicostata (von Hanstein, 1879) collected from the phosphatic chalk of Ciply, Mons basin, Hainaut, Belgium. Lower Maastrichtian (Belemniella obtusa Zone). Specimen preserved in the IRScNB. IST n° 10665. (Magnification: x 2.1).

Species removed from the genus Cretirhynchia Pettitt, 1950 and left without precise generic affinity.

ex “Cretirhynchia” subplicata (Mantell, 1822)

Fig. 6 — Adult specimen collected from Dover, Kent, England. Coniacian (Cortestudinarium Zone). Specimen preserved in the NHM. B. 79974. This specimen has been sectionned (Figure 7). (Magnification: x 2.6).

Fig. 7 — Smaller specimen collected from Offham Hill near Lewes, Sussex, England. Coniacian (Cortestudinarium Zone). Specimen preserved in the NHM. B. 47876. This specimen has been sectionned. (Magnification: x 3.4).