Bull. Inst. r. Sci. nat. Belg. Bull. K. Belg. Inst. Nat. Wet.	Bruxelles Brussel	31-XII-1972	
48	SCIENCES DE LA TERRE - AARDWETENSCHAPPEN		7

SYSTEMATIC REVISION OF THE CHLAMYDINAE (PECTINIDAE, BIVALVIA, MOLLUSCA) OF THE EUROPEAN CRETACEOUS

PART 2 : LYROPECTEN

BY

Annie V. DHONDT (Brussels)

(with three plates)

ABSTRACT

This paper is the second of a series dealing with the systematic revision of the European Cretaceous *Chlamydinae (Pectinidae, Bivalvia, Mollusca)*. Ten species of the genus *Lyropecten* CONRAD, 1863 are described : *L. (Aequipecten) arlesiensis* (WOODS, 1902), *L. (A.) campaniensis* (D'ORBIGNY, 1847), *L. (A.) pulchellus* (NILSSON, 1827), *L. (A.) acuteplicatus* (ALTH, 1850), *L. (A.) subinflexus* nom. nov., *L. (A.) subaratus* (NILSSON, 1827), *L. (A.) sarumensis* (WOODS, 1902) *(L. (A?) ternatus* (MUENSTER in GOLDFUSS, 1833), *L. (A?) trigeminatus* (GOLDFUSS, 1833), *Lyropecten ? septemplicatus* (NILSSON, 1827).

L. (A.) subinflexus is a new name for *Pecten inflexus* VON HAGENOW, 1842, non POLI in LAMARCK, 1818.

L. (A.) acuteplicatus (ALTH, 1850) is found to be a possible index fossil for Northern and Eastern European and Middle Eastern Maastrichtian strata.

RESUME

Ce travail est le second d'une série traitant de la révision systématique des *Chlamydinae (Pectinidae, Bivalvia, Mollusca)* du Crétacé européen. Dix espèces du genre *Lyropecten* CONRAD, 1863, sont décrites : *L. (Aequi-*

pecten) arlesiensis (WOODS, 1902), *L. (A.) campaniensis* (D'ORBIGNY, 1847), *L. (A.) pulchellus* (NILSSON, 1827), *L. (A.) acuteplicatus* (ALTH, 1850), *L. (A.) subinflexus* nom. nov., *L. (A.) subaratus* (NILSSON, 1827), *L. (A.) sarumensis* (WOODS, 1902), *L. (A?) ternatus* (MUENSTER in GOLDFUSS, 1835), *L. (A?) trigeminatus* (GOLDFUSS, 1833), *L ? septemplicatus* (NILSSON, 1827).

L. (A.) subinflexus est un nom nouveau pour *Pecten inflexus* VON HAGENOW, 1842, non POLI in LAMARCK, 1818.

L. (A.) acuteplicatus (ALTH, 1850) peut être employé comme fossile guide dans les dépôts maastrichtiens de l'Europe du Nord, de l'Est et dans le Proche Orient.

ZUSAMMENFASSUNG

Diese Arbeit ist der zweite Teil in einer Reihe von systematischen Revisionen der europäischen Kreide *Chlamydinae (Pectinidae, Bivalvia, Mollusca).*

Zehn Arten der Gattung *Lyropecten* CONRAD, 1863, sind beschrieben : *L. (Aequipecten) arlesiensis* (WOODS, 1902), *L. (A.) campaniensis* (D'ORBIGNY, 1847), *L. (A.) pulchellus* (NILSSON, 1827), *L. (A.) acuteplicatus* (ALTH, 1850), *L. (A.) subinflexus* nom. nov., *L. (A.) subaratus* (NILSSON, 1827), *L. (A.) sarumensis* (WOODS, 1902), *L. (A?) ternatus* (MUENSTER in GOLDFUSS, 1833), *L. (A?) trigeminatus* (GOLDFUSS, 1833), *L ? septemplicatus* (NILSSON, 1827).

L. (A.) subinflexus ist ein neuer Name für *Pecten inflexus* VON HAGENOW, 1842, non POLI in LAMARCK, 1818.

Lyropecten (Aequipecten) acuteplicatus (ALTH, 1850) ist kennzeichnend für Maastricht-Alter in Nord und Ost-Europa und im Nahen Osten.

INTRODUCTION : THE GENUS *LYROPECTEN*

The present paper is the second of a series on the subfamily *Chlamydinae* (cf. DHONDT, A., 1972) and deals with the genus *Lyropecten* CONRAD, 1863. Ten European Cretaceous *Lyropecten* species (1) are described of which seven undoubtedly belong to the genus *Aequipecten.*

The method followed is explained in DHONDT, A., 1973 (p. 2).

One species has been renamed *(L. (A.) subinflexus* nom. nov.). *L. (A.) acuteplicatus* (ALTH, 1850) is the only European Cretaceous *Pectinidae* species which fulfils the requirements of an index-fossil and can be used for Maastrichtian strata. Palaeoecologically, *Lyropecten* seems to be unknown in Cretaceous Tethyan Rudist bioherms.

(1) *L. (A.) arlesiensis* (WOODS, 1902), *L. (A.) campaniensis* (D'ORBIGNY, 1847), *L. (A.) pulchellus* (NILSSON, 1827), *L. (A.) acuteplicatus* (ALTH, 1850), *L. (A.) subinflexus* nom. nov., *L. (A.) subaratus* (NILSSON, 1827), *L. (A.) sarumensis* (WOODS, 1902), *L. (A?) ternatus* (MUENSTER in GOLDFUSS, 1833), *L. (A?) trigeminatus* (GOLDFUSS, 1833), *L? septemplicatus* (NILSSON, 1827).

ACKNOWLEDGMENTS

Many friends and colleagues kindly helped me during the course of my work and allowed me to study collections in their care. I wish to express my appreciation and sincere gratitude to :

Prof. D. AUBERT (Université de Neuchâtel).
Prof. F. BACHMAYER (Naturhistorisches Museum, Vienna).
Dr. H. D. BEEGER (Staatliches Museum für Geologie und Mineralogie, Dresden).
Dr. J. BERGSTRÖM (Palaeontologiska Institutionen, Universitet, Lund).
Prof. Tove BIRKELUND (Institut for historisk Geologi og Palaeontologi, Universitet, Copenhagen).
Mr. A. BRIGHTON (Sedgwick Museum, Cambridge).
Prof. R. DEHM (Bayerische Staatssammlung, Institut für Paläontologie und historische Geologie, Munich).
Mr. S. FLORIS (Mineralogisk Museum, Universitet, Copenhagen).
Dr. Suzanne FRENEIX (Muséum national d'Histoire naturelle, Paris).
Dr. J. FÜLÖP (Director, Hungarian Geological Institute, Budapest).
Dr. M. GLIBERT (I. R. Sc. N. B., Brussels).
Dr. J. GUEX (Musée géologique, Lausanne).
Dr. J. HELMS (Museum der von Humboldt Universität, Berlin).
Dr. F. HIRSCH (Muséum d'Histoire naturelle, Genève).
Dr. C. V. JEANS (Sedgwick Museum, Cambridge).
Dr. W. J. KENNEDY (Department Geology, Oxford University).
Dr. H. KOLLMANN (Naturhistorisches Museum, Vienna).
Dr. E. LANTERNO (Muséum d'Histoire naturelle, Genève).
Prof. P. LEMOINE (Ecole des Mines, Paris).
Prof. W. MATTHES (Geiseltal Museum Martin-Luther-Universität Halle-Wittenberg, Halle an der Saale).
Mr. R. V. MELVILLE (Institute of Geological Sciences, London).
Dr. G. MONTAGNE (Natuurhistorisch Museum, Maastricht).
Dr. N. J. MORRIS (Department of Palaeontology, British Museum, Natural History, London).
Mr. A. POCHON (Laboratoire de Géologie, Université de Neuchâtel).
Dr. H. PRESCHER (Staatliches Museum für Geologie und Mineralogie, Dresden).
Prof. A. ROSENKRANTZ (Institut for historisk Geologi og Palaeontologi, Universitet, Copenhagen).
Prof. R. SIEBER (Geologische Bundesanstalt, Vienna).
Dr. G. STEINICH (Sektion Geologische Wissenschaften der Ernst-Moritz-Arndt Universität, Greifswald).
Dr. F. STEININGER (Institut für Paläontologie, Universität, Vienna).
Dr. H. SUMMESBERGER (Naturhistorisches Museum, Vienna).
Mr. F. SURLYK (Mineralogisk Museum, Universitet, Copenhagen).

Dr. J. D. TAYLOR (Department of Zoology, British Museum (Natural History, London).
Prof. V. TZANKOV (formerly of Katedra de Paleontologia, Kliment Ochridski University, Sofia).
Dr. L. VAN DE POEL (I. R. Sc. N. B., Brussels).
Prof. E. VOIGT (Geologisches Staatsinstitut, Universität, Hamburg).
Dr. M. WEIDMANN (Musée géologique, Lausanne).
Dr. P. WELLNHOFER (Bayerische Staatssammlung, Institut für historische Geologie und Paläontologie, Universität, Munich).
Dr. H. WIENBERG RASMUSSEN (Mineralogisk Museum, Universitet, Copenhagen).
Mr. C. J. WOOD (Institute of Geological Sciences, London).

Part of the present work was done while I held a research-fellowship of the Nationaal Fonds voor Wetenschappelijk Onderzoek (Fonds national de la Recherche scientifique).

Dr. M. GLIBERT made the photographs; for this I am extremely grateful to him.

Mr. P. S. MACAULAY, Seminarie voor Engelse en Amerikaanse Letterkunde, Rijksuniversiteit, Ghent, corrected the English manuscript.

SYSTEMATIC DESCRIPTION

Abbreviations :

A.A.R. : anterior auricle ribs.
P.A.R. : posterior auricle ribs.
For other abbreviations : see in DHONDT, 1973 (p. 4).

Signs in synonymy lists :

See in DHONDT., 1973 (p. 5).

Family *Pectinidae* RAFINESQUE.

Subfamily *Chlamydinae* VON TEPPNER, 1922 em. SOBETZKI, 1961.

Genus *Lyropecten* CONRAD, 1863.

Type-species *Pallium estrellatum* CONRAD, 1856 (S. D. by DALL, 1898).

Subgenus *Aequipecten* FISCHER, 1887 (2).

Type-species *Ostrea opercularis* LINNAEUS, 1758 (O. D.).

Diagnostic characters of *Lyropecten (Aequipecten)* (applicable to Cretaceous species) :

Suborbicular, acline valves on small species, more elongated valves on larger species; the radial macrosculpture is always strongly developed but

(2) *Aequipecten* was regarded as a subgenus of *Lyropecten* by GLIBERT et VAN DE POEL, 1965, p. 25.

the number of ribs is variable; the ribstructure is different on both valves; on right valves the ribs are narrower and the intercostal intervals broader than on left valves. Byssal sinus is well developed, on very well preserved specimens the ctenolium is present, the auricles are unequal.

Lyropecten (Aequipecten) arlesiensis (H. Woods, 1902)

v . 1870	— *Pecten vraconensis* Pictet et Campiche	F. J. Pictet et G. Campiche, p. 205, pl. 173, f. 4, 5 (n. oblitum).
1871	— *Pecten vraconensis* Pictet and Campiche	F. Stoliczka, p. 428.
v . 1902	— *Pecten (Aequipecten) arlesiensis* sp. nov.	H. Woods, p. 194, pl. 38, f. 9-11.
v . 1925	— ? *Pecten (Aequipecten) arlesiensis* Woods	J. P. J. Ravn, p. 30.
(1931)	— *Pecten arlesiensis* Woodw. (sic)	B. Kokoszynska, p. 668.
? 1933	— *Pecten (Aequipecten) arlesiensis* Woods	W. Häntzschel, pp. 124-125, pl. 4, f. 12, 13.
v . 1939	— *Pecten (Aequipecten) arlesiensis* Woods	E. Dacqué, p. 46-47, pl. 1, f. 8, 9; pl. 5, f. 8 (non vidi).
? 1961	— *Chlamys (Aequipecten) arlesiensis* Woods	S. I. Pasternak, p. 19, f. 1, 3.
? 1965a	— *Pecten (Chlamys) saxonicus*	S. Cieslinski, p. 29, pl. 3, f. 4.
non 1913	*Pecten saxonicus* Scupin	

Location of type-specimens

Pecten vraconensis Pictet et Campiche : the type-series' specimens from the Pictet collection (Mus. Gen.) and Campiche collection (Mus. Laus.) are very poorly preserved; the best preserved specimen is the original of pl. 173, fig. 5 kept in the Muséum d'Histoire naturelle, Geneva (Switzerland). I have chosen it as the lectotype.

Pecten arlesiensis : lectotype chosen here : B 196, Sedgwick Museum, Cambridge (England).

Stratum typicum :

Pecten vraconensis : Le gault supérieur (étage vraconien) (Upper Albian)
Pecten arlesiensis : Chalk Marl in Folkestone (*S. varians* zone, Cenomanian).

Locus typicus :

Pecten vraconensis : La Vraconne près Sainte Croix (Canton de Vaud, Switzerland).
Pecten arlesiensis : Folkestone (Kent, England).

Original description of *Pecten vraconensis*

Pecten vraconensis
« Dimensions :
Longueur : 25 mm.
Par rapport à la longueur, largeur : 1,08.
Par rapport à la longueur, épaisseur : 0,44.
Angle apicial : 90°.

Description (moule). Coquille ovale, un peu plus large que longue, peu déprimée et peu inéquivalve. Chaque valve est ornée d'une quinzaine de côtes rayonnantes, droites, régulières, séparées par des intervalles plus larges qu'elles. Ces côtes sont légèrement noduleuses, ce qui provient de dépressions concentriques dans le test. Oreillettes inconnues.

Rapports et différences. La valve bombée de ce peigne ressemble un peu à celle du *P. Rhodani*, avec toutefois des côtes plus régulières. La valve plate en revanche est tout à fait différente.

Gisement à Sainte-Croix. Le gault supérieur (étage vraconien, RENEVIER). Coll. CAMPICHE, Coll. PICTET. Rare. »

Additional description

Number of specimens studied : 40.

Swiss Vraconian	6
Danish Cenomanian	2
English Cenomanian	32

Measurements :

On British specimens :

U. P. D. varies from 8.7 mm to 9.8 mm (n = 13)
W. varies from 7.8 mm to 9.6 mm(n = 13)
A. A. varies from 83° to 90° (n = 12)
ribnumber varies from 14 to 19 (n = 15).

Description :

Diagnosis — *Lyropecten (Aequipecten)* species with 14 to 19 undivided, straight radial ribs covered with small scales where the concentric growth lines cross the ribs.

Both valves are moderately convex.

Right valve : with rounded radial ribs; the intercostal intervals are deep and almost as wide as the ribs; the disc is covered with thin concentric

elevations; when crossing the ribs these form scales which are clearly visible near the umbo. Near the posterior disc margin the areas are covered with fine striae which are almost perpendicular to the radial ribs. Anterior auricle : winglike with deep byssal sinus, 3-4 radial ribs which diverge from the umbo and are crossed by concentric elevations which start perpendicular to the hinge line and which form scales on the ribs. Posterior auricle : smaller, rectangular with two not very well developed radial ribs which are crossed by concentric elevations in the same way as on the anterior auricle.

Left valve : more flattened than the right valve, covered with elevated radial ribs separated by wider, rounded intercostal intervals. Anterior auricle : long, acute to rectangular, covered with concentric striae; on one particularly well preserved specimen also three radial ribs. Posterior auricle : smaller, almost rectangular with concentric striae and two radial ribs.

Discussion

This species seems to be rare as it is only known from a few localities. In part, however, this could be explained by the following facts :

— it was first described in 1902 and most palaeontological collections have been made and determined before that date.

— it is a small species (the largest known specimen is WOOD's specimen from Arlesey (Totternhoe Stone) with a U. P. D. of 10 mm) and as such is only found during very careful collecting.

— it could be that Cenomanian (and Turonian ?) specimens of « *Pecten pulchellus* » and « *P. campaniensis* » from Saxony, Bohemia and Silesia are really *P. arlesiensis*. Unfortunately, the Central European specimens are poorly preserved and no decision can be reached regarding them. However, a complete identity seems unlikely : the Central European (particularly the Turonian specimens) have a higher ribnumber than is known for *P. arlesiensis*. For this reason I doubt W. HAENTZSCHEL's identification of specimens from Pennrich, *Plenus* zone.

S. I. PASTERNAK et al. describe and figure *P. arlesiensis* (pl. 33, f. 10-12) from Cenomanian strata of Ukraine; however, pl. 33, f. 13 from the Turonian has another ribpattern and could belong to *Lyropecten (Aequipecten) campaniensis* D'ORBIGNY.

L. (A.) arlesiensis (3) is the oldest of the typical Middle and Upper Cretaceous European species; the others are *L. (A.) pulchellus* (NILSSON, *L. (A.) acuteplicatus* (ALTH), *L. (A.) campaniensis* (D'ORBIGNY), *L. (A.)*

(3) PASTERNAK, 1961, p. 21, f. 2 gives a phylogenetic hypothesis, in which he considers some of the species here mentioned.

subinflexus nom. nov., *L. (A.) subaratus* (NILSSON), *L. (A.) sarumensis* (WOODS).

L. (A.) arlesiensis has characteristics of all these species and could be the common ancestor of all of them : *L. (A.) pulchellus* has the same oblique striae on the areas, but the ribs are divided and the concentric elevations are less developed; also the auricles are smaller.

L. (A.) acuteplicatus has a slightly higher ribnumber of undivided ribs but the concentric elevations are less developed and the auricles relatively smaller.

L. (A.) campaniensis has a very similar rib macrosculpture, but the ribs are divided and the concentric elevations are much more numerous.

L. (A.) subinflexus has more convex valves, a higher ribnumber of divided ribs and concentric elevations which are not very pronounced and relatively smaller auricles.

L. (A.) subaratus has the same auricle macrosculpture and auricle shape, but more convex valves and a higher ribnumber of divided ribs.

L. (A.) sarumensis has similar but more numerous and divided ribs and a pronounced concentric ornamentation of small scales on the ribs.

Generic attribution :

Pecten (Aequipecten) arlesiensis WOODS, 1902 has an orbicular, acline shape, left valves with elevated narrow ribs and right valves with rounded ribs which are mostly wider than the intercostal intervals; these are typical characteristics of *Aequipecten.*

The correct name therefore becomes *Lyropecten (Aequipecten) arlesiensis* (WOODS, 1902).

Stratigraphical and geographical distribution

Albian : SWITZERLAND :

La Vraconne, Sainte Croix (Vaud) (Mus. Gen., Mus. Laus.)

Cenomanian : DENMARK :

Madsegrav, Bornholm (KO. orig. RAVN, 1925)

GREAT BRITAIN :

S. varians zone :

Burham, Margett's Pit (Kent) (B. M.)
Culver (Isle of Wight) (B. M.)
Dover (Kent) (B. M.)
Folkestone (Kent) (B. M., Geol. Sci., Coll. C. V. JEANS, S. M.)
Merstham (Surrey) (B. M., Geol. Sci.)
Norton Ferris, Mere (Wilts.) (Geol. Sci.)
Wilmington (Devon) (B. M.)

Lyropecten (Aequipecten) campaniensis (A. d'Orbigny, 1847)

Pl. I, fig. 1a-c

1841 —	*Pecten subaratus*	F. A. Roemer, p. 52.
non 1827	*Pecten subaratus* Nilsson	
1842 —	*Pecten subaratus* (pro parte)	F. von Hagenow, p. 552.
v . 1847 —	*Pecten campaniensis* d'Orbigny	A. d'Orbigny, p. 620, pl. 440, f. 12-16.
(1850) —	*Pecten campaniensis* d'Orbigny	A. d'Orbigny, p. 251, n° 838.
(1860) —	*Pecten campaniensis* d'Orb.	W. Gabb, p. 157.
(1870) —	*Pecten campaniensis* d'Orb.	F. J. Pictet & G. Campiche, p. 215.
(1871) —	*Pecten campaniensis* d'Orb.	F. Stoliczka, p. 428.
v ? 1875 —	*Pecten pulchellus*	H. B. Geinitz, p. 33, pl. 10, f. 2-4.
non 1827	*Pecten pulchellus* Nilsson	
? 1877 —	*Pecten pulchellus*	A. Fritsch, p. 136, f. 130.
non 1827	*Pecten pulchellus* Nilsson	
. 1887 —	*Pecten campaniensis* d'Orb.	A. Péron, p. 164.
? 1889 —	*Pecten campaniensis* d'Orbigny	O. Griepenkerl, p. 44.
v . 1902 —	*Pecten (Aequipecten) campaniensis* d'Orbigny	H. Woods, p. 192, pl. 37, f. 4-8.
v . 1902 —	*Pecten fenestratus* n. sp.	J. P. J. Ravn, p. 85, pl. 1, f. 14-16, p. 378.
non 1844	*Pecten fenestratus*	E. Forbes, 13 Report. Brit. Assoc. p. 192 (fide Sherborn).
v . 1908 —	*Pecten Puggaardi*	J. P. J. Ravn, p. 72.
(1908) —	*Pecten campaniensis* d'Orb.	A. W. Rowe, p. 339.
v . 1918 —	*Pecten (Chlamys) Puggaardi* Ravn	J. P. J. Ravn, p. 27.
v . 1921 —	*Pecten (Chlamys) Puggaardi* Ravn	J. P. J. Ravn, p. 20.
1923 —	*Pecten (Chlamys) Puggaardi* Ravn	A. Jessen & H. Ødum, p. 35.
(1924) —	*Pecten campaniensis* d'Orb.	C. T. A. Gaster, p. 110.
(1926) —	*Pecten (Chlamys) Puggaardi* Ravn	H. Ødum, p. 181.
v . 1932 —	*Pecten (Aequipecten) fenestratus* Ravn	D. Wolansky, p. 14, pl. 2, f. 16-17.
? 1933 —	*Pecten (Aequipecten) campaniensis* d'Orb.	W. Haentzschel, p. 125.

? 1937	— *Pecten (Aequipecten) venustus* (pro parte) Morton	L. LEHNER, p. 190.
(1938)	— *Pecten campaniensis* d'Orb.	W. POZARYSKI, p. 23.
? 1941	— *Pecten (Aequipecten) puggaardi* Ravn	E. STOLL, p. 94, pl. 2, f. 6.
(1945)	— *Pecten Puggaardi* Ravn	A. JESSEN, p. 13.
v ? 1946	— *Pecten* cf. *Puggaardi* Ravn	J. P. J. RAVN, p. 24.
1952	— *Pecten (Aequipecten) puggaardi* Ravn	H. ØDUM, p. 18.
. 1961	— *Chlamys (Aequipecten) campaniensis* d'Orbigny	S. I. PASTERNAK, p. 20, f. 4.
. 1961	— *Chlamys (Aequipecten) puggaardi* Ravn	S. I. PASTERNAK, p. 20, f. 5.
. 1968	— *Chlamys (Aequipecten) campaniensis* d'Orbigny	S. I. PASTERNAK et al., p. 161, pl. 34, f. 2.
? 1968	— *Chlamys (Aequipecten)* aff. *campaniensis* d'Orbigny	S. I. PASTERNAK, p. 162, pl. 34, f. 3-5.
. 1968	— *Chlamys (Aequipecten) puggaardi* Ravn	S. I. PASTERNAK, p. 162, pl. 34, f. 6.

Location of type-specimens

Muséum d'Histoire naturelle in Paris : D'ORBIGNY coll. n° 7608.

Pecten fenestratus RAVN (non *P. fenestratus* FORBES, 1844) = *Pecten puggaardi* RAVN : Mineralogisk Museum, Copenhagen (Denmark).

Stratum typicum :

Craie blanche la plus supérieure (Upper Campanian — Lower Maastrichtian).

Pecten puggaardi : Skrivekridt (Maastrichtian).

Locus typicus :

Chavot (Marne, France).

Møens Klint, Denmark.

Original description

« P. testâ circulari, depressâ, radiatim costatâ; costis (26) aequalibus, elevatis, trasversim sublammellosis, sulcis angustatis; auriculis subaequalibus.

Dimensions. Largeur, 8 millim. — Par rapport à la largueur : longueur, 100/100. — Angle apicial, 109°.

Coquille plus longue que large, presque circulaire, déprimée, ornée, dans le jeune âge, de douze, et dans les adultes d'environ 26 côtes rayonnantes, bifurquées, le double plus larges que les sillons qui les séparent, assez élevées, et marquées de petites côtes

lamelleuses, transverses, surtout vers le sommet de la coquille, où elles passent même par dessus les sillons sans s'interrompre.

Rapports et différences. Cette jolie espèce est facile à reconnaître par sa forme arrondie, plus longue que large, et par ses singulières lignes concentriques élevées qui traversent l'ensemble des côtes et des sillons.

Localité. Elle a été recueillie, dans la craie blanche la plus supérieure, à Chavot (Marne), par M. DUTEMPLE. »

Additional description

Number of specimens studied : 677.

Danish Turonian	72
Danish Senonian	26
British Senonian	44
French Senonian	4
Belgian - Dutch Maastrichtian	60
British Maastrichtian	6
Danish Maastrichtian	202
East German Maastrichtian	303
West German Maastrichtian	20

Measurements :

	U. P. D.	W.	A. A.	number
Maastricht	4.4 to 11.1 mm av. 6.6 (n = 43)	4.4 to 11.1 mm av. 7.0 (n = 43)	83° to 111° av. 93° (n = 43)	20 to 32
Hemmoor	5.4 to 12.0 mm av. 9.0 (n = 18)	5.5 to 12.5 mm av. 9.1 (n = 18)	—	—
Norwich *(B. mucronata zone)*	6.2 to 12.0 mm av. 8.5 (n = 32)	4.8 to 11.4 mm av. 8.2 (n = 32)	80° to 95° av. 86° (n = 30).	21 to 31

Description :

Diagnosis. — Small, rather convex *Lyropecten (Aequipecten)* species with well developed radial ribs, which can be divided, and very clearly visible slightly elevated concentric growth striae which cross the ribs; this ornamentation gives the impression that the shell is covered with a trellis.

Macrosculpture on both valves :

Consists of concentric elevations and radial ribs. When the radial ribs are undivided they all have the same width; when they are divided the divided ribs are narrower than the undivided till they reach the pallial margin. The intercostal intervals are deep; the concentric elevations cross the radial ribs and thus the whole sculpture acquires the aspect of a trellis.

This unusual sculpture is most clearly visible in the umbonal region; on the other parts of the disc it seems to be worn off. On small (young) specimens the trellis sculpture is more visible than on large (older) specimens.

Right valve : radial ribs and intercostal intervals have the same width. Anterior auricle : winglike, with deep byssal sinus and 3 to 5 riblets parallel with the apical margin and crossed by fine concentric striae. Posterior auricle : much smaller, triangular; no clearly developed sculpture.

Left valve : radial ribs are narrower than the intercostal intervals. Anterior auricle : large, winglike and elongated with 2 to 4 riblets more or less parallel with the apical margin and crossed by fine concentric striae. Posterior auricle : smaller; macrosculpture is not clearly developed.

Discussion

Pecten campaniensis D'ORBIGNY = *Pecten fenestratus* RAVN (= *Pecten puggaardi* RAVN). *Pecten campaniensis* as drawn and described by D'ORBIGNY has a predominant radial ornamentation; the specimens figured by RAVN have a radial and concentric ornamentation of the same development and some specimens have a more pronounced concentric than radial ornamentation (4). In most localities specimens of both types are found and also those between the two extremes.

D'ORBIGNY's figures are reconstructions of poorly preserved specimens : fig. 13 does not tally with the reality of the specimens which are convex but the figure shows an almost flattened specimen; the auriculae on fig. 12 have been invented : it is impossible to see how the auricles were on the original specimen which is very poorly preserved.

WOODS (1902, p. 193) thinks it is a rare species since he saw only about 12 specimens; however, in some areas the species seems to be abundant : for instance in the Maastrichtian strata in Rügen and in Denmark.

The variability in ribnumber is indicated differently by the various authors :

D'ORBIGNY : 12 for young specimens and 26 for adults.

GRIEPENKERL : 15-25 ribs, average 22.

WOODS : average 24.

(4) *Chlamys (Aequipecten) wisniowski* PASTERNAK, 1961 is very probably this extreme of the variability of *L. (A.) campaniensis* : it has a perfect « trellis » ornamentation (PASTERNAK, 1961 f. 2 and PASTERNAK et al., 1968, text fig. 30, 4) in which the concentric element is slightly more pronounced than the radial one; besides the figured specimens (PASTERNAK et al., 1968, pl. 34, fig. 9-11) have a typical *L. (A.) campaniensis* shape.

HAENTZSCHEL : 24, not taking into account ribs which are divided.
WOLANSKY : 25-35 ribs.
PASTERNAK : *L. (A.) campaniensis* : 22-26, *L. (A.) puggaardi* : 27-30.

The only author who gives widely different numbers from those which I counted is GRIEPENKERL. It seems likely that he did not completely separate *L. (A.) campaniensis* from *L. (A.) acuteplicatus* (ALTH) : this would explain the low ribnumber.

HAENTZSCHEL's description of *L. (A.) campaniensis* is not wholly convincing : « ...an den Seitenrändern feine schräge Streifen » is an ornamentation which I have never seen on Campanian and Maastrichtian specimens. This type of ornamentation is found on *L. (A.) pulchellus* and *L. (A.) arlesiensis*.

LEHNER thinks *Pecten arlesiensis* WOODS is synonymous with *L. (A.) campaniensis*. Both species differ because :

1. *L. (A.) arlesiensis* has fewer ribs (14-18)
2. *L. (A.) arlesiensis* has undivided ribs
3. The concentric elevations on *L. (A.) arlesiensis* never form a « trellis ».

Whether *L. (A.) campaniensis* and *Pecten venustus* MORTON are synonymous as LEHNER suggested cannot be decided without seeing American specimens. According to MORTON's description it does not seem probable : « 15 or 20 double costae, those on the lower valve delicately beaded ». This reminds one rather of *L. (A.) arlesiensis* (WOODS) or of *L. (A.) acuteplicatus* (ALTH).

Differentiation :

L. (A.) campaniensis differs from *L. (A.) pulchellus* and *L. (A.) acuteplicatus* in having more convex shells and a « trellis » macrosculpture.
From *L. (A.) subaratus* it differs in having relatively larger auricles and the « trellis » macrosculpture.
From the other *L. (A.)* species it differs on the same grounds as given sub *L. (A.) pulchellus*.

Generic attribution :

The general morphology of *Pecten campaniensis* and of *Pecten opercularis* (LINNAEUS, 1758) are very similar; hence the correct name is *Lyropecten (Aequipecten) campaniensis*.

Stratigraphical and geographical distribution

Turonian : DENMARK :
H. planus zone : Bornholm :
Arnager (KO.)

Muleby aa « Glass marl » (KO.)
Stampe Aa (KO.)

Senonian : DENMARK :

Coniacian : Bornholm :
Ønsteds Kilde, Stampen (KO.)
Stampen (KO.)
Santonian : Bornholm :
Bavnodde (KO.)
Blykobbe aa (KO.)
Forchhammers Klint (KO.)
Horsemyreodde (KO.)
Risenholm (KO.)

FRANCE :

Campanian :
Chavot (Marne) (holotype, Musé.)

GREAT BRITAIN :

Coniacian :

cortestudinarium zone :

Dover (B. M.)

Santonian :

coranguinum zone :

Broadstairs (Kent) (S. M.)
Camden Park, Chislehurst (Kent) (B. M.)
Itchen Abbas (Hants) (S. M.)
Newlands Corner (Surrey) (B. M.)
Sporle, Swaffham (Norfolk) (B. M.)
Thanet Coast (Kent) (B. M.)

Uintacrinus zone :

Devizes Road, Salisbury (Wilts.) (B. M. orig. H. WOODS, pl. 37, f. 5)

Marsupites zone :

Chequer's Inn Well (Hants.) (B. M.)

Campanian :

quadrata zone :

East Harnham, Salisbury (Wilts.) (B. M. orig. H. WOODS, pl. 37, f. 8)

mucronata zone :

Clarendon, Salisbury (Wilts.) (B. M. orig. H. WOODS, pl. 37, f. 6 a, f. 7)
Edward's Pit, Mousehold, Norwich (Norfolk) (B. M.)
Norwich (Norfolk) (B. M.)

THE NETHERLANDS :

Campanian :

Valkenburg (Limburg) (B.)

Maastrichtian : BELGIUM-THE NETHERLANDS :

Ciply (I. R. Sc. N. B.)
Harmignies (I. R. Sc. N. B.)
Maastricht (B., I. R. Sc. N. B.)

DENMARK :

Aalborg (KO.)
Bjerre Thy (KO.)
Bögelund (KO.)
Dania, Mariagerfjord (KO.)
Dronningeren (KO.)
Gudumsholm (KO.)
Hanstholm (KO.)
Hillerslev (KO.)
Hvidskud (KO.)
Kastrup (KO.)
Kjölby Gaard (KO.)
Kongerslev (KO.)
Kongsdal (KO.)
Lindholm (KO.)
Mjels II (KO.)
Möen (KO.)
Nörre Uttrup (KO.)
Restrup (KO.)
Skovbakken, Aalborg (KO.)
Smidie (KO.)
Stevns Klint (KO.)
Störe Taler (KO.)
Svinklöv (KO.)
Vissegaard (KO.)

GREAT BRITAIN :

lunata zone :

Trimingham (Norfolk) (S. M.)

G. D. R. :

Lower Maastrichtian :

Rügen (GR., B. also orig. *P. subaratus* VON HAGENOW)

G. F. R. :

Upper Maastrichtian :
Hemmoor (GH.)

Lyropecten (Aequipecten) pulchellus (S. NILSSON, 1827)

Pl. I, fig. 2a-b

. 1827	— *Pecten pulchellus*	S. NILSSON, p. 22, pl. 9, f. 12.
. 1827	— *Pecten lineatus*	S. NILSSON, p. 22, pl. 9, f. 13.
non 1820	*Pecten lineatus* E. T. VON	SCHLOTHEIM, p. 222.
. 1833	— *Pecten pulchellus* Nilson (sic)	A. GOLDFUSS, p. 51, pl. 91, f. 9 a-b.
v . 1833	— *Pecten spurius* Münster	A. GOLDFUSS, p. 51, pl. 91, f. 10.
? 1833	— *Pecten miscellus* Münster	A. GOLDFUSS, p. 52, pl. 91, f. 8.
. 1841	— *Pecten pulchellus* Nilss.	F. A. ROEMER, p. 52, pl. 9, f. 12.
. 1841	— *Pecten spurius* v. Münster	F. A. ROEMER, pp. 52-53.
(1842)	— *Pecten pulchellus* Nilss.	F. VON HAGENOW, p. 550.
? 1845	— *Pecten subaratus*	A. E. REUSS, p. 29, pl. 39, f. 16.
non 1827	*Pecten subaratus* S. NILSSON.	
1847	— *Pecten pulchellus* Nilsson	J. MUELLER, p. 33.
(1848)	— *Pecten pulchellus* Nilss.	H. G. BRONN, p. 929.
(1850)	— *Pecten pulchellus* Nilss.	A. D'ORBIGNY, p. 252, n° 864.
(1850)	— *Pecten subpulchellus* d'Orb.	A. D'ORBIGNY, p. 252, n° 858.
(1850)	— *Pecten spurius* v. Münster	A. D'ORBIGNY, p. 252, n° 865.
(1850)	— *Pecten pulchellus* Nilsson	H. B. GEINITZ, p. 184.
(1850)	— *Pecten miscellus* Mün.	H. B. GEINITZ, p. 186.
v . 1850	— *Pecten Staszycii* m.	A. ALTH, p. 248, pl. 12, f. 35.
(1852)	— *Pecten pulchellus* Nils.	C. G. GIEBEL, p. 354.
1852	— *Pecten Staszyci* Alth	R. KNER, p. 316, pl. 17, f. 2.
(1859)	— *Pecten pulchellus* Nils.	J. T. BINKHORST VAN DEN BRINKHORST, p. 134, 154.
(1860)	— *Pecten pulchellus* Nilss.	J. BOSQUET, n° 480.
v . 1863	— *Pecten pulchellus* Nils.	A. VON STROMBECK, p. 154.
(1866)	— *Pecten miscellus* Mstr.	C. GIEBEL, p. 47.
(1866)	— *Pecten pulchellus* Nils.	C. GIEBEL, p. 47.
(1866)	— *Pecten spurius* Mstr.	C. GIEBEL, p. 47.
(1866)	— *Pecten pulchellus* Nilss.	F. L. CORNET & A. BRIART, p. 332.
(1868)	— *Pecten pulchellus*	A. DEWALQUE, p. 151.
1869	— *Pecten pulchellus* Nilsson	E. FAVRE, pp. 145-146.
1870	— *Pecten pulchellus*	C. SCHLUETER, p. 936, 951.
v . 1870	— *Pecten pulchellus* Nilsson	F. J. PICTET & G. CAMPICHE, p. 219.

(1870)	— *Pecten pulchellus ?*	F. L. CORNET & A. BRIART, p. 22.
(1871)	— *Pecten pulchellus* Nilss.	F. STOLICZKA, p. 428.
? 1882	— *Pecten* cf. *miscellus* Münst.	H. SCHROEDER, p. 265.
v . (1882)	— *Pecten pulchellus* (Nilss).	J. DE MORGAN, p. 38, 135.
(1882)	— *Pecten lineatus* (Nilss.)	J. DE MORGAN, p. 24, p. 38.
(1882)	— *Pecten pulchellus*	J. C. MOBERG in J. JØNSSON, p. 632.
(1884)	— *Pecten pulchellus*	J. C. MOBERG, p. 12.
(1887)	— *Pecten pulchellus* Nilss.	G. DE GEER, p. 15, p. 43.
(1888)	— *Pecten* cf. *pulchellus* Nilss.	F. E. GEINITZ, p. 734, 743.
(1888)	— *Pecten ? lineatus* Nilss.	F. E. GEINITZ, p. 743.
. 1889	— *Pecten pulchellus* Nilss.	E. HOLZAPFEL, pp. 234-235, pl. 26, f. 10-13.
1889	— *Pecten lineatus* Nilsson	O. GRIEPENKERL, p. 44.
v . 1889	— *Pecten pulchellus* Nilsson	O. GRIEPENKERL, p. 45.
1892	— *Pecten (Chlamys) pulchellus* Nilsson	E. STOLLEY, p. 240.
(1894)	— *Pecten pulchellus* Nilss.	W. DEECKE, p. 80.
. 1895	— *Pecten pulchellus* Nilss.	F. VOGEL, p. 23.
. 1895	— *Pecten spurius* Münst.	F. VOGEL, p. 22-23, pl. 1, f. 20-21.
(1896)	— *Pecten pulchellus* Nilss.	H. MUNTHE, p. 26.
v . 1897	— *Pecten pulchellus* Nilsson	A. HENNIG, p. 33, pl. 2, f. 27, 29, 30, pl. 3, f. 1, 2.
(1900)	— *Pecten pulchellus* Nilss.	J. V. ZELIZKO, p. 536.
1900	— *Pecten (Aequipecten) pulchellus* Nilss.	E. PHILIPPI, p. 101, textfig. 18 a-b.
(1901)	— *Pecten pulchellus* Nilsson	R. FORIR, p. 115.
1902	— *Pecten Farafrensis* var. *densiplicata* nov. var.	J. WANNER, pp. 114-115, pl. 17, f. 4.
v . 1902	— *Pecten pulchellus* Nilsson	J. P. J. RAVN, p. 82, pl. 1, f. 8.
v . 1902	— *Pecten (Aequipecten) pulchellus* Nilsson	H. WOODS, p. 194, pl. 37, f. 12-15.
1902a	— *Pecten pulchellus* Nilsson	A. WOLLEMANN, p. 60.
? (1904a)	— *Pecten pulchellus* Nilss.	W. PETRASCHECK, p. 61.
? (1904b)	— *Pecten* cf. *pulchellus*	J. J. JAHN, p. 318.
(1908)	— *Pecten* cf. *pulchellus* Nils.	W. CHIMENKOW, p. 124.
(1910)	— *Pecten pulchellus* Nilss.	J. C. MOBERG, p. 181.
1911	— *Pecten submiscellus* n. sp.	K. VOGEL VON FALCKENSTEIN, p. 553, pl. 10, f. 4.
1911	— *Pecten* cfr. *pulchellus* Nilss.	K. VOGEL VON FALCKENSTEIN, p. 554.
(1911)	— *Pecten (Aequipecten) pulchellus* Nilss.	W. ROGALA, p. 493.
1923	— *Pecten (Aequipecten) pulchellus* Nilss.	A. JESSEN & H. ØDUM, p. 37.
1924	— *Pecten pulchellus* Nilsson	R. HÄGG, p. 8.
(1926)	— *Pecten (Aequipecten) pulchellus* Nilss.	H. ØDUM, p. 181.

v . 1932	— *Pecten (Aequipecten) pulchellus* Nilsson	D. WOLANSKY, p. 15.
. 1933	— *Pecten (Aequipecten) pulchellus* Nilss.	W. HAENTZSCHEL, p. 124.
v . 1934	— *Pecten (Aequipecten) pulchellus* Nilsson	R. HÄGG, p. 37.
? 1937	— *Pecten* aff. *obrutus* Conrad	M. AVNIMELCH, p. 51.
1938	— *Pecten pulchellus* Nilsson	J. G. CARLSSON, p. 8.
? 1941	— *Pecten (Aequipecten) pulchellus* Nilsson	E. STOLL, p. 94, pl. 2, f. 9-10.
? 1943	— *Pecten* cf. *miscellus* Münster	W. J. M. VAN DER WEIJDEN, p. 85, pl. 7, f. 6.
(1945)	— *Pecten pulchellus* Nils.	A. JESSEN, p. 13.
v . 1946	— *Pecten pulchellus* Nilsson	J. P. J. RAVN, p. 25.
1947	— *Pecten (Aequipecten) pulchellus* Nilsson	R. HÄGG, p. 71.
1954a	— *Pecten (Aequipecten) pulchellus* Nilsson	R. HÄGG, p. 41.
? 1964	— *Pecten* aff. *pulchellus* Nilss.	H. ARNOLD & K. H. TASCH, p. 642.
(1964)c	— *Pecten (Aequ.) pulchellus* Nilss.	H. ARNOLD, p. 317.
1964	— *Pecten (Aequipecten) pulchellus* Nilss.	R. GIERS, p. 233.
1968	— *Chlamys (Aequipecten) pulchella* Nilsson	S. I. PASTERNAK et al., p. 166, pl. 34, f. 12-15.
non 1875	*Pecten pulchellus* H. B. GEINITZ, p. 33, pl. 10, f. 2-4.	
non 1877	*Pecten pulchellus* A. FRITSCH, p. 136, f. 130.	
non 1893	*Pecten pulchellus* R. MICHAEL, p. 243.	
non 1843	*Pecten pulchellus* P. MATHÉRON, p. 186, pl. 30, f. 4-6 (= *Syncyclonema haeggi* DHONDT, 1971).	

Location of type-specimens

The specimen L 0 71 t figured on pl. 9, f. 12 by NILSSON is, at present, lost in the Palaeontologiska Institutionen of the University of Lund. Since the species is generally well known there is no reason for selecting a neotype.

Pecten lineatus : L 0 72 t figured on pl. 9, f. 13 is also lost at present.

Pecten spurius : Bayerische Staatssammlung, Institut für Paläontologie und historische Geologie, University of Munich, G. F. R.

Pecten miscellus : I could not find this specimen in the Bayerische Staatssammlung; it is probably lost.

Pecten staszyci : Naturhistorisches Museum, Vienna : 1862 V 274.

Pecten farafrensis var. *densiplicata* : could not be retraced.

Pecten submiscellus : Museum of Gdansk, Poland, according to the author; thus probably lost during World War II.

Stratum typicum :

In arena viridi (Campanian)
Pecten spurius : grünliche Kreide (Campanian)
Pecten miscellus : grünliche Kreide (Campanian)
Pecten staszyci : Kreidemergel (Upper Maastrichtian)
Pecten farafrensis var. *densiplicata* : Weisse Kreide (Upper Senonian)
Pecten submiscellus : Kreidegeschiebe (Senonian).

Locus typicus :

Köpingemölla (Sweden)
Pecten spurius : Haldem (G. F. R.)
Pecten miscellus : Haldem (G. F. R.)
Pecten staszyci : Lemberg (Lwow) (U. S. S. R.)
Pecten farafrensis var. *densiplicata* : Farafrâh (Egypt)
Pecten submiscellus : Kreidegeschiebe in Westpreussen (Western Poland).

Original descriptions

Pecten pulchellus

« P. testa orbiculari, depresso-convexa, radiatim costata; costis latiusculis, plano-convexis, subfissis, subtiliter striatis; striis in media testa longitudinalibus, ad latera obliquis, arcuatis; auriculis inaequalibus virgatostriatis. Diam. 10-14 mm.

Descript. Inter mediocres sed pulcherrimos Pectinites formationis cretaceae, Saepe testa alba, et nitida obvenit, fasciis transversis rubescentibus ornata. Fere orbicularis est et parum convexa, radiatim costata; costae 22-24 satis latae, parum convexae, interdum fissae, subtiliter et pulchra striatae. Sulci intercostales angustissimi. Striae in media testa longitudinales sunt, sed in lateribus oblique et sub auriculis arcuatim transverse currunt. Auriculae inaequalissimae, radiatim striatae.

Obs. In quibusdam speciminibus lumini observis et per lenticulam observatis, inspiciuntur quoque striae costarum transversae; in quibusdam hae solae observantur.

Locus. In arena viridi ad Köpingemölla, frequens et bene conservata occurrit. In calce arenosa et carbonifera ejusdem regionis quoque obvenit, nec non in striatis conchaceis ad Balsberg, Ignaberga, Kjugestrand et Mörby. »

Pecten lineatus

« P. testa orbiculari, depresso-convexa, radiatim costata; costis angustissimis, compressis, elatis; interstitiis latioribus striatis; striis in media testa longitudinalibus, ad latera obliquis, arcuatis; auriculis inaequalibus striatis. Diam. praecedentis.

Obs. — Suspicor hanc et praecedentem esse tantum diversas valvulas unius ejusdemque speciei, quae, si probatur, nomen prioris retineat. Nondum tamen has valvulas junctas invenimus; sed ex centum vel pluribus examinatis, singulae prius descriptae constituunt sinistram, hae autem dextram valvam. Auricularum in utrisque similes, et striae valvarum, quae in illis costas, in his interstitia ornant. Costae vero valde sunt dissimiles; in his angustissimae, compressisimae, ad marginem productae, unde testa dentata fit; interstitia lata subtiliter striata.

Locus. — In arena viridi ad molinam Köpingemölla testae integrae et bene conservatae haud raro inveniuntur. In calce conchacea ad Mörby quoque obveniunt. »

Pecten spurius

« Pecten testa ovato-orbiculari convexo-plana laevigata, costis numerosis confertis planis, sulcis angustis, striis concentricis aliisque lateralibus diagonalibus decussantibus subtilissimis, auriculis striatis.
Occurrit cum praecedentibus (5).

(5) *Pecten miscellus* MÜNSTER et *Pecten pulchellus* NILSON (sic) : « E creta virescenti Westphaliae ».

Eyförmig, glatt und glänzend, flach-convex, durch zahlreiche, glatte, schmale Streifen in flache, breite Rippen abgetheilt, über welche äusserst zarte concentrische Streifen hinweglaufen. Am hintern Seitenrande ist ebenfalls eine sehr feine, diagonale Streifung bemerklich. Die ungleichen, kleinen Ohren zeigen zarte Streifenbüschel.
Aus der grünlichen Kreide bei Haldem. »

Pecten miscellus

« Pecten testa ovato-orbiculari, convexo-plana laevi, lineis sive costellis confertis depressiusculis minoribus dimidiatis interpositis, auriculis inaequalibus laevibus.
E creta virescenti Westphaliae.
Eyförmig-kreisrund, flach-gewölbt, glatt, mit zahlreichen, gedrängten, geraden, etwas flach gedrückten, ausstrahlenden Linien, zwischen welchen sich hier und da kleinere, die den Wirbel nicht erreichen, einschieben. Die schmalen Zwischenfurchen sind ebenfalls glatt, und die Ohren ungleich. Kommt in der grünlichen Kreide zu Haldem bei Osnabrück vor. »

Pecten staszyci

« P. testa suborbiculari, compressa, radiatim plicata; plicis numerosis (24-26) rotundatis, per sulcos longitudinales in 3 ad 4 costulas rotundatas divisis, et concentrice tenuissime striatis, interstitiis angustis. Rostro subrectangulo, marginibus ejus rectis aequalibus, auriculis inaequalibus.
Dim. Länge = der Breite 13 Mill., Länge der Schlosskanten 8 Mill., Schlosskantenwinkel 95°, Länge der Schlosslinie 6 Mill.
Schale fast kreisförmig, flachgewölbt, radial gefaltet, Falten zahlreich 24-26, wenig erhaben, breit, mit gerundeten fast flachen Rücken, durch feine Längsfurchen in 3-4 feine, runde stäbchenförmige Rippen getheilt, und fein concentrisch gestreift, Zwischenfurchen sehr schmal, Schlosskanten gerade und gleich, reichen bis zum ersten Drittheil der Breite, wo sie dann ohne einen Winkel zu bilden in den Rand der Schale übergehen. Schlosslinie gerade, die Ohren nicht deutlich erhalten, fast gleich.
Nur einmal im Kreidemergel von Lemberg. »

Additional description

Number of specimens studied : 1566.

Danish Senonian	2
Belgian-Dutch Campanian	225
Swedish	91
West German	22
Belgian-Dutch Maastrichtian : about	1000
British Maastrichtian	15
Danish	111
East German	63
West German	32
Maastrichtian of the U. S. S. R.	5

Measurements :

U. P. D.	varies from 6 mm to 24 mm; av. 18 mm (n = 148)
W.	varies from 6 mm to 22; av. 17.2 mm (n = 148)
A. A.	varies from 89° to 108.5°; av. 102° (n = 148)
U. P. D/W	varies from 1.000 to 1.200;

ribnumber : the ribs have been counted at the pallial margin; their number then varies from 22 to 60, with an average of 35. If one considers the different localities the variation is narrower :

Locality	L valve min.	L valve max.	L valve av.	R valve min.	R valve max.	R valve av.
Maastricht	22	38	28	25	42	32
Lanaye	22	41	27	22	54	31
Jandrain	25	38	33	23	43	35
Wansin	28	44	34	27	44	33
Hesbaye ... ... (collective)	24	34	28	22	43	34

The samples contain approximately 20 valves of each locality and side.

Description :

Diagnosis. — *Lyropecten (Aequipecten)* species with a large number (22-60) of radial divided ribs, which are covered with small globular structures lying at regular distances from one another.

Right valve :

— more convex than the left valve.
— ribnumber increases by bifurcation of the ribs starting from the umbo; in these ribs near the umbo a groove appears (there are sometimes two) : it deepens and becomes as deep as the initial intercostal interval. If the bifurcation is repeated, one rib near the umbo, can give origin to 8-10 ribs near the pallial margin.
— the ribs are broad and rounded.
— the intercostal intervals have a variable width : on some valves they are little more than grooves, whereas on others they can be as wide as the ribs themselves. The narrow, groove- like intervals are the most common type.
— very thin concentric elevations can be present on the whole shell-surface; they are seldom clearly visible.
— radial grooves are always present on the ribs; the deepening of these grooves is the origin of the bifurcation of the ribs.
— on the areas near the auricles the ribs are less developed, and, on some specimens these disc parts are covered with fine, slightly elevated striae perpendicular to the ribs and continuing on the auricles.
— anterior auricle : elongated and winglike with deep byssal sinus; on very well preserved specimens a ctenolium with nine teeth can be seen; covered with concentric and radial striae; the outer margin is recurved.
— posterior auricle : smaller, obtuse-angled; on very well preserved specimens some of the striae are serrate.

Left valve :

— more flattened than the right valve; the ribnumber increases by intercalation : a riblet appears in the intercostal interval near the umbo, becomes progressively larger, and near the pallial margin it reaches the same size as those ribs which started at the umbo.
— the ribs are narrow and elevated.
— the intercostal intervals are deep and wide : about 5 × as wide as the ribs; they are covered with radial striae.
— the umbonal part of the ribs is covered with globular structures; further on the ribs these structures cannot be seen; they are probably worn off.
— near the side margins there are no ribs; on the areas there are striae which are homologous with those of the right valve; they continue on the auricles.
— anterior auricle : the striae are parallel to the apical line; almost rectangular and larger than the posterior auricle.
— posterior auricle; small and obtuse-angled.

Discussion

Synonymy :

To what A. HENNIG, 1897 and H. WOODS, 1902 wrote little has to be added.

Pecten staszyci ALTH, as can be seen on the orignal specimen in Vienna, has all the characteristics of a right valve of *Lyropecten (Aequipecten) pulchellus.*

The originals of A. VON STROMBECK and O. GRIEPENKERL are in the Museum of the VON HUMBOLDT Universität in Berlin.

The specimens from Sweden of J. DE MORGAN's collection are in the Muséum national d'Histoire naturelle in Paris.

Differentiation :

Lyropecten (Aequipecten) pulchellus (NILSSON, 1827) is undoubtedly closely related to *L. (A.) acuteplicatus* (ALTH, 1850) (see sub *acuteplicatus*).

L. (A.) arlesiensis (WOODS, 1902) has fewer and undivided ribs.

L. (A.) subaratus (NILSSON, 1827) has more ribs, auricles with a different macrosculpture, and is more convex.

L. (A.) campaniensis (D'ORBIGNY, 1847) is broader and has a better developed concentric ornamentation; the same applies to *L. (A.) subinflexus* (nom. nov.).

L. (A.) sarumensis (WOODS, 1902) has more ribs and differently ornamented auricles.

L. (A?) ternatus (MUENSTER in GOLDFUSS, 1833) is larger and has fewer ribs.

Generic attribution :

The type-species of *Aequipecten*, *Pecten opercularis* (LINNAEUS, 1758) is similar to *Pecten pulchellus* NILSSON, 1827 in the following respects :

— broad rounded ribs on the right valve and narrow, elevated ribs on the left valve.
— auricle macrosculpture consists in the continuation of striae from the disc and of concentric striae which only exist on the auricles.
— general suborbicular shape and very unequal auricles.

The main difference between the two species is that *Pecten pulchellus* has an increasing ribnumber from umbo to pallial margin by division or intercalation.

Hence it seems logical to consider the correct name of *Pecten pulchellus* NILSSON is now *Lyropecten (Aequipecten) pulchellus* (NILSSON, 1827).

Stratigraphical and geographical distribution

Senonian : DENMARK :

Santonian : Bornholm :
Vest fra Bavnodde (KO.)
Risenholm, Blykobbe Aa (KO.)

G. F. R. :

Haldem (B.)
zwischen Königslutter und Lauingen (Bahnwatershaus 13) (B. orig. GRIEPENKERL)
Lüneburg (B. also orig. VON STROMBECK)

Senonian, Campanian : BELGIUM-THE NETHERLANDS :

Boirs (Liège) (I. R. Sc. N. B.)
Folx-les-Caves (Brabant) (Ec. Min., I. R. Sc. N. B.)
Galoppe (Limburg) (I. R. Sc. N. B.)
Henri-Chapelle (Liège) (I. R. Sc. N. B.)
Slenaken (Limburg) (B., Ma., I. R. Sc. N. B.)
Vaals (Limburg) (I. R. Sc. N. B.)

SWEDEN :

Balsberg (*A. mammillatus*-zone) (Lund)
Balsvig (KO.)
Barnakälla (*A. mammillatus*-zone) (Lund)
Blacksudden, Ivö (Lund)
Ignaberga (B., B. M., GR., KO., Lund, Musé. Coll. J. DE MORGAN)
Kjuge (Mucronat. Kreide) (Lund)
Köpinge (B., KO., Lund also from Museum Nilssonianum and orig. HENNIG, pl. 3, f. 1, 2)
Kullemölla (Lund also orig. HÄGG, 1935)
Maltesholm (KO.)

Oppmanna (Lund)
Svenstorp (Lund)
Ulricelund (Lund)

Maastrichtian : BELGIUM-THE NETHERLANDS :

Ciply (Hainaut) (Ec. Min., G. H., I. R. Sc. N. B., Ma., R. U. G.)
Eben-Emael (Limburg) (I. R. Sc. N. B.)
Gulpen (Limburg) (I. R. Sc. N. B.)
Hallembaye (Liège) (I. R. Sc. N. B.)
Hesbaye (I. R. Sc. N. B.)
Jandrain (Brabant) (I. R. Sc. N. B.)
Lanaye (Limburg) (I. R. Sc. N. B.)
Maastricht (Limburg) (B., I. R. Sc. N. B.)
Maastricht, ENCI quarry (Ma.)
Mesch (Limburg) (Ma.)
North quarry, Haccourt (Liège) (I. R. Sc. N. B., Ma.)
Orp-le-Grand (Brabant) (I. R. Sc. N. B.)
Saint-Symphorien (Hainaut) (I. R. Sc. N. B.)
Wansin (Liège) (I. R. Sc. N. B.)

DENMARK :

Aggersund (KO.)
Allindelille (KO.)
Bögelund (KO.)
« Dania », Mariagerfjord (KO.)
N. Ø. Gravlev (KO.)
Kastrup (KO.)
Kongerslev (KO.)
Kongsdal, Mariagerfjord (KO.)
Møens Klint (KO.)
Nörre Flödal, Aalborg (KO.)
Restrup (KO.)
Smidie (KO.)
Spenstrup (KO.)
Stevns Klint (KO.)
S. V. f. Udbyorre (KO.)
Voxlev II (KO.)

G. D. R. :

Rügen (GR.)

G. F. R. :

Lägerdorf (G. H.)
Lüneburg-Zeltberg (G. H.)

GREAT BRITAIN :

Lower Maastrichtian :

Trimingham (Norfolk) (B. M., G. H., Geol. Sci. orig. H. WOODS, pl. 37, f. 12, n° 8013, S. M.)

U. S. S. R. :

Ukraine : Lwow (N. M. W.)
Nagorzany (N. M. W.)

Lyropecten (Aequipecten) acuteplicatus (A. ALTH, 1850)

Pl. I, fig. 3a-b, Pl. II, fig. 1a-b

(v) . 1837	— *Pecten asper* var. *polonica*	G. PUSCH, p. 41, pl. 5, f. 7 a-b (nomen oblitum).
. 1850	— *Pecten acute-plicatus* m.	A. ALTH, p. 248, pl. 12, f. 34.
. 1850	— *Pecten Leopoliensis* m.	A. ALTH, p. 247, pl. 12, f. 35.
. 1852	— *Pecten acute-plicatus* Alth	R. KNER, p. 316, pl. 7, f. 1.
. 1852	— *Pecten obrutus*	T. A. CONRAD, p. 225, pl. 19, f. 114.
. 1863	— *Pecten Leopoliensis* Alth	S. PLACHETKO, p. 21, pl. 1, f. 21.
. 1863	— *Pecten acute-plicatus* Alth	S. PLACHETKO, p. 21, pl. 1, f. 22.
v . 1869	— *Pecten acute-plicatus* Alth	E. FAVRE, p. 148, pl. 13, f. 3-4.
v . 1869	— *Pecten Leopoliensis* Alth	E. FAVRE, p. 149, pl. 13, f. 5-6.
(1871)	— *Pecten (Chlamys) acute-plicatus* Alth	F. STOLICZKA, p. 429.
(1883)	— *Pecten Farafrensis* Zitt.	K. A. ZITTEL, p. 85 (nomen nudum).
. 1898	— *Pecten Mayer-Eymari* n. sp.	R. B. NEWTON, p. 535, pl. 19, f. 9-11.
(1899)	— *Pecten acuteplicatus* Alth	N. KRISCHTAFOVITSCH, p. 9.
(1899)	— *Pecten Leopoliensis* Alth	N. KRISCHTAFOVITSCH, p. 9.
(1900)	— *Pecten farafrensis* Zitt.	M. BLANCKENHORN, p. 46.
(1901)	— *Pecten Mayer-Eymari, Pecten farafrensis*	M. BLANCKENHORN, p. 477.
v . 1902	— *Pecten inflexus* v. Hagenow (p.p.)	J. P. J. RAVN, p. 83, pl. 1, f. 10 (non pl. 1, f. 9).
. 1902	— *Pecten Farafrensis* v. Zitt.	J. WANNER, p. 114, pl. 17, f. 1-3.
. 1903	— *Pecten farâfrensis* Zitt.	A. QUAAS, pp. 168-169, pl. 20, f. 6-8, pl. 31, f. 21-23.
. 1909a	— *Pecten (Aequipecten) acute-plicatus* Alth	W. ROGALA, p. 696, pl.28, f. 17-19.
(1911)	— *Pecten (Aequipecten) acuteplicatus* Alth	W. ROGALA, p. 493.
1913	— *Pecten Mayer-Eymari* Newton	C. DE STEFANO & M. SFORZA, p. 747.
(1915)	— *Pecten Mayer-Eymari* Newton	C. F. PARONA, p. 35.

(1915)	— *Pecten obrutus* Conr.	M. BLANCKENHORN, p. 187-191.
v ? 1932	— *Pecten (Aequipecten) acuteplicatus* Alth	D. WOLANSKY, p. 15, pl. 2, f. 21.
1934	— *Pecten (Aequipecten) obrutus* Conr.	M. BLANCKENHORN, p. 188.
(1938)	— *Pecten acuteplicatus* Alth	W. POZARYSKI, p. 22.
(1942)	— *Aequipecten acuteplicatus* Alth	H. PUTZER, p. 371.
(1955)	— *Pecten obrutus* Conrad	Z. REISS, p. 121-126.
(1962)	— *Pecten farafrensis*	R. SAID, p. 74, 108.
(1965)b	— *Pecten (Aequipecten) acuteplicatus* Alth	S. CIESLINSKI, p. 120.
1968	— *Chlamys (Aequipecten)* ? *acuteplicata* Alth	S. I. PASTERNAK et al., p. 165, pl. 34, f. 16-19.
non 1902	*Pecten Farafrensis* var. *densiplicata* nov. var.	J. WANNER, pp. 114-115, pl. 17, f. 4.
non 1937	*Pecten aff. obrutus*	M. AVNIMELCH, p. 51.

= *Lyropecten (Aequipecten) pulchellus* (Nilsson, 1827).

Location of type-specimens

Pecten asper var. *polonica* : the Museum of the von Humboldt University in Berlin (G. D. R.) has a large *Aequipecten acuteplicatus* with a label signed by PUSCH. On this label the specimen is named *Pecten asper* LAM. and is said to come from « Kadzimirz an der Weichsel », « Kreide ». It is very similar to PUSCH'S figure, and if it is not its original then it can be chosen as lectotype. It belonged to the collection of Leopold von BUCH.

Pecten acuteplicatus et *P. leopoliensis* : lost; very few ALTH originals are still extant, and those are kept in the Naturhistorisches Museum in Vienna; they arrived there in 1862 and were bought from a monk from Prague. ALTH taught at Cracow University but his collection cannot be found (written communication by Prof. W. KRACH).

Pecten obrutus CONRAD : probably lost as are most CONRAD-types.

Pecten farafrensis ZITTEL : lost; could not be found in the Bayerische Staatssammlung in Munich.

Pecten mayereymari NEWTON : Egyptian Geological Survey in Cairo, Egypt.

Stratum typicum :

Pecten asper var. *polonica* : Kreidemergel (Maastrichtian)
Pecten acuteplicatus : id.
Pecten leopoliensis : id.
Pecten obrutus : bituminous limestone (Campanian — Maastrichtian)
Pecten farafrensis : schneeweisser Kalkstein (Campanian — Maastrichtian)
Pecten mayereymari : erroneous interpretation by NEWTON : Lower Eocene.

Locus typicus :

Pecten asper var. *polonica* : Kadzimirz an der Weichsel (Poland)
Pecten acuteplicatus et *Pecten leopoliensis* : Lemberg (Lwow) (U. S. S. R.)
Pecten obrutus : Neby Musâ (Jordan)
Pecten farafrensis : Farafrâh (Egypt)
Pecten mayereymari : « right bank of the Nile opposite Esna » (Egypt).

Original descriptions

Pecten asper var. polonica

« Testa suborbiculari convexa, costis 18 plus minusve squamoso-asperis, rostro rectangulo, auriculis subaequalibus squamulatis; margine interno fimbriato-crenato.

Ich habe hier Fig. a von aussen und b von innen die beiden Schaalen einer Pektiniten-Art abbilden lassen, welche, wie es scheint, immer nur in unausgewachsenen Individuen in ausserordentlichen Menge, aber stets gut erhalten in dem Kreidemergel bei Kadzimirz an der Weichsel und in der ganzen Lubliner Woiwodschaft, dagegen fast gar nicht im Krakauer Kreidemergel voorkommt. Ich betrachte dieselbe nur als eine Varietät von *P. asper* LAM., denn wenn gleich bei dieser Spielart die schuppenförmig rauhen und der Länge nach dreifach gerieften Rippen nicht so ausgezeichnet sind, als an der grössern Exemplaren aus der Französischen und Englischen untern Kreide, so kommt diese Rauheit doch an einzelnen Exemplaren deutlich vor, und scheint besonders durch Wachsthumsringe veranlasst zu werden. Alle übrigen Kennzeichen sind mit denen des *P. asper* völlig übereinstimmend : die Zahl der Rippen, hier 18, nach SOWERBY 17, nach BRONGNIART's Zeichnung 16; die Gestalt und schuppige Oberfläche der Ohren; die innere glatte Schaale mit den falblich gefalteten Rand (SOWERBY sagt : the inside is plain with a furbelowed margin). — Die innere Seite der Schaale Fig. b ist oft noch mit der natürlichen, lichte braunen, weiss konzentrisch gebänderten Farbe erhalten; äusserlich ist die Schaale lichter und nicht gebändert. — Ganz dieselbe Art findet sich auch, nur nicht so schön erhalten, im karpathischen Nummulitenkalk bei Zakopane und Koscieliske, von wo ich einen Steinkern Fig. c zur Vergleichung habe abbilden lassen; ausserdem, wie bei *P. aequivalvis* erwähnt wurde, auch im tatrischen Quarzsandstein unter dem Alpenkalk im Koscielisker Thal. »

Pecten acuteplicatus

« P. testa suborbiculari, compressa, radiatim plicata, plicis (15) acutissimis maxime elevatis, dorso plicae cujusque imbricato, lateribus laevigatis, subconcavis, interstitiis latis, profundis, concavis, concentrice striatis; rostro obtusangulo, marginibus ejus rectis, aequalibus, auriculis subaequalibus, altera rectangula, altera obtusa.

Dim. Länge und Breite 23 Mill. Länge der Schlosskanten 11 Mill. Länge der Schlosslinie 9 Mill. Schlosskantenwinkel = 115°. Höhe einer Falte in der Mitte der Schale = 1 Mill., Breite derselben 1/2 Mill., Breite der Zwischenfurche 2-2 1/2 Mill.

Schale dünn, fast kreisförmig, flach gewölbt, radial gefaltet. Die Falten von Aussen sehr scharf und erhaben, leistenartig, indem ihre Seiten parallel selbst etwas concav sind. Der Rücken der Falten durch starke genäherte concentrische Furchen, wie mit dachziegelförmigen Schuppen bedeckt. Die Zwischenfurchen tief, fast fünfmal so breit als die Falten, im Grunde etwas concav, und concentrisch gestreift. Gegen die Schlosskanten hören diese höhen Falten plötzlich auf, und dafür erscheinen viel flachere und mehr genäherte ebenfalls scharfe Falten. Auf Steinkernen erscheinen die Falten als wenig erhabene schmale abgerundete Rippen, mit breiten concaven Zwischenräumen. Die Schlosskanten sind gerade, gleich, und reichen kaum bis zum Ende des ersten Drittheils der Breite, ihr Winkel ist sehr stumpf, die Schlosslinie gerade, verhältnissmässig kurz, die Ohren klein, fast gleich, das grössere recht-, das kleinere etwas stumpfwinklig. Die Beschaffenheit der Falten unterscheidet diese Species hinhänglich von Allen bekannten.

Sehr selten im Kreidemergel von Lemberg. »

Pecten leopoliensis

« P. testa suborbiculari, convexiuscula, radiatim plicata, concentrice tenuiter sulcata, plicis 15 ad 20 simplicibus, elevatis, acutis, interstitiis aequalibus, rostro obtuso, marginibus rectis, aequalibus, auriculis inaequalibus, altera rotundata, altera rectangula.

Dim. Länge gleich der Breite = 10 Mill.

Fast kreisrund, ziemlich convex, radial gefaltet, und von zahlreichen feinen concentrischen Streifen bedeckt die sich leicht abreiben. 15-20 einfache Radialfalten, sie sind oben agerundet, und haben Zwischenfurchen von gleicher Breite. Auf den Steinkernen sind sie auch abgerundet, und werden gegen den Wirbel oft schnell schwächer. Schlosskanten gerade, gleich, bis über ein Drittheil der Breite herabreichend, ihr Winkel etwas grösser als ein rechter, die Ohren nicht gross, concentrisch gefurcht, das grössere abgerundet, das kleinere fast rechtwinklig.

Von *P. campaniensis* D'ORB. durch viel geringere Grösse, viel geringere Zahl der scharfen Falten, und die mehr genäherte und feine concentrische Streifung derselben unterschieden.

Ziemlich häufig im Kreidemergel von Lemberg. »

Pecten obrutus

« Ovate, convex-depressed; ribs about 22 in number, angulated, narrower than the interstices, smooth and destitute of distinct lines; ears unequal.

Loc. Bituminous limestone of Neby Mûsa. »

Pecten mayereymari

« Shell lenticular, circular, fan-shaped, costated; costae 20, subrotund or carinated, obsolete laterally; grooves well channeled; surface ornamented with fine concentric lines of growth; auricles subequal.

Dimensions : Heigth : 27 mm; Length : 27 mm.

This species bears a true Eocene facies, being related to *P. reconditus*, SOLANDER, and *P. carinatus* of J. DE C. SOWERBY. It differs from the former in the absence of any grooval squamulose ornamentation and in the possession of almost smooth sides; from the latter it is separated by its rounder and more fan-shaped contour, the closer arrangement of its costae and consequently narrower grooves. In the adult stage the summits of the ribs show a decided angularity, suggesting affinities with *P. carinatus*. On the early stages of the ribs a minute nodulose character is present, somewhat resembling *P. solariolum* of MAYER-EYMAR from the Egyptian Eocene.

Remarks. The shell appears to be fairly common, occurring in a soft cream-coloured chalky rock as well as in a reddish-brown matrix of a marly character. The specimens are, however, rarely well-preserved, being chiefly impressions; associated with them are some obscure plant remains, a small *Arca* (*A. Esnaensis*, n. sp.), and other Mollusca of a fragmentary nature. Professor MAYER-EYMAR's name is associated with this shell in acknowledgement of his important researches on the geology and palaeontology of Egypt.

Horizon. Lower Eocene (Libyan Series).

Distribution. Egypt : Hills west of Jebel Zait, western shore of the Gulf of Suez (28 a to 30 a); and right bank of the river Nile opposite Esna (49 c). Coll. Geol. Surv. Egypt (nº 628, Box nº 28 a to 40 a; nº 1003 box nº 49 c. »

Additional description

Number of specimens studied : total 147.

Belgian-Dutch Maastrichtian	40
Danish Maastrichtian	40
East German Maastrichtian	2
Egyptian Maastrichtian	12
Israeli Maastrichtian	1
Jordanian Maastrichtian	6
Polish Maastrichtian	10
Syrian Maastrichtian	8
West German Maastrichtian	16
Maastrichtian of the U. S. S. R.	12

Measurements :

PUSCH-lectotype : left valve :

U. P. D. 28.8 mm; W. 30.4 mm; A. A. 105°; ribnumber 15.

Localities	U. P. D.	W.	A. A.	ribnumber	
Maastricht (Limburg)	9.4 to 24.0	9.4 to 23.8	90° to 106°	16 to 22 (L)	n = 22
	av. 15	av. 13.9	av. 98°	15 to 22 (R)	
Bochotnica (Poland)	17.7 to 27.6	17.6 to 27.2	90° to 105°	16 to 19 (L)	n = 8
	av. 22.3	av. 21.9	av. 99°	18 to 20 (R)	
Bachtissavaj	18.0	17.8	95°	17	
Bachtiserai (Crimea, U. S. S. R.)	34.1	33.3	99°	18 R	
Lwow (Ukraine, U. S. S. R.)	19.2	18.8	—	19	

Index U. P. D./W. from Maastricht and neighbourhood : 1.000 to 1.150; av. 1.027.

Description :

Diagnosis — *Lyropecten (Aequipecten)* species with 15 to 22 usually undivided radial ribs covered, at regular distances, with globular structures.

Right valve : covered with radial, rounded and wide ribs which do not divide unless at growth ridges (« Wachstumsabsätze »); the intercostal intervals are narrow. Concentric lines cross the ribs and intercostal intervals; sometimes they are slightly elevated. Anterior auricle : with byssal sinus; covered with lines parallel and perpendicular to the hinge line. Posterior auricle : smaller, triangular and almost smooth.

Left valve : covered with narrow and elevated radial ribs; the intercostal intervals are 3 to 5 times as wide as the ribs; close to the umbo the ribs are covered with globular structures; further on the disc it is difficult to see these structures; the intercostal intervals are smooth. Anterior auricle : almost rectangular, covered with 12 parallel riblets, perpendicular to the hinge margin. Posterior auricle : smaller and obtuse-angled; the longest margin (parallel with the medial disc-rib) is incurved; auricle is covered with about 3 riblets parallel with the hinge margin and crossed by concentric lines.

Discussion

Synonymy :

Pecten acuteplicatus and *P. leopoliensis* are different valves of the same species and not, as put forward by W. ROGALA, different growthstages : they have in ALTH's descriptions different sizes but *P. acuteplicatus* is clearly a left valve and *P. leopoliensis* a right valve (6).

Pecten inflexus in RAVN, 1902 and in later Danish authors is a mixture of *P. acuteplicatus* and *P. inflexus* VON HAGENOW. The origin of the confusion lies probably in the presence on both species of « Wachtumsabsätze » and a more or less similar ornamentation, though the ribnumber is different. The« Absätze » are not a good characteristic; they are due to the environment (see also p. 34); often after such a growth ridge the ribs divide and this explains why in *L. (A.) acuteplicatus* which is characterized by undivided ribs, Schreibkreide specimens have them sometimes divided at these ridges.

D. WOLANSKY, 1932 mentions and figures a specimen from Finkenwalde; it is very poorly preserved and is probably not a pectinid. There is one other specimen in the Greifswald collection which is from Crampas, Rügen and is a *L. (A.) acuteplicatus;* in the von Humboldt University in Berlin there is one other specimen of this species from Rügen.

Pecten obrutus CONRAD : the description and figure tally with a left valve of *L. (A.) acuteplicatus.*

Pecten farafrensis ZITTEL, 1883 nomen nudum = *Pecten farafrensis* ZITTEL in J. WANNER, 1902 = *Pecten mayereymari* R. B. NEWTON, 1898 (see BLANCKENHORN, 1901).

The description and figure in NEWTON clearly belong to *L. (A.) acuteplicatus.*

Pecten farafrensis as described and figured by J. WANNER is not such a clear-cut problem; the description and figure are discrepant; the description, apart from the ribnumber, refers undoubtedly to *L. (A.) acuteplicatus* with the characteristic differences between both valves; on the figures very little of this is visible. According to WANNER fig. 1 represents a left valve, but figs 2 and 3 represent right valves whereas in fact, all three figures represent left valves. The ribnumber mentioned in the text is 20-24; this is higher than on European specimens (14-22); on the figures, however, I count resp. 31 (fig. 1), 25 (fig. 2), 24 (fig. 3). It seems likely that the figures are poor and probably inaccurate and thus I consider that the description rather than the figures gives a faithful image of the species. The average size seems to be slightly greater in the Egyptian strata than in European specimens; this can probably be explained by more favourable ecological circumstances. It could be that the slightly higher ribnumber is also due to the larger size.

(6) Cf. *Pecten pulchellus* and *Pecten lineatus* NILSSON which are also two different nominal taxa for the right and left valve of the same species.

Pecten meridionalis EICHWALD, 1865 (p. 448, pl. 20, f. 8 a-d) is very similar to *L. (A.) acuteplicatus* : it is probable that both are conspecific but the described « zones claires, parallèles aux stries d'accroissement » do not make it completely certain. *P. meridionalis* is described from Bachtiserai, Crimea, Ukraine.

Differentiation :

This species seems closely related with *Lyropecten (Aequipecten) pulchellus* NILSSON. The major difference is in the ribnumber : *L. (A.) pulchellus* has dividing ribs and *L. (A.) acuteplicatus* has undivided ribs. The auricle ornamentation is also fairly different : on *L. (A.) pulchellus* the auricles are covered with a *Camptonectes*-like striation whereas on *L. (A.) acuteplicatus* they bear riblets.

Both species have very close values for both measurements and indexes. *L. (A.) acuteplicatus* only rarely appears in the same strata as *L. (A.) pulchellus*, and if they do appear together then *L. (A.) pulchellus* is rare.

For the differentiation towards the other *Lyropecten (Aequipecten)* species see under *L. (A.) pulchellus*.

Generic attribution :

As for *L. (A.) pulchellus*.

Stratigraphical and geographical distribution

Restricted to the Maastrichtian.

BELGIUM-THE NETHERLANDS :

Limburg basin :
Genk (I. R. Sc. N. B.)
Houthalen (I. R. Sc. N. B.)
Maastricht (B., B. M., I. R. Sc. N. B.)
Vroenhoven (Md 4) (I. R. Sc. N. B.)
Zolder (I. R. Sc. N. B.)
Zwartberg (I. R. Sc. N. B.)
Hainaut basin :
Bois d'Havré (I. R. Sc. N. B.)

DENMARK :

Aggersund syd (KO.)
« Dania », Mariagerfjord (KO.)
Hanstholm (Øst for Bjorge) (KO.)
Hillerslev (KO.)
Klitgaard (KO.)
« Norden », Aalborg (KO.)

Nörholm, Aalborg (KO.)
Nörre Uttrup (KO.)
Skovbakken, Aalborg (KO.)
Stevns Klint (KO.)
Voxlev II (KO.)

EGYPT :

24 km E. N. E. of Ain El Wadi, N. end of Farafra Oasis (B. M.)
33 km W of Bauwitti, Baharia Oasis (B. M.)
Gebel Thelemet, W. Coast G. of Suez, W. Arabia (B. M.)
Hills W. of Jebel Zait, N. shore of Gulf of Suez (B. M.)
St. Anthony, E. Desert, W. Arabia (B. M.)

G. D. R. :

Rügen (B., GR.)

G. F. R. :

Hemmoor (G. H.)
Lemförde (DR.)

ISRAEL :

« Danian » : Artuf (B. M.)

JORDAN :

« bituminous limestone » Nebi Musa, Jericho (B. M.)

POLAND :

Bochotnica (G. H.)
Wola y bychavska (B. M.)

SYRIA :

Doumar (B. M.)

U. S. S. R. :

Crimae : Bachtiserai (Mus. Gen.)
Bachtissavaj (G. H.)
no specific locality but « Crimée » (Musé, Coll. D'ORBIGNY, 7614F)
Ukraine : Lwow (B., N. M. W.)

Lyropecten (Aequipecten) subinflexus nom. nov.

. 1842	— *Pecten inflexus* nobis	F. VON HAGENOW, p. 551.
(1849)	— *Pecten inflexus* Hag.	H. G. BRONN, p. 925.
v . 1853	— *Pecten inflexus* Hag. ?	C. PUGGAARD, p. 16, f. 29.
(1871)	— *Pecten inflexus* Hagenow	F. STOLICZKA, p. 429.
v . 1902	— *Pecten inflexus* von Hagenow p.p.	J. P. J. RAVN, p. 83, pl. 1, f. 9 (non 10).
1921	— *Pecten (Chlamys) inflexus* v. Hag.	J. P. J. RAVN, p. 20.

?	1925	— *Pecten* cf. *inflexus* v. Hag.	R. POTONIÉ, p. 618.
	1930	— *Pecten (Chlamys) inflexus* v. Hagenow	R. HÄGG, p. 39.
v .	1932	— *Pecten (Chlamys) inflexus* Hagenow	D. WOLANSKY, p. 15, pl. 2, f. 18-19.
?	1940	— *Chlamys inflexus* v. Hagenow (sic)	V. TZANKOV, p. 486, pl. 6, f. 4.
?	1941	— *Pecten (Chlamys) inflexus* v. Hag.	E. STOLL, p. 93, pl. 2, f. 5.
?	1945	— *Pecten inflexus* v. Hag.	A. JESSEN, p. 13.
	1946	— *Pecten (Chlamys) inflexus* Hagenow	J. P. J. RAVN, p. 24.
	1964	— *Pecten (Chlamys) inflexus* v. Hag.	R. GIERS, p. 233.
non	1818	*Pecten inflexus* (POLI) in LAMARCK, p. 173.	
non	1902	*Pecten inflexus* J. P. J. RAVN, pl. 1, f. 10.	
non	1923	*Pecten (Chlamys) inflexus* A. JESSEN and H. ØDUM, p. 35, pl. 2, f. 5.	
non	1926	*Pecten (Chlamys) inflexus* H. ØDUM, p. 180. = *Lyropecten (Aequipecten) acuteplicatus* (ALTH, 1850).	

Derivatio nominis

Pecten inflexus being pre-employed, I replace it by *subinflexus*.

Location of type-specimens

VON HAGENOW'S collection was destroyed in the Museum of Szczecin during the Second World War; only those specimens which were on loan during that period are still extant.

Stratum typicum :

Kreide (here : Lower Maastrichtian).

Locus typicus :

Rügen (G. D. R.).

Original description

« Grösse und Gestalt wie bei der vorigen Art (7). Bei jungen Exemplaren: welche etwas 2/3 der Grösse erreicht haben, ist der Wirbel und der grösste Theil der Schaale glatt oder zart konzentrisch gestrichelt, und nur am unteren Rande zeigen sich Spuren kurzer Rippen. Hinter dem ersten, schon ziemlich stark aufliegenden Wachsthums-Absatze nehmen die Rippen an Stärke zu und haben mit den Zwischenräumen gleiche Breite. Ganz alte Exemplaren haben 3 bis 4 solcher Absätze, welche einander Ziegel-artig

(7) *Pecten pulchellus* NILSSON.

überlagern und deren letzter nach innen scharf umgekrämpf ist und der Schaale ein Napf-förmiges Ansehen gibt.

Die zuweilen dichotomirenden flachen Rippen strahlen geradlinig aus und sind, wie auch die Zwischenräume, konzentrisch fein gestrichtelt, letzte am deutlichsten. Am vorderen und hinteren Rande ist bei ganz alten Exemplaren noch eine diagonale Streifung bemerkbar; die ungleichen Ohren sind wie der vorigen Art (7) gestaltet und schuppig gerippt. »

Additional description

Number of specimens studied : 67.

Senonian in Lüneburg (G. F. R.)	2
Maastrichtian in Belgium	1
Maastrichtian in Denmark	43
Maastrichtian in Rügen (G. D. R.)	21

Measurements :

U. P. D. varies from 4.5 mm to 12.3 mm (n = 27)
W. varies from 4.3 mm to 12.0 mm (n = 25)
A. A. varies from 86° to 105° (n = 19)

Description :

Diagnosis. — Small *Lyropecten (Aequipecten)* species with 24 to 45 ribs, sometimes divided, but rarely well developed near the umbo; many specimens have growth ridges (« Absätze ») and some have slight concentric ornamentation. The valves are rather flattened.

The ornamentation consists of ribs which are very weakly developed near the umbo; indeed, on some specimens the umbonal part appears smooth. Near the pallial margin they are more developed but they are never very prominent. The intercostal grooves are narrow.

The auricles are unequal on both valves; on the right valves the anterior one is elongated and winglike. It bears radial riblets. The posterior auricle is much smaller and acute-angled. On the left valve the anterior auricle is acute angled and bears radial riblets; the posterior one is as on the right valve.

Discussion

Synonymy and variability :

The State of preservation of the different specimens makes the counting of the ribs fairly difficult; the « Absätze » are not a specific characteristic : this type of growth interruption is found in species from very fine chalky sediments : *L. (A.) campaniensis* (D'ORBIGNY), *L. (A.) sarumensis* (WOODS), *Mimachlamys cretosa* (DEFRANCE), *Mimachlamys mantelliana*

(D'ORBIGNY), *Neithea (Neithea) sexcostata* (WOODWARD) and it is probably due to environment rather than to specific factors.

The original diagnosis by VON HAGENOW is explicit but does not indicate rib-numbers. This probably explains the confusion which exists since RAVN, though VON HAGENOW himself must not have been very certain either : in the University of Greifswald a specimen labelled by him is « *Pecten inflexus* » but in the von Humboldt University another specimen labelled by VON HAGENOW as *Pecten inflexus* is in fact a *L. (A.) subaratus* (NILSSON).

RAVN, 1902, and many authors after him describe as *Pecten inflexus* specimens belonging to *L. (A.) subinflexus* and to *L. (A.) acuteplicatus* (ALTH).

TROELSEN, 1937, in his division of the « Skrivekridt » used 3 « varieties » of *Pecten inflexus* as index fossils for his zones : *Pecten inflexus* var. *moenensis* indicates zone I and II; *P. inflexus* var. *aalborgensis* indicates zone I, II, IIIa; *P. inflexus* var. *stevnensis* indicates zone IIIb and IV. TROELSEN's « varieties » remained nomina nuda. I found some specimens in the Mineralogisk Museum in Copenhagen which had been labelled by him and in Prof. ROSENKRANTZ's coll. there are also a few specimens with TROELSEN-labels. By counting the ribs of all the specimens I came to the conclusion that it is impossible to separate var. *moenensis* and *aalborgensis*. They are normal *L. (A.) subinflexus* specimens as described above.

The specimens of var. *stevnensis* are different and belong to *L. (A.) acuteplicatus* (ALTH). It seems to be true that there is a stratigraphic discrepancy between both species : *L. (A.) subinflexus* occurs in strata which are older than those from which *L. (A.) acuteplicatus* has been recorded.

Chlamys inflexus in V. TZANKOV, 1940, is unfortunately lost. Consequently, it is impossible to be sure that the attribution was correct.

Generic attribution :

Pecten inflexus VON HAGENOW non POLI in LAMARCK has the auricle shape, ribstructure, orbicular disc-shape known for *Pecten opercularis* (LINNAEUS, 1758) type-species of *Aequipecten*; its correct name thus becomes *Lyropecten (Aequipecten) subinflexus* nom. nov.

Stratigraphical and geographical distribution

Senonian : G. F. R. :

Lüneburg (B.)

Maastrichtian : BELGIUM - THE NETHERLANDS :

Sint Pietersberg (I.R.Sc.N.B.)

DENMARK :

Bjerre Thy (KO.)
Gudumsholm (KO.)

Hillerslev (KO.)
Hundevangsklint (KO.)
Møen (KO.)
Nörre Uttrup (KO.)
Skovbakken, Aalborg (KO.)
Stevns Klint (KO.)

G. D. R. :

Rügen (GR.)

Lyropecten (Aequipecten) subaratus (S. Nilsson, 1827)

Pl. II, fig. 2a-b

. 1827	— *Pecten subaratus*	S. Nilsson, p. 21, pl. 9, f. 11.
(1850)	— *Pecten subaratus* Nilss.	H. B. Geinitz, p. 187.
(1870)	— *Pecten subaratus* Nils.	C. Schlueter, p. 937.
(1882)	— *Pecten subaratus* (Nilss.)	J. de Morgan, p. 22, 38.
(1884)	— *Pecten subaratus*	J. C. Moberg, p. 16, 17, 35.
(1884)	— *Pecten subaratus* ?	J. C. Moberg, p. 18.
(1887)	— *Pecten subaratus* Nilss.	G. De Geer, p. 15.
(1888)	— *Pecten ? subaratus* Nilss.	F. E. Geinitz, p. 735, 736.
(1888)	— *Pecten subaratus* Nilss.	F. E. Geinitz, p. 735, 737, 743.
? 1889	— *Pecten subaratus* Nilsson	O. Griepenkerl, p. 44.
(1894)	— *Pecten subaratus* Nilss.	B. Lundgren, p. 9, 13, 18, 19, 21, 27.
1894	— *Pecten subaratus* Nilss.	A. Hennig, p. 519.
(1895)	— *Pecten subaratus* Nilss.	W. Deecke, p. 80.
. 1897	— *Pecten subaratus* Nilss.	A. Hennig, p. 46, pl. 3, f. 14, 16, 17.
1935	— *Pecten (Aequipecten) subaratus* Nilsson	R. Hägg, p. 38-39.
. 1938	— *Pecten subaratus* Nilsson	J. G. Carlsson, p. 9.
1954	— *Pecten (Aequipecten) subaratus* Nilsson	R. Hägg, p. 41.
? 1961	— *Chlamys (Aequipecten) subarata* Nilsson	S. I. Pasternak, p. 20, f. 7.
1968	— *Chlamys (Aequipecten) subarata* Nilsson	S. I. Pasternak et al., p. 164, pl. 34, f. 7, 8.
non 1841	*Pecten subaratus* Nilsson	F. A. Roemer, p. 52.
non 1842	— *Pecten subaratus* Nilss. = *Lyropecten (Aequipecten) campaniensis* (d'Orbigny, 1847).	F. von Hagenow, p. 550.
non 1846	*Pecten subaratus*	A. E. Reuss, p. 29, pl. 39, f. 16.

Location of type-specimens

The original of Pl. 9, fig. 11, in S. NILSSON which was kept in the Palaeontologiska Institutionen of Lund University is, at present, lost. In the Museum Nilssonianum however, there are seven fairly good specimens from Balsberg : these are well preserved and make the designation of a neotype unnecessary.

Locus typicus :

Balsberg, Sweden.

Stratum typicum :

In stratis conchaceis (Campanian).

Original description

« P. testa orbiculari, gibbo-convexa, radiatim costulata; costulis compressis, interdum squamoso-asperis, sulcis profundis; rostro rectangulo; auriculis inaequalissimis, rugoso-striatis. Long. : 22 mm. Lat. : 22 mm.

Descript. — Variat quoad magnitudinem, interdum icone nostra aliquantum major. Valva utraque satis convexa, orbicularis, ita ut latitudo longitudinem aequet, sulcis radiantibus numerosis profundis subarata; costae compressae inaequales interdum dichotomae, marginem versus fissae, et, in speciminibus bene conservatis, squamulis parvis rugosis scabrae; numquam vero longitudinaliter striatae. Sulci et costae aequales. Auriculae inaequalissimae, striatae, scabrae, minore obtusangula, majore (valvae sinistrae) sinu acutangulo, valvae dextrae sinu rotundo incisa.

Linea basalis recta, serrata.

Locus. — In stratis conchaceis ad Ignaberga et Balsberg rarius; in petra conchacea ad Kjugestrand frequentissime obvenit. Haec vero petra, granulis atro viridibus conspersa, cum arena viridi Köpingensi coaeva esse videtur ».

Additional description

Number of specimens studied : 138.

Swedish Campanian	131
Belgian Maastrichtian	3
Danish Maastrichtian	2
West German Maastrichtian	2

Measurements :

Balsberg (Sweden) :

U.P.D.	W.	A. A.	R.	S.	A. A. R.	P. A. R.
17.4	—	99°	33	L	4	—
19.0	19.1	90°	34	L	4	—
19.1	—	92°	36	L	—	3

U.P.D.	W.	A. A.	R.	S.	A. A. R.	P. A. R.
Barnakällagrottan (Sweden) :						
12.3 to 22.9 av. 18.99 (n = 19)	11.95 to 22.9 av. 19.06 (n = 21)	85° to 100° av. 93° (n = 20)	27 to 43 av. 35.9 (n = 18)	9 L 13 R	L : 7-8 (n = 4) R : 3-7 (n = 10)	L : 2-7 (n = 3) R : smooth
Kjuge (Sweden) :						
14.5	14.2	92°	—	R	—	—
to	—	82°	—	R	—	—
19.4 av. 16.82 (n = 6)	18.9	91°	—	L	—	—
Ciply (Belgium) :						
11.6	11.4	91°	30	L	—	—
14.8	14.8	92°	47	L	—	—
16.3	14.8	94°	55	L	—	—
Hemmoor (G. F. R.) :						
10.0	10.2	—	—	—	—	—
11.3	10.4	—	—	—	—	—

Description :

Diagnosis. — Rather convex *Lyropecten (Aequipecten)* species with a large number of dividing ribs crossed by well developed concentric striae.

Right valves : ribs are rounded and intercostal intervals fairly narrow; the rib-number increases by division. All ribs do not reach the same development and, on some specimens there is almost an alternation of strongly with weakly developed ribs. Apical margins are very long : they reach U. P. D./2. Concentric striae cross the ribs and the intercostal intervals; they are clearly visible near the side margins. Auricles are very unequal : anterior auricle is elongated and winglike, has a deep byssal sinus and is covered with 3 to 7 radial-riblets which are crossed by concentric striae; on some specimens the striae are more pronounced than the riblets, ctenolium with 9 teeth; posterior auricle is triangular, small and almost smooth.

Left valves : more convex, the ribs are more or less elevated and the intervals often wide and deep; the ribnumber increases by intercalation.

Apical margin as on right valves. Concentric lines also.

Auricles are very unequal : anterior auricle is elongated and with a very slight byssal sinus : covered with 7 or 8 radial riblets almost parallel to the hinge margin and crossed by concentric striae; posterior auricle is small and triangular and covered with 2 to 7 radial riblets.

Discussion

Variability :

The ribnumber given for Belgian specimens is much higher than for Swedish specimens. This can be explained by the fact that on Belgian specimens tertiary ribs have been counted and on Swedish specimens not.

Distribution and synonymy :

GRIEPENKERL's interpretation of *Pecten subaratus* seems dubious : he indicates a ribnumber of 24 and 30, after division. It is possible that he really means *L. (A.) subinflexus.*

The distribution of the species is unusual : it is very common in Swedish Campanian deposits and occurs but rarely in Danish, Northern German and Belgian Maastrichtian deposits.

It is difficult to compare PASTERNAK's interpretation of *P. subaratus* NILSSON with the Swedish specimens : these are much larger than the measurements given for the Ukrainian specimens and besides none of the Swedish specimens bear the granules figured (PASTERNAK, 1961, p. 20, fig. 7) but they have a concentric ornamentation.

Differentiation :

L. (A.) subaratus can be differentiated from :

— *L. (A.) pulchellus* (NILSSON) by its more convex shells, differently shaped and ornamented auricles and less regular disc macrosculpture.

— *L. (A.) acuteplicatus* (ALTH) by its more convex shells, by its differently shaped and ornamented auricles and by its divided ribs.

— *L. (A.) campaniensis* (D'ORBIGNY) by the number and the width of the ribs, by the auricle ornamentation and by the convex shells.

— *L. (A.) subinflexus* nom. nov. by the number and width of the ribs, the ornamentation of the auricles and their shape.

Generic attribution :

The shells are acline, with very unequal auricles, a deep byssal sinus and ribs which are broader on the right than on the left valves in *Pecten subaratus* NILSSON, 1827. All these are characteristics of *Pecten operculatis* (LINNAEUS, 1758) type-species of *Aequipecten* FISCHER. Consequently, the correct name of *Pecten subaratus* becomes *Lyropecten (Aequipecten) subaratus* (NILSSON, 1827).

Stratigraphical and geographical distribution

Campanian : SWEDEN :

Balsberg (Lund also Museum Nilssonianum)
Balsvig (KO.)
Barnakälla (Lund also Museum Nilssonianum)
Hörvik (KO.)
Ifö (GR., KO.)
Ignaberga (KO., Lund also Museum Nilssonianum)
Karlshamm (Lund)
Kjuge (Halle, Lund also Museum Nilssonianum)
Köpinge (KO., Lund also Museum Nilssonianum)
Lund (KO.)
Lyckås (KO.)
Maltesholm (KO.)
Ringeleslätt (KO.)
Svenstorp (Lund)
Ullstorp (KO.)

Maastrichtian : BELGIUM :

Ciply (Hainaut) (I.R.Sc.N.B.)

DENMARK :

Aalborg (KO.)
Møen (KO.)

G. F. R. :

Hemmoor, Schleswig Holstein (G. H.).

Lyropecten (Aequipecten) sarumensis (H. WOODS, 1902)

v . 1902 — *Pecten (Aequipecten) sarumensis* sp. nov. H. WOODS, p. 192, pl. 37, f. 1, 2 a, b, 3.

Location of lectotype :

British Museum (Nat. Hist.) London (England) L 64209 : orig. of pl. 37, fig. 1.

Stratum typicum :

A. quadratus zone (Lower Campanian)

Locus typicus :

East Harnham, Salisbury, Wilts., Great Britain.

Original description

See WOODS, 1902.

Additional description

Number of specimens studied : 24.

All the specimens are from the British Senonian and are kept in the British Museum (Natural History), London.

Measurements :

H. WOODS measurements seem to be correct except for the apical angle : he indicates values varying between 107° and 111° whereas I measured values varying between 92° and 95°. The difference is probably due to different measuring methods.

Description :

Diagnosis. — Small *Lyropecten (Aequipecten)* species with numerous (45-65), spiny scaled, ribs and relatively large auricles.

For details see WOODS's description.

Discussion

Synonymy :

The limited occurrence can probably be explained as it has been for *L. (A.) arlesiensis* (WOODS) (p. 7).

It could be that *Pecten pulchellus* GEINITZ non NILSSON described from Strehlen near Dresden and which occurs frequently in the Czech Cretaceous (according to A. FRIC) belongs to *L. (A.) sarumensis*. The specimens which GEINITZ had figured I have been unable to identify in the Dresden Collections and the figures are too poor to permit a definite conclusion. There is a slight stratigraphical discrepancy between *L. (A.) sarumensis* and *Pecten pulchellus* GEINITZ non NILSSON : the former occurs throughout the Senonian but the latter seems to be known principally from the Saxonian and Czech Upper Turonian.

Differentiation :

L. (A.) sarumensis can be differentiated from the other *L. (A.)* species by its large number of dividing ribs and by its concentric spiny scales on the ribs. As WOODS stated there is an important similarity between *L. (A.) sarumensis* and *L. (A.) campaniensis* (D'ORBIGNY) but the latter species has fewer ribs and the ornamentation does not become scaly.

L. (A.) arlesiensis (WOODS) is larger than *L. (A.) sarumensis* and has undivided ribs.

Generic attribution :

See under *L. (A.) campaniensis.*

Stratigraphical and geographical distribution

Only known from GREAT BRITAIN and restricted to the Senonian.

M. coranguinum zone :

Grays (Essex) (B. M.)

Uintacrinus band :

Margate (Kent) (B. M.)
Thanet Coast (B. M.)

Marsupites zone :

Farnborough (Kent) (B. M.)

Offaster pilula zone :

Onslow, Guildford (Surrey) (B. M.)

Gonioteuthis quadratus zone :

Coddenham, Ipswich (Suffolk) (B. M.)
East Harnham, Salisbury (Wilts.) (B. M. also figured specimens in WOODS : L 64209, 64210, 64211)

B. mucronata zone :

Attoe's Pit, Catton, Norwich (Norfolk) (B. M.)
Clarendon, Salisbury (Wilts.) (B. M.)
Cunnell's Pit, Newmarket Road, Norwich (Norfolk) (B. M.)
Edward's Pit, Mousehold, Norwich (Norfolk) (B. M.)
Furze Hill, Thanston, Long Stratton (Norfolk) (B. M.)
Harford Bridge, Norwich (Norfolk) (B. M.)

Lyropecten (Aequipecten ?) ternatus
(G. VON MUENSTER in A. GOLDFUSS, 1833)
(Pl. II, fig. 3a-b; Pl. III, fig. 1a-d)

? 1822	— *Pecten*	G. MANTELL, p. 203, pl. 25, fig. 6.
v . 1833	— *Pecten ternatus* Münster	A. GOLDFUSS, p. 52, pl. 91, f. 13.
v . 1833	— *Pecten decemcostatus* Münster	A. GOLDFUSS, p. 53, pl. 93, f. 3.
v . 1833	— *Pecten actinodus* nobis	A. GOLDFUSS, p. 52, pl. 91, f. 12 a-b.

. 1833	— *Pecten cicatrisatus* nobis	A. GOLDFUSS, p. 56, pl. 93, f. 6 a-b.
. 1837	— *Pecten septemplicatus*	F. DUJARDIN, p. 227, pl. 16, f. 11.
non 1827	*Pecten septemplicatus* S. NILSSON.	
. 1837	— *Pecten squamulatus* Duj.	F. DUJARDIN, p. 227, pl. 16, f. 12.
. 1839	— *Pecten decemcostatus* Mün.	H. B. GEINITZ, p. 21.
. 1839	— *Pecten cicatrisatus* Goldf.	H. B. GEINITZ, p. 21.
(1839)	— *Pecten ternatus* Mün.	H. B. GEINITZ, p. 21.
1841	— *Pecten ternatus* v. Münster Goldf.	F. A. ROEMER, p. 53.
. 1841	— *Pecten Dujardini* N.	F. A. ROEMER, p. 53.
1841	— *Pecten decemcostatus* v. Münster Goldf.	F. A. ROEMER, p. 54.
v . 1842	— *Pecten ternatus* Mün. Goldf.	H. B. GEINITZ, p. 83.
v . 1842	— *Pecten squamifer* m.	H. B. GEINITZ, p. 83, pl. 21, f. 5.
. 1843	— *Pecten cicatrisatus* (?) Goldf.	H. B. GEINITZ, p. 16, pl. 3, f. 16.
? 1846	— *Pecten decemcostatus* v. Münster	A. E. REUSS, p. 28, pl. 39, f. 14.
. 1846	— *Pecten Dujardinii* Roemer	A. E. REUSS, pp. 30-31, pl. 39, f. 17.
1846	— *Pecten cicatrisatus* Goldfuss	A. E. REUSS, p. 31.
. 1846	— *Pecten rarispinus* Reuss	A. E. REUSS, p. 31, pl. 39, f. 15.
v . 1847	— *Pecten cenomanensis* d'Orbigny	A. D'ORBIGNY, pp. 603-604, pl. 434, f. 11-14.
v . 1847	— *Pecten Dujardinii* Roemer	A. D'ORBIGNY pp. 615-616, pl. 439, f. 5-11.
(1849)	— *Pecten actinodus* Gf.	H. G. BRONN, p. 919.
(1849)	— *Pecten cicatrisatus* Gf.	H. G. BRONN, p. 921.
(1849)	— *Pecten decemcostatus* Mü., Gf.	H. G. BRONN, p. 922.
(1849)	— *Pecten Dujardini* Roe.	H. G. BRONN, p. 923.
(1849)	— *Pecten rarispinus* Reuss	H. G. BRONN, p. 930.
(1849)	— *Pecten squamifer* Gein.	H. G. BRONN, p. 932.
(1849)	— *Pecten ternatus* Mü. Gf.	H. G. BRONN, p. 933.
(1850)	— *Pecten squammifer* (sic) Geinitz	A. D'ORBIGNY, p. 169, n° 492.
(1850)	— *Pecten decemcostatus* v. Münster, Goldf.	A. D'ORBIGNY, p. 169, n° 497.
(1850)	— *Pecten Dujardini* Roemer	A. D'ORBIGNY, p. 251, n° 834.
(1850)	— *Pecten actinodus* Goldf.	A. D'ORBIGNY, p. 252, n° 848.
(1850)	— *Pecten cicatrisatus* Goldf.	A. D'ORBIGNY, p. 252, n° 850.

(1850)	— *Pecten ternatus* v. Münster, Goldf.	A. D'ORBIGNY, p. 252, n° 855.
(1850)	— *Pecten rarispinus* Reuss	A. D'ORBIGNY, p. 252, n° 870.
(1850)	— *Pecten rarispinus* Reuss	H. B. GEINITZ, p. 184.
(1850)	— *Pecten cicatrisatus* Goldf.	H. B. GEINITZ, p. 184.
(1850)	— *Pecten squamifer* Gein.	H. B. GEINITZ, p. 184.
(1850)	— *Pecten Dujardini* Römer	H. B. GEINITZ, p. 184.
1850	— *Pecten Dujardinii*	J. DE CARLO SOWERBY in F. DIXON, p. 356, pl. 28, f. 4.
(1854)	— *Pecten Dujardini* D'Orb.	J. MORRIS, p. 176.
(1859)	— *Pecten Dujardini* Roem.	J. T. BINKHORST VAN DEN BINKHORST, p. 134.
1859	— *Pecten Dujardini* Roemer	J. MUELLER, p. 8.
(1859)	— *Pecten Dujardini* Roemer	H. COQUAND, p. 984, 1007.
(1860)	— *Pecten actinodus* Goldf.	J. BOSQUET, n° 482.
(1860)	— *Pecten cicatrisatus* Goldf.	J. BOSQUET, n° 484.
(1860)	— *Pecten Dujardini* A. Roem.	J. BOSQUET, n° 488.
(1860)	— *Pecten decemcostatus* v. Münst.	J. BOSQUET, n° 490.
(1860)	— *Pecten actinodus* Goldf.	W. GABB, p. 213.
(1860)	— *Pecten Cenomanensis* d'Orb.	W. GABB, p. 213.
(1860)	— *Pecten cicatrisatus* Goldf.	W. GABB, p. 214.
(1860)	— *Pecten decemcostatus* Münst. in Goldf.	W. GABB, p. 214.
(1860)	— *Pecten Dujardini* d'Orb.	W. GABB, p. 214.
(1860)	— *Pecten rarispinus* Reuss	W. GABB, p. 216.
(1860)	— *Pecten squammifer* Gein.	W. GABB, p. 216.
(1860)	— *Pecten ternatus* Münst. Goldf.	W. GABB, p. 217.
v . 1863	— *Pecten decemcostatus* Goldf.	R. DRESCHER, p. 311, 354.
(1869)	— *Pecten Dujardini* Roemer	E. FAVRE, p. 140.
? 1869	— *Pecten scissus* E. Favre	E. FAVRE, p. 152, pl. 13, f. 9.
. 1870	— *Pecten Dujardini* A.Roemer	F. ROEMER, p. 316, pl. 37, f. 5.
. 1871	— *Pecten (Chlamys) asperulinus* Stoliczka	F. STOLICZKA, pp. 432-433, pl. 31, f. 10-11, pl. 44, f. 5.
(1871)	— *Pecten (Chlamys) cenomanensis* d'Orb.	F. STOLICZKA, p. 428.
(1871)	— *Pecten (Chlamys) Dujardini* Roem.	F. STOLICZKA, p. 428.
(1871)	— *Pecten (Chlamys) squamifer* Gein.	F. STOLICZKA, p. 428.
(1871)	— *Pecten cicatrisatus* Goldf.	F. STOLICZKA, p. 429.
(1871)	— *Pecten* (?) *(Chlamys) actinodus* Goldf.	F. STOLICZKA, p. 429.
v . 1872	— *Pecten cenomanensis* d'Orb.	H. B. GEINITZ, p. 197, pl. 43, f. 17.

. 1875	— *Pecten decemcostatus* Münster	H. B. GEINITZ, p. 35, pl. 10, f. 8-9.
v . 1875	— *Pecten Dujardini* A. Röm.	H. B. GEINITZ, p. 36, pl. 10, f. 10, 11, 13.
v . 1875	— *Pecten Dujardini* var. *rarispinus* Reuss	H. B. GEINITZ, p. 36, pl. 10, f. 12.
(1875)	— *Pecten Dujardini* Roem.	H. ARNAUD, p. 32.
. 1877	— *Pecten Dujardini* Roemer	A. PÉRON, P. 502.
. 1877	— *Pecten Dujardinii*	A. FRITSCH, p. 136, f. 129.
1883	— *Pecten Dujardini* Römer	A. FRITSCH, p. 116.
? 1885	— *Pecten (Liropecten) cenomanencis* d'Orbigny	F. NOETLING, p. 18.
1889	— *Pecten Dujardini* Röm.	A. FRITSCH, p. 85.
. 1889	— *Pecten* cf. *Dujardini* Roem.	E. HOLZAPFEL, p. 232.
. 1892	— *Pecten actinodus* Goldf.	F. VOGEL, p. 57.
(1892)	— *Pecten ternatus*	F. VOGEL, p. 57.
(1892)	— *Pecten decemcostatus*	F. VOGEL, p. 58.
. 1892	— *Pecten cicatrisatus* G.	F. VOGEL, p. 58.
. 1892	— *Pecten Dujardini*	F. VOGEL, p. 60.
(1893)	— *Pecten Dujardini* Röm.	R. MICHAEL, p. 242.
(1893)	— *Pecten* sp. cf. *decemcostatus* Münster	R. MICHAEL, p. 243.
1893	— *Pecten Dujardini* Röm.	A. FRITSCH, p. 100.
1893	— *Pecten cicatrisatus* Goldf.	A. FRITSCH, p. 101.
. 1895	— *Pecten actinodus* Goldf.	F. VOGEL, p. 24.
. 1895	— *Pecten cicatrisatus* Goldf.	F. VOGEL, p. 24.
(1895)	— *Pecten decemcostatus* Münst.	F. VOGEL, p. 25.
(1895)	— *Pecten Dujardini* Roemer	F. VOGEL, p. 25.
(1896)	— *Pecten* aff. *squamifer* Gein.	O. REIS, p. 7.
1896	— *Pecten Krenneri* Pethö	J. PETHÖ, p. 32 (fide M. VON PALFY, 1902).
1897	— *Pecten Dujardini* A. Roem.	R. LEONHARD, p. 45.
(1897)	— *Pecten Dujardini* Röm.	J. V. ZELIZKO, p. 175.
(1897)	— *Pecten decemcostatus* Münst.	J. V. ZELIZKO, p. 175.
. 1897	— *Pecten (Chlamys) Dujardini* Roemer	F. NOETLING, p. 43, pl. 12, f. 1-1a.
(1898)	— *Pecten Dujardini*	L. M. VIDAL, p. 896.
? 1898	— *Pecten (Chlamys) trunensis* nov. sp.	O. REIS, p. 95.
? 1898	— *Pecten (Chlamys) Dujardini* Roem.	O. REIS, p. 96.
(1899)	— *Pecten Dujardini* A. Römer	S. ATHANASIU, p. 439, 442, 448.
(1899)	— *Pecten Dujardini* Roem.	N. KRISCHTAFOVITSCH, p. 9.
(1900)	— *Pecten Dujardini* Röm.	J. V. ZELIZKO, p. 536.
? 1902	— *Pecten Krenneri* Pethö	M. VON PALFY, p. 276, pl. 20, f. 6.

(1903)	— *Pecten Dujardini* Roem.	F. NOETLING, p. 518.
(1904)a	— *Pecten Dujardini* Röm.	W. PETRASCHECK, p. 62.
(1904)b	— *Pecten* cf. *Dujardini* Röm.	W. PETRASCHECK, p. 4.
. 1906	— *Pecten (Aequipecten) decemcostatus* Münst.	W. PETRASCHECK, p. 429, pl. 10, f. 5-7.
(1906)	— *Pecten rarispinus* Reuss	W. PETRASCHECK, p. 430.
? 1906	— *Pecten (Aequipecten) pexatus*	W. PETRASCHECK, p. 430, pl. 10, f. 8-9.
? 1906	— *Pecten Krenneri* Pethö nov. sp.	J. PETHÖ, p. 206, pl. 14, f. 11-12.
(1907)	— *Pecten Dujardini* A. Roem.	H. SCUPIN, p. 697.
1909	— *Pecten (Aequipecten) Dujardini* A. Röm.	W. ROGALA, p. 696.
? 1910	— *Pecten subdecemcostatus* n. sp.	K. VOGEL VON FALCKENSTEIN, p. 552.
. 1911	— *Pecten Dujardini* Röm.	A. FRITSCH, p. 45, f. 205.
(1911)	— *Pecten (Aequipecten) Dujardini* A. Röm.	W. ROGALA, p. 493.
. 1912	— *Pecten (Chlamys) decemcostatus* Goldf.	H. SCUPIN, p. 223.
. 1912	— *Pecten (Chlamys) Dujardini* A. Roem.	H. SCUPIN, p. 226.
. 1912	— *Pecten (Chlamys) Dujardini* A. Roemer.	L. PERVINQUIÈRE, pp. 141-142.
(1915)	— *Pecten (Chlamys) Dujardini* Roem.	C. F. PARONA, p. 35.
1918	— *Pecten (Aequipecten) decemcostatus* Münster	W. WOLDRICH, p. 284.
v . 1922	— *Aequipecten Falki* nov. sp.	J. BOEHM, p. 158, pl. 5, f. 4.
v . 1922	— *Aequipecten ptychodes*	J. BOEHM, p. 159, pl. 5, f. 6.
non 1833	*Pecten ptychodes* GOLDFUSS.	
(1924)	— *Pecten ternatus* Mue.	L. LEHNER, p. 177.
(1930)	— *Pecten Dujardini* (Roemer)	H. BESAIRIE & E. BASSE, p. 276.
. 1931	— *Pecten (Aequipecten)* aff. *Dujardini* Roem.	L. NOETH, p. 336, pl. 18, f. 22.
v . 1931	— *Pecten septemplicatus*	W. HAENTZSCHEL, p. 497.
non 1827	*Pecten septemplicatus* NILSSON.	
(1931)	— *Pecten Dujardini* Roem.	V. TZANKOV, tabl. III.
(1932)	— *Pecten (Chlamys) Dujardini* Roemer	E. CHAPUT, p. 1961.
? 1932	— *Chlamys Dujardinii* Roemer	E. BASSE, p. 21.
. 1933	— *Pecten (Chlamys) decemcostatus* Münst.	W. HAENTZSCHEL, pp. 128-129.
1933	— *Pecten cenomanensis* d'Orb.	W. HAENTZSCHEL, p. 129.
(1934)	— *Pecten decemcostatus* Münst.	H. ANDERT, p. 17.
v (p.p.) . 1934	— *Pecten (Chlamys) Dujardini* A. Roem.	H. ANDERT, p. 163.

	1937	— *Pecten (Aequipecten) ternatus* Münster (pro parte)	L. LEHNER, p. 189.
?	1937	— *Pecten (Aequipecten)* cf. *cenomanensis* d'Orbigny	L. LEHNER, p. 190.
	(1938)	— *Pecten Dujardini* Roem.	W. POZARYSKI, p. 22.
.	1939	— *Pecten (Aequipecten) dujardini* Roem.	E. DACQUÉ, p. 124, pl. 7, f. 8, pl. 14, f. 15.
	1939	— *Pecten* cfr. *decemcostatus* Gdf.	E. DACQUÉ, p. 203, pl. 16, f. 19.
.	1940	— *Pecten (Chlamys) Dujardini* Roem.	C. MAXIA, p. 2, pl. 1, f. 1-2.
.	1942	— *Chlamys dujardini* Roemer	A. M. TORRIANI, pp. 86-87, pl. 6, f. 2-3a, 3b.
	1942	— *Pecten* cf. *cenomanensis* d'Orbigny	A. M. TORRIANI, pp. 87-88.
	(1942)	— *Aequipecten dujardini* Roem.	H. PUTZER, p. 371.
?	1947	— *Pecten (Aequipecten) ptychodes* Goldfuss	R. HÄGG, p. 71.
	(1949)	— *Chlamys cicatrisata* (Goldf).	A. CHAVAN, p. 495.
	(1953)	— *Pecten (Chlamys) dujardini*	J. F. DVORAK, p. 29.
	(1953)	— *Pecten (Aequipecten) decemcostatus*	J. F. DVORAK, p. 29.
	(1953)a	— *Pecten (Chlamys) dujardini*	J. F. DVORAK, p. 528, 529.
	(1953)b	— *Pecten (Aequipecten) decemcostatus*	J. F. DVORAK, p. 528, 529.
	(1956)	— *Pecten cenomanensis* d'Orb.	K. A. TROEGER, p. 90.
	(1957)	— *Pecten Dujardini* A. Roem.	H. D. BEEGER, p. 34.
	(1960)	— *Chlamys dujardini* A. Roem.	K. A. TROEGER & L. WOLF, p. 291.
?	1961	— *Chlamys (Aequipecten) cenomanensis* (d'Orbigny)	H. DIETZE, p. 25, pl. 10, f. 4.
v .	(1961)	— *Pecten septemplicatus*	H. PRESCHER, p. 14.
non	1827	*Pecten septemplicatus* S. NILSSON.	
	1961	— *Pecten* cf. *dujardini* Roem.	BOBKOBA, p. 103, pl. 3, f. 3.
	(1964)c	— *Pecten* (Chl.) *decemcostatus* Mstr. in Glf.	H. ARNOLD, p. 317.
.	1967	— *Chlamys dujardini* Römer	E.J. KOTETISCHVILI, p. 34, pl. 1, f. 11.
.	1968	— *Chlamys (Aequipecten) dujardini* Roemer	S. I. PASTERNAK et al., p. 160, pl. 34, f. 1.
non	1852	*Pecten Dujardini* ? (= *Pecten septemplicatus* NILSSON, 1827.)	R. KNER, p. 316.
non	1897	*Chlamys ternata* (= 1902 *Merklinia pexata* H. WOODS.)	H. WOODS, p. 382.

Location of type-specimens

Holotype : Institut für Paläontologie und historische Geologie der Universität München, Bayerische Staatssammlung (G. F. R.).

Pecten decemcostatus : id.
Pecten cicatricatus and *Pecten actinodus* : Paläontologisches Institut, Universität Bonn (G. F. R.).
Pecten septemplicatus DUJARDIN non NILSSON : lost.
Pecten squamulatus DUJARDIN : id.
Pecten cenomanensis D'ORBIGNY : Muséum national d'Histoire naturelle, Paris, D'ORBIGNY collection, n° 6451.
Pecten dujardini ROEMER : Roemer Museum, Hildesheim (G. F. R.).
Pecten squamifer GEINITZ : Staatliches Museum für Mineralogie und Geologie, Dresden (G. D. R.).
Pecten rarispinus REUSS : lost (8).
Pecten scissus FAVRE : lost.
Pecten asperulinus STOLICZKA : probably Geological Survey of India in Calcutta.
Pecten trunensis REIS : the REIS collection was almost completely destroyed during the burning of the palaeontological collections of the University of Munich, into which collections the former Bayerische kgl. Geologische Landesanstalt had been integrated after World War I.
Pecten krenneri PETHÖ : Hungarian Geological Institute, Budapest (Hungary).
Pecten subdecemcostatus VOGEL von FALCKENSTEIN : was in the Museum in Gdansk (Poland); was probably destroyed in World War II.
Aequipecten falki : lost; the Geologische Landesanstalt in Berlin was largely destroyed in World War II.

Stratum typicum :

Quadersandstein (= Lower Senonian).
Pecten decemcostatus : id.
Pecten actinodus and *P. cicatrisatus* : Kreidetuff (Maastrichtian).
Pecten cenomanensis : craie chloritée (Cenomanian).
Pecten septemplicatus DUJARDIN non NILSSON : craie tufau *(sic)* (Lower Turonian).
Pecten squamulatus : id.
Pecten dujardini : Pläner (Senonian).
Pecten squamifer : not indicated.
Pecten rarispinus : Plänermergel (Turonian).
Pecten scissus : not indicated.
Pecten asperulinus : Ariyalur group (Campanian).

(8) For details of the REUSS collection see DHONDT, 1971, *Bull. Inst. r. Sci. nat. Belg.*, 47, 32 sub *Syncyclonema gamsensis*, p. 63.

Pecten krenneri : Hyper-Senon (Upper Senonian).
Pecten subdecemcostatus : Obersenon (Upper Senonian).
Aequipecten falki : not indicated.

Locus typicus :

Schandau in Sachsen (G. D. R.).
Pecten decemcostatus : id.
Pecten actinodus and *P. cicatrisatus* : St. Petersberg, Maastricht (The Netherlands).
Pecten cenomanensis : Tourtenay (Deux-Sèvres) (France).
Pecten septemplicatus DUJARDIN non NILSSON : « Touraine » (France).
Pecten squamulatus : id.
Pecten dujardini : Weinböhla, Sachsen (G. D. R.).
Pecten squamifer : Postelberg, Praha (Czechoslovakia)
Pecten rarispinus : Priesen (= Brezno) (Czechoslovakia)
Pecten scissus : Nagorzany (Ukraine) (U. S. S. R.)
Pecten krenneri : Peterwardeiner Schichten (Fruška Gora) (Yugoslavia)
Pecten subdecemcostatus : Kreidegeschiebe Westpreussen (Poland)
Aequipecten falki : Steinbruch zwischen den Galgenberg und Gehöft Punsmann bei Kl. Reken in Westfalen (G. F. R.)
Pecten asperulinus : Kaudoor (India).

Original descriptions

Pecten ternatus

« Pecten testa ovato-orbiculari, convexo-plana, costis (9) acutis utrinque lineatis, sulcis plano-concavis latitudine aequalibus auriculis...
Ex arenaceo quadrato Saxoniae M.M.
Wir kennen diese Art nur unvollständig durch einen Steinkern aus dem Quadersandstein von Schandau in Sachsen. Er ist eyförmig-kreisrund, flach-convex, und hat 9 entfernte, breite, scharfe Rippen, welche an beiden Seiten durch eine Linie begrenzt sind. Die Zwischenfurchen sind flach-concav und eben so breit als die Rippen. »

Pecten decemcostatus

« Pecten testa ovato-acuta plano-convexa, costis (10) convexis distinctis, sulcis plano-concavis, auriculis subaequalibus.
Ex arenaceo quadrato saxoniae M.M.
Die Schale hatte, wie der abgebildete Abdruck ihrer innern Fläche zeigt, einen spitzig-eyförmigen Umfang, eine flache Wölbung und 10 erhabene, convexe, gleichförmige Rippen. Die etwas breitern Zwischenfurchen haben einen flachen Boden, sind scharf von den Rippen geschieden, und lassen eine feine Querstreifung erkennen. Die Ohren sind klein, fast gleichförmig, und bilden gleichschenkelige Dreiecke. Aus diesen noch erkennbaren Merkmalen erhellet, dass die Schale dem *Pecten multicostatus* hinsichtlich der Gestalt der Rippen ähnlich war, sich jedoch durch die geringere Zahl derselben unterschied.
Kommt im Quadersandstein zu Schandau bei Dresden vor. »

Pecten actinodus

« Pecten testa ovato-acuta convexo-plana, striis concentricis undulatis, radiis (7) latis subconvexis costulatis, sulcis interstitialibus concavis marginatis, auriculis inaequalibus margine crenatis.
E monte St. Petri. M.B.
Spitzig-eyförmig, flach-convex, mit feinen, wellenförmigen, concentrischen Linien und 7 breiten, etwas gewölbten Strahlen, welche durch schmale, flach-concave Furchen

von einander getrennt und mit 5-7 ausstrahlenden, niedrigen Linien geziert sind. Die beiden Linien, welchen die Furchen begrenzen, erheben sich am meisten. Die ungleichen Ohren sind am obern Rande gekerbt, und lassen feine, parallele, concentrischen Linien erkennen.

Aus dem Kreidetuff des St. Petersberges. »

Pecten cicatrisatus

« Pecten testa ovato-acuta convexo-plana concentrice subtilissime striata, costis (8) formicatis sulcisque conformibus lineatis, linea dorsali costarum intermedia remote cicatrisata, auriculis...

E monte St. Petri. M.B.

Die linke Schale ist flach-convex, spitzig-eyförmig, und hat 8 gewölbte, gleichförmige Rippen, und entsprechende Furchen. Beide sind mit ausstrahlenden, gedrängten, ziemlich dicken Linien bedeckt, welche am untern Rande ungleichförmig erscheinen, weil kleinere zur Ausfüllung eingeschoben sind. Die Mittellinie auf der Höhe jeder Rippe ist doppelt breiter als die übrigen, und mit entfernten, halbkreisförmigen Schuppennarben besetzt. Zwischen diesen Linien befinden sich kaum sichtbare concentrischen Linien.

Kommt bei Mastricht vor. »

Pecten septemplicatus DUJARDIN non NILSSON

« Testâ ovato-rotundatâ subobliquâ, radiatim plicatâ, plicis septem convexis et interstitis longitudinaliter striatis, striis, squamiferis, squamis fornicatis, auriculis inaequalibus striatis. »

Pecten squamulatus

« Testâ ovatâ, planiusculâ, radiatim plicatâ, plicis septem acutis, simpliciter squamulatis; squamis minoribus, fornicatis, erectis.

Cette espèce, très voisine de la précédente, s'en distingue par sa forme plus allongée et par ses plis simples. »

Pecten dujardini

« Beinahe kreisrund, wenig schief; flach gewölbt 1" gross, mit 9-11 niedrigen, gerundeten etwas knotigen Falten; diese tragen jederseits eine Längsfurche und werden dadurch zwischen zwei grösseren Falten immer zwei kleinere abgesondert. Die linke Schale ist flach gewölbt und hat ein stumpfwinkeliges, ausstrahlend gefaltetes Ohr.

Pläner bei Weinböhla-Oberkreide der Touraine. »

Pecten squamifer

« Etwas schief-eiförmig, mit 8-9 Längsfalten, deren jede durch zwei Furchen in drei getheilt ist, von denen die mittelste zwar die höchste, doch gleich stark den einschliessenden ist. Die schwachen, den Hauptfalten gleich breiten Zwischenräume sind gleichfalls mit drei feinen Falten besetzt (in der Zeichnung sind deren nur zwei angegeben), so dass man zwischen je zweien der erhabensten Falten fünf andere zählt. Ueber alle laufen in ziemlicher Entfernung Anwachsringe hinweg, welche auf jeder Falte eine deutliche Schuppe zurücklassen. Auf Steinkernen sind diese Falten glatt. Die grossen Ohren sind ungleich und stossen entweder in einer geraden Linie oder unter einem sehre stumpfen Winkel zusammen. Das vordere ist fast rechtwinkelig, das hintere spitzwinkelig, oben etwas abegrundet, unten ausgeschnitten. Radiale und concentrische Linien laufen über beide hinweg. Die Seiten stossen etwa unter einem rechten Winkel zusammen.

Häufig am Postelberge. »

Pecten rarispinus

« 1" hoch, kreisrund, flach, etwas ungleichseitig, mit wenig stumpfwinkligen Buckel. Die vordere Schlosskante kürzer, eingebogen. Die hintere fast gerade. Die dünne Schale mit 11 breiten, schrägseitigen, oben scharfen Rippen und ebenso breiten, konkaven Zwischenfurchen. Jede Rippe ist durch zwei schmale, nicht sehr tiefe seitliche Furchen in drei Leisten getheilt, deren mittlere die höchste und schärfste ist und entferntstehende, kleine, röhrenformige Stacheln trägt. Jede seitliche Leiste wird nach aussen noch von einer erhabenen Linie begleitet. Drei solcher Leistchen befinden sich auch in jeder Zwischenfurche. Zarte, stark wellenförmige, konzentrische Linien bedecken dicht die ganze Oberfläche und setzen bis in die Ohren fort.

An der innern Fläche der Schale, welche ebenfalls sehr deutliche konzentrische Linien zeigt, stehen die Zwischenrinnen als breite, oben ebene Rippen empor, die an den Seiten scharf gekantet sind und an der innern Seite jeder Kante eine schmale seichte Furche tragen.

Die Ohren klein; das vordere spitzwinklig, an der Basis tief ausgeschnitten, mit einigen ausstrahlenden Rippen; das hintere rechtwinklig, beide radial und konzentrisch linirt. Kleine Exemplare aus dem Plänermergel von Priesen haben nur 10 Rippen, breitere, am Grunde flach konkave Zwischenfurchen ohne Leisten und entfernt stehende, lange, gerade Dornen.

Selten im untern Plänerkalk von Kostritz und Laun. »

Additional description

Number of specimens studied : total 275.

Czech Cenomanian	4
East German Cenomanian	2
French Cenomanian	13
British Turonian	2
Czech Turonian	8
East German Turonian	22
French Turonian	10
Polish Turonian	2
West German Turonian	4
Belgian-Dutch Senonian	9
Czech Senonian	8
French Senonian	34
Polish Senonian	4
Swedish Senonian	62
West German Senonian	7
Bulgarian Maastrichtian	2
Belgian-Dutch Maastrichtian	78
French Maastrichtian	4

Measurements :

On Maastrichtian specimens from Maastricht (The Netherlands).
U. P. D. varies from 8.5 mm to 53.8 mm; av. 28.9 mm (n = 26).
W. varies from 8.5 mm to 45.4 mm; av. 25.8 mm (n = 28);
A. A. varies from 70° to 99°; av. 85° (n = 24).
Ribnumber varies from 7 to 10; mostly 8 or 9 ribs.

Description :

Diagnosis. — Acline *Lyropecten* species, of varying size, with a semicircular pallial margin; valves rather flattened, equally curved; auricles unequal and small; apical margins are straight and their length equals 1/2 U. P. D.; the macrosculpture is very different on left and right valves but the ribnumber is the same.

Right valve : the ribs are broad but the intercostal intervals narrow; each principal rib bears lateral riblets and thus seems to be subdivided into 5 or 7 equal riblets (depending on the shell-size) : 2 or 3 riblets laterally on each side of the principal rib and one riblet forming the top part of this principal rib. Concentric slightly elevated lines cross the ribs

and the intercostal intervals; on some of the ribs, mostly on larger shells, the concentric lines form spinules which are the miniature replica of the spines on the left valve. Anterior auricle : winglike and elongated; the length equals 1/3 to 1/2 of the total W. of the valve; the byssal sinus is deep; 3 to 5 riblets parallel with the hinge line and end at the byssal sinus; they are almost straight and are crossed by concentric elevated lines. Posterior auricle : triangular; acute to right angled, sometimes smooth but usually covered with radial and concentric riblets in varying number.

Left valve : the ribs are narrower and more elevated than on the right valve; on top of the ribs are spines which vary in number and size : on some specimens their length reaches 4 mm and it is likely that they were longer than that on all shells during their lifetime (since then the shells were worn and the spines broke off); it is difficult to count the spines because they vary in size on the same shell and are often broken off in such a way that hardly any trace is left.

On the ribs and in the intercostal intervals, radial, slightly elevated riblets are disposed in the following way : two in the deepest part of the intercostal interval (smooth or with spinules), two on each side of the principal rib (the riblet nearest to the top of the rib can bear spinules, but the one furthest away from the top is always smooth).

The extreme types of left valve macrosculpture are :

— one series of large spines on the top of the ribs and all riblets smooth;

— many smaller spines on the top of the ribs and spines of almost the same size on the upper lateral riblet and on the intercostal riblets.

Between both types all transitions are found : some specimens have large spines on the tops of the ribs and, at the same time, small spines on the intercostal riblets, others have medium-sized spines on the tops of the ribs but smooth lateral and intercostal riblets. The existence of transitions between both variability types proves that both belong to the same species.

Concentric elevated lines cross the ribs and intercostal intervals : they connect the spines and this explains why specimens with many spines have more clearly developed concentric lines. Anterior auricle : acute angled, with 3-5 radial riblets, parallel with the hinge-line, but rarely well developed. Posterior auricle : right to obtuse angled, almost smooth.

Discussion

Synonymy :

The very variable macrosculpture of *L. (A ?) ternatus* is the origin of the species' confused systematics. Left and right valves have different macrosculptures and older authors considered these as belonging to

different species; the left valve's macrosculpture is highly variable by itself so that the extremes in variability were often taken for different species too.

GOLDFUSS was the first to describe and figure valves of *L. (A?) ternatus* and he described his specimens under four different names. Of those two *(Pecten ternatus* and *Pecten decemcostatus)* are « Steinkernen » and are poorly preserved, but they still show the general shape and the typical distribution and number of the ribs. On these specimens, however, it is impossible to get an accurate idea of the ribmacroscrulpture, particularly where it concerns their spines.

The two other GOLDFUSS nominal species are from the Maastrichtian type-area (Sint Pietersberg, Maastricht) and are well preserved. *Pecten actinodus* is a right valve and *Pecten cicatrisatus* a left valve.

Pecten septemplicatus DUJARDIN, 1837 non NILSSON, 1827 (from the craie micacée de la Touraine) renamed *Pecten dujardini* by F. A. ROEMER, 1841, is a right valve, but *Pecten squamulatus* DUJARDIN, 1837 from the same locality and horizon is the left valve of the same species.

GEINITZ, 1842 described another « new » species : *Pecten squamifer,* but in 1872 he declared this nominal species to be synonymous with *Pecten dujardini.*

REUSS, 1846 was the first to suppose that the right valve of *Pecten dujardini* did not bear spines but he still found it necessary to create a « new » species : *Pecten rarispinus.*

D'ORBIGNY, 1847 confused matters still further : he drew reconstructions of both right and left valves of *Pecten dujardini* but he only knew left valves. He assumed erroneously the right valve to be the reflex of the left one.

His *Pecten cenomanensis* is not different from *L. (A?) ternatus; P. cenomanensis* has the rib macrosculpture which I have described above as one of the extremes : long spines on top of the ribs, smooth lateral riblets and intercostal riblets. The ribnumber is only 7, but this is also the case in *Pecten actinodus* as described by GOLDFUSS and anyway, the ribnumber varies slightly from one locality to the other : in literature the ribnumber for *P. dujardini* is given as 8-12 but in the Maastricht area none of the specimens has more than 10 ribs.

FRITSCH in 1877 indicated clearly that left and right valves in *Pecten dujardini* were different and what the differences were between both valves.

Later several authors began to consider that the four GOLDFUSS « species » and the ROEMER « species » were probably synonymous, but exactly how this could be done was not clear for most of them.

The most absolute « lumping » was undertaken by LEHNER. He rightly pointed out that all these « species » are synonymous.

To the synonymy he also added *Pecten trigeminatus* GOLDFUSS. As stated later sub *L. (A?) trigeminatus,* I do not think that is correct.

LEHNER considers *Pecten (Aequipecten) pexatus* WOODS, 1902 (p. 190, pl. 36 f. 5-7) as var. *pexata* of *L. (A?) ternatus*. There is a similarity between WOODS's species and *L. (A?) ternatus* where the rib macrosculpture is concerned but the general shape and auricle-shape are different (9).

Among the four nominal GOLDFUSS-species LEHNER chose the name *Pecten ternatus;* this is an unfortunate choice since the type is an insufficiently preserved « Steinkern ».

Pecten krenneri PETHÖ : Dr. FÜLÖP of the Hungarian Geological Institute kindly sent me photographs of the type-specimen figured on pl. 14, f. 11. The specimens are very worn and it is difficult to decide whether they belong to *L. (A?) ternatus* or to *L? septemplicatus* (NILSSON). Their shape and ribdistribution make the former more likely, but the limited ornamentation is less developed than on most *L. (A?) ternatus* specimens. This lack of ornamentation could be due to the state of preservation.

Differentiation between *L. (A?) ternatus* and the other *L. (A.) species* is easy : *L. (A.) arlesiensis*, *L. (A.) acuteplicatus*, *L. (A.) pulchellus*, *L. (A.) campaniensis*, *L. (A.) subinflexus*, *L. (A.) subaratus* are more circular in shape and have more ribs. *L. (A?) trigeminatus* has approximately the same number of ribs, but the intercostal intervals are narrower and the ribs smooth; the shape is more prosocline. *L? septemplicatus* has the same ribnumber but rounded ribs, flattened broad intercostal intervals and auricles without macrosculpture.

Generic attribution :

It cannot be ascertained whether *Pecten ternatus* GOLDFUSS really belongs to *Aequipecten*. Small specimens have the typical almost circular shape, the auricle shape and the different detailed rib macrosculpture on left and right valves as is the case in *Pecten opercularis* (LINNAEUS, 1758). Older, larger specimens have an elongated shape and are slightly prosocline and this is not known in *Aequipecten*. Because of this doubt it seems preferable to consider *Pecten ternatus* GOLDFUSS as being *Lyropecten (Aequipecten ?) ternatus* (GOLDFUSS).

Stratigraphical and geographical distribution

Cenomanian : CZECHOSLOVAKIA :

Korycany (Halle, Musé. B 18255 Coll. J. DE MORGAN)

FRANCE :

Le Mans (Sarthe) (Ec. Min., Mus. Gen.)
Saint-Paterne (Sarthe) (Mus. Gen.)
Tourtenay (Deux-Sèvres) (Musé. D'ORBIGNY coll. 5451)

(9) For details on *Pecten pexatus* WOODS : « Systematic revision of the *Chlamydinae*. Part 4. *Merklinia* » in the species *Merklinia variabilis* (von HAGENOW).

G. D. R. :

Döltzschen (DR.)

Turonian : CZECHOSLOVAKIA :

Malnitz (B., Univ. Neuch.)
Priesen (B.)
Priziblitz (B.)
Trziblitz (KO.)
Wobora (Mus. Gen.)

FRANCE :

Blois (Mus. Laus.)
Châtellerault (Vienne) (Mus. Gen.)
Gros Peyrou, Martigues (Bouches-du-Rhône) (Mus. Gen.)
Meaulnes (Maine-et-Loire) (DR.)
Samoussay, Saumur (Maine-et-Loire) (Mus. Gen.)
Tours (Indre-et-Loire) (Mus. Laus.)

GREAT BRITAIN :

Holaster planus-zone :
Culver (Isle of Wight) (S. M.)

G. D. R. :

Dohna (DR.)
Dresden (B. M.)
Gostritz (DR.)
Gross Cotta (DR.)
Hohnstein (DR.)
Königstein (DR.)
Kreitwitz, Pirna (DR.)
Neuendörfel, Cotta (B.)
Pennrich (DR.)
Plauen (DR.)
Rottwernsdorf, Pirna (B., DR.)
Schandau (Mü, GOLDFUSS orig.)
Strehlen (B., B. M., DR., Halle, KO., Mus. Gen., S. M.)

G. F. R. :

Thalmässing südl. Regensburg (Mü.)
Winzerberg, Regensburg (Mü.)

POLAND :

Silesia : Oppeln (B.)

Senonian : BELGIUM - THE NETHERLANDS :

Campanian :
Battice (I. R. Sc. N. B.)
Slenaken (I. R. Sc. N. B.)
Teuven (I. R. Sc. N. B.)

CZECHOSLOVAKIA :

Bilin (Mus. Gen.)
Randnitz (DR.)

FRANCE :

Cognac (Musé. coll. D'ORBIGNY 7529 A, U. C. L.)
Meudon (DR.)
Périgueux (B.)
Saint-Christophe (Indre-et-Loire) (Musé. coll. D'ORBIGNY 7599 E)
Tours (Musé. coll. D'ORBIGNY 7599 F)

G. F. R. :

Hoheneggelsen (GH.)
Martersberg, Passau (DR.)

POLAND :

Neu-Warthau (Silesia) (B.)
Wola y bychavska (B. M.)

SWEDEN :

Balsberg (KO.)
Barnakälla (Lund)
Ignaberga (GH., GR.)
Ivö (GH., GR., KO.)
Karlshamm (KO.)
Kjuge (KO., Lund)
Maltesholm (KO.)

Maastrichtian : BELGIUM - THE NETHERLANDS :

Ciply (I. R. Sc. N. B.)
Eben-Emael (I. R. Sc. N. B.)
Lanaye (I. R. Sc. N. B.)
Maastricht (B., DR., I. R. Sc. N. B., KO., Ma., Mus. Gen., Mus. Laus., Musé. coll. D'ORBIGNY 7605)
Spiennes (I. R. Sc. N. B.)
Valkenburg (B.)
Vroenhoven (I. R. Sc. N. B.)

BULGARIA :

Somovit (Univ. Sofia)

FRANCE :

Valognes (Manche) (B. M., Mus. Gen.)

Lyropecten (Aequipecten ?) trigeminatus (A. GOLDFUSS, 1833)

(Pl. III, fig. 2)

. 1833 — *Pecten trigeminatus* nobis A. GOLDFUSS, p. 52, pl. 91, f. 14.

? 1837 — *Pecten excisus* m. G. PUSCH, p. 41, pl. 5, f. 6.

1841	— *Pecten trigeminatus* Goldf.	F. A. ROEMER, p. 53.
? 1846	— *Pecten trigeminatus* Goldfuss	A. E. REUSS, p. 29.
(1849)	— *Pecten trigeminatus* Gf.	H. G. BRONN, p. 933.
(1850)	— *Pecten trigeminatus* Roemer	A. D'ORBIGNY, p. 252, n° 856.
(1850)	— *Pecten trigeminatus* Goldf.	H. B. GEINITZ, p. 184.
(1859) ?	— *Pecten trigeminatus* Goldfuss	J. MUELLER, p. 8, pl. 7, f. 6.
(1859)	— *Pecten trigeminatus* Müll.	J. T. BINKHORST VAN DEN BINKHORST, p. 134.
(1860)	— *Pecten trigeminatus* Goldf.	J. BOSQUET, n° 486.
(1861)	— *Pecten trigeminatus* Roem.	W. GABB, p. 217.
? 1863	— *Pecten trigeminatus* Goldf.	A. VON STROMBECK, p. 155.
(1866)	— *Pecten trigeminatus* Gf.	C. GIEBEL, p. 47.
(1871)	— *Pecten trigeminatus* Goldf.	F. STOLICZKA, p. 429.
1889	— *Pecten trigeminatus* Goldf.	E. HOLZAPFEL, p. 237.
(1893)	— *Pecten trigeminatus* Goldf.	A. FRITSCH, p. 101.
(1895)	— *Pecten trigeminatus* Goldfuss	F. VOGEL, p. 25.
(1902)b	— *Pecten trigeminatus* Goldf.	A. WOLLEMANN, p. 33.
? 1910	— *Pecten trigeminatus* Goldf.	K. VOGEL VON FALCKENSTEIN, p. 552.
1941	— *Pecten (Chlamys) trigeminatus* Goldf.	E. STOLL, pp. 92-93, pl. 2, f. 4.
(1942)	— *Chlamys trigeminatus* Gldf.	H. PUTZER, p. 363.
? 1964	— *Chlamys* cf. *trigeminatus* Glf.	H. ARNOLD & K. H. TASCH, p. 642.
(1964)b	— *Pecten* sp. cf. *trigeminatus* Glf.	H. ARNOLD, p. 207.
(1964)c	— *Pecten (Aequ.) trigeminatus* Glf.	H. ARNOLD, p. 317.
non 1889	*Pecten trigeminatus*	O. GRIEPENKERL, p. 42.
non 1889	*Pecten trigeminatus* var. *armata*	O. GRIEPENKERL, p. 42.
non 1932	*Pecten (Chlamys) trigeminatus* var. *armata*	D. WOLANSKY, p. 15.
= 1842	*Chlamys (Merklinia ?) variabilis* (von HAGENOW)	

Location of type-specimen

Paläontologisches Institut, University of Bonn (G. F. R.) (the specimen which according to GOLDFUSS is in the Munich collections seems to be lost).

Stratum typicum :

Grünliche Kreide (here : Campanian).

Locus typicus :

Lemförde bei Osnabrück (Westphalia) (G. F. R.).

Original description

« Pecten testa ovato-acuta convexo-plana laevi, costis fasciculatim ternatis mediis maioribus, sulcis plano-concavis, auriculis inaequalibus subplicatis.

E creta virescenti Westphaliae. M.B. M.M.

Spitzig-eyförmig, flach-convex, glatt, mit büschelförmig ausstrahlenden convexen Rippen. Je drei derselben, von welchen die mittlere die grösseste ist, bilden einen Strahl. Die Zwischenfurchen sind glatt, und die ungleichen Ohren streifig und schwach gefaltet. Die grosse Höhe und die Abrundung der mittlern Rippen unterscheiden diese Art von der vorhergehenden (10).

Sie findet sich in der grünlichen Kreide zu Lemförde und Haldem bei Osnabrück. »

Additional description

Material. — One left valve from Maatstricht, Upper Maastrichtian.

Measurements :

U. P. D. 27 mm; W. cannot te measured because the specimen is incomplete;

A. A. 101°; Ribnumber : 11 groups of 3 ribs.

Description :

Flattened, prosocline shell with well developed unequal auricles; 11 groups of 3 ribs start at the umbo and continue straight towards the pallial margin; the intercostal intervals are almost as broad as the ribs and on their lowest part are 2 slightly elevated radial riblets; all ribs are smooth.

Anterior auricles : large and rectangular with straight outer margin; no macrosculpture.

Posterior auricle : rectangular and smaller.

Discussion

The specimen from the I. R. Sc. N. B. differs from the specimen described by GOLDFUSS in being of a more prosocline appearance and in having two intercostal riblets.

These differences can be explained :

1. The posterior side of the valve from Maastricht is partly broken off; this would explain the prosocline shape.

(10) *Pecten ternatus* MÜNSTER.

2. The intercostal riblets could occur in left valves and not in right ones (the specimen from Maastricht is a left valve, but GOLDFUSS's specimens are right valves).

The species seems to be extremely rare and is not sufficiently known.

It can be differentiated from

— *L. (A?) ternatus* by the smoothnees, number and distribution of the ribs and by its smooth auricles.

— from the other *L. (A.)* -species on the same grounds as those stated in the description of *L. (A?) ternatus*.

Generic attribution :

The rib distribution in *Pecten trigeminatus* GOLDFUSS is fairly different from the other *Lyropecten (Aequipecten)* species; the general shape is slightly more elongated. This explains the doubt as to the generic attribution of the present species.

Stratigraphical and geographical distribution

Maastrichtian : THE NETHERLANDS :
Maastricht (I. R. Sc. N. B.)

Lyropecten ? septemplicatus (S. NILSSON, 1827)
(Pl. III,. fig. 3)

v .	1827	— *Pecten septemplicatus*	S. NILSSON, p. 20, pl. 10, f. 8.
?	1833	— *Pecten ptychodes* nobis	A. GOLDFUSS, p. 56, pl. 93, f. 4 a-b.
	1841	— *Pecten septemplicatus* Nilss.	F. A. ROEMER, p. 51.
	(1849)	— *Pecten septemplicatus* Nilss.	H. G. BRONN, p. 931.
	(1850)	— *Pecten septemplicatus* Nilss.	A. D'ORBIGNY, p. 252, n° 862.
	(1850)	— *Pecten ptychodes* Goldf.	A. D'ORBIGNY, p. 252, n° 846.
	(1850)	— *Pecten septemplicatus* Nilsson	H. B. GEINITZ, p. 184.
	(1852)	— *Pecten ptychodes* Goldfuss	C. G. GIEBEL, p. 353.
	(1860)	— *Pecten septemplicatus* Nilss.	J. BOSQUET, n° 483.
	(1861)	— *Pecten septemplicatus* Nilss.	W. GABB, p. 216.
	(1861)	— *Pecten ptychodes* Goldf.	W. GABB, p. 216.
	(1866)	— *Pecten ptychodes* Gf.	C. G. GIEBEL, p. 48.
v .	1866	— *Pecten septemplicatus* Nilss.	K. A. ZITTEL, p. 113, pl. 18, f. 3 a-c.
	(1870)	— *Pecten septemplicatus* Nils.	C. SCHLUETER, p. 937.

(1871)	— *Pecten (? Lyropecten) septemplicatus* Nilss.	F. STOLICZKA, p. 425, 429.
1875	— *Pecten (Pseudamusium) septemplicatus* Nilsson	D. BRAUNS, p. 389.
1876	— *Pecten septemplicatus* Nilss.	B. LUNDGREN, p. 18.
? 1882	— *Pecten septemplicatus* Nilss.	H. SCHROEDER, p. 264.
(1882)	— *Pecten septemplicatus* Nilss.	J. DE MORGAN, p. 18, p. 38.
(1884)	— *Pecten septemplicatus*	J. MOBERG, p. 20, 33, 41.
1888	— *Pecten septemplicatus* Nilss.	G. MUELLER, p. 407.
(1888)	— *Pecten septemplicatus* Nilss.	F. E. GEINITZ, p. 743.
(1888)	— *Pecten septemplicatus* Nilss.	B. LUNDGREN, p. 27.
(1892)	— *Pecten septemplicatus*	J. MOBERG in BLOMBERG, p. 21.
(1894)	— *Pecten septemplicatus* Nilss.	B. LUNDGREN, p. 17, 21, 30.
(1894)	— *Pecten septemplicatus* Nilsson	B. LUNDGREN, p. 45.
v . 1894	— *Pecten septemplicatus* Nilss.	A. HENNIG, p. 499, 519.
(1895)	— *Pecten ptychodes* Goldf.	F. VOGEL, p. 25.
(1895)	— *Pecten septemplicatus* Nilss.	F. VOGEL, p. 25.
v . 1897	— *Pecten septemplicatus* Nilss.	A. HENNIG, p. 53.
1898	— *Pecten septemplicatus* Nilss.	G. MUELLER, p. 32, pl. 5, f. 2.
v . 1902	— *Pecten septemplicatus* Nilsson	J. P. J. RAVN, p. 89, pl. 2, f. 1-2.
1905	— *Pecten septemplicatus* Nilss.	T. WEGNER, p. 173.
(1910)	— *Pecten septemplicatus* Nilss.	J. MOBERG, p. 181.
1918	— *Pecten septemplicatus* Nilss.	J. BOEHM, p. 194.
v . 1921	— *Pecten (Chlamys) septemplicatus* Nilss.	J. P. J. RAVN, p. 22.
. 1922	— *Pecten infractus* nov. sp.	J. BOEHM, p. 159, pl. 5, f. 3.
v . 1922	— *Aequipecten Brandesi* Joh. Böhm	J. BOEHM, p. 158, pl. 5, f. 4.
(1923)	— *Pecten septemplicatus* Nilss.	A. JEANNET, p. 229.
v . 1927	— *Pecten* cf. *septemplicatus* Nilsson	C. T. TRECHMANN, p. 34, pl. 2.
(1930)	— *Pecten septemplicatus*	A. LUNDEGREN, p. 119.
1930	— *Pecten (Chlamys) septemplicatus* Nilsson	R. HAGG, p. 40.
v . 1931	— *Pecten septemplicatus* Nilss.	V. TZANKOV, Tabl. II.
. 1934	— *Pecten (Chlamys) septemplicatus* Nilss.	H. ANDERT, p. 162, pl. 9, f. 8 a-c, 9.
1935	— *Pecten (Aequipecten) septemplicatus* Nilsson	R. HÄGG, p. 38.
? 1936	— *Pecten (Aequipecten) falki* J. Böhm	E. BEYENBURG, p. 304, pl. 12, f. 4-5.
1938	— *Pecten septemplicatus* Nilsson	J. G. CARLSSON, p. 8.
1947	— *Pecten (Aequipecten) septemplicatus* Nilsson	R. HÄGG, p. 71.
1954b	— *Pecten (Aequipecten) septemplicatus* Nilsson	R. HÄGG, p. 255.

(1964)a — *Pecten* cf. *septemplicatus falki* Beyenb. H. ARNOLD, p. 94.

(1964)a — *Pecten (Aequipecten) septemplicatus falki* J. Böhm H. ARNOLD, p. 98.

(1964)a — *Pecten (Chlamys) septemplicatus* Nilss. H. ARNOLD, p. 99.

(1964)b — *Pecten (Chlamys) septemplicatus* Nilss. H. ARNOLD, p. 207.

(1964)c — *Pecten (Chlamys) septemplicatus falki* J. Böhm H. ARNOLD, p. 317.

(1964)c — *Pecten (Chlamys) septemplicatus* Nilss. H. ARNOLD, p. 317.

. 1968 — *Chlamys (Chlamys) septemplicata* (Nilsson) S. I. PASTERNAK et al., p. 157, pl. 33, f. 6.

non 1837 *Pecten septemplicatus* F. DUJARDIN.
(= *Lyropecten (Aequipecten ?) ternatus* (MUENSTER in GOLDFUSS, 1833)).

non 1954a *Pecten (Aequipecten) septemplicatus* R. HÄGG, p. 41, pl. 5, f. 55.
(= *Merklinia variabilis* (VON HAGENOW, 1842)).

Location of type-specimens

Palaeontologiska Institutionen, University of Lund (Sweden)
LO 64 t : orig. of NILSSON pl. 10, f. 8 A i
(the original of pl. 10, 8 B, LO 65 t seems to be lost).

Pecten ptychodes : Paläontologisches Institut of the University of Bonn (G. F. R.).

Pecten infractus J. BOEHM = *Pecten septemplicatus* ZITTEL : Geologische Bundesanstalt, Vienna (Austria).

Pecten brandesi : according to J. BOEHM the original specimens are in the University of Halle/Saale; in all probability they were lost during World War II.

Stratum typicum :

in petra conchacea (Campanian).
Pecten ptychodes : E creta margacea (Upper Maastrichtian).
Pecten falki : Untersenon (Lower Senonian).
Pecten infractus : Gosau (Turonian-Santonian).
Pecten brandesi : Senon (Senonian).

Locus typicus :

Balsberg (Sweden).
Pecten ptychodes : Sankt Petersberg, Maastricht (The Netherlands).

Pecten infractus : Gosau (Austria).
Pecten brandesi : Salzberg, Quedlinburg (G. D. R.).

Original descriptions

« P. testa ovato-rotundata, subobliqua, radiatim plicata; plicis septem convexis et interstitiis longitudinaliter striatis; striis squamiferis; squamis fornicatis; auriculis inaequalibus striatis.
Long. 1 1/4-2 poll.

Descript. — Haec pulchra species, quam nullibi descriptam invenimus, dignoscitur testa ovato-rotundata, obliqua, inaequivalvi; valva altera magis, altera minus convexa; utraque radiatim plicata; plicae septem convexae, quas inter totidem concavae. Accretionis stationes duae vel tres distinctissimae sunt, & valva convexior ad illas quasi infracta. Tota testa ornatur lamellis tenuibus transversis undatis, quae tamen in speciminibus plurimis evanuerunt. In omnibus vero cernuntur striae longitudinales squamulis formicatis ornatae, quarum tres plerumque series in unaquaque plica, & tres in interstitio observantur. Hae quoque squamulae haud raro oblitteratae sunt; sed in interstitiis concavis lenticulo examinatis, vestigia earum plerumque deteguntur. Auriculae inaequales et transversim striatae. Intus inspecta testa quoque septemplicata, plicis radiantibus laevibus, margine subangulatis. Hac quoque nota dignoscitur facillime a praecedente specie cujus valva convexa intus ornatus sulcis numerosissimis.

Locus. — In parte septentrionali litoris Kjugestrand cum praecedente (11). Ad Balsberg in petra conchacea; atque in petra arenacea regione lacus Yngsjo dicti, cum *Ostrea lunata* et c. repetitur. »

Pecten ptychodes

« Pecten testa ovato-orbiculari convexa concentrice subtilissime lineata, costis (6) fornicatis interstitiisque conformibus costulatis, auriculis...
E creta margacea montis St. Petri.
Dieses Bruchstück aus der Gegend von Mastricht ist flach-convex, am untern Rande kreisförmig, und hat 6 gewölbte, gleichförmige Rippen und eben so breite, auf dem Boden flach-concave Furchen. Beide sind mit gleichförmigen, ausstrahlenden, ziemlich dicken Linien bedeckt, welche hier und da entfernte, sparrige Schuppen zeigen. In den kleinen Zwischenfurchen sind sehre feine und gedrängte concentrische Linien bemerklich. »

Additional description

Number of specimens studied : total : 38.

Austrian Senonian	3
Danish Senonian	2
East German Senonian	2
West German Senonian	7
Belgian Campanian	1
Swedish Campanian	8
Belgian-Dutch Maastrichtian	6
Bulgarian Maastrichtian	9

(11) = *Pecten quinquecostatus* SOWERBY (= *Neithea quinquecostata*).

Measurements on Belgian specimens :

	U. P. D. (mm)	W (mm)	R number	A. A.
Spiennes	30.6 to 32.1	28.6 to 30.5	7	91°
Maastricht	44.3	42.8	6	90°
Geulhem	—	27.8	8	—
Folx-les-Caves	31.5	29.0	5	76°

Description :

Diagnosis. — Medium sized *Lyropecten* species, with prosocline valves, very unequal auricles, rounded radial ribs with broad intercostal intervals. Pallial margin is semi-circular; the radial ribs are straight in the median part of the valves, but recurve towards the side margin on the lateral parts of the shell. The ribs are rounded and smooth apart from radial lines and rare traces of spines; the flat intervals are as broad or broader than the ribs.

Right valve : Anterior auricle : broad and with acute outer angle, with byssal sinus. Posterior auricle : small and with obtuse angle.

Left valve : Anterior auricle : with acute to obtuse angle. Posterior auricle : as on the right valve.

No macrosculpture can be seen on the auricles.

Discussion

The type specimen has not been very well figured by NILSSON : the measurements are U. P. D. 44.9 mm, W. 41.85 mm, A. A. 86°, R number 7.

The shape is rather convex and prosocline with two concentric pronounced growth ridges and an abrupt steep transition between the second growth ridge and the pallial margin; the ribs are covered with small unevenly distributed spines. The differences between *Pecten ptychodes* GOLDFUSS and *P. septemplicatus* are probably only due to variability : the size, number of ribs and general shape are identical but the spines as drawn by GOLDFUSS seem to be far more numerous and mostly located in the intercostal intervals, whereas on NILSSON's type specimen and on all the other specimens they are limited to the ribs. It could be that GOLDFUSS (fig. 4b) does not give a good idea of the specimen since the description states explicitly that both ribs and intervals carry riblets with spines.

The very convex form described by ZITTEL for specimens from the Gosau is found on one specimen from Maastricht type area, and the type specimen also has it. This explains why it is unnecessary to consider the Gosau specimens as belonging to another species as did J. BOEHM, 1922 *(Pecten infractus)*.

L? septemplicatus differs from :

— *L. (A?) ternatus* in having undivided rounded ribs.

— *L. (A?) trigeminatus* in having fewer, undivided, rounded ribs and shallow intercostal intervals.

The differentiation towards the other *L. (A?)* species on the same grounds as those indicated for differentiating those species from *L. (A?) ternatus.*

Generic attribution :

The elongated, prosocline shape and the low ribnumber make it difficult to decide whether *Pecten septemplicatus* NILSSON, 1827 does really belong into *Lyropecten.* Tentatively, because of its morphological similarity with *L. (A?) ternatus* and *L. (A?) trigeminatus* it is attributed to *Lyropecten.* Hence *Lyropecten ? septemplicatus* (NILSSON, 1827).

Stratigraphical and geographical distribution

Senonian : Lower Senonian : AUSTRIA :

Gosau, Wegscheidgraben (N. M. W., Geol. Bund. Anst. orig. ZITTEL)

DENMARK :

Bornholm : Bavnodde (KO. orig. RAVN, 1902, 1921)

G. D. R. :

Quedlinburg (B.)

G. F. R. :

Adenstedt (GH.)
Gross Bülten (GH.)
Hoheneggelsen (GH., coll. Brandes)

Campanian : BELGIUM :

Folx-les-Caves (I. R. Sc. N. B.)

SWEDEN :

Balsberg (Lund, also type NILSSON)
Barnakälla (Lund)
Ivö (KO.)
Mörby (KO.)
Tosterup (Lund)

Maastrichtian : BELGIUM - THE NETHERLANDS :

Geulhem (Ma.)
Spiennes (I. R. Sc. N. B.)
St. Pietersberg, Maastricht (Ma.)

BULGARIA :

Jambolsk (Univ. Sofia)
Momin (Univ. Sofia)
Nekovo (Univ. Sofia)
Pleven, Kaulka (Univ. Sofia).

KONINKLIJK BELGISCH INSTITUUT VOOR NATUURWETENSCHAPPEN.
INSTITUT ROYAL DES SCIENCES NATURELLES DE BELGIQUE.

REFERENCES

ALTH, A.

1850. *Geognostisch-paläontologische Beschreibung der nächsten Umgebung von Lemberg.* (Haidinger's naturw. Abh. 3 : 171-284, pls. 10-13, map.)

ANDERT, H.

1934. *Die Kreideablagerungen zwischen Elbe und Jeschken. III. Die Fauna der obersten Kreide in Sachsen, Böhmen und Schlesien.* (Abh. preuss. geol. Landesanst. N. F. 159 : 5-477, pls. 1-19, textfigs. 1-93, tables.)

ARNAUD, H.

1875. *Mémoire sur le crétacé du sud-ouest de la France.* [Mém. Soc. géol. Fr. (2), 10 : 1-110, pls. 21-28, 3 tables.]

ARNOLD, H.

1964a. *Die Halterner Sande und ihre Fauna.* (Fortschr. Geol. Rheinld Westf. 7 : 85-112, textfigs. 1-9, 1 pl.)

1964b. *Die Fossilführung des Bottroper Mergels in der Ziegelei Ridderbusch westlich Dorsten.* (Fortschr. Geol. Rheinld Westf. 7 : 199-212, textfigs. 1-5.)

1964c. *Fossilliste für die Münsterländer Oberkreide.* (Fortschr. Geol. Rheinld Westf. 7 : 309-330, 1 textfig.)

ARNOLD, H. & TASCH, K. H.

1964. *Das Oberkreide-Profil der Bohrung Prosper 4 nördlich Bottrop.* (Fortschr. Geol. Rheinld Westf. 7 : 635-648, textfigs. 1-6.)

ATHANASIU, S.

1899. *Geologische Studien in den nordmoldauischen Karpathen.* (Jb. geol. Reichsanst. 49 : 429-492.)

AVNIMELCH, M.

1937. *Etudes géologiques dans la région de la Shépélah en Palestine.* (Trav. Lab. Géol. Univ. Grenoble 20 : 1-144, 14 textfigs., pls. 1-4, map.)

BASSE, E.

1931-1932. *Monographie paléontologique du crétacé de la province de Maintirano (Madagascar).* (Serv. Min. Madagascar 5-86, pls. 1-13.)

BESAIRIE, H. et BASSE, E.

1930. *Observations stratigraphiques et paléontologiques nouvelles sur le Crétacé supérieur de la province de Maintirano (ouest de Madagascar).* (C. r. Acad. Sci. Paris 190, 4 : 275-277.)

BEEGER, H. D.

1957. *Kreidestratigraphie und Tektonik des Gebietes zwischen Stadt Wehlen und Hohnstein (Sächs. Schweiz).* (Jb. st. Mus. Miner. Geol. Dresd. 1957 : 25-55.)

BEYENBURG, E.

1937. *Die Fauna der Halterner Sandfazies im westfälischen Untersenon.* (Jb. preus. geol. Landesanst. 57, 1 : 284-332, textfigs. 1-4, pls. 11-13.)

BLANCKENHORN, M.

1900. *Neues zur Geologie und Paläontologie Aegyptens I.* (Z. dt. geol. Ges. 52 : 21-47.)

1901. *Referat über :* R. B. NEWTON : *Notes on the Lower Tertiary Shells from Egypt Geol. Mag. 1898.* (Neues Jb. Miner. Geol. Paläont. 1901, 1 : 476-477.)

1915. *Das Danien in Palästina mit der Leitform Pecten obrutus Conr. (= P. farafrensis Zitt. = Mayer-Eymari Newt.)* (Z. dt. geol. Ges. 67 : 187-191.)
1934. *Die Bivalven der Kreideformation von Syrien-Palästina.* (Palaeontographica 81 A : 161-296, pls. 7-14.)

BINKHORST VAN DEN BINKHORST, J. T.
1859. *Esquisse géologique et paléontologique des couches crétacées du Limbourg, et plus spécialement de la craie tuffeau.* (Maastricht, pp. I-XVIII, 1-268, pls. 1-5, 1 map.)

BOEHM, J.
1918. *Ueber Versteinerungen aus der Hohen Mark östlich Lembeck in Westfalen.* (Z. dt. geol. Ges. 69 : 194-195.)
1922. *Ueber Pecten septemplicatus auct.* (Jb. preuss. geol. Landesanst. 40, 2 : 156-160, pl. 5, figs. 1-6.)

BOSQUET, J.
1860. *Fossiele Fauna en Flora van het Krijt in Limburg. in* W. C. H. STARING's *Natuurlijke Historie van Nederland.* (De Bodem van Nederland vol. 2 : Bivalvia : pp. 376-388.)

BRAUNS, D.
1875. *Die senonen Mergel des Salzberg bei Quedlinburg.* (Z. ges. Naturw. N. F. 12 : 325-420, pls. 7-10.)

BRONN, H. G.
1849. *Handbuch einer Geschichte der Natur : Index Palaeontologicus Stuttgart.* (I : A-M : 1-775, II : N-Z : 776-1382.)

CARLSSON, J. G.
1938. *A. M. Malms samling av kritfossil från Kristianstadtsonradet. I. Cephalopda, Gastropoda, Lamellibranchiata och Brachiopoda.* (Göteborgs K. Vetensk-o. Vitterh. Samh. Handl. Ser. B. 6, 5 : 1-25, pls. 1-5.)

CHAPUT, E.
1932. *Observations géologiques en Asie Mineure : le Crétacé supérieur dans l'Anatolie Centrale.* (C. R. Acad. Sci. Paris 194, 22 : 1960-1962.)

CHAVAN, A.
1949. *Les caractères de la faune du calcaire de Vigny.* (C. R. Acad. Sci. Paris. 228, 6 : 494-496.)

CHIMENKOW, W.
1907. *Zur Frage über den geologischen Bau der Umgebung von Chwalynsk und über die Kreide Ablagerungen im Wolga-Gebiet des nördlichen Teils des Gouv. Saratov.* (Ezheg. Geol. Miner. Ross. 9, 5 : 115-130.)

CIESLINSKI, S.
1965a. *Stratigraphy and Fauna of the Cenomanian in Poland (Excluding the Carpathians and Silesia).* (Biul. Inst. geol. 192 : 5-56, 6 pls., 3 textfigs.)
1965b. *Results of the macropalaeontological investigations of the bore-hole Ostrowa Mazowiecka I G 1.* (Biul. Inst. geol. 186 : 119-123.)

CONRAD, T. A. in LYNCH, W. F.
1852. *Paleontological Report : Description of the Fossils of Syria.* (pp. 211-235, pls. 1-21, appendix pls, 1-8.)

COQUAND, H.
1859. *Synopsis des animaux et des végétaux fossiles observés dans la formation crétacée du sud-ouest de la France.* [Bull. Soc. géol. Fr. (2), 16 : 945-1020.]

CORNET, F. L. & BRIART, A.
1866. *Note sur l'existence dans l'Entre-Sambre-et-Meuse d'un dépôt contemporain du système du tufeau de Maestricht et sur l'âge des autres couches crétacées de cette partie du pays.* [Bull. Acad. r. Belg. Cl. Sci. (2) 22 : 329-339, 1 plate.]
1870. *Sur la division de la craie blanche du Hainaut en quatre assises.* (Mém. cour. Acad. r. Sci. Belg. 35 : 1-26.)

DACQUÉ, E.
1939. *Die Fauna der Regensburg-Kelheimer Oberkreide.* (Abh. bayer. Akad. Wiss. N. F. 45 : 1-218, pls. 1-17.)

DEECKE, W.

1894. *Die Mesozoischen Formationen der Provinz Pommern.* (Mitt. naturw. Ver. Neu-Vorpomm. 25 : 1-115.)

DEWALQUE, G.

1868. *Prodrome d'une description géologique de la Belgique.* (pp. I-VIII, 1-442.)

DIETZE, H.

1960. *Paläontologische und stratigrafische Untersuchungen der Klippenfazies von Oberau und Meissen (Sächsische Oberkreide).* (Jb. st. Mus. Miner. Geol. Dresd. 1960 : 1-74.)

DHONDT, A.

1971. *Systematic revision of Entolium, Propeamussium (Amusiidae) and Syncyclonema (Pectinidae, Bivalvia, Mollusca) of the European boreal Cretaceous.* (Bull. Inst. r. Sc. nat. Belg. 47, 32.)

1973. *Systematic Revision of the Chlamydinae (Pectinidae, Bivalvia, Mollusca) of the European Cretaceous. Part. 1. Camptonectes.* [Bull. Inst. r. Sci. nat. Belg. 48, 3.]

DRESCHER, R.

1863. *Ueber die Kreidebildungen der Gegend von Löwenberg.* (Z. dt. geol. Ges. 15 : 291-365, pls. 8-9.)

DUJARDIN, F.

1837. *Mémoire sur les couches du sol en Touraine et description des coquilles de la craie et des faluns.* [Mém. Soc. géol. Fr. (1), 2 : 211-311, pls. 15-23.]

DVOŘÁK, J. F.

1953a. *The Cretaceous formation east of the river Svitava between Letovice and Hradec nad Svit (Moravia).* (Rozpr. čsl. Akad. Věd. 63 : 1-30, 2 pls.)

1953b. *Stratigraphy and palaeontology of the Middle Turonian between Letovice and Opatov (Moravia).* (Bull. int. Acad. tchèque Sci. 52, 2 : 523-642, 4 pls. map.)

EICHWALD, E.

1865-1869. *Lethaea Rossica ou Paléontologie de la Russie.* (Second Volume : Pecten : 422-455, pls. 20-27.)

FAVRE, E.

1869. *Description des Mollusques fossiles de la craie des environs de Lemberg en Galicie.* (Genève et Bâle, pp. VI-XII, 1-187, pls. 1-13.)

FORIR, H.

1901. *Fossiles du phosphate de Chaux de la Hesbaye (Assise de Spiennes).* (Annls Soc. géol. Belg. 28 : M 9-M 17.)

FRITSCH, A.

1877. *Studien im Gebiete der böhmischen Kreideformation. II. Die Weissenberger und Malnitzer Schichten.* (Arch. naturw. LandDurchforsch. Böhm. 4, 1 : 3-151, textfigs. 1-154.)

1883. *III. Die Iserschichten.* (Arch. naturw. LandDurchforsch. Böhm. 5, 2 : 1-138, textfigs. 1-132.)

1889. *IV. Die Teplitzer Schichten.* (Arch. naturw. LandDurchforsch. Böhm. 7, 2 : 1-119, textfigs. 1-167.)

1893. *V. Die Priesener Schichten.* (Arch. naturw. LandDurchforsch. Böhm. 9, 1 : 3-123, textfigs. 1-192.)

1911. *Ergänzung zu Band I. Illustriertes Verzeichniss der Petrefacten der cenomanen Koryzaner Schichten.* (Arch. naturw. LandDurchforsch. Böhm. 15, 1 : 3-101, textfigs. 1-417.)

GABB, W. M.

1860-1861. *Synopsis of the Mollusca of the Cretaceous formations, including the geographical and stratigraphical range and synonymy.* (Proc. Am. phil. Soc. 8 : 150-245.)

GASTER, C. T. A.

1924. *The Chalk of the Worthing District, Sussex.* (Proc. Geol. Ass. 35 : 89-110, pl. 8.)

GEER, G. DE
1887. *Beskrifning till kartbladet Lund.* (Sver. geol. Unders. Afh. 92 : 1-78.)

GEINITZ, F. E.
1888. *Die Kreidegeschiebe des mecklenburgischen Diluviums.* (Z. dt. geol. Ges. 40 : 720-749.)

GEINITZ, H. B.
1839-1842. *Charakteristik der Schichten und Petrefacten des sächsisch-böhmischen Kreidegebirges.* (I, 1839 : 1-28; II, 1840 : 31-60, III, 1842 : 63-116, pls. 1-24.)
1843. *Die Versteinerungen von Kieslingswalde im Glatzischen und Nachtrag zur Charakteristik des sächsischen-böhmischen Kreidegebirges.* (pp. 1-19, pls. 1-6.)
1849-1850. *Das Quadersandsteingebirge oder Kreidegebirge in Deutschland.* (Freiberg, 1849 : 1-96, pls. 1-6; 1850 : 97-292, pls. 7-12.)
1872. *Das Elbthalgebirge in Sachsen. Der untere Quader, V. Brachiopoden und Pelecypoden.* (Palaeontographica 20, 1 : 147-276, pls. 35-45.)
1873. *Das Elbthalgebirge in Sachsen. Der mittlere und obere Quader. II. Brachiopoden und Pelecypoden.* (Palaeontographica 20, 2 : 23-72, pls. 7-13.)

GIEBEL, C. G.
1852. *Deutschlands Petrefacten : Ein systematischen Verzeichniss aller in Deutschland und in den angrenzenden Ländern vorkommenden Petrefacten nebst Angaben der Synonymen und Fundorte.* (Leipzig. Bivalvia : pp. 329-441.)

GIEBEL, C.
1866. *Repertorium zu Goldfuss' Petrefakten Deutschlands. Ein Verzeichniss aller Synonymen und literarischen Nachweise zu den von Goldfuss abgebildeten Arten.* (Leipzig, pp. 1-122.)

GIERS, R.
1964. *Die Grossfauna der Mukronatenkreide (unteres Obercampan) im östlichen Münsterland.* (Fortschr. Geol. Rheinld Westf. 7 : 213-294, pls. 1-8, textfigs. 1-10, 3 tables.)

GOLDFUSS, A.
1833-1835. *Petrefacta Germaniae.* (Vol. II. 1833 : pp. 1-68, pls. 72-97; 1835 : pp. 69-140, pls. 98-130.)

GRIEPENKERL, O.
1889. *Die Versteinerungen der Senonen Kreide von Königslutter in Herzogthum Braunschweig.* (Paläont. Abh. 4 : 5-116, pls. 1-12.)

HAENTZSCHEL, W.
1931. *Zur stratigrafischen Stellung der Kreidesandsteine an der Lausitzer Ueberschiebung bei Hohnstein.* (Zentbl. Miner. Geol. Paläont. 9 : 493-499.)
1933. *Das Cenoman und die Plenus-Zone der sudetischen Kreide.* (Abh. preuss. geol. Landesanst. N. F. 150 : 5-161, pls. 1-4, textfigs. 1-7.)

HAGENOW, F. VON
1842. *Monographie der Rügen'schen Kreideversteinerungen III. Mollusken.* (Neues Jb. Miner. Geol. Paläont. 1842 : 528-575, pl. 9.)

HÄCG, R.
1925. *Svenska kritbrachiopoder och kritmollusker i Hisingers samling.* (Ark. Zool. 16, 8 : 1-22.)
1930. *Die Mollusken und Brachiopoden der Schwedischen Kreide. 1. Eriksdal.* (Sver. geol. Unders. Afh. 23, 8 : 1-93, pls. 1-5.)
1935. *2. Kullemölla, Lyckås, Kåseberga und Gräsryd.* (Sver. geol. Unders. Afh. 28, 5 : 1-94, pls. 1-10.)
1947. *3. Das Kristianstadgebiet.* (Sver. geol. Unders. Afh. C 41, 5 : 3-143.)
1954a. *Die Mollusken und Brachiopoden der Schwedischen Kreide. 4. Die Mammillaten und Mucronaten Kreide des Ystadgebietes.* (Sver. geol. Unders. Afh. 47, 6 : 1-72, pls. 1-9.)
1954b. *Die Mollusken und Brachiopoden der Schwedischen Kreide. Die Mammillaten und Mucronaten Kreide des Båstadgebietes.* (Geol. För. Stockh. Förh. 76 : 237-278.)

HENNIG, A.
1894. *Om Åhussandstenen.* (Geol. Förh. 16 : 492-530, pl. 2.)

1897. *Revision af Lamellibranchiaterna i Nilsson's « Petrificata Suecana formationis cretaceae ».* (Acta Univ. lund. 33, 3 : 1-66, pls. 1-3.)

HOLZAPFEL, E.

1889. *Die Mollusken der Aachener Kreide. II. Lamellibranchiata.* (Palaeontographica 35 : 139-268, pls. 8-29.)

JAHN, J. J.

1904. *Ueber das Vorkommen von Bonebed im Turon des östlichen Böhmens.* (Verh. geol. Reichsanst. 14 : 317-326.)

JEANNET, A.

1923. *Le Crétacé supérieur de la région du Drusberg, Ct. de Schwyz.* (Eclog. geol. Helv. 18 : 227-231, 1 textfig.

JESSEN, A.

1945. *Beskrivelse til geologisk Kort over Danmark. Kortbladet Sønderborg.* [Danm. geol. Unders. (1), 20 : 1-91, 2 maps.]

JESSEN, A. & ØDUM, H.

1923. *Senon og Danien ved Voxlev.* [Danm. geol. Unders. (2), 39 : 1-73, pls. 1, 2.]

KNER, R.

1852. *Neue Beiträge zur Kenntniss der Kreideversteinerungen von Ost-Galizien.* (Denkschr. Akad. Wiss. Wien 3 : 293-334, pls. 15-17.)

KOKOSZYNSKA, B.

1956. *Lower Cretaceous of the neighbourhood of Tomaszów Mazowiecki (Central Poland).* (Biul. panst. Inst. geol. 113 : 5-64, pls. 1-4, fig. 1-3.)

KOTETISHVILI, E. V.

1967. *Materials on the stratigraphy and fauna from the volcaneous folded stratum Adzjaro-Trialetka.* (Trudy geol. Inst. Akad. Nauk Gruzh. S. S. R. N. S. 15 : 26-53, pls. 3-5.)

KRISCHTAFOVITSCH, N.

1899. *Lithologischer Character, Fauna, Stratigraphie und Alter der Kreide Ablagerungen in den Gouvernements Lublin und Radom.* (Mater. Geol. Ross. 19 : 1-19).

LAMARCK, J. B. DE

1815-1822. *Histoire naturelle des animaux sans vertèbres...* (Bivalvia : 1818 vol. 5 : 424-612; 1819 vol. 6 : 1-233.)

LEHNER, L.

1924. *Die Gliederung der fränkischen albüberdeckenden Kreide.* (Zentbl. Miner. Geol. Paläont. 1924 : 176-181.)

1937. *Fauna und Flora der fränkischen Alb-überdeckenden Kreide.* (Palaeontographica 85 A : 115-228, pls. 18-26.)

LEONHARD, R.

1897. *Die Fauna der Kreideformation in Oberschlesien.* (Palaeontographica 44 : 11-70, pls. 3-6.)

LUNDEGREN, A.

1930. *Actinocamax westfalicus in N. O. Schonen.* (Geol. För. Stockh. Förh. 52 : 116-122, textfig. 1.)

LUNDGREN, B.

1876. *Om Belimniterna i Sandkalken i Skåne.* (Öfvers. K. VetenskAkad. Förh. 33, 10 : 15-21.)

1888. *Öfversikt af Sveriges mesozoiska bildningar.* (Acta Univ. lund. 24 : 1-37.)

1894. *Mollusk-faunan i Mammillatus och Mucronata zonerna i nordöstra Skåne.* (K svenska VetenskAkad. Handl. N. F. 26, 6 : 35-52.)

MANTELL, G.

1822. *Fossils of the South Downs or Illustrations of the Geology of Sussex.* (London, pp. VII-XIV, 1-320, pls. 1-42.)

MATHÉRON, P.

1842. *Catalogue méthodique et descriptif des Corps organisés fossiles du Département des Bouches du Rhône et lieux circonvoisins.* (Répertoire Trav. Soc. statist. Marseille 6 : 1-269, pls. 1-41.)

MAXIA, C.
1940. *Illustrazione di alcuni Pettinidi maestrichtiani della Tripolitania.* (Boll. Soc. geol. ital. *59*, 1 : 1-9, pl. 1.)

MICHAEL, R.
1893. *Cenoman und Turon in der Gegend von Cudowa in Schlesien.* (Z. dt. geol. Ges. 45 : 195-252, pl. 5.)

MOBERG, J. C. in JÖNSSON, J.
1882. *Om förekomsten af Skrifkrita vid Näsbyholmi Skåne.* (Geol. För. Stockh. Förh. 5 : 630-633.)
1884. *Cephalopoderma i Sveriges kritsystem. 1. Sveriges kritsystem systematiskt framställdt.* (Sver. geol. Unders. Afh. C 63 : 4-45, 2 maps.)

MOBERG, J. C. in BLOMBERG
1892. *Beskrifning till Kartbladet Glimåkra.* (Sver. geol. Unders. Ser. A a 108 : 1-36, 1 map.)

MOBERG, J. C.
1910. *Guide for the principal Silurian districts of Scania (with notes on some localities of Mesozoic beds).* (Geol. För. Stockh. Förh. 32, 1 : 45-194, pls. 1-5.)

MORGAN, J. DE
1882. *Mémoire sur les Terrains crétacés en Scandinavie.* [Mém. Soc. géol. Fr. (3), 2 : 1-46, pls. 1, 2.]

MORRIS, J.
1854. *A Catalogue of British Fossils.* (2nd Ed. pp. 1-372.)

MORTON, S. M.
1834. *Synopsis of the organic remains of the Cretaceous group of the United States.* (pp. 1-88, 19 pls.)

MUELLER, G.
1888. *Beitrag zur Kenntniss der oberen Kreide am nördlichen Harzrande.* (Jb. preuss. geol. Landesanst. 1887 : 372-456, pls. 16-18.)
1898. *Die Molluskenfauna des Untersenon von Braunschweig und Ilsede. I. Lamellibranchiaten und Glossophoren.* (Abh. preuss. geol. Landesanst. N. F. 25 : 1-140, pls. 1-18, textfigs. 1-18.)

MUELLER, J.
1847. *Monographie der Petrefacten der Aachener Kreideformation.* (Bonn, pp. 2-48, 2 pls.)
1859. *Monographie der Petrefacten der Aachener Kreideformation.* (Supplementheft pp. 1-32, 2 pls.)

MUNTHE, H.
1896. *Till kännedomen om foraminiferfaunan i Skånes kritsystem.* (Geol. För. Stockh. Förh. 18, 1 : 21-32.)

NEWTON, R. B.
1898. *Notes on some Lower Tertiary Shells from Egypt.* (Geol. Mag. 1898 : 531-541. pls. 19, 20.)

NILSSON, S.
1827. *Petrificata Suecana formationis cretaceae, descripta et iconibus illustrata. Pars Prior, Vertebrata et Mollusca sistens.* (Londini Gothorum, pp. 1-39, pls. 1-10.)

NOETH, L.
1931. *Oberkreide Fossilien aus Paphlagonien (Kleinasien).* (Neues Jb. Miner. Geol. Paläont. Beil. Bd. *65*, 2 : 321-362, pls. 17, 18.)

NOETLING, F.
1885. *Die Fauna des baltischen Cenoman Geschiebe.* (Paläont. Abh. 2 : 199-247, pls. 16-23.)
1897. *Fauna of Baluchistan : Fauna of the Upper Cretaceous (Maëstrichtien) Beds of the Mari Hills.* (Mem. geol. Surv. India. Palaeont. indica XVI, 1, 3 : 1-79, pls. 1-23.)
1903. *Uebergang zwischen Kreide und Eocän in Baluchistan.* (Zentbl. Miner. Geol. Paläont. 1903 : 514-523.)

ØDUM, H.

1926. *Studier over Daniet i Jylland og paa Fyn.* [Danm. geol. Unders. (2), 45 : 1-306, pls. 1-3.]

ORBIGNY, A. D'

1844-1847. *Paléontologie française — Description des Mollusques et Rayonnés fossiles — Terrains crétacés. III. Lamellibranches.*
(1844 : pp. 1-288, pls. 237-343.
1845 : pp. 289-448, pls. 344-386.
1846 : pp. 449-520, pls. 387-413.
1847 : pp. 521-807, pls. 414-489.)

1850. *Prodrome de Paléontologie stratigraphique universelle des animaux mollusques et rayonnés. II.* (Bivalvia cretacica : pp. 72-84, 117-120, 135-139, 157-171, 194-198, 233-257.)

PALFY, M. VON

1902. *Alvincz környékenek felsökretakoru rétegei.* (Magy. allami földt. Intéz. Evk. 13 : 203-302, pls. 19-27.)

PARONA, C. F.

1915. *Per la Geologia della Tripolitania.* (Atti Accad. Sci. Torino 50 : 16-38.)

PASTERNAK, S. I.

1961. *On the systematics of Upper Cretaceous Pectinids.* (Paleont. Sborn. 1 : 19-21, 2 figs.)

PASTERNAK, S. J., GAVRISHILIN, V. I., GINDA, V. A., KOTSYUBINSKY, S. P. & SENKOVSKY, I. M.

1968. *The stratigraphy and fauna of the Cretaceous deposits of West Ukraine (without the Carpathians).* (Kiev, pp. 1-272, pls. 1-50, textfigs. 1-49.)

PÉRON, A.

1877. *Observations sur la Faune des Calcaires à Echinides de Rennes-les-Bains et sur quelques Fossiles du terrain crétacé supérieur.* [Bull. Soc. géol. Fr. (3), 5 : 499-535, pl. 7, f. 1-6.]

1887-1888. *Notes pour servir à l'histoire du Terrain de Craie dans le sud-est du Bassin Anglo-Parisien.* [Bull. Soc. Sci. Yonne (3), 12 : 145-224 (1887), 225-324 (1888).]

PERVINQUIÈRE, L.

1912. *Etudes de Paléontologie tunisienne. — II. Gastropodes et Lamellibranches des Terrains Crétacés. Carte géologique de la Tunisie.* (Paris, 352 pp., 21 pls.)

PETHÖ, J.

1906. *Die Kreide- (Hypersenon) Fauna des Peterwardeiner (Pétervárader) Gebirges (Fruška Gora).* (Palaeontographica 52 : 57-331, pls. 5-26.)

PETRASCHECK, W.

1904a. *Ueber das Vorhandensein von Malnitzer Schichten in der Gegend von Chotebor in Ostböhmen.* (Verh. geol. Reichsanst. 1904 : 59-62.)

1904b. *Ueber die jüngsten Schichten der Kreide Sachsens.* (Sber. Abh. naturw. Ges. Isis Bautzen : 1904 : 3-10.)

1906. *Die Zone des Actinocamax plenus in der Kreide des östlichen Böhmen.* (Jb. geol. Reichsanst. 55 : 399-434, textfigs. 1-8, pl. 10.)

PHILIPPI, E.

1900. *Beiträge zur Morphologie und Phylogenie der Lamellibranchier. II. Zur Stammesgeschichte der Pectiniden.* (Z. dt. geol. Ges. 52 : 64-117, textfigs. 1-24.)

PICTET, F. J. & CAMPICHE, G.

1868-1871. *Descriptions des fossiles du terrain crétacé des environs de Sainte Croix.* [Matér. Paléont. suisse (5), 5 : Pectinidae : 178-255, pls. 157-181.]

PLACHETKO, S.

1863. *Das Becken von Lemberg. Ein Beitrag zur Geognosie und Palaeontologie Ostgaliziens.* (Jber. k. k. Zweit. Obergymn. Lemberg 1863 : 1-36, 2 pls.)

POTONIÉ, R.

1925. *Ueber die Fauna norddeutschen Obersenongeschiebe insbesondere des Cerithiumkalks.* (Jb. preuss. geol. Landesanst. 45 : 610-624, pl. 28.)

POZARYSKI, W.
1938. *Senonstratigraphie im Durchbruch der Weichsel zwischen Rachow und Pulawy in Mittelpolen.* (Biul. Inst. geol. 6 : 1-94, 1 table.)

PRESCHER, H.
1961. *Stratigrafische Untersuchung turoner Kreidesandsteine bei Hohnstein/Elbsandsteingebirge.* (Jb. st. Mus. Miner. Geol. Dresd. 1961 : 12-34.)

PUGGAARD, C.
1852. *Geologie der Insel Möen : eine Untersuchung über die Umwälzungen der Kreide und der Glacialbildung...* (pp. 1-116, pls. 1-4, pls. A, B, figs. 1-18.)

PUSCH, G.
1837. *Polens Paläontologie oder Abbildung und Beschreibung der vorzüglischsten und der noch unbeschriebenen Petrefakten aus den Gebirgsformationen in Polen, Volhynien und den Karpathen nebst einigen allgemeinen Beiträgen zur Petrefaktenkunde und einem Versuch zur Vervollständigung der Geschichte des Europäischen Auer-Ochsen.* (Stuttgart, pp. 1-218, pls. 1-16.)

PUTZER, H.
1942. *Die oberste Kreide bei Bochotnica a. d. mittleren Weichsel.* (Zentbl. Miner. Geol. Paläont. 1942 B : 361-377.)

QUAAS, A.
1903. *Die Fauna der Overwegischichten und der Blätterthone in der libyschen Wüste.* (Palaeontographica 30, 2 : 153-336, pls. 20-33.)

RAVN, J. P. J.
1902. *Molluskerne i Danmark's Kridtaflejringer. I. Lamellibranchiater.* [K. danske Vidensk. Selsk. Skr. (6), 11 : 69-140, pls. 1-4, map.]
1908. *Fortgn. over Kridtforst. fra Stevns Klint.* (Danm. geol. Unders. I, 11 : 66-76.)
1918. *Kridtaflejringerne paa Bornholms Sydvestkyst og deres Fauna. II. Turonet.* [Danm. geol. Unders. (2), 31 : 1-37, pls. 1, 2.]
1921. *Kridtaflejringerne paa Bornholms Sydvestkyst og deres Fauna. III. Senonet. IV. Kridtaflejringerne ved Stampe.* [Danm. geol. Unders. (2), 32 : 1-52, pls. 1-3.]
1925. *Det cenomane Basalkonglomerat paa Bornholm.* [Danm. geol. Unders. (2), 42 : 1-64, pls. 1-4.]
1946. *Om nyker-omraadets Kridtaflejringer.* (Biol. Skr. 4/6 : 1-36, pl. 1.)

REIS, O.
1896. *Erläuterungen zu der geologischen Karte der Vorderalpenzone zwischen Bergen und Teisendorf. I. Stratigraphischer Theil.* (Geogn. Jh. 8 : 8-23.)
1898. *Die Fauna der Hachauer Schichten. II. Lamellibranchiaten.* (Geogn. Jh. 10 : 94-128, pl. 2.)

REISS, Z.
1955. *Remarks on the age of some Late Cretaceous and Early Tertiary stratigraphic units of Israel.* (Bull. Res. Coun. Israel 5 B 1 : 121-126.)

REUSS, A. E.
1845-1846. *Die Versteinerungen der böhmischen Kreideformation.* (1845 : I : pp. 1-58, pls. 1-13, 1846 : II : pp. 1-148, pls. 14-51.)

ROEMER, F.
1870. *Die Geologie von Oberschlesien.* (Breslau, pp. 1-587, pls. 1-50, 1 map.)

ROEMER, F. A.
1840-1841. *Die Versteinerungen des norddeutschen Kreidegebirges.* (1840 : 1-48; 1841 : 49-146, pls. 1-16.)

ROGALA, W.
1909. *Ueber einige Lamellibranchen aus dem Lemberg-Nagorzanyer Senon.* (Bull. int. Acad. Sci. Lett. Cracovie 1909 : 689-703, pl. 1.)
1911. *Ein Beitrag zur Kenntniss der Mukronatenkreide der Gegend von Lemberg.* (Kosmos (Lwow) 36 : 487-499, 1 pl.)

ROWE, A. W.
1908. *The Zones of the White Chalk of the English Coast. V. The Isle of Wight. The White Chalk of the Isle of Wight.* (Proc. Geol. Ass. 20 : 209-352, pls. 8-23, maps. A-F.)

SAID, R.
1962. *The Geology of Egypt.* [(Elsevier) Amsterdam-New York, pp. I-XV, 1-377, 10 pls. figs.]

SCHLOTHEIM, E. T. VON
1820-1823. *Die Petrefactenkunde und Nachträge zur Petrefactenkunde.* (Gotha, pp. III-LXII, 1-437.)

SCHLUETER, C.
1870. *Bericht über eine geognostisch-paläontologische Reise in südlichen Schweden.* (Neues Jb. Miner. Geol. Paläont. 1870 : 929-969.)

SCHROEDER, H.
1882. *Ueber senone Kreidegeschiebe der Provinzien Ost- und Westpreussen.* (Z. dt. geol. Ges. 34 : 243-287, pls. 15, 16.)

SCUPIN, H.
1907. *Die stratigraphischen Beziehungen der obersten Kreideschichten in Sachsen, Schlesien und Böhmen.* (Neues Jb. Miner. Geol. Paläont. Beil. Bd. 24 : 676-715.)
1912-1913. *Die Löwenberger Kreide und ihre Fauna.* (Palaeontographica Suppl. 6 : 5-275, pls. 1-15.)

SOWERBY, J. DE C. in FITTON, W. H.
1836. *Observations on some of the Strata between the Chalk and the Oxford Oolite in the South-East of England.* [Trans. geol. Soc. London (2), 4 : Bivalvia : 335-342, 353-361.]

STEFANO, C. DE & SFORZA, M.
1913. *Creta superiore da Orfella a Gebel Soda in Tripolitania.* (Atti Accad. naz. Lincei Rc. 1, 22 : 744-749.)

STOLICZKA, F.
1871. *Cretaceous Fauna of Southern India. The Pelecypoda.* [Mem. geol. Surv. India Palaeont. indica (VI), III Fam. Pectinidae : 423-439, pls. 31, 32, 37, 40, 41, 42, 44.]

STOLL, E.
1941. *Mollusken aus einigen Senongeschiebe von Anhalt.* (Z. Geschiebeforsch. Flachldgeol. 17, 2 : 75-109, pls. 1-2.)

STOLLEY, E.
1892. *Die Kreide Schleswig-Holsteins.* (Mitt. miner. Inst. Univ. Kiel 1 : 235-244, pls. 7-10.)

STROMBECK, A. VON
1863. *Ueber die Kreide am Zeltberg bei Lüneburg.* (Z. dt. geol. Ges. 15 : 97-187, pl. 4.)

TORRIANI, A. M.
1942. *Revisione della fauna neocretacica della Libia : Gen. Chlamys, Pecten, Neithea e Plicatula.* (Annali Mus. libico Stor. nat. 3 : 83-95, pl. 6.)

TRECHMANN, C. T.
1927. *The Cretaceous Shales of Jamaica.* (Geol. Mag. 64 : 27-42, pls. 1-4, textfigs. 1-2.)

TROEGER, K. A.
1956. *Ueber die Kreideablagerungen des Plauenschen Grundes.* (Jb. st. Mus. Miner. Geol. Dresd. 2 : 22-124, 10 pls., fig.)

TROEGER, K. A. & WOLF, L.
1960. *Zur Stratigrafie und Petrografie der Strehlener Schichten.* (Geologie 9 : 288-298, textfigs. 1-6.)

TZANKOV, V.
1931. *Sur la stratigraphie de la craie supérieure du Nord-Est de la Bulgarie.* (Spis. bülg. geol. Druzh. 3, 2 : 43-65, tables 1-3.)
1940. *Etudes stratigraphiques et paléozoologiques du Danien de la Bulgarie du Nord.* (Spis. bulg. geol. Druzh. 11 : 455-514, pls. 1-11, textfigs. 1-5.)

VIDAL, L. M.
1898. *Compte rendu des excursions dans la province de Lérida du 11 au 15 octobre.* [Bull. Soc. géol. Fr. (3), 26 : 884-900, textfigs. 1-7.]

VOGEL, F.
1892. *Das Ober-Senon von Irnich am Nordrand der Eifel.* (Verh. naturh. Ver. preuss. Rheinl. 49 : 1-106, pl. 1.)
1895. *Beiträge zur Kenntniss der holländischen Kreide.* (Samml. geol. Reichsmus. Leiden N. F. 2, 1 : 1-64, pls. 1-3.)

VOGEL VON FALCKENSTEIN, K.
1911. *Brachiopoden und Lamellibranchiaten der senonen Kreidegeschiebe aus Westpreussen.* (Z. dt. geol. Ges. 62 : 544-570, pls. 10-13.)

WANNER, J.
1902. *Die Fauna der obersten weisse Kreide der libyschen Wüste.* (Palaeontographica 30, 2 : 91-152, pls. 13-19.

WEGNER, T.
1905. *Die Granulatenkreide des westlichen Münsterlandes.* (Z. dt. geol. Ges. 57 : 112-232, pls. 7-20, textfigs. 1-20.)

WEIJDEN, W. J. M. VAN DER
1943. *Die Macrofauna der Hervenschen Kreide mit besonderer Berücksichtigung der Lamellibranchiaten.* (Meded. geol. Sticht. C 4, 2, 1 : 1-139, pls. 1-15.)

WOLANSKY, D.
1932. *Die Cephalopoden und Lamellibranchiaten der Ober-Kreide Pommerns.* (Abh. geol.-palaeont. Inst. Greifswald 9 : 1-72, pls. 1-5, textfigs. 1-7, tables 1-5.)

WOLDRICH, J.
1918. *Die Kreidefauna von Neratovic in Böhmen.* (Jb. geol. Reichsanst. 67 : 267-334, pls. 4-6, textfigs. 1-3.)

WOLLEMANN, A.
1902a. *Die Fauna der Lüneburger Kreide.* (Abh. preuss. geol. Landesanst. N. F. 37 : 1-129, pls. 1-7.)
1902b. *Einige Bemerkungen über die Versteinerungen aus der Kreide von Misburg bei Hannover.* (Z. dt. geol. Ges. 54 : Mitth. 30-33.)

WOODS, H.
1902-1903. *A monograph of the Cretaceous Lamellibranchia of England.* [Vol. I. Palaeontogr. Soc. (Monogr.). Pectinidae : 145-232, pls. 27-52. (1902 : pp. 145-196; 1903 : 197-232).]

ZELIZKO, J. V.
1897. *Beitrag zur Studium der Weissenberger Pläner bei Neu-Straschitz.* (Ver. geol. Reichsanst. 1897 : 173-176.)
1900. *Die Kreideformation der Umgebung von Pardubitz und Prelouc in Ostböhmen.* (Jb. geol. Reichsanst. 49 : 529-544.)

ZITTEL, K. A.
1866. *Die Bivalven der Gosaugebilde in den Nordöstlichen Alpen. II. Monomyaria.* (Denkschr. Akad. Wiss. Wien 25 : 77-198, pls. 11-27.)
1883. *Beiträge zur Geologie und Paläontologie der libyschen Wüste und der angrenzenden Gebiete von Aegypten. I. Geologischer Theil.* (Palaeontographica 30, 1 : 1-147, textfigs. map.

SYSTEMATIC INDEX

GEOGRAPHICAL INDEX

EXPLANATION OF PLATES

PLATE I

Fig. 1. — *Lyropecten (Aequipecten) campaniensis* (D'ORBIGNY, 1847).
a : left valve, × 3, Maastricht (The Netherlands); Upper Maastrichtian; T. M. C. I. 9867.
b : right valve, × 3; Ciply (Hainaut, Belgium); T. C. M. I. 9871.
c : left valve, × 3; Ciply (Hainaut, Belgium); T. C. M. I. 9872.

Fig. 2. — *Lyropecten (Aequipecten) pulchellus* (NILSSON, 1827).
a : left valve, × 2; Ciply (Hainaut, Belgium); T. C. M. I. 9862.
b : right valve, × 2; Ciply (Hainaut, Belgium); T. C. M. I. 9863.

Fig. 3. — *Lyropecten (Aequipecten) acuteplicatus* (ALTH, 1850).
a : right valve, × 3; Zwartberg, Genk (Belgium); T. C. M. I. 9866.
b : left valve, × 3; Zwartberg, Genk (Belgium); T. C. M. I. 9864.
(all specimens in I. R. Sc. N. B., Section of Mesozoic and Caenozoic Invertebrates, Department of Palaeontology; T. C. M. I. : Type Collection Mesozoic Invertebrates)

PLATE II

Fig. 1. — *Lyropecten (Aequipecten) acuteplicatus* (ALTH, 1850).
a : right valve, × 3; Zwartberg, Genk (Belgium); T. C. M. I. 9865.
b : right valve, × 1,5; Bachtiserai, Crimea (U. S. S. R.); Musée de Genève.

Fig. 2. — *Lyropecten (Aequipecten) subaratus* (NILSSON, 1827).
a : left valve, × 3; Ciply (Hainaut, Belgium); T. C. M. I. 9868.
b : left valve, × 3; Ciply (Hainaut, Belgium); T. C. M. I. 9873.

Fig. 3. — *Lyropecten (Aequipecten ?) ternatus* (MUENSTER *in* GOLDFUSS, 1833).
a : right valve, × 1,5; Sint Pietersberg, Maastricht (The Netherlands); T. C. M. I. 9841.
b : right valve, × 1,5; Sint Pietersberg, Maastricht (The Netherlands); T. C. M. I. 9835.
(all specimens, fig. 1b excepted, in I. R. Sc. N. B., Section of Mesozoic and Caenozoic Invertebrates)

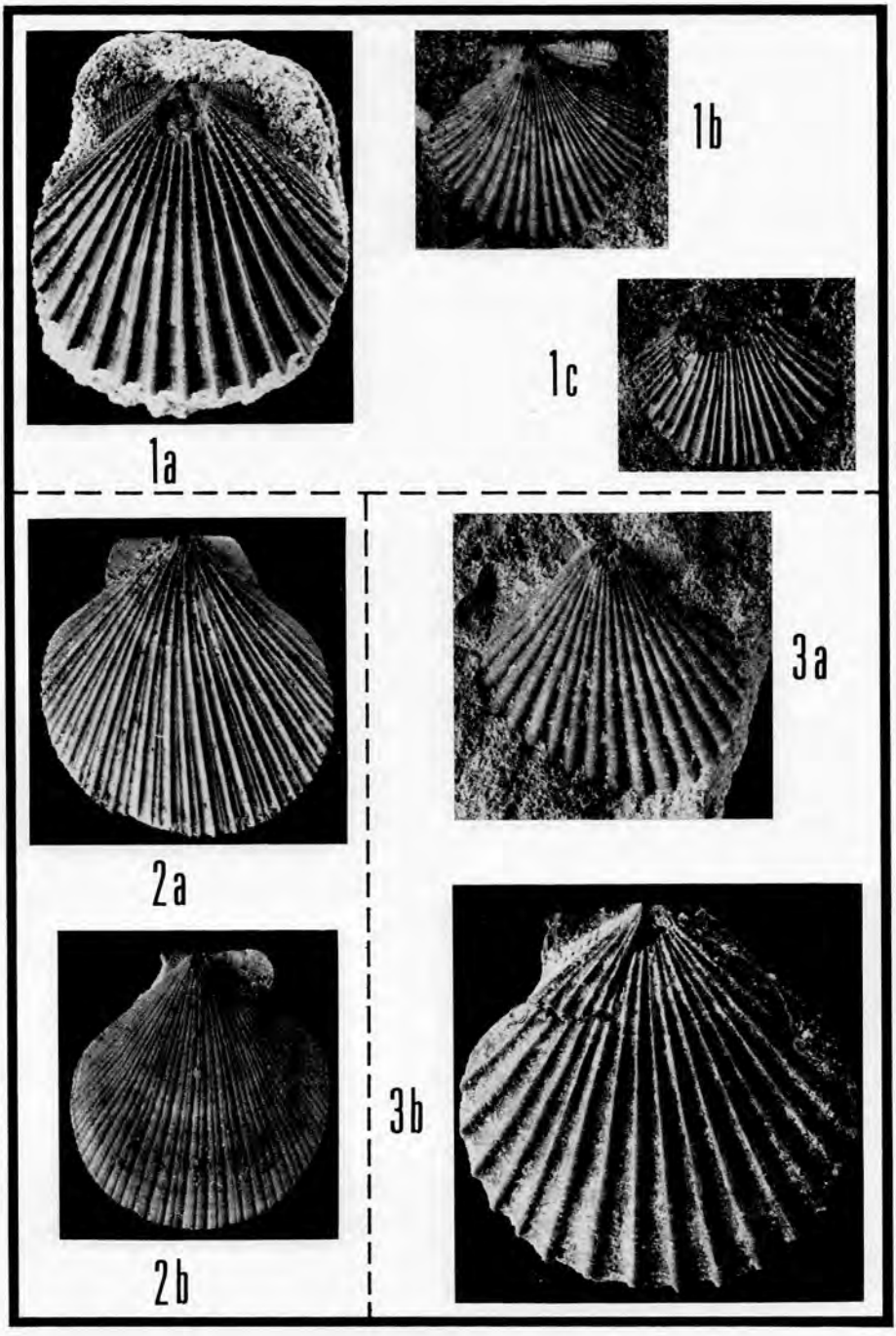
PLATE III

Fig. 1. — *Lyropecten (Aequipecten ?) ternatus* (MUENSTER *in* GOLDFUSS, 1833).
a : left valve, × 1,5; Sint Pietersberg, Maastricht (The Netherlands); T. C. M. I. 9844.
b : left valve, × 1; Sint Pietersberg, Maastricht (The Netherlands); T. C. M. I. 9827.
c : left valve, × 1,5; Sint Pietersberg, Maastricht (The Netherlands); T. C. M. I. 9840.
d : left valve, × 4; Sint Pietersberg, Maastricht (The Netherlands); T. C. M. I. 9841 (detail).

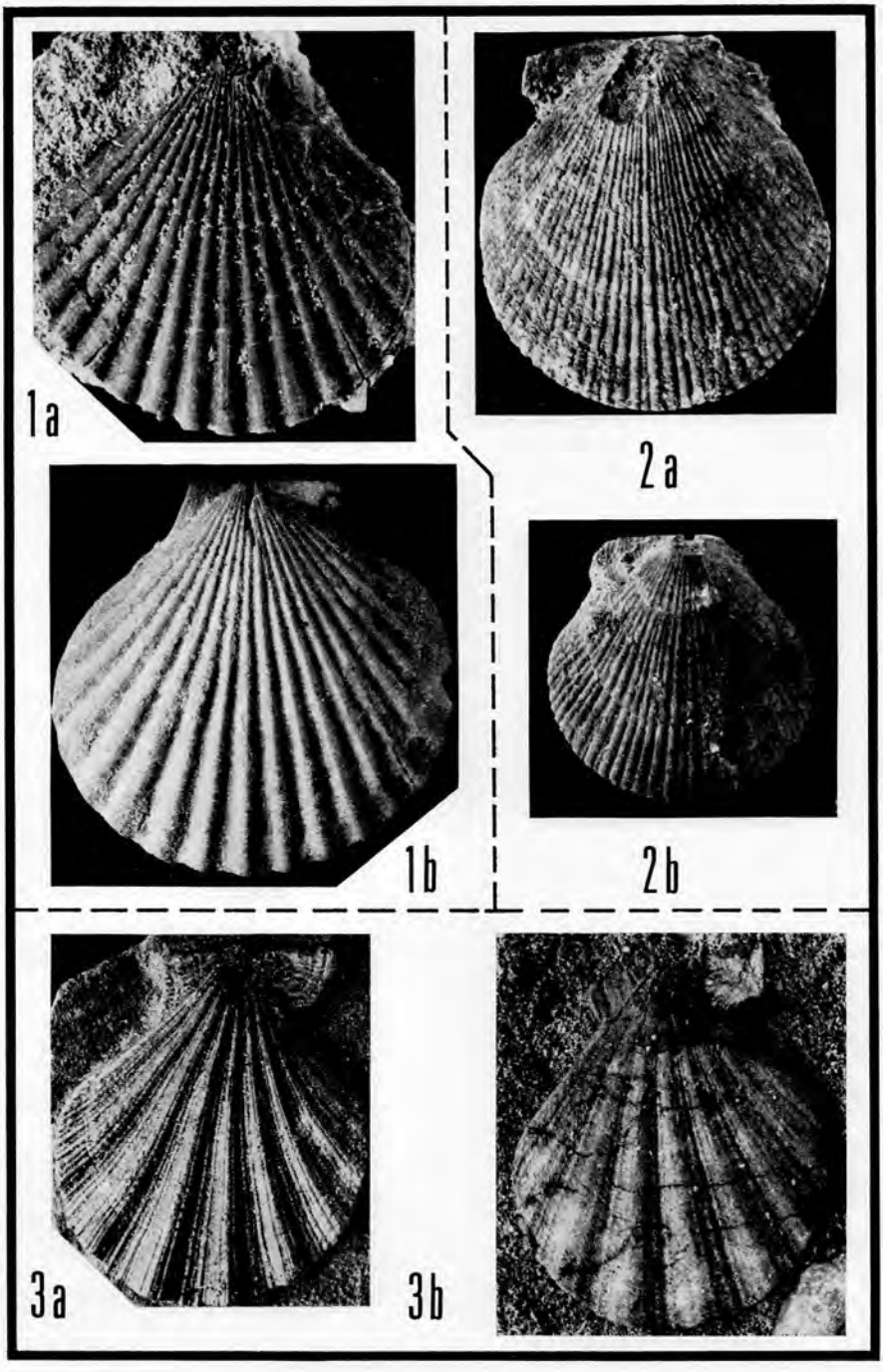
Fig. 2. — *Lyropecten (Aequipecten ?) trigeminatus* (GOLDFUSS, 1833).
Left valve, × 1,5; Ciply (Hainaut, Belgium); T. C. M. I. 9849.

Fig. 3. — *Lyropecten ? septemplicatus* (NILSSON, 1827).
Left valve, × 2; Harmignies (Hainaut, Belgium); T. C. M. I. 9852.
(all specimens in I. R. Sc. N. B., Section of Mesozoic and Caenozoic Invertebrates)

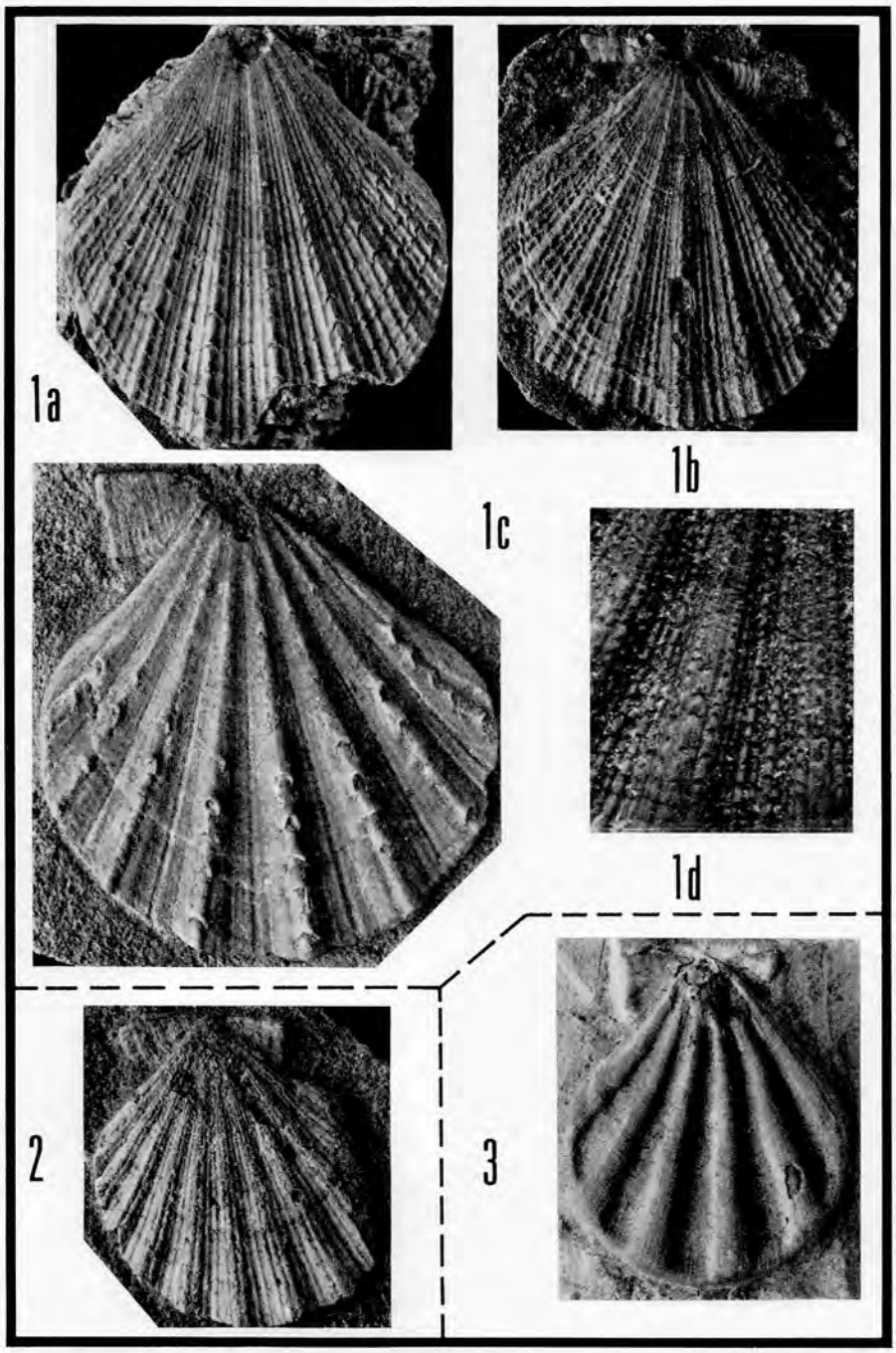
CONTENTS



A. V. DHONDT. — Systematic revision
of the *Chlamydinae (Pectinidae, Bivalvia, Mollusca)*
of the European Cretaceous. — Part 2 *Lyropecten.*



A. V. DHONDT. — Systematic revision
of the *Chlamydinae (Pectinidae, Bivalvia, Mollusca)*
of the European Cretaceous. — Part 2 *Lyropecten.*



A. V. DHONDT. — Systematic revision
of the *Chlamydinae (Pectinidae, Bivalvia, Mollusca)*
of the European Cretaceous. — Part 2 *Lyropecten.*