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Revision of the Middle Jurassic dimorphic ammonite genera *Strigoceras*/*Cadomoceras* (Strigoceratidae) and related forms

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Facies non omnibus una,
nec diversa tamen.
OVID, Metamorphoses

Abstract

We present a modern revision of the dimorphic ammonite pair *Strigoceras* QUENSTEDT, 1886/*Cadomoceras* MUNIER-CHALMAS, 1892 from the Middle Jurassic. The stratigraphically oldest hitherto known chronospecies of *Strigoceras*, *S. praenuntium* (BUCKMAN) appears in the Middle Aalenian as an extreme rarity. Records of the microconch genus *Cadomoceras* remain unknown from strata older than Early Bajocian, but otherwise its stratigraphical range corresponds well with that of the macroconchs. The genus probably became extinct in the Early Bathonian (Zigzag Zone). The youngest known *Strigoceras* is *S. callomoni* n. sp. described here from the Macrescens Subzone of the Early Bathonian. Another new strigoceratid species, *Granulochetoceras oppeliisculptum* n. sp., is recorded by a single specimen from the early Garantiana Zone of eastern Spain, representing an interesting phyletic link between *Strigoceras* QUENSTEDT, 1886 and *Granulochetoceras* GEYER, 1960. We include a brief review of the latter genus. By including *Granulochetoceras* in the Strigoceratidae the family would extend to the Late Kimmeridgian of the Late Jurassic.

The palaeogeographic distribution of *Strigoceras*/*Cadomoceras* is focussed on the western Tethyan Province, but some species also occur in the northern Pacific and its adjacent shelves. A benefit of this large area of distribution is that strigoceratids may be used to correlate distant locations, but this is partly hampered by the relatively wide range of variability within succeeding chronospecies and remarkably large variation in size of adult macroconchs.
Keywords: Ammonites, biostratigraphy, Strigoceratidae, *Strigoceras*, *Cadomoceras*, *Granulochetoceras*, dimorphism, taxonomy, palaeobiogeography, Jurassic.

Zusammenfassung

Über das dimorphe Ammonitenpaar *Strigoceras*/*Cadomoceras* aus dem Mittel-Jura wird eine ausführliche moderne Revision vorgelegt und dessen phylogenetische Entwicklung dargestellt. Die bislang älteste bekannte Chronospezies von *Strigoceras*, *S. praenuntium* (BUCKMAN), tritt bereits im Mittel-Aalenium auf, wenngleich extrem selten. Zugehörige Mikroconche der Gattung *Cadomoceras* sind bisher zwar erst ab dem Bajocium nachgewiesen, doch stimmt deren stratigraphische Reichweite ansonsten mit derjenigen der Makroconche überein. Das Dimorphenpaar *Strigoceras/Cadomoceras* scheint im Verlauf des Unter-Bathonium (Zigzag-Zone) erloschen zu sein. Aus der Macrescens-Subzone des Unter-Bathonium wird mit *Strigoceras callomoni* n. sp. die bisher jüngste bekannte *Strigoceras*-Art beschrieben, mit der die Gattung vermutlich erlosch. In der frühen Garantiana-Zone leitet eine weitere, bisher nur in einem Einzelstück bekannte neue Strigoceratiden-Art, *Granulochetoceras oppeliisculptum* n. sp., zur Gattung *Granulochetoceras* GEYER, 1960 über. Wir schließen eine kurze Übersicht über diese Gattung an. Die stratigraphische Reichweite der Familie Strigoceratidae insgesamt erweitert sich dadurch bis in das Ober-Kimmeridgium des Ober-Jura.

Die paläobiogeographische Verbreitung von *Strigoceras/Cadomoceras* liegt überwiegend in der westlichen Tethys, aber auch im Nordpazifik und dessen Randmeeren treten vereinzelte Vertreter auf. Dadurch besitzt dieses Dimorphenpaar eine gewisse Bedeutung für weltweite Korrelationen, die allerdings durch die teilweise beträchtliche Variabilität der aufeinander folgenden Chronospezies wieder deutlich eingeschränkt wird. Bemerkenswert ist auch eine beachtliche Größenvariation bei adulten Makroconchen.

Contents

1. Introduction

In 1886, QUENSTEDT tentatively proposed a new Middle Jurassic ammonite genus *Strigoceras*, which is characterized by spiral striation of the shell, lateral depressions or furrows, and a smooth, septicarinate keel. In a revision of the ammonite genus *Strigoceras* and related genus *Phlycticeras*, SCHEURLEN (1928) overlooked numerous new taxa introduced by BUCKMAN (1924) that are affiliated to *Strigoceras*. This author's sample of *Strigoceras* was poor, low in number and did not extend over the known stratigraphical range of the genus. In the early part of the 20th century BUCKMAN (1909–1930) designated numerous new taxa with brief descriptions. Almost all were unknown outside Britain until the ammonitologist L. F. SPATH sent copies to the German authority O. H. SCHINDEWOLF. ARKELL (1950) considered Strigoceratidae as of cryptogenic affiliation, possibly parallel with Oppeliidae. Later, ARKELL (1957) synonymised several of BUCKMAN's genera with *Strigoceras*.

The microconch genus *Cadomoceras* was introduced by MUNIER-CHALMAS (1892: 171); it possesses an eccentric bodychamber and large lateral lappets. MUNIER-CHALMAS was among the first scientists to recognize sexual dimorphism in ammonites, and the first to give some convincing examples of dimorphic pairs (CALLOMON 1963; MAKOWSKI 1963). The origin of *Cadomoceras* remained a mystery, even after a first revision of this genus by COEMME (1918). DACQUÉ (1934) included *Cadomoceras* into the oppeliids. ARKELL (1957) retained *Cadomoceras* in the Haploceratidae ZITTEL, 1884, which at that time was a polyphyletic taxon in which micro- and macroconchs of various systematic affinities were lumped together.

The dimorphism between *Strigoceras* and the minute *Cadomoceras* was first observed by STURANI (1971). The striking resemblance between the inner whorls is obvious, but there were sound objections to disagree with this association (DIETL 1986) based on a long-lasting confusion between the two striate genera *Strigoceras* and *Phlycticeras*. There was also the erroneous assumption that *Phlycticeras* had evolved from *Strigoceras* (CALLOMON in DONOVAN et al. 1981). The dimorphism between *Phlycticeras* and *Oecoptychius* is well established, but for practical reasons we still distinguish the corresponding dimorphs taxonomically (SCHWEIGERT & DIETZE 1998, 1999; SCHWEIGERT et al. 2003). The development of the suture line during early ontogeny was studied by SCHINDEWOLF (1964, fig. 205 *(Strigoceras)*, fig. 209 *(Cadomoceras)*). However, at that time dimorphism between both genera was not taken in consideration.

A brief phyletic overview, almost exclusively based on material from south-eastern Spain, was presented by SANDOVAL (1985). In his phyletic tree he separated two parallel lineages of strigoceratids, one leading to *Strigoceras truellei* (D'ORBIGNY), the other to *Strigoceras paronai* (TRAUTH). Following ARKELL (1957) he also tentatively included *Hebetoxyites* BUCKMAN, 1924 in Strigoceratidae, a primitive oppeliid genus known from the Lower Bajocian. Recently, MOYNE & NEIGE (2004) proposed a phyletic relationship for *Praestrigites* within a hammatoceratoid ancestry based on a computer cladistic analysis that included very few morpho-genera, totally ignoring the dimorphism, which in our opinion is one of the most significant features.

In the present revision strigoceratid specimens from worldwide sources are included along with available types. There is special emphasis on the biostratigraphically well documented localities yielding strigoceratids from Submediterranean sections in England, SW Germany, and Central Spain.

Abbreviations

BGS	British Geological Survey, Keyworth, Nottingham, United Kingdom
BNHM	Natural History Museum, London, United Kingdom
BSPM	Bayerische Staatssammlung für Paläontologie und Geologie München, Germany
GBA	Geologische Bundesanstalt, Wien, Austria
GIUS	Geological Institute, Department of Ecosystem Stratigraphy, University of Silesia, Sosnowiec, Poland
IFGT	Institut für Geowissenschaften der Universität Tübingen, Germany
MNHN	Muséum Nationale d'Histoire naturelle, Paris, France
NHMB	Naturhistorisches Museum Basel, Switzerland
RBC	ROBERT BARON CHANDLER Collection, Whyte Leafe, Surrey, United Kingdom
SM	Sedgwick Museum, Cambridge, United Kingdom
SMNS	Staatliches Museum für Naturkunde Stuttgart, Germany
VNIGNI	All-Russia Research Geological Oil Institute Moscow, Russia
[M]	ammonite macroconch dimorph
[m]	ammonite microconch dimorph
d	diameter [mm]
h	height of last whorl [mm]
u	width of umbilicus [mm]
w	width of last whorl [mm]
r/2	secondary and tertiary ribs per half a whorl

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2. Palaeobiogeographic distribution of *Strigoceras/Cadomoceras*

The Middle Jurassic ammonite genus *Strigoceras* and/or its microconch partner *Cadomoceras* is recorded from the following regions (specimens not determined as strigoceratids by the original authors are included here, but erroneous citations are omitted):

Belgium: MAUBEUGE (1951).

France (extraalpine part): DEFRANCE (1830); BLAINVILLE (1840); D'ORBIGNY (1845); BAYLE (1878); DOUVILLÉ (1884); QUENSTEDT (1886); BRASIL (1895); FISCHER (1994); LISSAJOUS (1906, 1907–1912); COEMME (1918); WETZEL (1924); SCHEURLEN (1928); ROCHÉ (1939); MOUTERDE (1953); DORÉ et al. (1987); GAUTHIER et al. (1995, 2002); RIOULT (1964, 1971); RIOULT et al. (1997); FERNÁNDEZ LÓPEZ & MOUTERDE (1994a, 1994b); RULLEAU (1997); ELMI & RULLEAU (1993); THIERRY et al. (1997); RICHTER (2003); RULLEAU (2006); this study.

Germany (southern part): OPPEL (1856); QUENSTEDT (1886); ENGEL (1908); SCHEURLEN (1928); DIETL (1977); DIETL & RIEBER (1980); WITTMANN (1983); SCHATZ (1985); SCHLEGELMILCH (1985); GASSMANN & OHMERT (1990); HEGELE (1990, 1995); OHMERT (1988, 1990); OHMERT et al. (1995); SCHLAMPP (1997); SCHWEIGERT & DIETZE (1999); ARP (2001); DIETZE et al. (2002, 2004); SCHWEIGERT et al. (2002); this study.

Germany (northern part): KUMM (1952); WESTERMANN (1958); HUF (1968); this study.

England: WRIGHT (1860); BUCKMAN (1893, 1910, 1923, 1924); ARKELL (1933); WILSON et al. (1958); TORRENS (1969); WHICHER (1969); SENIOR et al. (1970); WHICHER & PALMER (1971); MORTON (1975, 1976); PARSONS (1974, 1975, 1976, 1977, 1979); CALLOMON & CHANDLER (1990, 1994); CALLOMON & COPE (1995); HUXTABLE (1991, 2000, 2006); COX & SUMBLER (2002); CHANDLER & DIETZE (2001, 2003); CHANDLER et al. (2006); DIETZE et al. (2007); this study.

Poland (extracarpathian part): ZATOŃ & MARYNOWSKI (2004, 2006); this study.

Portugal: ROCHA et al. (1990); MOUTERDE (1991).

Spain and Baleares: FALLOT & BLANCHET (1923); WESTERMANN (1955); MENSINK (1965); HINKELBEIN (1975); SEQUEIROS et al. (1978); FERNÁNDEZ LÓPEZ (1977, 1982, 1985, 1988); FERNÁNDEZ LÓPEZ & AURELL (1988); FERNÁNDEZ LÓPEZ & GÓMEZ (1990); FERNÁNDEZ LÓPEZ & SUÁREZ-VEGA (1979); FERNÁNDEZ LÓPEZ et al. (1988, 1997, 1998); SANDOVAL (1979, 1985, 1986, 1990, 1994); ALVARO et al. (1989); LINARES & SANDOVAL (1979, 1990, 1993); this study.

Switzerland: OOSTER (1860); SCHEURLEN (1928); BIRCHER (1935); MAUBEUGE (1955); DOLLFUSS (1961); this study.

Austria (Eastern Alps): TRAUTH (1923a, 1923b, 1928); KRYSTYN (1971, 1972).

France (French part of Western Alps): HAUG (1891); LANQUINE (1929); PAVIA & STURANI (1968); PAVIA (1969, 1973).

Italy (Southern Alps): PARONA (1896); STURANI (1964a, 1964b, 1971); BENETTI (1977); DELLA BRUNA & MARTIRE (1985).

Italy (Apennines): CRESTA (1988); BALDANZA et al. (1990); CRESTA & GALÁCZ (1990); CECCA et al. (1991).

Italy (Sicily): WENDT (1963, 1971); D'ARPA in PAVIA & CRESTA (2002); DI STEFANO et al. (2002); SANTANTONIO (2002).

North Africa: FLAMAND (1911); MENCHIKOFF (1936); VERLET & ROCH (1940); ATROPS (1974); ENAY et al. (1987); BENHAMOU & ELMI (1994); SADKI (1994a, 1994b, 1996); SADKI et al. (1986).

Hungary: GALÁCZ (1970, 1976, 1980, 1988, 1991).

Poland and Slovakia (Carpathians): KROBICKI & WIERZBOWSKI (2004); SCHLÖGL (2002); SCHLÖGL et al. (2005).

Caucasus and Turkmenistan: ARKELL (1956); KRYMHOLTZ & STANKEVITCH (1963); ROSTOVTSEV (1985); ROSTOVTSEV (1992); BESNOSOV & MITTA (1998, 2000); this study.

Iran: SEYED-EMAMI (1988); SEYED-EMAMI & ALAVI-NAINI (1990).

Alaska: IMLAY (1964); this study.

Canada: HALL & WESTERMANN (1980); POULTON et al. (1992).

Oregon: LUPHER (1941); IMLAY (1973); TAYLOR (1988); TAYLOR & SMITH (1991).

Mexico: SANDOVAL & WESTERMANN (1986); SALVADOR et al. (1992).

Japan: SATO (1962, 1972); SATO & WESTERMANN (1991).

In contrast to the morphologically similar and phylogenetically related dimorphs *Phlycticeras/Oecoptychius*, the genus *Strigoceras* and its anti-dimorph *Cadomoceras* has to date not been recorded from the Indo-East African Province nor from South America. A record of *Strigoceras* from Chile (HILLEBRANDT et al. 1997: 349) was erroneous (pers. comm. A. v. HILLEBRANDT) and referred to records of *Phlycticeras* from around the Bathonian/Callovian boundary (see SCHWEIGERT & DIETZE 1998). The absence of *Strigoceras/Cadomoceras* in the Indo-East African Province is probably due to the scarcity of ammonite-bearing Middle Jurassic strata of pre-Bathonian age in this area. Strigoceratids are completely missing in Boreal or Subboreal faunas. *Liroxyites* IMLAY, 1961 from the Bajocian of Alaska may be an endemic oppeliid genus with striking homoeomorphy with *Strigoceras* and *Hebetoxyites*.

MOYNE et al. (2004) analyzed the palaeobiogeographic distribution of several Middle Jurassic ammonite subfamilies, including Strigoceratinae. Their data for Strigoceratinae fits well with ours, but is based on morphotaxa, not chronospecies; therefore their records tell us little about real abundance or specific diversity in an area.

The bulk of strigoceratids comes from the western Tethys. It is unclear if this region was also a centre of diversification or even origination for this family, in view of the general scarcity of stratigraphically early representatives of strigoceratids, and isolated discoveries in some north-Pacific terrains.

3. Systematics of the macroconch ammonite genus *Strigoceras*

The species concept adopted in this study follows DIETZE et al. (2005). The phyletic lineage of a genus is built up as a succession of chronospecies, based on their identified and defined type horizons. Transitional morphs showing the plasticity of the shell parameters and the sculptural characteristics are treated as morphological variants below the subspecific level. We formally retain separate macro- and microconch taxa at both generic and specific level. In the extreme dimorphic associations we describe, microconchs have restricted morphological variability in contrast to macroconchs. Unification of corresponding, co-occurring micro- and macroconch taxa into a single (palaeo-)biospecies seems inappropriate here. Sometimes the known stratigraphical ranges of microconch morphospecies do not follow perfectly that of their presumed macroconch counterparts (Fig. 1). This is comparable to what is observed in closely related *Phlycticeras* [M]/*Oecoptychius* [m] (see SCHWEIGERT & DIETZE 1998). Despite common usage we reject subgeneric ranking of corresponding dimorphs, not only for nomenclatorial reasons (see PAVIA 2006) but because subgeneric placement should express (palaeo-)biogeographic or habitat differentiation within a genus.

Order Ammonoidea ZITTEL, 1884
Suborder Ammonitina HYATT, 1889
Superfamily Haploceratoidea ZITTEL, 1884
Family Strigoceratidae BUCKMAN, 1924
Subfamily Strigoceratinae BUCKMAN, 1924

Genus *Strigoceras* QUENSTEDT, 1886 [M]
(Syn.: *Stringoceras* DOUVILLÉ, 1916; *Praestrigites* BUCKMAN, 1924; *Deltostrigites* BUCKMAN, 1924; *Leptostrigites* BUCKMAN, 1924; *Plectostrigites* BUCKMAN, 1924; *Strigites* BUCKMAN, 1924; *Varistrigites* BUCKMAN, 1924)

Type species: *Ammonites truellei* D'ORBIGNY, 1845.
Species included: *Praestrigites praenuntius* BUCKMAN, 1924; *Strigites strigifer* BUCKMAN, 1924; *Leptostrigites languidus* BUCKMAN, 1924; *Strigoceras bessinum* BRASIL, 1895; *Plectostrigites symplectus* BUCKMAN, 1924; *Strigites septicarinatus* BUCKMAN, 1924; *Ammonites truellei* D'ORBIGNY, 1845; *Strigoceras callomoni* n. sp. (this study). Other synonymous taxa are presented.

Diagnosis. – Medium-size ammonites with high-oval to oxyconic cross section, longitudinal spiral striation of the shell with one to four lateral depressions or furrows, very narrow umbilicus, rounded umbilical wall, falcoid or irregular polyschizotome ribbing and low, rounded, unsculptured septicarinate keel; aptychi unknown.

Age		Zone	Subzone	*Strigoceras*	*Cadomoceras*
BATH.	Early	Zigzag	Tenuiplicatus		
			Yeovilensis		
			Macrescens	*S. callomoni*	unknown
			Convergens		*C. cadomense*
BAJOCIAN	Late	Parkinsoni	Bomfordi	*S. truellei*	
			Truellei		
			Acris	*S. septicarinatum*	
		Garantiana	Tetragona		
			Garantiana		
			Dichotoma		
		Niortense	Baculata	*S. symplectum*	*C. nepos*
			Polygyralis		
			Banksii		
	Early	Humphriesianum	Blagdeni		
			Humphriesianum		
			Romani	*S. bessinum*	*C. sullyense*
		Sauzei	Hebridica	*S. languidum*	*C. carinatum*
			Patella		
		Laeviuscula	Laeviuscula	*S. strigifer*	*C. costellatum*
			Trigonalis		
		Ovale	Ovale	*S. compressum*	
		Discites	Subsectum		
			Walkeri		
AALENIAN	L.	Concavum	Formosum		unknown
			Concavum		
	Middle	Bradfordensis	Gigantea	*S. praenuntium*	
			Bradfordensis		
		Murchisonae	Murchisonae		
			Obtusiformis		
			Haugi		
	E.	Opalinum	Comptum		
			Opalinum		

Fig. 1. Biochronostratigraphy of the Aalenian to Early Bathonian, with zonal and subzonal subdivisions mentioned in the text. Times during which *Strigoceras* or *Cadomoceras* are recorded are indicated by grey colour.

Strigoceras praenuntium (BUCKMAN, 1924)

Figs. 2–3

v * 1924 *Praestrigites praenuntius*, nov. – BUCKMAN, pl. 466.
v 1924 *Deltostrigites deltotus*. – BUCKMAN, pl. 467.
v 1957 *Praestrigites praenuntius*. – ARKELL, p. L271.
1967 *Praestrigites praenuntius* BUCKMAN, 1924. – GÉCZY, p. 223, pl. 26, fig. 2, pl. 57, fig. 2.

? 1971 *Praestrigites praenuntius* BUCKMAN, 1924. – GÉCZY, p. 415.
v 1971 *Strigoceras* sp. indet. – WENDT, p. 156.
1973 *Praestrigites* cf. *P. deltotus* (BUCKMAN). – IMLAY, p. 75, pl. 35, figs. 1–9, 11–14; p. 75, figs. 3–4.
1973 *Strigoceras* cf. *S. languidum* (BUCKMAN). – IMLAY, p. 76, pl. 36, figs. 13–21.
1976 *Strigoceras*. – GALÁCZ, p. 180.
1983 *Praestrigites* sp. – SANDOVAL, p. 116, tab.-fig. 77a.
1983 *Strigoceras* sp. – SANDOVAL, p. 116.
? 1985 *Praestrigites deltotus* (BUCKMAN, 1924). – SANDOVAL, p. 89, pl. 1, fig. 1.
1986 *Strigoceras* sp. – SADKI et al., p. 452.
1988 *Praestrigites*. – CRESTA, tab.-fig. 3.
? 1988 *Praestrigites*. – CRESTA, tab.-fig. 4.
? 1988 *Strigoceras*. – CRESTA, tab.-fig. 4.
1988 *Praestrigites*. – FERNÁNDEZ LÓPEZ et al., text-figs. 2–3. – [1988c].
1988 *Strigoceras harrisense*. – TAYLOR, p. 135, pl. 3, figs. 4–5.
1990 *Praestrigites deltotus* (BUCKMAN). – BALDANZA et al., p. 226.
1990 *Strigoceras* sp. – BALDANZA et al., p. 226.
1990 *Praestrigites* cfr. *praenuntius* BUCKMAN. – BALDANZA et al., p. 226.
1990 *Praestrigites deltotus* (BUCKMAN). – CRESTA & GALÁCZ, pp. 168, 171, pl. 13, fig. 4, pl. 11, aff.-specimen text-fig. 1, pl. 2, fig. 2.
1990 *Praestrigites* sp. – CRESTA & GALÁCZ, pl. 10, fig. 2.
1990 *Praestrigites*. – FERNÁNDEZ LÓPEZ & GOMEZ, p. 47.
pars 1990 *Praestrigites* sp. – ROCHA et al., pl. 1, fig. 4, tab.-fig. 2.
1990 *Strigoceras deltotus*. – SANDOVAL, p. 144.
1990 *Praestrigites deltotus*. – LINARES & SANDOVAL, tab.-fig. 2.
v non 1990 *Praestrigites protrusus*. – CALLOMON & CHANDLER, p. 97 [comment see p. 49].
1991 *Praestrigites deltotus* BUCKMAN. – CECCA et al., p. 92.
1991 *Praestrigites praenuntius* BUCKMAN. – CECCA et al., p. 92.
1992 *Strigoceras harrisense* TAYLOR. – POULTON et al., p. 72, pl. 42, fig. 6.
1993 *Praestrigites* sp. – LINARES & SANDOVAL, tab.-fig. 5.
? 1994 *Praestrigites*. – SADKI, pp. 315, 320. – [1994b].
1996 *Praestrigites*. – SADKI, pp. 48, 137, tab.-figs. 12–13, 30.
1997 *Praestrigites*. – RIOULT et al., p. 46.
1997 *Strigoceras*. – RIOULT et al., p. 46.
2002 *Praestrigites deltotus* BUCKMAN. – CRESTA et al. in SANTANTONIO, p. 229.

Holotype: Specimen figured by BUCKMAN 1924, pl. 466, BGS GSM 37314, refigured herein as Fig. 2.

Type locality: Horn Park, Beaminster, Dorset, England.

Type horizon: Inferior Oolite, Ironshot Bed ("Ludwigian, *platychora* hemera" of BUCKMAN). An investigation of the specimen's matrix showed it to be ironshot and therefore later than bed 4 of Horn Park. By comparison of the matrix it probably comes from bed 5a (Middle Aalenian, Bradfordensis Zone, Gigantea Subzone, Aa-11, *gigantea* horizon, see CALLOMON 1995).

Studied material: 3 specimens.

Stratigraphic range: The stratigraphically oldest record of *Strigoceras praenuntium* (BUCKMAN), if correctly identified, was from the late Opalinum Zone of Hungary (GÉCZY 1971). The preservation of ammonites in the Rosso Ammonitico lithology at Csernye makes it difficult to distinguish between early *Strigoceras* and co-occurring *Csernyeiceras*. It was impossible to trace a specimen in the collection of Budapest University labelled as "*Strigoceras praenuntium*" of this age, and most likely the reference is based on specimens from the Middle Aalenian earlier recognized and illustrated by GÉCZY (1967: 223, pl. 56, fig. 2, pl. 57, fig. 2, pl. 65, fig. 78; pers. comm. A. GALÁCZ, Budapest). Therefore the oldest undoubted record is that

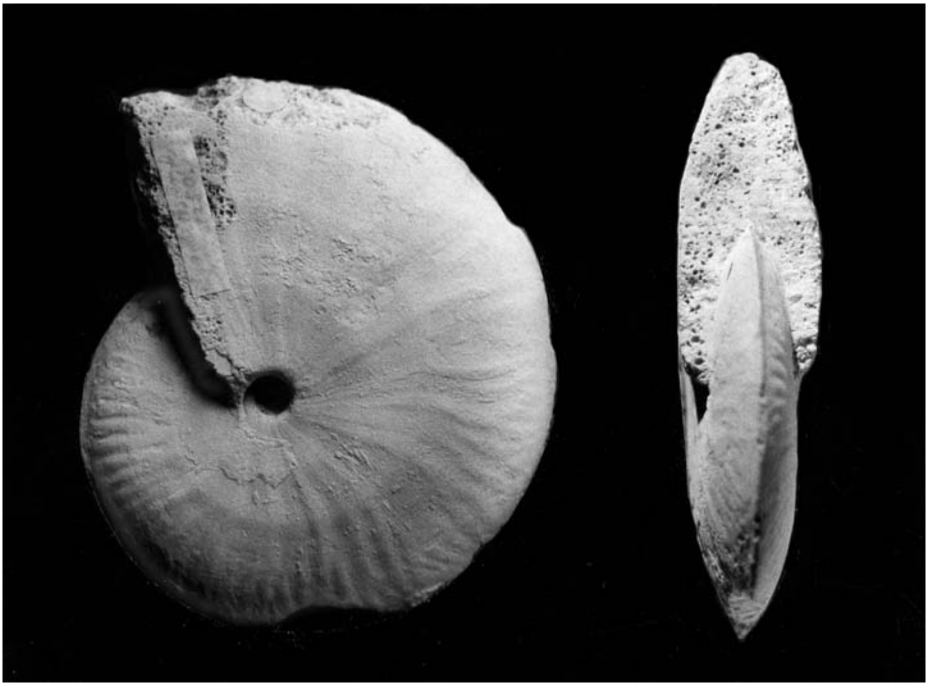


Fig. 2. *Strigoceras praenuntium* (BUCKMAN), holotype, lateral and ventral views; Horn Park; Inferior Oolite, bed 5a, Middle Aalenian, Bradfordensis Zone, *Brasilia gigantea* horizon (= horizon Aa-11 of CALLOMON 1995); BGS GSM 37314. – ×1.

of the holotype itself coming from the Middle Aalenian. Very rare specimens of *S. praenuntium* from the Concavum Zone are recorded from Spain, Portugal, Morocco, from the Apennines and Southern Alps, and from Hungary. Records from the Discites Zone come from England, France, Spain, Morocco, Apennines, Sicily, Hungary, and from Oregon. The latest known representatives of the morphospecies *S. praenuntium* are from the Discites Zone.

Records: England, Oregon, Spain, Portugal, Morocco, Apennines, Southern Alps, Hungary.

Diagnosis. – *Strigoceras* with a slender cross section, a weakly developed median lateral furrow, rectiradiate to rursiradiate, irregularly falcoid to polyschizotome ribbing.

Description. – The holotype is a complete phragmocone with a little body chamber in shell preservation. The original length of the bodychamber was about half a whorl, reconstructed from the length of the spur line. The shell is preserved in brown calcite. In the last third of one flank, the shell has been removed to study the extremely complex suture line. The cross section is oxyconic with its maximum width at mid-height of the flank. The septicarinate keel is low and rounded. A median lateral furrow is weakly developed and only discernible in specimens with the shell preserved. The ornament consists of rather dense falcoid/polyschizotome ribs with numerous irregular secondaries. The secondaries are generally rectiradiate, but in BUCKMAN's original figure they are painted in to show a prorsiradiate direction; this is misleading. In the latest stage of ribbing the ribs become coarse and more widely spaced. A longitudinal striation is developed but scarcely discernible due to the calcitic preservation of the shell. The umbilical wall is steep and the umbilical width very small; however it attains the largest value at equal diameter for the entire genus. In contrast to many other specimens of similar size, the suture line of the holotype of *S. praenuntium* appears relatively simple, but this feature is individual and means that the specimen was far from being adult.

Comparisons. – *Strigoceras praenuntium* differs from other slender chronospecies of the genus in possessing quite densely ribbed inner whorls, with ribs becoming irregular and polyschizotome early in ontogeny and rapidly coarsening towards maturity. In *S. bessinum* BRASIL similar morphology is seen, but with a more accentuated lateral furrow and stronger ribbing overall.

Remarks. – *Strigoceras praenuntium* was originally erected as type species of *Praestrigites* BUCKMAN, 1924. Unlike many other generic names introduced by BUCKMAN for strigoceratids of different ages, *Praestrigites* was accepted by ARKELL (1957) and, more recently SANDOVAL (1985) as a separate taxon. There is no doubt that it does have a close relationship with *Strigoceras* but the morphological differences between *Strigoceras* s. str. and *Praestrigites* cited in their emendations are a factor of the preservational state of the types of species included. The lateral median furrow is shallow and often only visible when the shell is preserved.

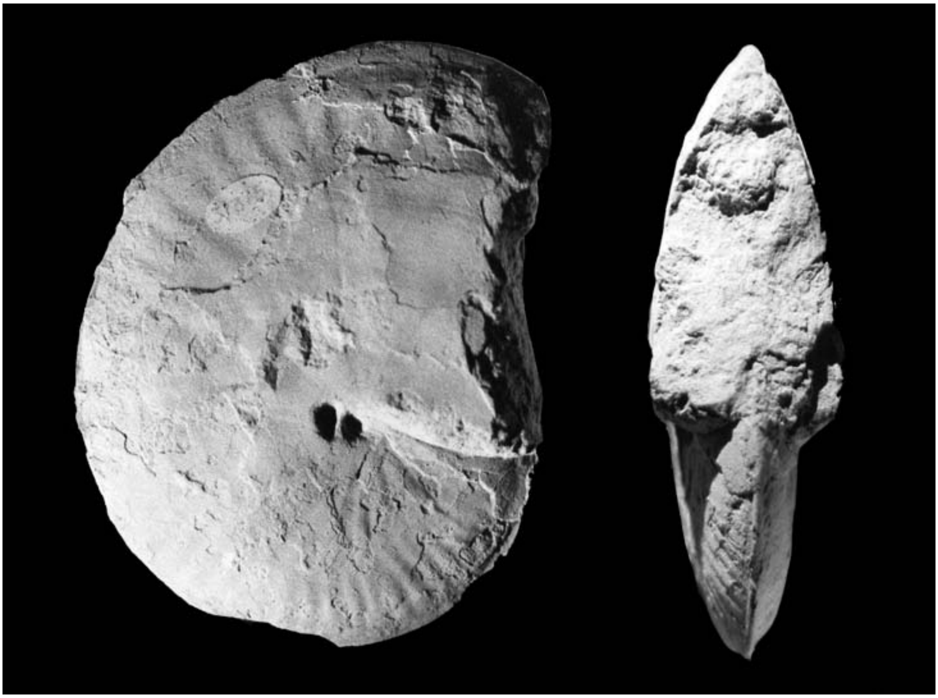


Fig. 3. *Strigoceras praenuntium* (BUCKMAN) (= holotype of *Deltostrigites deltotus* BUCKMAN), lateral and ventral views; Bradford Abbas; Inferior Oolite, Fossil Bed, Lower Bajocian, Discites Zone; BGS GSM 37315. – ×1.

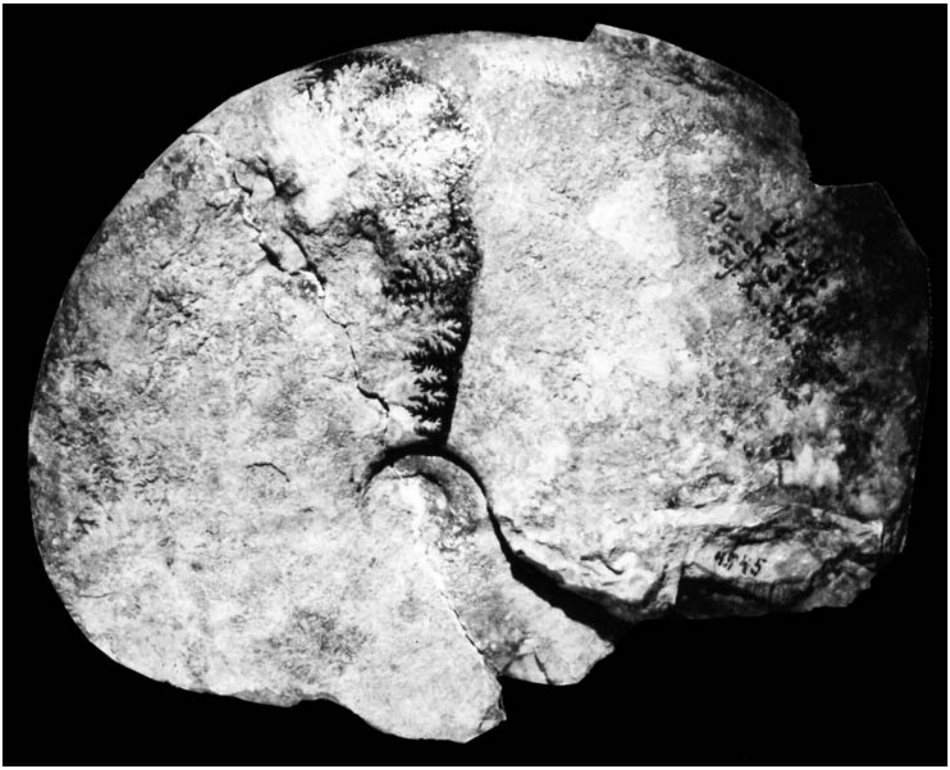


Fig. 4. *Csernyeiceras subaspidoides* (VACEK), syntype, lateral view; Cap San Vigilio, Lake Garda, N Italy; Aalenian,? Concavum Zone; GBA 1886/05/29a. – ×1.

The holotype of *Deltostrigites deltotus* BUCKMAN (Fig. 3) is from the Discites Zone (Inferior Oolite, Fossil Bed) of Bradford Abbas. The distinction between *S. praenuntium* and *S. deltotum* made in literature is entirely based on the horizon of occurrence. There is little foundation for separating the two taxa on the analysis of their types by morphology or on the grounds of intraspecific variation (although number of specimens is still low). We prefer to include both in the same taxon.

Recent reinvestigation of all three syntypes of *Oppelia subaspidoides* VACEK, 1886, from the Aalenian of Cap San Vigilio proved them all to belong to *Csernyeiceras*, not to *Praestrigites* as recently suggested by SCHWEIGERT et al. (2000) for the remaining syntypes besides the lectotype. This determination is based on the extremely high, razor-sharp septicarinate keel, a relatively wide umbilicus, and the absence of any lateral furrows (see also p. 50; Fig. 4). The suture line, however, is hardly distinguishable from that of a *Strigoceras*, thus demonstrating the close phyletic relationship between Phlycticeratinae and Strigoceratinae. A specimen described as "*Oppelia* cfr. *subaspidoides* VACEK" by PRINZ (1904, pl. 20, fig. 1) is more involute than any of the syntypes of *Oppelia subaspidoides*, but this specimen has an extraordinarily sharp keel and a cross section more typical of *Csernyeiceras* (GÉCZY 1967, pl. 56, fig. 1, text-fig. 236), although its rather poor preservation in Rosso Ammonitico lithology hampers any reliable comparison.

Measurements

	d	h	w	u	r/2	h/d	w/d	u/d
GSM 37314 (holotype)	(75.5)	(44)	18.5	4.8	~45	0.58	0.25	0.06
dito	65.0	38.0	15.0	4.3	35.0	0.58	0.23	0.07
GSM 37315 (Fig. 3)	83.5	51.0	23.3	2.0	~25	0.61	0.28	0.02

Strigoceras compressum BUCKMAN, 1896
Figs. 5–6

1896 *Strigoceras compressum* (ETHERIDGE). – BUCKMAN in BUCKMAN & WILSON, p. 701.
v * 1924 *Varistrigites compressus*, ETHERIDGE sp. – BUCKMAN, pl. 468.
1974 *Strigoceras compressum* (S. B.). – PARSONS, p. 169.
1977 *Strigoceras compressum* (S. B.). – PARSONS, p. 116.
1979 *Strigoceras (S.) compressum* (S. BUCKMAN). – PARSONS, p. 144.
1979 *Varistrigites compressus*. – PARSONS, p. 148, table 4.
1985 *Strigoceras compressum*. – DELLA BRUNA & MARTIRE, p. 42.
1985 *Strigoceras comprexum* (ETHERIDGE) sensu BUCKMAN 1924. – SANDOVAL, p. 93, pl. 1, figs. 2–3.
1988 *Strigoceras compressum*. – FERNÁNDEZ LÓPEZ et al., tab.-fig. 2.
1990 *Strigoceras compressum*. – SANDOVAL, p. 146.
v 2006 *Strigoceras compressum* (ETHERIDGE). – CHANDLER et al., tab.-fig. 2.
v 2007 *Strigoceras strigifer* (BUCKMAN). – DIETZE et al., p. 17, text-fig. 5a, b.
v 2007 *Strigoceras compressum* BUCKMAN. – DIETZE et al., p. 17, text-fig. 5c, d.

Taxonomic remarks. – *Ammonites truellei* var. *compressus* ETHERIDGE in WRIGHT (1860: 24) was erected without a figure, description or indication of any syntypes and its exact stratigraphical position within the Inferior Oolite is unknown. Originally the name was applied to various slender specimens coming from different stratigraphical horizons (BUCKMAN in BUCKMAN & WILSON 1896: 701), thus prior to BUCKMAN (1924), the taxon represents a nomen nudum. BUCKMAN (1924) emended the species to include a "large" form from his *fissilobatum* hemera retaining ETHERIDGE as author. The figured specimen is extremely coarse-ribbed (BUCKMAN 1924, pl. 468), and was referred to as a "topotype". It is the only strigoceratid from S. S. BUCKMAN's 'Type Ammonites' that could not be located in the palaeontological collections of BGS. The specimen from J. W. TUTCHER's collection is now in the Natural History Museum, London (communication by J. H. CALLOMON). It has been impossible to define an original type series at disposal by BUCKMAN in 1896. The specimen illustrated here (Fig. 5) from the TUTCHER collection was recently erected as neotype, characteristic of the species (DIETZE et al. 2007).

Neotype: Specimen figured by BUCKMAN 1924, pl. 468, designated by DIETZE et al. (2007), BNHM C.41727, re-figured here as Fig. 5.

Type locality: Dundry Hill near Bristol.

Type horizon: Inferior Oolite (Early Bajocian, "*fissilobatum* hemera" in BUCKMAN 1924), probably from bed 8a of CHANDLER et al. 2006, horizon Bj-5 in CALLOMON 1995, Ovale Zone, based on newly collected topotypes), Bj 6b, however, cannot be excluded with certainty.

Studied material: 10 specimens.

Stratigraphic range: Ovale Zone.

Records: England, Spain, Portugal, Southern Alps.

Fig. 5. *Strigoceras compressum* BUCKMAN, neotype, lateral and ventral views (= specimen figured by BUCKMAN 1924, pl. 468); Dundry, West End, Castle Farm; Inferior Oolite, Lower Bajocian, "*fissilobatum* hemera" (= Ovale Zone, horizon Bj-5 or Bj-6b of CALLOMON 1995, reconstructed after topotypes); BNHM C.41727 (J. W. TUTCHER collection). – ×1.

Diagnosis. – *Strigoceras* with slender cross sections, weakly developed lateral furrow, radiate to rectiradiate polyschizotome ribbing which is extremely coarse.

Description. – The neotype of *Strigoceras compressum* is an internal mould with some poor remnants of the shell preserved. Two thirds of the outer whorl is body-chamber. The cross section is oxycone with a partly preserved rounded septicarinate keel. The umbilicus is very narrow. Primary ribs start on the inner third of the flanks and give rise to extremely coarse, very broad, marginally truncated secondaries, with many intercalatory ribs. The ribbing style is polyschizotome. A weak lateral furrow is developed and is visible on the mould. The suture line is extremely complicated consistent with that in other species of *Strigoceras*.

Remarks. – An extremely coarse ribbing is diagnostic for this chronospecies, however, it also occurs in the inner whorls of younger chronospecies, notably in *Strigoceras symplectum* (BUCKMAN, 1924) from the Bajocian, Niortense Zone.

Measurements

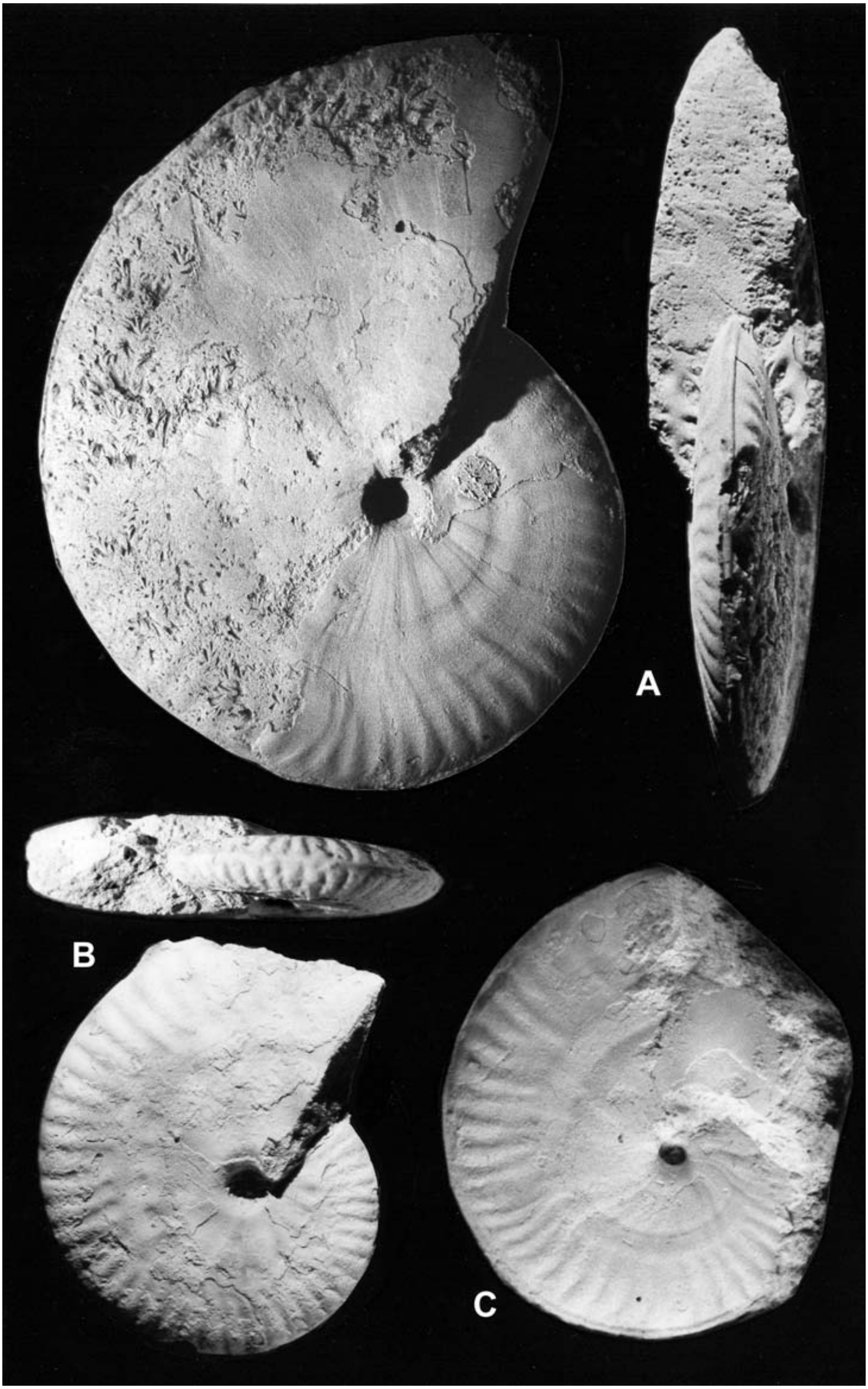
	d	h	w	u	r/2	h/d	w/d	u/d
BNHM C.41727SM	~83	49.0	17.5	~3	30	0.59	0.21	0.03
SM X.29140 (Fig. 6)	103.5	57.0	23.2	7.5	(–)	0.55	0.22	0.07

Fig. 6. *Strigoceras compressum* BUCKMAN, lateral view; Dundry, South Main Road Quarry; Inferior Oolite, bed 8a, Lower Bajocian, Ovale Zone, *Witchellia romanoides* horizon (= horizon Bj-5 of CALLOMON 1995); SM X.29140 (leg. J. H. CALLOMON, ex RBC collection). – ×1.

Strigoceras strigifer (BUCKMAN, 1924)
Fig. 7A–B

v * 1924 *Strigites strigifer*, nov. – BUCKMAN, pl. 469A (holotype)–B.
v 1955 *Strigoceras pseudostrigifer* n. sp. – MAUBEUGE, p. 31 pars.
1964 *Strigoceras* cf. *S. languidus* (BUCKMAN). – IMLAY, p. 37, pl. 23, figs. 2–4, 8.
1964 *Strigoceras* sp. juv. – IMLAY, pl. 23, figs. 5–7.
1965 *Strigoceras strigifer* (BUCKMAN). – MENSINK, p. 81.
1967 *Strigites strigifer* BUCKMAN. – MAUBEUGE, pp. 92–94, text-figs. on pp. 92–93.
1974 *Strigites strigifer* BUCKMAN, 1924. – ATROPS, p. 86, pl. 2, fig. 5.
1976 *Strigoceras languidum*. – MORTON, p. 27.

Fig. 7. A. *Strigoceras strigifer* (BUCKMAN), holotype, lateral and ventral views; Clatcombe near Sherborne, Dorset; Inferior Oolite, Lower Bajocian, Laeviuscula Zone; BGS GSM 37316. **B.** *Strigoceras strigifer* (BUCKMAN), lateral and ventral views; Oborne, Dorset, Frogden Quarry; Inferior Oolite, Green-Grained Marl, Lower Bajocian, Laeviuscula Zone, Laeviuscula Subzone, *Witchellia laeviuscula* horizon (= horizon Bj-10 of CALLOMON 1995); SMNS 65360 (leg. G. DIETL). **C.** *Strigoceras languidum* (BUCKMAN), lateral view; Albstadt-Streichen, SW Germany; Ostreenkalk Formation, basal Humphriesioolith Member, Lower Bajocian, Sauzei Zone; SMNS 65364 (leg. G. STAPPENBECK). – ×1.


A
B
C

1979 *Strigoceras (S.)* sp. – PARSONS, p. 138.
1979 *Strigoceras* sp. – FERNÁNDEZ LÓPEZ & SUÁREZ-VEGA, p. 6.
1983 *Strigoceras strigifer.* – SANDOVAL, p. 117, text-fig. 54, tab.-pl. 77a.
1983 *Strigoceras* sp. – SANDOVAL, p. 117, text-fig. 54, tab.-pl. 77a.
1985 *Strigoceras strigifer* (BUCKMAN) 1924. – FERNÁNDEZ LÓPEZ, p. 133, pl. 12, fig. 7.
1988 *Strigoceras.* – GALÁCZ, p. 220.
v 1990 *Strigoceras strigifer.* – CALLOMAN & CHANDLER, p. 98.
1990 *Strigoceras strigifer.* – CRESTA & GALÁCZ, p. 168.
1991 *Strigoceras strigifer* BUCKMAN. – CECCA et al., p. 92.
? 1994 *Strigoceras.* – SADKI, tab.-fig. 3. – [1994a].
1996 *Strigoceras languidum* (BUCK). – SADKI, p. 139, text-figs. 13, 46.
1997 *Strigoceras strigifer.* – RIOULT et al., p. 47.
1998 *Strigoceras strigifer.* – PAVIA & MARTIRE, p. 168.

Holotype: BUCKMAN 1924, pl. 469A, BGS GSM 37316, re-figured here as Fig. 7A.
Paratype: BUCKMAN 1924, pl. 469B, BGS GSM 37317.
Type locality: Clatcombe near Sherborne, Dorset.
Type horizon: Inferior Oolite (Early Bajocian, Laeviuscula Zone, as indicated by BUCKMAN 1924). The paratype is said to come from the *Astarte spissa* Bed = Green-grained Marl of Dorset, the age of which is late Laeviuscula Zone.
Studied material: 10 specimens.
Stratigraphic range: Laeviuscula Zone.
Records: England, France, Spain, Portugal, Switzerland, Southern Alps, Apennines, Algeria, Morocco, Alaska (Peninsular Terrane).

Diagnosis. – *Strigoceras* with slender cross section, weakly developed lateral furrow, rectiradiate to rursiradiate, moderately coarse polyschizotome ribbing.

Description. – The holotype of *Strigoceras strigifer* is a moderately large internal mould with remains of the striate shell and the rounded keel in the first half of the last whorl that is still completely septate. The cross section is oxyconic with a very narrow umbilicus that is a little larger in the adult stage. The ornament consists of weak radiate primary ribs starting on the inner third of the flanks giving rise to coarse, very broad, marginally truncated secondaries. The ribbing style is more or less falcoid – slightly polyschizotome. On the flanks, a lateral furrow is developed but interrupted by the primaries.

Remarks. – The paratype of *Strigoceras strigifer* was separated from *Strigoceras* by MAUBEUGE (1955) and interpreted as belonging to his newly erected species *Strigites pseudostrigifer*. The paratype of *S. strigifer* is nearly from the same horizon as the holotype and doubtlessly belongs to the same chronospecies. Slight differences in sculpture between the two specimens result from differences in the onset of the adult stage and do not justify placing in different taxa. The holotype of *S. pseudostrigifer* is a juvenile specimen from the Humphriesianum Zone of Switzerland (see below).

Measurements

	d	h	w	u	r/2	h/d	w/d	u/d
GSM 37316 (holotype)	112.0	66.0	25.0	5.5	–	0.59	0.22	0.05
dito	74.0	40.5	17.0	4.5	25	0.55	0.23	0.06

Strigoceras languidum (BUCKMAN, 1924)
Figs. 7C, 8–9

v 1893 *Strigoceras* sp. – BUCKMAN, p. 494.
1911 *Oppelia (Strigoceras) Truellei* D'ORBIGNY sp. – FLAMAND, p. 884, pl. 4, fig. 14.
v * 1924 *Leptostrigites languidus*, nov. – BUCKMAN, pl. 477A–B.
? 1940 *Strigoceras Truellei* D'ORB., sp. – VERLET & ROCH, p. 82.
1955 *Strigoceras strigifer* (BU.). – WESTERMANN, pp. 519ff.
v ? 1958 *Strigoceras septicarinatum* (BUCKMAN, 1924). – WESTERMANN, p. 54, pl. 17, fig. 6.
1968 *Strigoceras* cf. *strigifer*. – PAVIA & STURANI, p. 311.
1972 *Strigoceras* sp. cf. *S. languidum* (BUCKMAN). – SATO, p. 285, pl. 34, figs. 12–13.
1974 *Strigoceras strigifer* (S. B.). – PARSONS, p. 166.
v 1975 *Strigoceras strigifer* (BUCKMAN). – HINKELBEIN, p. 149, tab.-figs. 11–12, 14.
v 1975 *Strigoceras pseudostrigifer* (MAUBEUGE). – HINKELBEIN, p. 149, tab.-figs. 11–14.
1975 *Strigoceras bessinum* BRASIL. – MORTON, p. 86, pl. 16, figs. 3–4.
1976 *Strigoceras*? *languidum* (BUCKMAN). – MORTON, p. 27.
1977 *Strigoceras strigifer* (BUCKMAN). – FERNÁNDEZ LÓPEZ, p. 50.
1979 *Leptostrigites languidus*. – PARSONS, p. 148, table 4.
1983 *Strigoceras strigifer* (BUCK.). – SANDOVAL, p. 118, text-figs. 60, 77A.
1985 *Strigoceras langidum* (BUCKMAN) 1924. – FERNÁNDEZ LÓPEZ, p. 135, pl. 13, figs. 1–2 [small adults].
1985 *S. (Strigoceras) pseudostrigifer* (MAUBEUGE, 1955). – SANDOVAL, p. 94, pl. 1, figs. 4–7.
1986 *Strigoceras* sp. – SADKI et al., p. 455.
1986 *Strigoceras* cf. *languidus* BUCK. – SADKI et al., p. 455.
1988 *Strigoceras* cf. *languidum* (BUCKMAN, 1924). – SEYED-EMAMI, p. 76, text-fig. 23.
1988 *Strigoceras languidum*. – FERNÁNDEZ LÓPEZ et al., tab.-fig. 2.
1988 *Strigoceras languidum* (BUCK.). – FERNÁNDEZ LÓPEZ et al., p. 55.
1988 *Strigoceras* cf. *languidum* (BUCK.). – FERNÁNDEZ LÓPEZ et al., p. 177.
1988 *Strigoceras pseudostrigifer* (MAUBEUGE). – FERNÁNDEZ LÓPEZ et al., p. 177.
1988 *Strigoceras* cf. *languidum*. – FERNÁNDEZ LÓPEZ & AURELL, tab.-fig. 4.
1990 *Strigoceras pseudostrigifer*. – SANDOVAL, pp. 147, 149.
1990 *Strigoceras longuidum*. – SEYED-EMAMI & ALAVI-NAINI, tab.-pl. 2.
1991 *Strigoceras strigifer*. – GALÁCZ, p. 111.
1992 *Strigoceras* cf. *longuidum*. – SATO in WESTERMANN, p. 205.
? 1994 *Strigoceras*. – SADKI, tab.-fig. 4. – [1994a].
? 1994 *Strigoceras strigifer*. – SADKI, tab.-fig. 4. – [1994a].
v 1995 *Strigoceras* cf. *pseudostrigifer* (MAUBEUGE). – OHMERT et al., p. 69.
1996 *Strigoceras strigifer* (BUCK). – SADKI, tab.-figs. 14, 46.
1996 *Strigoceras* sp. – SADKI, p. 73.
1996 *Strigoceras pseudostrigifer* (MAUB.). – SADKI, p. 142, tab.-fig. 46.
1997 *Strigoceras* sp. – RIOULT et al., p. 47.
1998 *Strigoceras longuidum*. – SEYED-EMAMI et al., pl. 2.
v 2000 *Strigoceras languidum*. – HUXTABLE, p. 104.
v 2001 *Strigoceras* sp. – CHANDLER & DIETZE, p. 115, text-fig. 2.
2002 *Strigoceras* sp. – CRESTA et al. in SANTANTONIO, p. 231.
v 2006 *Strigoceras langidum* (BUCKMAN). – CHANDLER et al., text-fig. 2.

Holotype: BUCKMAN 1924, pl. 477A, BGS GSM 37324, re-figured here as Fig. 8B.
Paratype: BUCKMAN 1924, pl. 477B, BGS GSM 37325.
Type locality: Sandford Lane, Dorset, England.
Type horizon: Inferior Oolite, Fossil Bed, upper part (bed 6b of BUCKMAN 1893), Sauzei Zone, horizon Bj-11 in CALLOMON (1995). The paratype comes from the Inferior Oolite, bed 10a of South Main Road Quarry (Bajocian, Sauzei Zone) at Dundry Hill near Bristol, see PARSONS (1979: 148) and CHANDLER et al. 2006: fig. 1).
Stratigraphic range: Sauzei Zone.
Studied material: ca. 30 specimens.


A
B
C

Fig. 9. *Strigoceras languidum* (Buckman), lateral view; Oborne, Frogden Quarry; Inferior Oolite, bed 4a (section see Callomon 1995), Lower Bajocian, Sauzei Zone (horizon Bj-11 of Callomon 1995); SM X40232 (leg. R. B. Chandler). – ×1.

Records: England, Scotland, France, SW Germany (this study, Fig. 7C), ? NW Germany, Spain, Apennines, Hungary, Algeria, Morocco, Iran, Japan.

Diagnosis. – *Strigoceras* with slender cross section, weakly developed lateral furrow, rectiradiate to rursiradiate, polyschizotome ribbing.

Description. – The holotype of *S. languidum* is small and has a slender, oxyconic whorl section. Falcoid ribbing persists up to the last preserved whorl display-

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Fig. 8. *Strigoceras languidum* (Buckman), lateral and ventral views. **A**. Topotype; Sandford Lane near Sherborne, Dorset; Inferior Oolite, bed 6b, Lower Bajocian, Sauzei Zone (horizon Bj-11 of Callomon 1995); SMNS 67153 (ex coll. V. Dietze). **B**. Holotype; Sandford Lane near Sherborne, Dorset; Inferior Oolite, Lower Bajocian, Fossil Bed, upper part, Sauzei Zone (horizon Bj-11 of Callomon 1995); BGS GSM 37324. **C**. Juvenile specimen; Riodeva, Keltiberian Ranges, E Spain; Chelva Formation, bed 7 in section F of Hinkelbein (1975, text-fig. 13), Lower Bajocian, Sauzei Zone; SMNS 65362 (Coll. K. Hinkelbein). – ×1.

ing regularly arranged retrocostate secondaries. The umbilicus is very narrow. Lateral furrows are not seen due to the internal mould preservation.

Comparisons. – *S. languidum* differs mainly from older chronospecies e. g. *S. strigifer* (BUCKMAN) in its overall denser and finer ribbing, in which primaries are barely visible and the medium longitudinal furrow is interrupted by ribs crossing it.

Measurements

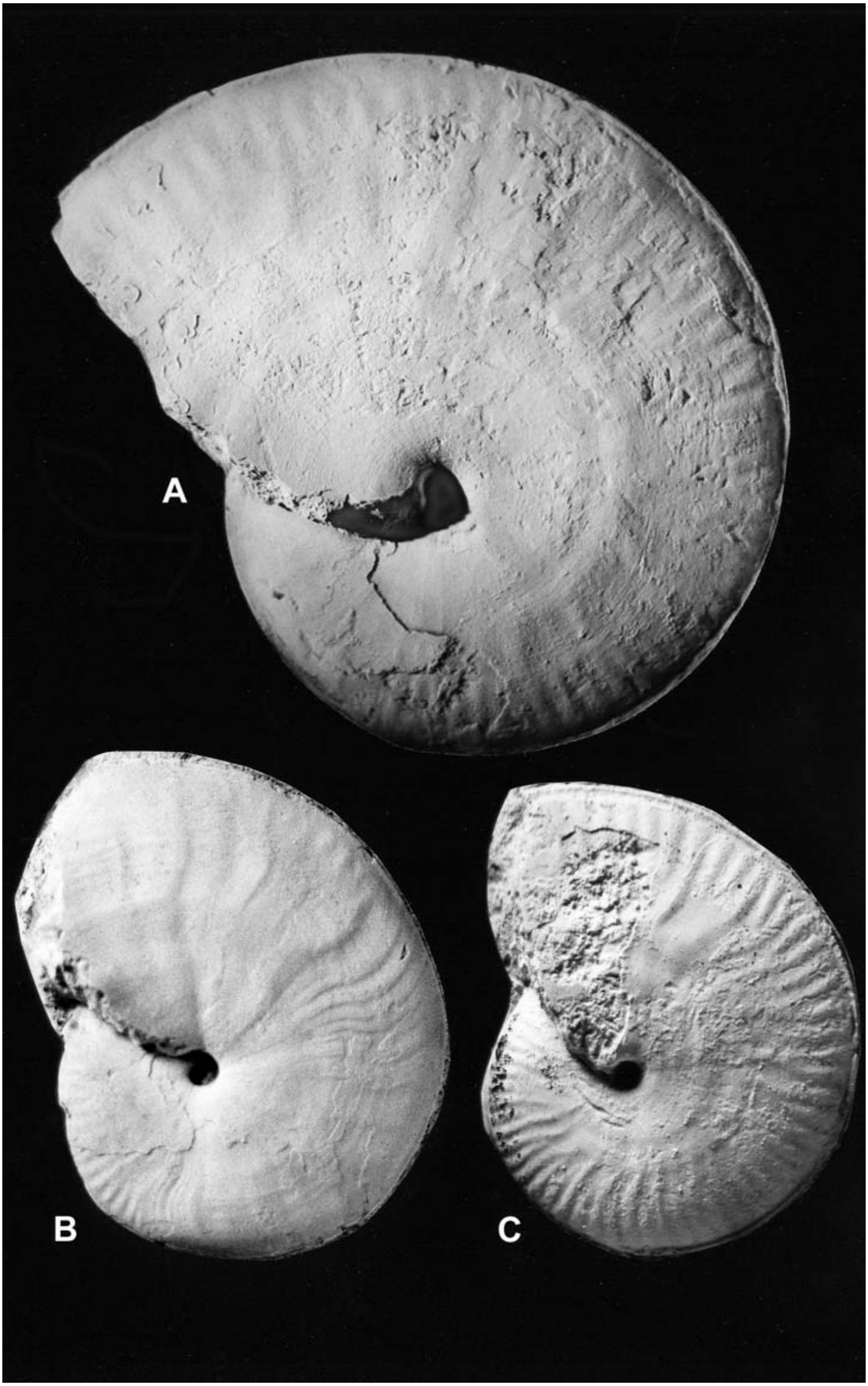
	d	h	w	u	r/2	h/d	w/d	u/d
GSM 37324 (holotype)	57.0	31.5	15.0	4.0	~21	0.55	0.26	0.07
RBC 28	43.0	25.0	9.5	2.8	28	0.58	0.22	0.07
RBC 19	68.0	40.0	15.3	4.5	27	0.59	0.23	0.07
SM X40232 (Fig. 9)	~98	~57	24.0	4.0	25	0.58	0.24	0.04
SMNS 67153 (Fig. 8A)	116.3	68.5	28.0	4.5	22	0.59	0.24	0.04

Strigoceras bessinum BRASIL, 1895
Figs. 10–12

v 1857 *Ammonites Truellei.* – QUENSTEDT, p. 395, pl. 54, fig. 6.
pars 1878 *Amaltheus Truellei.* – NEUMAYR, p. 68.
v 1886 *Ammonites Truellei gracilis.* – QUENSTEDT, p. 568, pl. 69, fig. 10 (= holotype of *S. gracile*, see HÖLDER 1964: 98).
* 1895 *Strigoceras bessinum* nov. sp. – BRASIL, p. 43, pl. 4, figs. 6–7.
? 1924 *Strigoceras Truellei.* – WETZEL, p. 210.
1952 *Strigoceras* sp. – KUMM, p. 388.
? 1952 *Strigoceras truellei.* – KUMM, p. 413.
1953 *Strigoceras* sp. – MOUTERDE, pp. 91 f., 123.
1954 *Strigoceras symplectum.* – WESTERMANN, p. 25.
1955 *Strigites pseudostrigifer* n. sp. – MAUBEUGE, p. 31 pars, pl. 11, fig. 5, pl. 2, fig. 8, pl. 5, fig. 3.
1964 *Strigoceras* aff. *strigifer* (S. BUCKM.). – STURANI, p. 26, pl. 4, fig. 6. – [1964b].
1964 *Strigoceras* cf. *S. languidum.* – IMLAY, pl. 23, figs. 2–4, 8.
1971 *Strigoceras bessinum* BRASIL. – STURANI, pl. 4, figs. 17–19.
1971 *Strigoceras* sp. ind. juv. aff. *strigifer* (S. BUCKMAN). – STURANI, p. 119, pl. 4, figs. 11–15.
1971 *Strigoceras* sp. ind. juv. cf. *strigifer* (S. BUCKM.) – STURANI, p. 119, pl. 16, fig. 10.
1971 *Strigoceras strigifer.* – WHICHER & PALMER, p. 117.
v 1975 *Strigoceras symplectum* (BUCKMAN). – HINKELBEIN, tab.-fig. 12.
? 1976 *Strigoceras* cf. *compressum.* – MORTON, p. 28.
? 1976 *Strigoceras (S.) bessinum* BRASIL. – PARSONS, p. 131.
1978 *Stringoceras* sp. – SEQUEIROS et al., p. 296.
1979 *Strigoceras* aff. *strigifer.* – LINARES & SANDOVAL, tab.-fig. 2.
v 1980 *Strigoceras.* – DIETL & RIEBER, pp. 61, 65.
1983 *Strigoceras* sp. – SANDOVAL, p. 120, tab.-fig. 77A pars.
1983 *Strigoceras* aff. *strigifer* BUCK. – SANDOVAL, p. 119–120, tab.-fig. 77A pars.
1985 *S. (Strigoceras) paronai.* – SANDOVAL, pl. 1, fig. 10.
1985 *S. (Strigoceras) truellei.* – SANDOVAL, pl. 2, fig. 3.
1985 *Strigoceras* cf. *strigifer* (BUCKM.). – SCHATZ, fig. 5.
1988 *Strigoceras bessinum* BRASIL. – FERNÁNDEZ LOPÉZ, p. 76.
1988 *Strigoceras paronai* (TRAUTH). – FERNÁNDEZ LOPÉZ et al., p. 178. – [1988a].
v 1990 *Strigoceras* sp. – OHMERT, text-fig. 2.
v 1990 *Strigoceras.* – GASSMANN & OHMERT, p. 164.
1990 *Strigoceras strigifer.* – SANDOVAL, tab.-fig. 6.
1992 *Strigoceras* cf. *languidum.* – POULTON et al. in WESTERMANN, p. 72.
1994 *Strigoceras* sp. – FERNÁNDEZ LOPÉZ & MOUTERDE, p. 122 pars. – [1994a].
v 1995 *Strigoceras pseudostrigifer* (MAUBEUGE). – OHMERT et al., p. 67, pl. 4, figs. 6–8.

v 1995 *Strigoceras egertense* n. sp. – OHMERT et al., p. 69, pl. 4, figs. 9–10.
v 1995 *Strigoceras bessinum* BRASIL. – OHMERT et al., p. 72, pl. 4, fig. 4.
1996 *Strigoceras* sp. – SADKI, tab.-fig. 46 pars.
? 1997 *Strigoceras bessinum*. – RIOULT et al., p. 47.
1997 *Strigites pseudostrigifer*. – RULLEAU, pl. 5, figs. 1–2.
1997 *Strigites strigifer*. – RULLEAU, pl. 5, figs. 4–5.
2000 *Strigoceras* sp. – HUXTABLE, p. 105.
2004 *Strigoceras* cf. *strigifer* (BUCKMAN). – KROBICKI & WIERZBOWSKI, pp. 73, 75.
2006 *Strigoceras strigifer* BUCKMAN. – RULLEAU, p. 112, pl. 88, fig. 1.
2006 *Strigoceras pseudostrigifer* MAUBEUGE. – RULLEAU, p. 112, pl. 88, fig. 2.

Fig. 10. *Strigoceras bessinum* BRASIL var. *symplectum* (BUCKMAN) (= holotype of *Ammonites truellei gracilis* QUENSTEDT 1986, pl. 69, fig. 10), lateral view; Spaichingen, SW Germany; Lower Bajocian, Humphriesioolith Formation, Humphriesianum Zone, probably *Poecilomorphus cycloides* horizon (after lithology of the matrix); IFGT, QUENSTEDT collection, without number. – ×1.


A
B
C

Taxonomic remarks. – The specific name *Ammonites truellei gracilis* QUENSTEDT, 1886 is not valid because it is preoccupied by the older homonym *Ammonites gracilis* ZIETEN, 1830 (for the treatment of QUENSTEDT's trinomina see CALLOMON et al. 2004a, b; International Commission on Zoological Nomenclature 2005). We replace this name by its next younger subjective synonym introduced by BRASIL (1895). *Strigites pseudostrigifer* MAUBEUGE, 1955 is based on a juvenile specimen from the Humphriesianum Zone of Switzerland and represents a coarser ribbed variety of the chronospecies *Strigoceras bessinum* BRASIL, 1895.

Holotype: BRASIL (1895, pl. 4, figs. 6–7), depository unknown, probably housed in the collections of the University of Caen, France.
Type locality: Vicinity of Bayeux, Normandy, France.
Type horizon: Oolithe ferrugineuse de Bayeux (Late Bajocian, Humphriesianum Zone, probably Romani Subzone, horizon à *Dorsetensia edouardiana*).
Stratigraphic range: Humphriesianum Zone.
Studied material: Ca. 25 specimens.
Records: England, France, Spain, Morocco, SW Germany, Switzerland, Southern Alps, Sicily, Polish Carpathians.

Diagnosis. – *Strigoceras* with slender cross section, one weakly developed lateral furrow; weak rectiradiate, polyschizotome ribbing.

Description. – See BRASIL (1895). The holotype of *Strigoceras bessinum* from the Humphriesianum Zone is a dwarf variant of this chronospecies, becoming almost smooth very early in ontogeny (see p. 44). Although the typical '*bessinum*' morphology seems to be restricted to the Humphriesianum Zone, where it is rather abundant, the average morphology is represented by much larger and stronger ribbed specimens figured here (see also RULLEAU 2006, figs. 1–2). These differ from the older chronospecies *S. languidum* (BUCKMAN) in a denser and more radiate ribbing at a medium growth stage. In the younger chronospecies *S. symplectum* (BUCKMAN) the lateral furrow is more accentuated, and the width of the cross section is larger. Morphologically transitional specimens are common. Taxonomically, they can be treated as variety *symplectum* (BUCKMAN) within the chronospecies *S. bessinum* (BRASIL) (e. g. Figs. 10, 11A, 12).

Measurements

	d	h	w	u	r/2	h/d	w/d	u/d
Holotype (after BRASIL 1895)	26.0	14.0	6.0	2.0	–	0.54	0.23	0.07
SMNS 65367 (Fig. 11C)	71.0	42.0	~14	3.7	30	0.59	0.20	0.05
SM X40233 (Fig. 11B)	75.7	43.0	(–)	5.2	–	0.57	–	0.07
SMNS 65368 (Fig. 12)	~104	61.7	~22	4.3	31	0.59	0.21	0.04

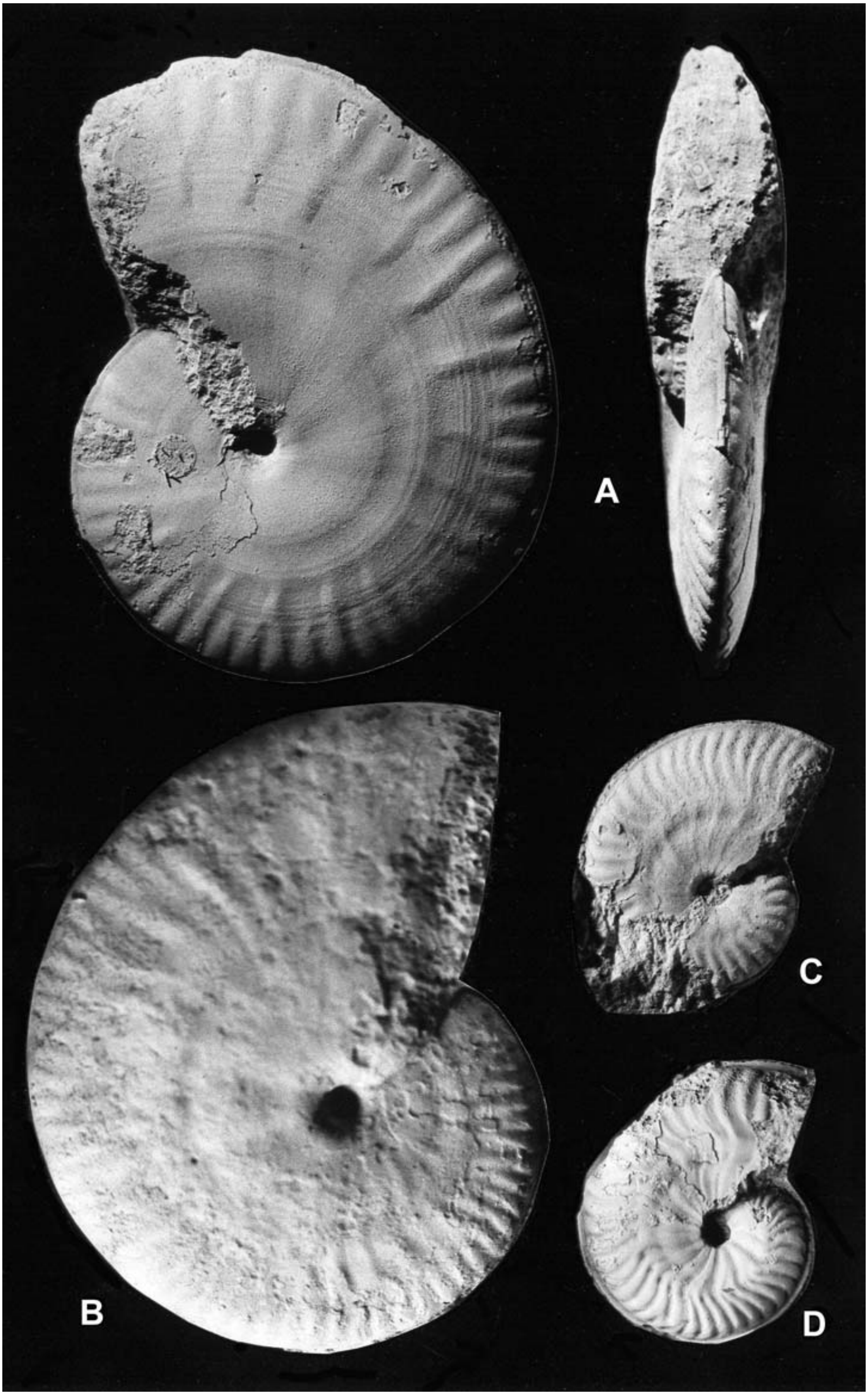
Fig. 11. A. *Strigoceras bessinum* BRASIL var. *symplectum* (BUCKMAN), lateral view; Oborne, Frogden Quarry, Inferior Oolite, bed 4b (section see CALLOMON 1995), Lower Bajocian, Humphriesianum Zone, Romani Subzone (horizon Bj-14b of CALLOMON 1995); SMNS 67154 (ex coll. V. DIETZE). **B**. *Strigoceras bessinum* BRASIL, lateral view; same locality and bed as Fig. 11A; SM X40233 (ex RBC collection). **C**. *Strigoceras bessinum* BRASIL var. *symplectum* (BUCKMAN), lateral view; Thurnau, Kanton Baselland, Switzerland; Humphriesioolith Formation, Lower Bajocian, Humphriesianum Zone, Humphriesianum Subzone; SMNS 65367. – ×1.

Fig. 12. *Strigoceras bessinum* BRASIL var. *symplectum* (BUCKMAN), lateral view; Öfingen, SW Germany; Humphriesioolith Formation, Lower Bajocian, Humphriesianum Zone, Humphriesianum Subzone, probably *Stephanoceras umbilicum* horizon; SMNS 65368 (ex coll. N. WANNENMACHER). – ×1.

Strigoceras symplectum (BUCKMAN, 1924)
Figs. 13–15, 16A–F

v pars 1886 *Ammonites Truellei trifurcatus.* – QUENSTEDT, p. 567, pl. 69, fig. 9, non fig. 8.
v ? 1886 *Ammonites Truellei.* – QUENSTEDT, p. 570, pl. 69, fig. 13.
1891 *Ammonites Truellei.* – HAUG, p. 74.
v 1893 *Strigoceras.* – BUCKMAN, p. 500.
1896 *Hecticoceras* (?) *pingue* PAR. – PARONA, p. 12, pl. 1, fig. 5.
1896 *Lunuloceras canovincola* DE GREG. – PARONA, p. 13, pl. 1, fig. 6.
1896 *Oppelia? propefusca* DE GREG. – PARONA, p. 14, pl. 1, figs. 8–9.
1906 *Strigoceras Truellei* D'ORB. – LISSAJOUS, p. 693.
1923 *Oppelia paronai.* – TRAUTH, pp. 183, 185. – [1923a].
? 1923 *Strigoceras Truellei* D'ORB. sp. – FALLOT & BLANCHET, pl. 4, fig. 8; pl. 6, fig. 5; pl. 9, fig. 4.
v * 1924 *Plectostrigites symplectus*, nov. – BUCKMAN, pl. 471.
v pars 1928 *Strigoceras Parkinsoni* QU. – SCHEURLEN, pl. 1, fig. 12, non figs. 13–16 [= *Phlycticeras dorsocavatum* (QUENSTEDT), see SCHWEIGERT & DIETZE 1998].
1939 *Strigoceras* cf. *strigifer* BUCKMAN. – ROCHÉ, p. 166, pl. 6, fig. 3.
1958 *Strigoceras* sp. juv. cf. *compressus.* – WILSON et al., p. 96.
pars 1964 *Strigoceras truellei.* – RIOULT, p. 245.

1968 *Strigoceras truellei*. – PAVIA & STURANI, p. 314.
1970 *Strigoceras truellei* (D'ORB.). – GALÁCZ, p. 118.
1971 *Strigoceras paronai* (TRAUTH). – STURANI, p. 121, pl. 4, figs. 1 (= lectotype), 2–5, 10.
1971 *Strigoceras truellei* (D'ORB.). – STURANI, p. 120, pl. 4, figs. 6–9.
1971 *Strigoceras* aff. *bessinum* BRASIL. – STURANI, p. 118, pl. 4, fig. 16.
1971 *Strigoceras* sp. ind. juv. cf. *septicarinatum* (S. BUCKM.). – STURANI, p. 120, pl. 16, fig. 9.
v 1971 *Strigoceras* sp. indet. – WENDT, pp. 157f.
1973 *Strigoceras truellei* (D'ORBIGNY). – PAVIA, pl. 16, fig. 10.
v pars 1974 *Strigoceras truellei* (D'ORB.). – DIETL, table 1.
v pars 1975 *Strigoceras truellei* (D'ORBIGNY). – HINKELBEIN, p. 153, tab.-figs. 11–12, 14.
v pars 1975 *Strigoceras septicarinatum* (BUCKMAN). – HINKELBEIN, tab.-figs. 11–12.
1976 *Strigoceras (Strigoceras)* sp. – PARSONS, pp.126, 129.
1978 *Strigoceras truellei* (D'ORB.). – SEQUEIROS et al., p. 297.
v 1979 *Strigoceras symplectum*. – DIETL & HUGGER, tab.-fig. 2.
v 1979 *Strigoceras septicarinatum*. – DIETL & HUGGER, tab.-fig. 2.
v 1979 *Strigoceras truelli*. – DIETL & HUGGER, tab.-fig. 2.
1979 *Strigoceras truelli*. – LINARES & SANDOVAL, text-figs. 2–3.
1980 *Strigoceras truellei* (D'ORBIGNY). – GALÁCZ, p. 54, pl. 11, fig. 4.
1982 *Strigoceras truellei*. – FERNÁNDEZ LÓPEZ, tab.-fig. 2.
1983 *Strigites pseudostrigifer*. – PAVIA, pl. 8, figs. 1–2.
pars 1983 *Strigoceras* aff. *strigifer* BUCK. – SANDOVAL, p. 122, figs. 67, 77A.
pars 1983 *Strigoceras* sp. – SANDOVAL, p. 122, figs. 67, 77A.
pars 1983 *S. truellei* "sensu" PAVIA. – SANDOVAL, p. 122, figs. 67, 77A.
pars 1983 *S. paronai* (TRAUTH). – SANDOVAL, p. 122, figs. 67, 77A.
1984 *Strigoceras strigifer*. – DIETL & PAVIA, p. 328.
1984 *Strigoceras pseudostrigifer*. – DIETL & PAVIA, pp. 328, 331, tab.-fig. 3.
1985 *Strigoceras truellei* (D'ORBIGNY) 1845. – FERNÁNDEZ LÓPEZ, p. 127, pl. 12, fig. 6.
1985 *Strigoceras* sp. nov. 1. – FERNÁNDEZ LÓPEZ, p. 137, pl. 13, fig. 3.
1985 *Strigoceras paronai* (TRAUTH) 1922. – FERNÁNDEZ LÓPEZ, p. 132, pl. 13, fig. 4.
pars 1985 *S. (Strigoceras) truellei* (D'ORBIGNY, 1845). – SANDOVAL, p. 98, pl. 2, fig. 4, non fig. 3 [= *S. truellei*].
1986 *Strigoceras (Liroxyites)* cf. *kellumi* IMLAY, 1961. – SANDOVAL & WESTERMANN, p. 123, figs. 12.5–12.6.
1990 *Strigoceras*. – HEGELE, p. 317.
1990 *Strigoceras truellei*. – SANDOVAL, tab.-fig. 7.
1991 *Strigoceras symplectus* (S. S. BUCKMAN). – HUXTABLE, p. 198.
1992 *Strigoceras (Liroxyites)* cf. *kellumi* IMLAY. – SALVADOR et al., p. 98.
v 1993 *Strigoceras truellei* (D'ORBIGNY), 1845. – BESNOSOV & MITTA, p. 23, pl. 1, figs. 4–6.
v 1993 *Strigoceras (Strigoceras) paronai* (TRAUTH), 1922. – BESNOSOV & MITTA, p. 24, pl. 1, fig. 7.
1994 *Strigoceras* sp. – BENHAMOU & ELMI, p. 274.
pars 1994 *Strigoceras* sp. – FERNÁNDEZ LOPÉZ & MOUTERDE, p. 122. – [1994a].
1995 *Strigoceras* cf. *truellei*. – GAUTHIER et al., p. 321.
1995 *Strigoceras truellei* (D'ORB.). – HEGELE, p. 222, fig. bottom right and p. 224, fig. bottom right.
1997 *Strigoceras septicarinatum*. – RIOULT et al., p. 50.
1997 *Strigoceras pseudostrigifer*. – RIOULT et al., p. 50.
1997 *Strigoceras symplectum*. – RIOULT et al., p. 50.
1998 *Strigoceras paronai* (TRAUTH). – FERNÁNDEZ LÓPEZ et al., tab.-fig. 3. – [1998a].
v 2000 *Strigoceras (Strigoceras) truellei* (D'ORBIGNY). – BESNOSOV & MITTA, pp. 13, 51, pl. 1, figs. 1–4.
v 2000 *Strigoceras (Strigoceras) paronai* (TRAUTH). – BESNOSOV & MITTA, pp. 13, 51, pl. 1, figs. 5–6.
2002 *Strigoceras truellei* (D'ORB.). – GAUTHIER et al., p. 82.


A
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D

Taxonomic remarks. – The specific name *Ammonites truellei trifurcatus* QUENSTEDT, 1886 is preoccupied by *Ammonites trifurcatus* REINECKE in ZIETEN (1830). The next youngest subjective synonym of this chronospecies is *S. paronai* introduced by TRAUTH (1923a). The lectotype of *S. paronai*, re-figured by STURANI (1971, pl. 4, fig. 1), is a juvenile specimen that does not differ significantly from the nuclei or juveniles of other chronospecies. The ammonites from the *Posidonia alpina* Bed are usually extremely small, immature and dwarfed. Macroconchs predominate due to current sorting in a high-energy environment on a pelagic submarine swell. This is clear because the corresponding microconchs *(Cadomoceras nepos)* exhibit normal diameters in the same bed. Larger specimens of the same age from other localities allow a much better understanding of this species. We take *S. paronai* as a nomen dubium, in favour of *Plectostrigites symplectus* BUCKMAN, 1924.

Holotype: BUCKMAN (1924, pl. 471), BGS GSM 37319, re-figured here as Fig. 13A.
Type locality: Frogden Quarry, Oborne, Dorset, England.
Type horizon: Inferior Oolite, bed 6a (for section see PARSONS 1979; Niortense Zone, Baculata Subzone, faunal horizon Bj-23 in CALLOMON 1995).
Stratigraphic range: Niortense Zone.
Studied material: Ca. 30 specimens.
Records: Spain, France, SW Germany, England, Algeria, Southern Alps, Sicily, Hungary, Caucasus (Dagestan), Turkmenistan, Mexico.

Diagnosis. – *Strigoceras* with a slender cross section, one deep, prominent median lateral furrow, and prorsiradiate polyschizotome ribbing.

Description. – See detailed description in SANDOVAL (1985: 96) for *Strigoceras paronai* (TRAUTH). The holotype of *S. symplectum* is a moderately large specimen, partly with shell preserved. It exhibits a prominent longitudinal striation, particular-

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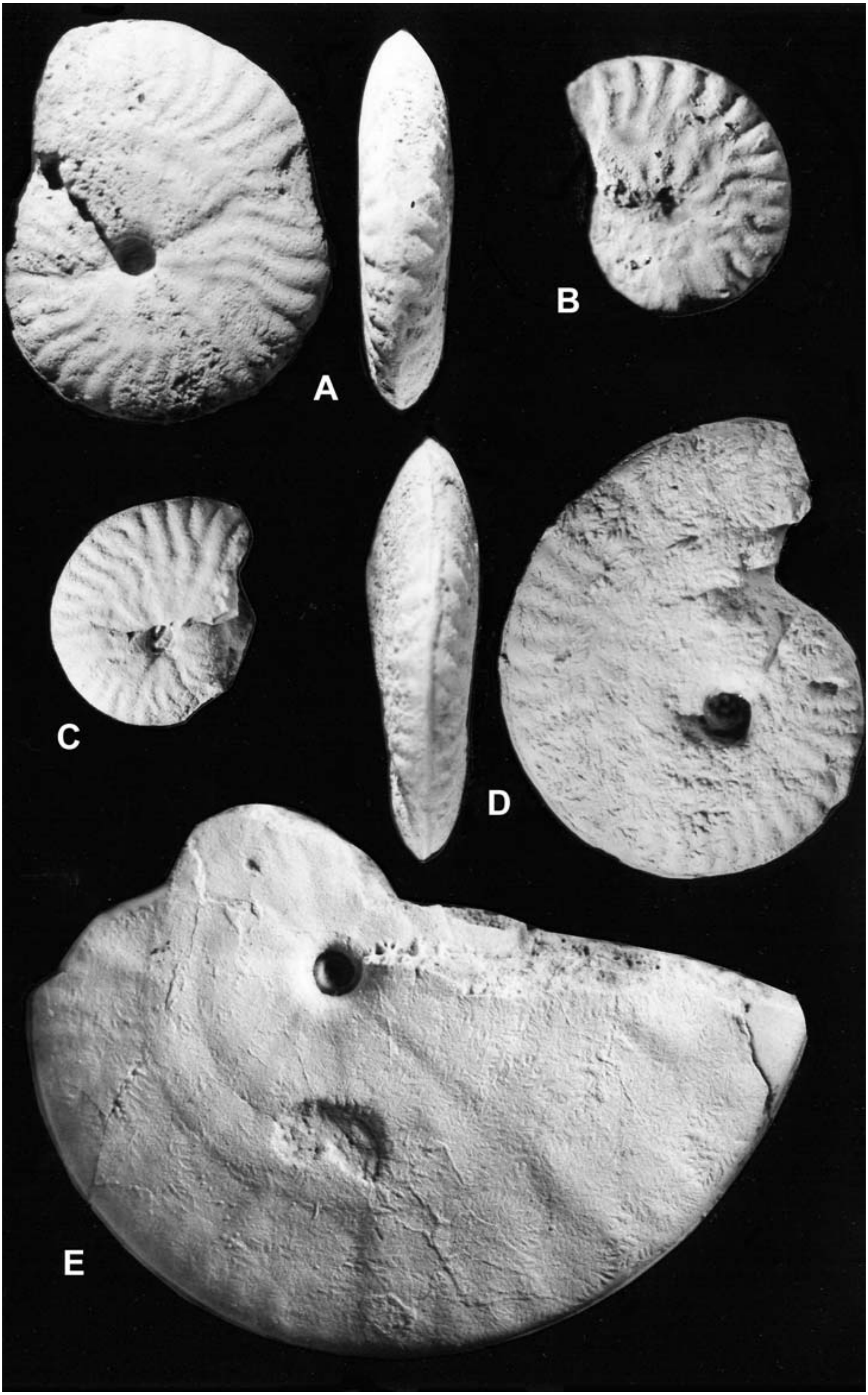
◀ **Fig. 13**. *Strigoceras symplectum* (BUCKMAN). **A**. Holotype, lateral and ventral views; Frogden Quarry, Oborne, Dorset, England; Inferior Oolite, bed 6a (for section see PARSONS 1979), Upper Bajocian, Niortense Zone, Baculata Subzone (horizon Bj-23 of CALLOMON 1995); BGS GSM 37319. **B**. Lateral view; Bretteville-sur-Odon, Normandy, France; Oolithe ferrugineuse de Bayeux, Upper Bajocian, Niortense Zone; SMNS 65377 (Coll. G. SCHWEIGERT). **C**. Topotype, lateral view; Oborne, Dorset, Frogden Quarry; Inferior Oolite, bed 6a (for section see PARSONS 1979), Upper Bajocian, Niortense Zone, Baculata Subzone (horizon Bj-23 of CALLOMON 1995); SMNS 65373 (leg. G. DIETL). **D**. Lateral view; Oborne, Dorset, Frogden Quarry; Inferior Oolite, bed 6a (for section see PARSONS 1979), Upper Bajocian, Niortense Zone, Banksii Subzone (horizon Bj-20 of CALLOMON 1995); SMNS 67155 (ex coll. V. DIETZE). – ×1.

Fig. 14. *Strigoceras symplectum* (BUCKMAN). **A**. Lateral and ventral views; Streichen near Balingen, SW Germany; Ostreenkalk Formation, Subfurcatenoolith Member, Lower Bajocian, Niortense Zone, Banksii Subzone; SMNS 65371 (leg. G. DIETL & M. KAPITZKE). **B**. Lateral view of a juvenile specimen; Zimmern near Balingen, SW Germany; Ostreenkalk Formation, Subfurcatenoolith Member, Upper Bajocian, Niortense Zone; SMNS 65372 (leg. G. DIETL & M. KAPITZKE). **C**. Lateral view of a juvenile specimen; Rabanera I, Keltiberian Ranges, NE Spain (for section see DIETL 1974: 6); Chelva Formation, Upper Bajocian, Niortense Zone; SMNS 65374 (leg. G. DIETL). **D**. Ventral and lateral views; Albarracín, Keltiberian Ranges, E Spain; Chelva Formation, bed 27f in section A of HINKELBEIN (1975, text-fig. 11), Upper Bajocian, Niortense Zone; SMNS 65375 (Coll. K. HINKELBEIN). **E**. Lateral view; motorway cut near Aichelberg, SW Germany; Ostreenkalk Formation, Subfurcatenoolith Member, Upper Bajocian, Niortense Zone, Polygyralis Subzone; SMNS 67156 (ex coll. V. DIETZE). – B ×1.5, others ×1. ▶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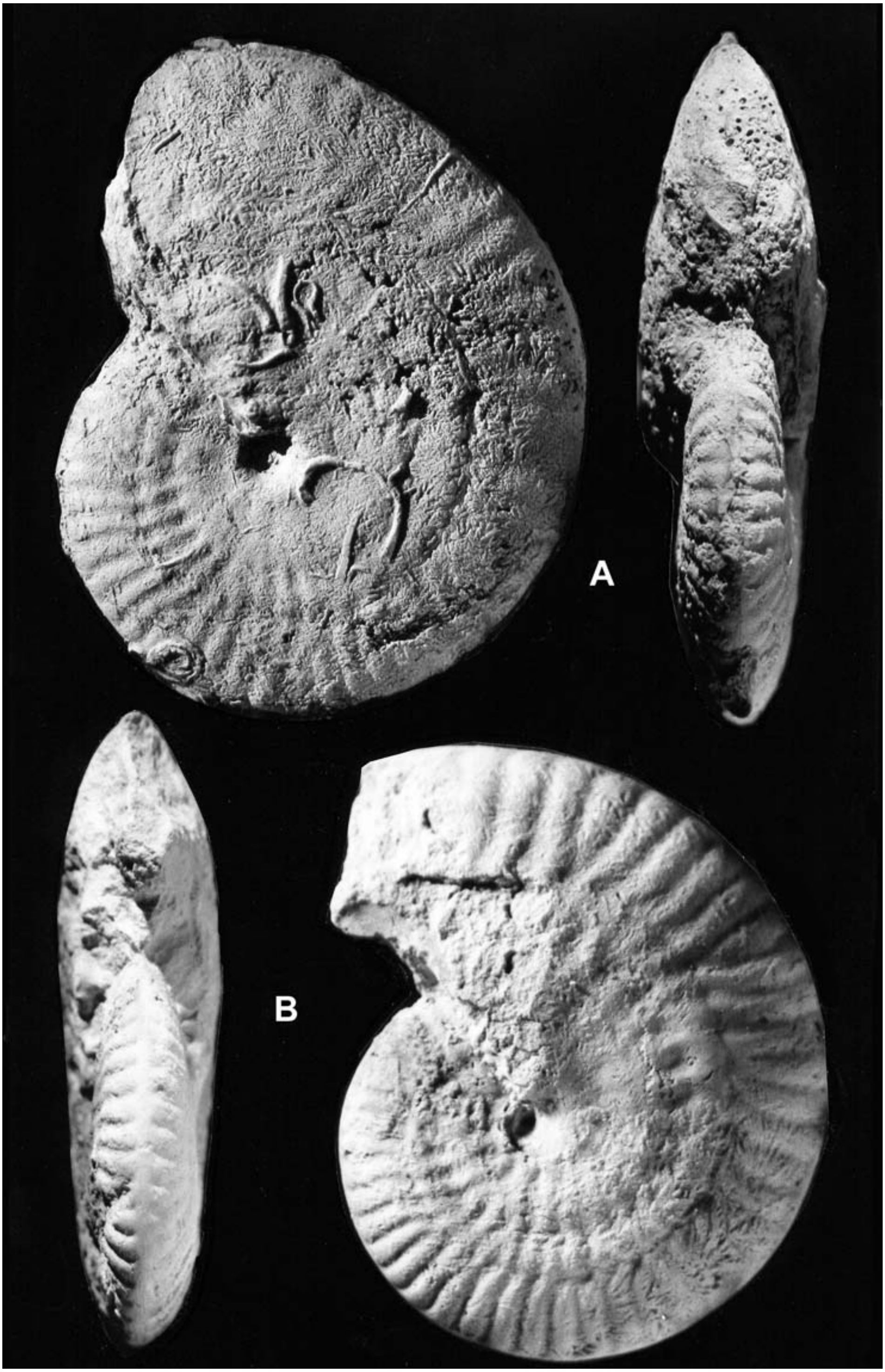
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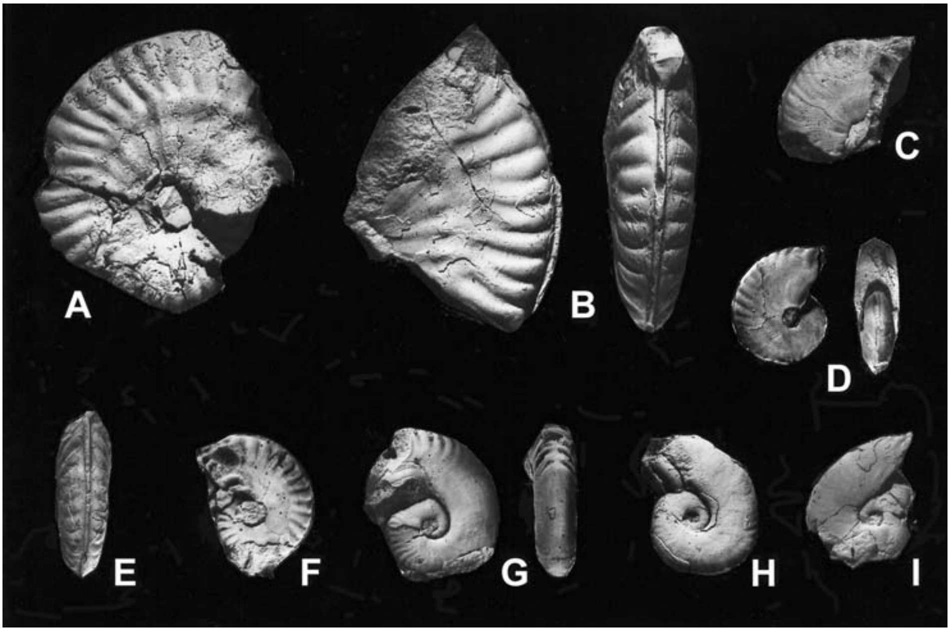


Fig. 16. **A–F** *Strigoceras symplectum* (BUCKMAN) and **G–I** corresponding microconch dimorph *Cadomoceras nepos* (PARONA); Upper Bajocian, Niortense Zone. **A, B, E, F**. West Turkmenistan, Great Balkhan Range, South of Porsaiman source; lower part of Tschaloi Formation; VNIGNI N 115/1985, N 115/7393, N 115/7390, N 115/1983. **C, D**. West Turkmenistan, Great Balkhan Range, South of Schorli source; lower part of Tschaloi Formation; VNIGNI N 115/7387, N 115/7391. **G, I**. West Turkmenistan, Great Balkhan Range, Karaiman source; lower part of Tschaloi Formation; NIGNI N 115/7287, N 115/7991. **H**. North Caucasus, Dagestan, section near the village Irganai; uppermost part of Kumuh Formation; VNIGNI N 115/7283. – ×1.

ly bordering the lateral furrows. This is shown clearly by BUCKMAN's shell rubbings. The rather widely-spaced ribbing is slightly prorsiradiate, polyschizotome, most with one or two secondaries intercalated between longer primaries. The ventral ends of the secondaries are truncated. Although the oxycone cross section is comparatively slender, the median longitudinal furrow is prominent. In large specimens weak furrows around the umbilicus are developed ventrally to the median furrow. This is seen due to a weakening of the striation in the furrows. In *S. symplectum* thicker specimens with coarse ribbing persisting to the innermost whorls occur rather frequently within the variability of the species.

◀ **Fig. 15**. *Strigoceras symplectum* (BUCKMAN), lateral and ventral views. **A**. Bisingen-Zimmern near Balingen, SW Germany; Ostreenkalk Formation, Subfurcatenoolith Member, Upper Bajocian, Niortense Zone; SMNS 67157 (leg. R. HUGGER). **B**. La Jeandonnière, Dept. Vendée, France; Upper Bajocian, ?Niortense or Garantiana Zone; SMNS 65378 (Coll. G. SCHWEIGERT). – ×1.

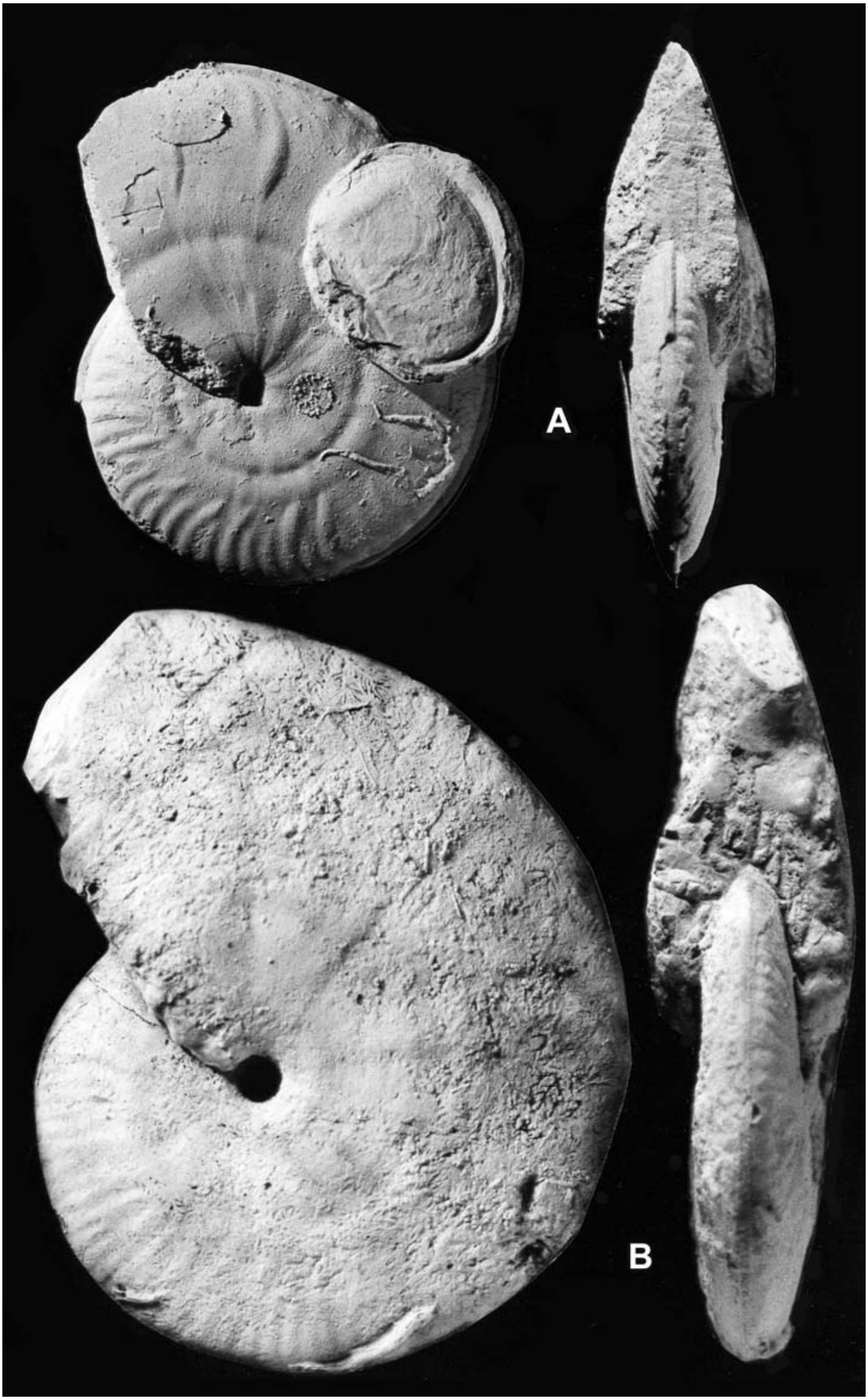
Measurements

	d	h	w	u	r/2	h/d	w/d	u/d
GSM 37319 (holotype)	91.0	53.5	20.0	4.5	25	0.59	0.22	0.05
SMNS 65371 (Fig. 14A)	58.0	30.7	14.3	5.5	20	0.53	0.25	0.09
SMNS 65378 (Fig. 15B)	85.0	50.0	22.5	4.1	29	0.59	0.26	0.05
SMNS 65377 (Fig. 13B)	95.0	54.3	22.5	4.8	36	0.57	0.24	0.05
SMNS 67157 (Fig. 15A)	99.0	57.0	25.7	5.8	24	0.58	0.26	0.06

Strigoceras septicarinatum (BUCKMAN, 1924)
Figs. 17, 18A, 19

v pars 1886 *Ammonites Truellei*. – QUENSTEDT, p. 565, pl. 69, figs. 11–12 only.
1912 *Strigoceras Truellei*, SOWERBY. – ROMAN & GENNEVAUX, p. 88, pl. 3, fig. 3.
v * 1924 *Strigites septicarinatus* nov. sp. – BUCKMAN, pl. 470.
? 1927 *Oppelia (Strigoceras) truellei* D'ORBIGNY. – ROMAN & PÉTOURAUD, p. 50.
1953 *Strigoceras* sp. – MOUTERDE, p. 211.
v ? 1963 *Strigites pseudostrigifer*. – WENDT, p. 118, pl. 17, fig. 3.
pars 1964 *Strigoceras truellei*. – RIOULT, p. 245.
1965 *Strigoceras truellei* (D'ORBIGNY). – MENSINK, p. 82.
1968 *Strigoceras truellei*. – PAVIA & STURANI, p. 314.
1970 *Strigoceras truellei* (D'ORB.). – GALÁCZ, p. 119.
1970 *Strigoceras septicarinatum*. – SENIOR et al., p. 117.
1970 *Strigoceras compressum*. – SENIOR et al., p. 117.
v pars 1974 *Strigoceras truellei* (D'ORB.). – DIETL, table 1.
v pars 1975 *Strigoceras truellei* (D'ORBIGNY). – HINKELBEIN, p. 156, tab.-figs. 11–12.
1982 *Strigoceras paronai*. – FERNÁNDEZ LÓPEZ, tab.-fig. 2.
1982 *Strigoceras truellei*. – FERNÁNDEZ LÓPEZ, tab.-fig. 2.
1983 *Strigites paronai* (TRAUTH). – PAVIA, p. 69, pl. 8, fig. 3.
1983 *Strigoceras* sp. – SANDOVAL, tab.-figs. 21, 26, 36, 41, 48.
1983 *Strigoceras* cf. *truellei* (D'ORB.). – SANDOVAL, tab.-figs. 29, 48, 67.
1983 *Strigoceras truellei* (D'ORB.). – SANDOVAL, tab.-figs. 67, 68, 69, 77A.
1983 *Strigoceras paronai* (TRAUTH). – SANDOVAL, tab.-figs. 69, 77A.
v 1985 *Strigoceras septicarinatum* BUCKM. 1924. – SCHLEGELMILCH, pl. 21, fig. 2 (re-figuration of BUCKMAN's holotype).
1986 *Strigoceras* cf. *pseudostrigifer* (MAUBEUGE, 1955). – SANDOVAL & WESTERMANN, p. 1230, pl. 12, figs. 3–4.
? 1987 *Strigoceras simplectum* (BUCKM.). – ENAY et al., p. 112.
1988 *Strigoceras septicarinatum*. – FERNÁNDEZ LÓPEZ & AURELL, tab.-fig. 4.
1990 *Strigoceras* sp. – SANDOVAL, tab.-fig. 3.
1991 *Strigoceras* sp. – HUXTABLE, p. 197.
1994 *Strigoceras* sp. – SANDOVAL, pl. 2, fig. 5.
1995 *Strigoceras paronai*. – GAUTHIER et al., p. 322.
1996 *Strigoceras symplectum*. – GAUTHIER et al., pl. 8, fig. 4.
1997 *Strigoceras*. – RIOULT et al., p. 51.
1997 *Strigoceras* cf. *paronai*. – FERNÁNDEZ LÓPEZ et al., tab.-fig. 12.
1997 *Strigoceras* cf. *truellei*. – FERNÁNDEZ LÓPEZ et al., tab.-fig. 12.
1997 *Strigoceras trullei* (D'ORBIGNY 1845). – SCHLAMPP, p. 194, fig. top right.
v ? 2000 *Strigoceras paronai*. – BESNOSOV & MITTA, pl. 1, figs. 5–6.
v 2002 *Strigoceras* sp. – DIETZE et al., p. 40.
v 2002 *Strigoceras* sp. – SCHWEIGERT et al., p. 9.
2003 *Strigoceras truellei* (ORBIGNY). – RICHTER, p. 331, text-fig. bottom.
v 2004 *Strigoceras septicarinatum* (S. BUCKMAN). – DIETZE et al., p. 68.

Holotype: BUCKMAN (1924, pl. 470), BGS GSM 37318, re-figured here as Fig. 17A.
Type locality: Burton Bradstock, Dorset, England.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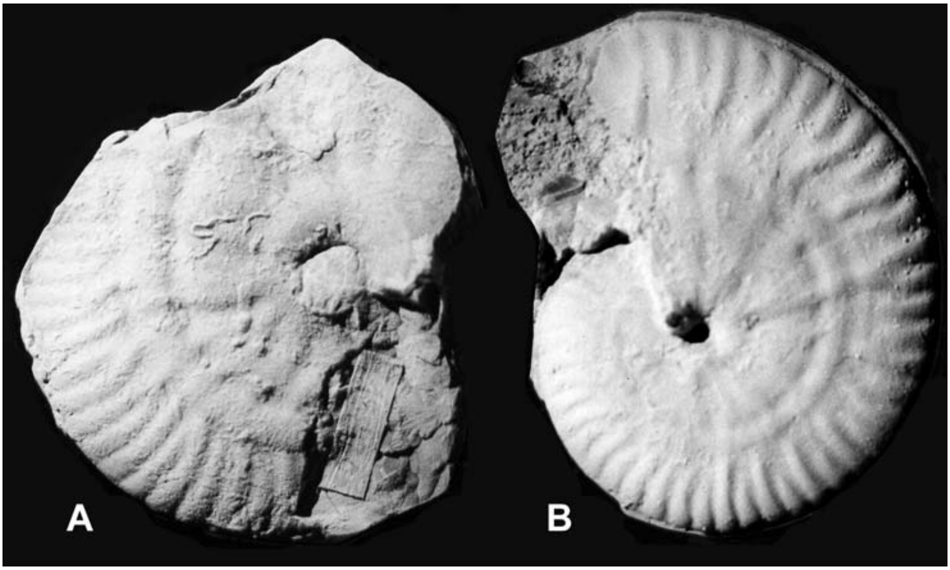

Fig. 18. **A**. *Strigoceras septicarinatum* (BUCKMAN) var. *truellei* (D'ORBIGNY), lateral view; Villel, Keltiberian Ranges, E Spain; bed 19 in section E of HINKELBEIN (1975, fig. 12), Upper Bajocian, Garantiana Zone; SMNS 65376 (Coll. K. HINKELBEIN). **B**. *Strigoceras truellei* (D'ORBIGNY) var. *septicarinatum* BUCKMAN, lateral view; Burton Bradstock, Freshwater Caravan Park; Inferior Oolite, Upper Bajocian, Parkinsoni Zone, Acris Subzone, *Parkinsonia rarecostata* horizon (= horizon Bj-26b of CALLOMON 1995); SM X.29151 (leg. D. SOLE, ex RBC collection). – ×1.

Type horizon: Inferior Oolite, Shell Bed P. I of BUCKMAN 1910 (Parkinsoni Zone, Acris Subzone, *rarecostata* horizon, see DIETZE 2000; CHANDLER et al. 2001; DIETZE et al. 2002).

Stratigraphic range: Garantiana Zone to early Parkinsoni Zone (Acris Subzone).

Studied material: 30 specimens.

Records: S Germany, Spain, France, England, Hungary, Southern Alps, Turkmenistan, Alaska (Wrangellia Terrane), Morocco, Mexico, ?Sicily.

Diagnosis. – *Strigoceras* with two well-developed lateral furrows separated by a marked ridge, extremely narrow umbilicus, juvenile sculpture strong, irregularly polyschizotome, lunulate secondary ribbing with a swollen point of bifurcation.

Description. – The holotype of *Strigoceras septicarinatum* (BUCKMAN) is a small adult specimen with most of the striate shell preserved on both flanks. The specimen is a phragmocone with about one half whorl of bodychamber. One flank is encrusted by several serpulids and an oyster. The cross section is oxyconic with a low rounded keel. The umbilicus is extremely narrow. There are two lateral furrows developed parallel to an enclosed ridge. The primary ribs are very weak with

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Fig. 17. *Strigoceras septicarinatum* (BUCKMAN), lateral and ventral views. **A**. Holotype. Burton Bradstock, Dorset, England; Inferior Oolite, Shell Bed P. I of BUCKMAN 1910, Upper Bajocian, Parkinsoni Zone, Acris Subzone, *Parkinsonia rarecostata* horizon; BGS GSM 37318. **B**. Bopfingen-Oberdorf, SW Germany; Sengenthal Formation, Bifurcatenoolith Member, bed B3 in DIETZE et al. (2002), Upper Bajocian, Garantiana Zone, Garantiana Subzone, *Garantiana subgaranti* horizon; SMNS 67158 (ex coll. V. DIETZE). – ×1.

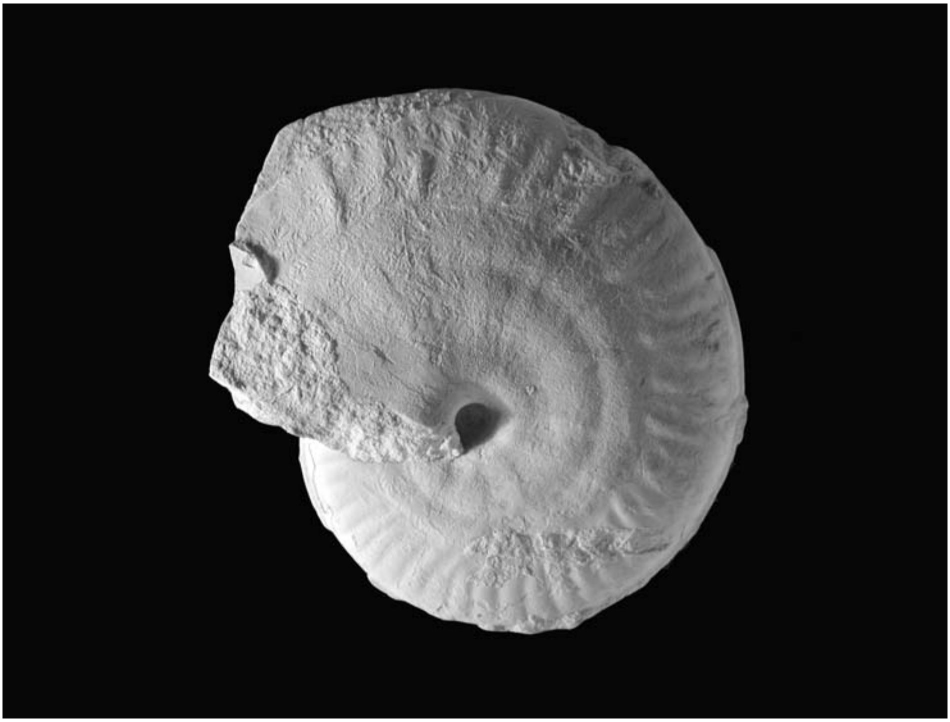


Fig. 19. *Strigoceras septicarinatum* (Buckman), lateral view; Southern Alaska, Talkeetna Mountains, Boulder Creek area, 26 km NE of Chickaloon (Imlay 1980: fig. 1, block 2), US co-ordinates Anchorage D-3 quadrangle, R7E, T22N, SE1/4; 148° 5′40″W, 61° 58′10″N; ca. 1 km E of Imlay's locality 17 (Imlay 1980: fig. 9); altitude ca. 1680 m; Tuxedni Group, lower Chinitna Formation (Wrangellia Terrane), Upper Bajocian, ?Garantiana Zone – Parkinsoni Zone, Acris Subzone; University of Alaska Museum, Fairbanks, AK, Earth Sciences, no. A 2489.11a (leg. J. H. Callomon & R. C. Allison). – Diameter of specimen 110 mm.

stronger secondaries that are falcoid, with some swollen bifurcation points. On the bodychamber these become weak, with some retaining a swollen crescent ornament. In larger specimens the ribbing resembles that of the phragmocone of the holotype, but persists later in ontogeny.

Comparisons. – *S. septicarinatum* (Buckman) represents a direct phyletic ancestor of *S. truellei* differing from it in possessing a generally more slender whorl section and stronger lateral furrows. Nodular swelling of the primaries is very typical of this chronospecies, otherwise seen only in some coarsely ribbed variants of *S. truellei*. Within the variation of the chronospecies *S. septicarinatum* (Buckman) there are some morphologically transient forms in which swollen ribs only rarely occur, here treated as *S. septicarinatum* (Buckman) var. *truellei* (e. g. Fig. 18A). In the older chronospecies *S. symplectum* (Buckman), swollen primaries may occur only exceptionally in some extreme variants.

Identification of a well-preserved specimen of *S. septicarinatum* (Buckman) in a Middle Jurassic section of the Wrangellia Terrane in southern Alaska (Fig. 19) provides an estimate of the age. Soft shales with scattered fossiliferous concretions (Tuxedni Group, lower Chinitna Formation) occur at levels probably equivalent to

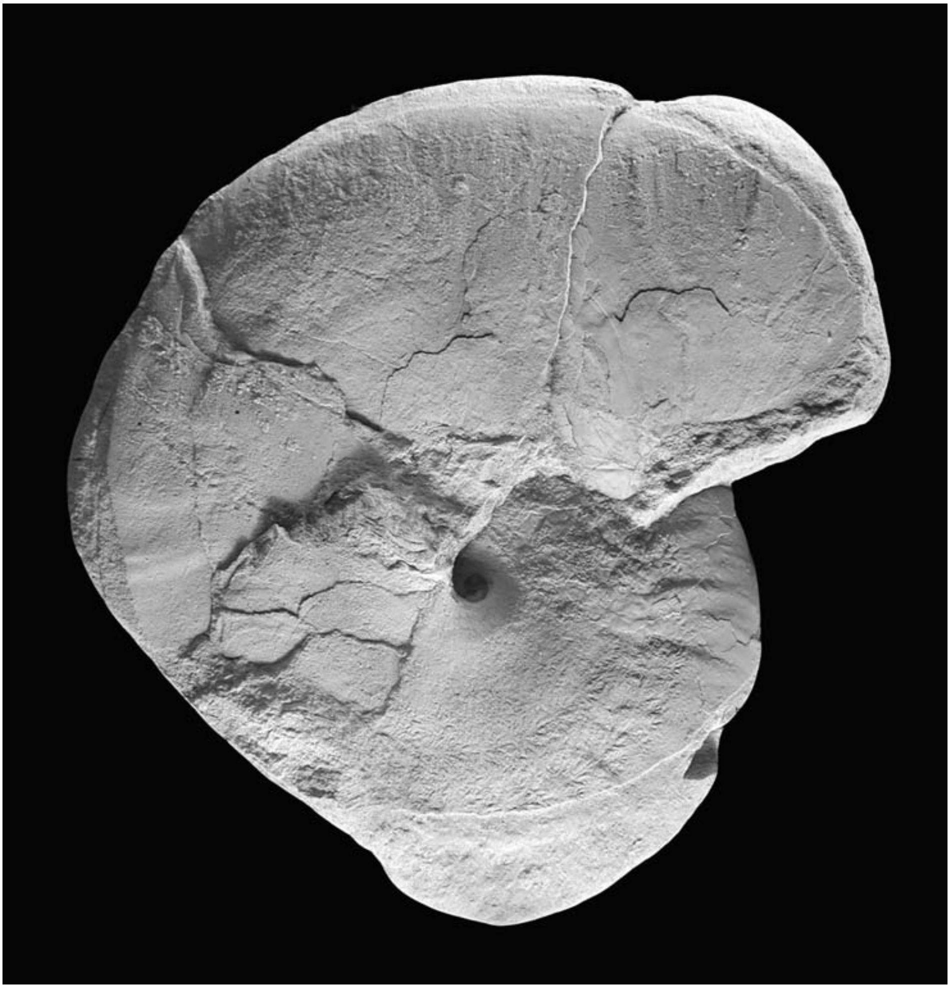


Fig. 20. *Oxycerites* cf. *aspidoides* (OPPEL), lateral view; same locality and bed as Fig. 19. University of Alaska Museum, Fairbanks, AK, Earth Sciences, no. A 2489.10 (leg. J. H. CALLOMON & R. C. ALLISON). – Diameter of specimen 140 mm.

the upper part of the *Cranocephalites costidensus* Beds in IMLAY's section (see IMLAY 1980, fig. 4). The specimen was found together with *Oxycerites* cf. *aspidoides* (OPPEL) (Fig. 20). The lectotype of *Oxycerites aspidoides* comes from the Upper Bajocian, late Parkinsoni Zone, of SW Germany (DIETL 1982). This *Strigoceras* is recorded as being slightly older, the equivalent of the Garantiana Zone or at least Acris Subzone of the early Parkinsoni Zone.

Measurements

	d	h	w	u	r/2	h/d	w/d	u/d
GSM 37318 (holotype)	74.5	44.5	19.0	1.5	~25	0.60	0.26	0.01
SMNS 67158 (Fig. 17B)	104.7	57.0	28.2	4.3	28	0.54	0.27	0.04

Strigoceras truellei (d'Orbigny, 1845)
Figs. 18B, 21–24

v *1845 *Ammonites Truellei.* – d'Orbigny, pl. 117, figs. 1–3 (= lectotype), pl. 129, figs. 1–2.

1856 *Ammonites Truellei* d'Orb. 1845. – Oppel, p. 492.

v 1857 *Ammonites truellei.* – Quenstedt, p. 525, pl. 69, fig. 23.

1860 *Ammonites Truellei* d'Orbigny 1845. – Ooster, p. 61.

v non 1865 *Ammonites Truellei* Orbigny. – Schloenbach, p. 173, pl. 3, fig. 2 (= *Phlycticeras dorsocavatum* (Quenstedt), see Schweigert & Dietze 1998).

pars 1878 *Amaltheus Truellei.* – Neumayr, p. 68.

1878 *Oppelia Truellei* d'Orbigny, sp. – Bayle, pl. 89, figs. 1, 3–4.

1884 *Amaltheus Truellei.* – Douvillé, pp. 34–35, text-fig. 16.

v pars 1886 *Ammonites Truellei.* – Quenstedt, p. 565, pl. 69, fig. 7 only.

v pars 1886 *Ammonites Truellei trifurcatus.* – Quenstedt, pl. 69, fig. 8 only [Fig. 21B].

1893 *Strigoceras Truellei.* – Buckman, p. 487.

1896 *A. Truellei* d'Orb. – Koken, p. 648.

1906 *Strigoceras Truellei* d'Orb. – Lissajous, p. 694.

1908 *Amaltheus (Strigoceras) Truellei.* – Engel, pp. 329, 340.

1910 *Strigoceras truellei.* – Buckman, pp. 55, 73.

? 1923 *Strigoceras Truellei* d'Orb. sp. – Trauth, p. 228. – [1923a].

v 1924 *Strigoceras truellei* d'Orbigny sp. 1846. – Buckman, pl. 472.

v 1924 *Strigoceras gracile* Quenstedt sp. – Buckman, pl. 585.

v 1928 *Strigoceras Truellei* d'Orb. – Scheurlen, p. 7, pl. 1, figs. 5, 7–11.

1935 *Strigoceras Truellei* d'Orb. sp. – Bircher, p. 133, tab. D.

v 1938 *Strigoceras Truellei* d'Orb. – Roman, pl. 17, fig. 178. – [re-figuration of holotype]

1939 *Strigoceras symplectus.* – Roché, p. 166.

1939 *Strigoceras septicarinatus.* – Roché, p. 166.

1952 *Strigoceras truellei.* – Kumm, p. 430.

1955 *Strigoceras truellei* (d'Orb.). – Westermann, p. 521.

1956 *Strigoceras truellei.* – Arkell, p. 366.

1957 *Strigoceras truellei* (Orb.). – Arkell, p. L272, text-fig. 314.1.

1958 *Strigoceras* aff. *truellei* (d'Orb.). – Wilson et al., p. 91.

1961 *Strigoceras truellei* (d'Orbigny). – Dollfuss, p. 95, pl. 2, fig. 4.

v 1963 *Strigoceras kuznetsovi* sp. nov. – Krymholtz & Stankevitch, p. 112, pl. 1, figs. 6–7.

1964 *Strigoceras truellei* (d'Orbigny). – Sturani, pl. 2, fig. 1. – [1964a].

1964 *Strigoceras truellei* (d'Orbigny). – Sturani, p. 37, pl. 5, fig. 6. – [1964b].

1964 *Strigoceras truellei.* – Hölder, p. 90.

1964 *Strigoceras truellei.* – Rioult, p. 246.

1968 *Strigoceras truellei.* – Pavia & Sturani, p. 315.

non 1969 *Strigoceras septicarinatum* (Buckman). – Mihajlovic, p. 61, pl. 2, fig. 6, pl. 3, fig. 1 (= *Prohecticoceras bisculptum* (Oppel), see Galácz 1999: 156).

1969 *Strigoceras gracilis* (Quenstedt). – Torrens, p. 327.

1969 *Strigoceras septicarinatus* S. S. Buckman. – Torrens, p. 327.

1970 *Strigoceras* cf. *truellei* (d'Orb.). – Galácz, p. 119.

1970 *Strigoceras septicarinatum* (Buckman). – Senior et al., pp. 114, 117.

1970 *Strigoceras truellei* (d'Orb.) – Senior et al., p. 116.

1970 *Strigoceras compressum* Etheridge. – Senior et al., p. 117.

1971 *Strigoceras truellei* (d'Orb.). – Rioult, p. 380.

1971 *Strigoceras truellei* (d'Orb.). – Sturani, p. 69.

1971 *Strigoceras truellei* (d'Orbigny). – Krystyn, p. 498.

1972 *Strigoceras truellei* (d'Orbigny). – Krystyn, p. 246, text-fig. 15.

pars 1973 *Strigoceras truellei.* – Pavia, table 3.

v 1977 *Strigoceras truellei.* – Dietl, p. 16.

v 1977 *Strigoceras truellei* d'Orb. – Benetti, p. 232, text-figs. 10–11.

1978 *Strigoceras* sp. – Sequeiros et al., p. 297.

1980 *Strigoceras truellei*. – GALÁCZ, p. 55.
1982 *Strigoceras truellei* (ORBIGNY). – RICHTER, text-fig. 143.
1983 *Strigoceras truellei* (D'ORB.). – SANDOVAL, p. 123, tab.-figs. 8, 20, 21, 77A.
v 1985 *Strigoceras truellei*. – ROSTOVTSEV, pl. 34, figs. 8–9.
pars 1985 *S. (Strigoceras) truellei* (D'ORBIGNY, 1845). – SANDOVAL, p. 98, pl. 2, fig. 3, non fig. 4 [= *S. paronai*].
1985 *Strigoceras septicarinatum* (BUCKMAN). – FERNÁNDEZ LÓPEZ, pl. 13, fig. 5.
v 1985 *Strigoceras truellei* (D'ORB. 1845). – SCHLEGELMILCH, pl. 20, fig. 5.
1987 *Strigoceras truellei*. – DORÉ et al., pl. 5, fig. 6.
1987 *Strigoceras symplectum*. – ENAY et al., p. 112, tab.-fig. 2.
1988 *Strigoceras septicarinatum* (BUCK.). – FERNÁNDEZ LÓPEZ, p. 78.
1988 *Strigoceras truellei* (ORBIGNY). – GÓMEZ-ALBA, pl. 208, fig. 1.
1990 *Strigoceras truellei*. – SANDOVAL, pl. 4, fig. 7.
v 1992 *Strigoceras truellei* ORB. – ROSTOVTSEV, pp. 106, 134.
v 1994 *Strigoceras truellei*. – RIOULT et al. in FISCHER, pl. 50, figs. 1–2.
1995 *Strigoceras truellei* (D'ORBIGNY). – CALLOMON & COPE, p. 65.
1995 *Strigoceras septicarinatus* BUCKMAN. – CALLOMON & COPE, p. 66.
1997 *Strigoceras truellei* (D'ORB.). – RIOULT et al., pl. 15, fig. 7.
1998 *Strigoceras compressum*. – PAVIA & MARTIRE, p. 173.
1998 *Strigoceras septicarinatum*. – PAVIA & MARTIRE, p. 173.
v 1999 *Strigoceras truellei*. – SCHWEIGERT & DIETZE, p. 55.
v 2001 *Strigoceras truellei* (D'ORB. 1845). – ARP, p. 214, pl. 6, fig. 4.
2002 *Strigoceras truellei* (D'ORBIGNY). – DI STEFANO et al., p. 288.
2002 *Strigoceras* cf. *septicarinatum* (BUCKMAN). – D'ARPA in: PAVIA & CRESTA, p. 199, fig. 131.
2002 *Strigoceras truellei* (D'ORBIGNY, 1845). – SCHLÖGL, pl. 15, fig. 1.
v 2003 *Strigoceras truellei*. – CHANDLER & DIETZE, p. 39.
2004 *Strigoceras (Strigoceras)*. – ZATOŃ & MARYNOWSKI, p. 342.
2005 *Strigoceras truellei* (D'ORBIGNY, 1845). – SCHLÖGL et al., p. 343, pl. 3, fig. 4.
2006 *Strigoceras (Strigoceras)* sp. indet. juv. gr. *strigifer/pseudostrigifer*. – ZATOŃ & MARYNOWSKI, p. 435, fig. 3.14.
v 2006 *Strigoceras truellei* (D'ORBIGNY). – DIETZE & DIETL, p. 10, fig. 6.

Lectotype: D'ORBIGNY (1845, pl. 117, figs. 1–3) MNHN IPM-R 4117 (coll. D'ORBIGNY no. 2135-1), designated as "holotype" by RIOULT et al. in FISCHER (1994: 103); re-figured here as Fig. 21A. This specimen is very close to the illustration of D'ORBIGNY's specimen, although there are 3 syntypes in D'ORBIGNY's collection. Hence the "holotype" may be considered as a lectotype.

Type locality: Vicinity of Bayeux, Calvados, France.

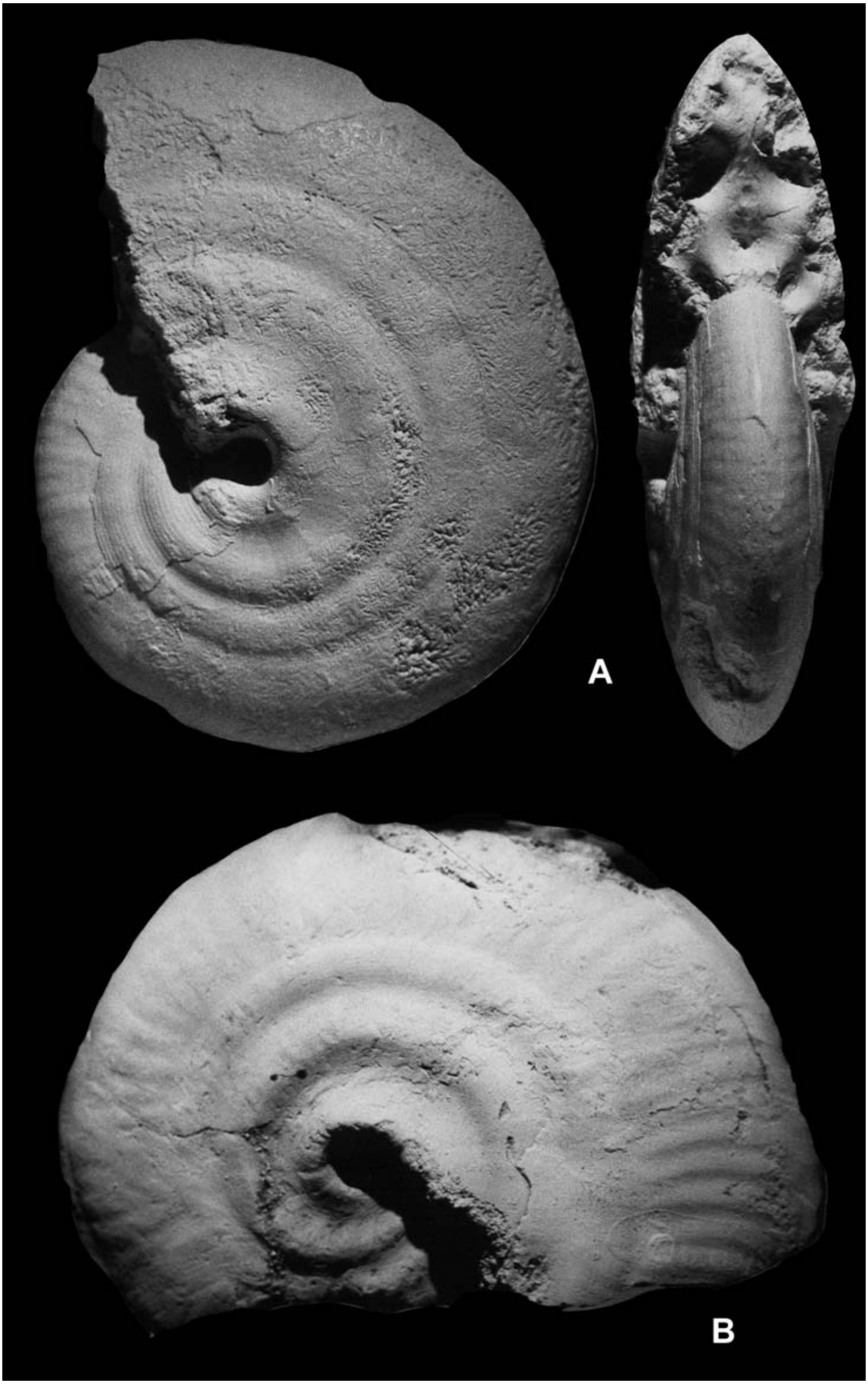
Type horizon: Oolithe ferrugineuse de Bayeux (Late Bajocian, Parkinsoni Zone, Truellei Subzone).

Stratigraphic range: Middle Parkinsoni Zone (Truellei Subzone) – late Parkinsoni Zone (Bomfordi Subzone).

Studied material: Ca. 25 specimens.

Records: France, England, SW Germany, Central Poland, Switzerland, S Spain, Southern Alps, Eastern Alps, Carpathians, W Sicily, Hungary, Caucasus.

Fig. 21. *Strigoceras truellei* (D'ORBIGNY). **A**. Lectotype, lateral and ventral views; surroundings of Bayeux, France; Oolithe ferrugineuse de Bayeux, Upper Bajocian, Parkinsoni Zone; MNHN IPM-R 4117 (coll. D'ORBIGNY no. 2135-1). **B**. Original specimen of *Ammonites truellei trifurcatus* QUENSTEDT 1886, pl. 69, fig. 8, lateral view; according to lithology not coming from "Oberer Brauner Jura delta of Geisingen" as indicated on the label and in the publication, but from the Sengenthal Formation, Parkinsonienoolith Member of the Ipf area in eastern Swabia; Upper Bajocian, Parkinsoni Zone, Truellei Subzone; IFGT, QUENSTEDT collection, without number. – A: ×2/3, B: ×0.5. ▶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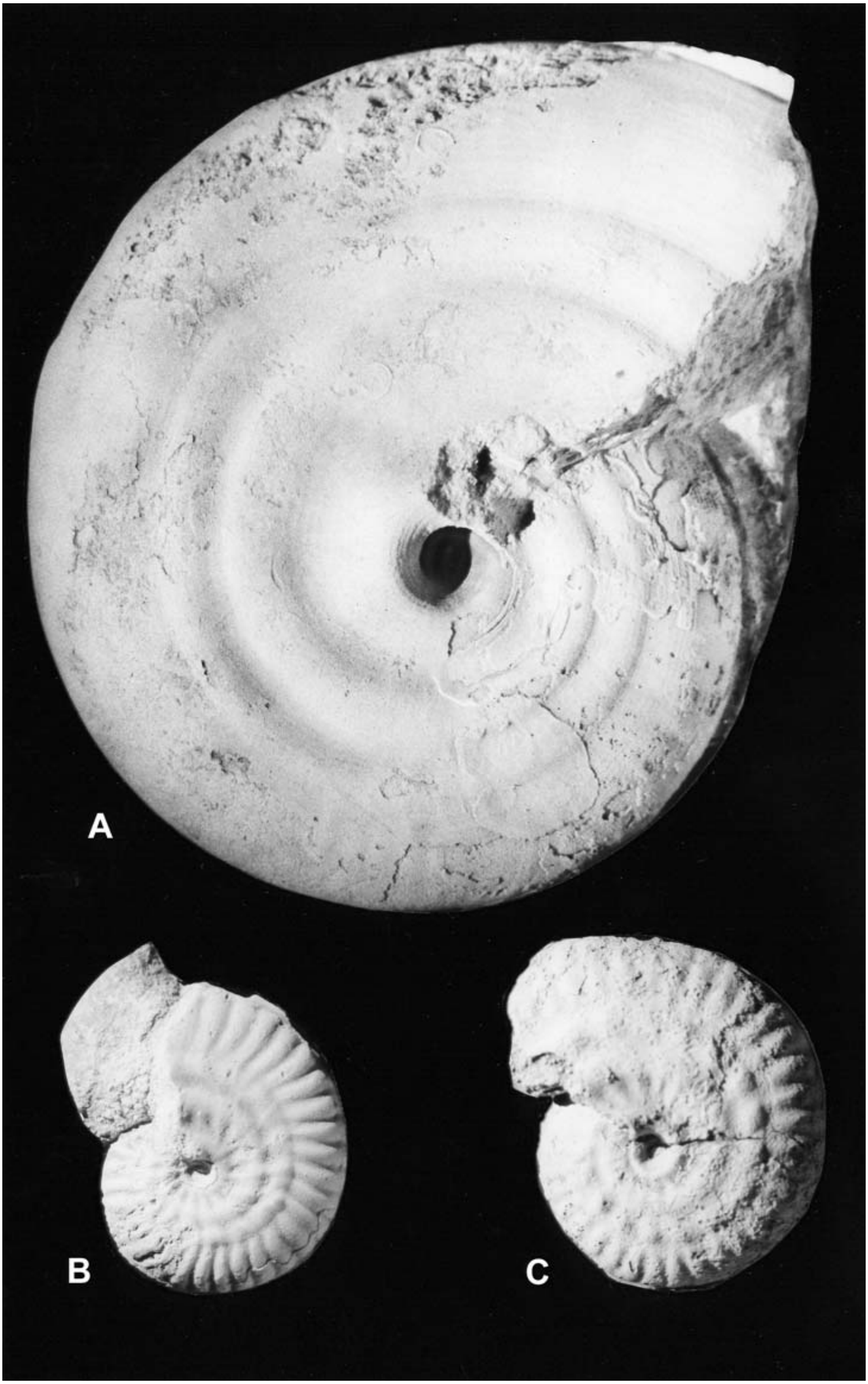
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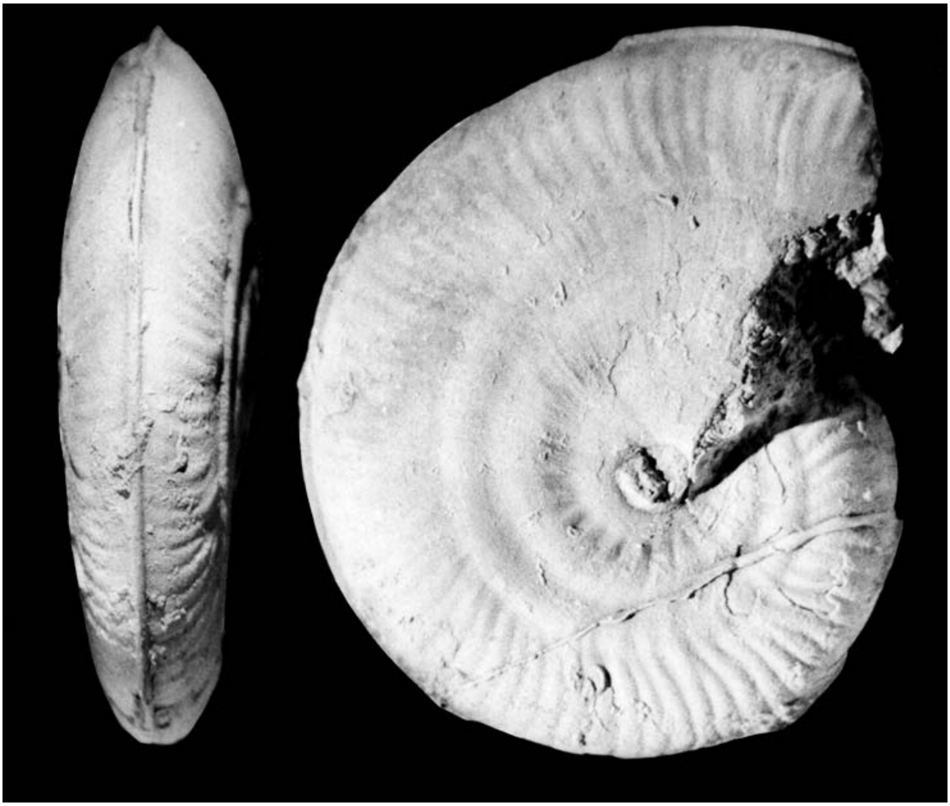

Fig. 23. *Strigoceras truellei* (D'ORBIGNY), ventral and lateral views of a relatively slender and fine-ribbed specimen; Burton Bradstock, beach exposure; Inferior Oolite, Truellei Bed (bed 13 b of CALLOMON & CHANDLER 1994), Upper Bajocian, Parkinsoni Zone, Truellei Subzone, *Parkinsonia parkinsoni* β horizon; SM X40234 (ex RBC collection). – ×1.

Diagnosis. – *Strigoceras* showing three well-developed lateral furrows or depressions. It attains the broadest shell morphology for the genus.

Description. – For details see RIOULT et al. (1994). The lectotype of *S. truellei* is a relatively large, completely septate, discoid phragmocone with remnants of the shell. The umbilicus is extraordinarily deep with a steep but rounded umbilical shoulder. Three longitudinal furrows are developed, the umbilical one being the broadest. The low, rounded keel is not preserved in the lectotype. The sculpture

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◀ **Fig. 22**. *Strigoceras truellei* (D'ORBIGNY). **A**. Lateral view. Burton Bradstock, Dorset, beach exposure; Inferior Oolite, Truellei Bed (bed 13 b of CALLOMON & CHANDLER 1994), Upper Bajocian, Parkinsoni Zone, Truellei Subzone, *parkinsoni* β horizon; SMNS 67159 (ex coll. V. DIETZE). **B**. Lateral view; same locality and horizon as Fig. A; SMNS 65381 (ex coll. N. SCHAFFELD). **C**. Lateral view (= original specimen figured by DIETZE & DIETL 2006, fig. 6). Bopfingen, SW Germany, Oberer Kreuzheckenweg; Sengenthal Formation, Parkinsonienoolith Member, Upper Bajocian, Parkinsoni Zone, Truellei Subzone; SMNS 66129 (leg. H.-D. BOLTER). – ×1.

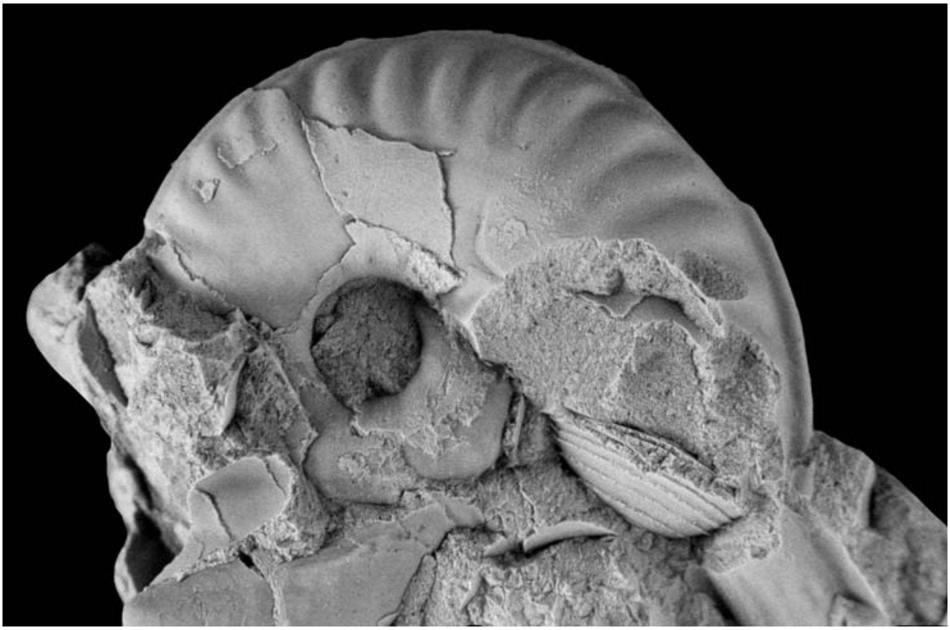

Fig. 24. *Strigoceras truellei* (D'ORBIGNY), juvenile specimen; Kawodrza Górna (brick-pit "Sowa") near Czêstochowa, Central Poland; Upper Bajocian, Parkinsoni Zone, Bomfordi Subzone; GIUS-8-2456. – Diameter of specimen 14.3 mm.

consists of weak or feeble primaries and stronger, slightly prorsiradiate secondaries. One primary rib usually gives rise to three secondaries. The shell is smooth anterior to the last half of the outer whorl.

Comparisons. – Compared to many older chronospecies, *S. truellei* is quite common in the "Truellei Beds" of N France and S England. The great variability from compressed to stout forms is clearly due to the large sample size. Nevertheless we did not find any of the older chronospecies equivalent in the broadness of the shell. The development of three lateral furrows is clearest in the broader and larger specimens, in which the umbilical wall is slightly overhanging. Some specimens are already adult at a small diameter. These have a minute umbilicus and distinct nodular primaries strongly resembling those in the ancestral *S. septicarinatum* (BUCKMAN). These specimens may be taxonomically treated as a *septicarinatum* variety of *S. truellei* (e. g. Fig. 18B). In coarsely ribbed specimens the lateral furrows are often "segmented" by crossing primaries.

The contemporaneous *Phlycticeras buckmani* (BRASIL) differs from slender specimens of *S. truellei* by possession of a different type of keel, a wider umbilicus and the lack of lateral furrows (SCHWEIGERT & DIETZE 2004).

Remarks. – A single juvenile specimen (Fig. 24) from Central Poland is the only record from that area (ZATOŃ & MARYNOWSKI 2004, 2006). It was associated with parkinsoniids (*P.* aff. *bomfordi* ARKELL, *P.* aff. *dorni* ARKELL), *Phylloceras* sp., *Nannolytoceras tripartitum* (RASPAIL), *Vermisphinctes* sp., *Lissoceras (Lissoceras) oolithicum* (D'ORBIGNY), and *Lissoceras (Microlissoceras) solitarium* ZATÓN & MARYNOWSKI. A specimen of the subzonal index *Parkinsonia bomfordi* ARKELL was also recorded from the same bed and locality (MATYJA & WIERZBOWSKI 2000). These data suggest an age of Bomfordi Subzone of the Parkinsoni Zone. This is therefore the only hitherto documented *Strigoceras* of this age.

Strigoceras kuznetsovi KRYMHOLTZ & STANKEVITCH was recorded from the Late Bajocian or earliest Bathonian of Dagestan. Both syntypes of this species represent nuclei or juvenile specimens that do not differ significantly from nuclei of true *S. truellei* (D'ORBIGNY) so that a specific separation of this taxon seems arbitrary.

Measurements

	d	h	w	u	r/2	h/d	w/d	u/d
MNHN, IPM-R 4117 (lectotype)	158.5	89.5	42.0	10.0	(–)	0.56	0.26	0.06
SMNS 66129 (Fig. 22C)	55.0	29.5	18.8	4.0	19	0.54	0.34	0.07
SM X40234 (Fig. 23)	100.0	58.0	28.0	7.0	38	0.58	0.28	0.07
SMNS 67159 (Fig. 22A)	139.0	81.2	~50	7.8	(–)	0.58	0.36	0.06

Strigoceras callomoni n. sp.
Fig. 25

? 2000 *Strigoceras* sp. – FERNÁNDEZ LÓPEZ, p. 48, tab.-fig. 2.
? 2000 *Phlycticeras dorsocavatum* (QUENSTEDT). – FERNÁNDEZ LÓPEZ, p. 48, pl. 1, fig. 8.

Holotype: Specimen illustrated on Fig. 25, housed in the SMNS, no. 65380 (leg. A. & D. BERGER, Wiesloch).
Derivation of name: In honour of Prof. Dr. JOHN H. CALLOMON, London, our friend and renown ammonitologist, who has instructed us in principles of stratigraphy, taxonomy, and nomenclature.
Type locality: St. Honorine-des-Pertes, Calvados, France.
Type horizon: The holotype is an ex-situ find, according to the lithology of the rock matrix coming from the middle limestone bed of the Couches de Passage Member (Zigzag Zone, Macrescens Subzone, see DUGUÉ et al. 1998, figs. 28, 31). The preservational state of the holotype of *S. callomoni* n. sp. excludes reworking of this specimen.
Stratigraphic range: Early Bathonian.
Studied material: 1 specimen (holotype).
Records: N France, ? SE Spain.

Diagnosis. – Almost smooth species of *Strigoceras*, with four lateral depressions.

Description. – The holotype is a phragmocone with preserved striate calcitic shell. The specimen is almost entirely filled with sparry calcite. Part of the bodychamber on the last preserved whorl was broken away prior to burial indicating the length of the bodychamber was about 230 degrees. The remains of the rock matrix consist of a greyish marly biopelmicritic limestone containing pyritic inclusions, suggesting the middle limestone bed of the "Couches de Passage". The cross section is discoidal. The keel is rounded (partly restored in the holotype). Although only weakly developed, four longitudinal depressions are present in the first half of the last whorl. The outermost one on the third quarter of the whorl height fades out in the preadult stage.

Comparisons. – *Strigoceras callomoni* n. sp. differs from the older *S. truellei* (D'ORBIGNY) by becoming smooth at a much earlier ontogenetic stage. Some extreme variants of *S. truellei* from the younger part of the Parkinsoni Zone already re-

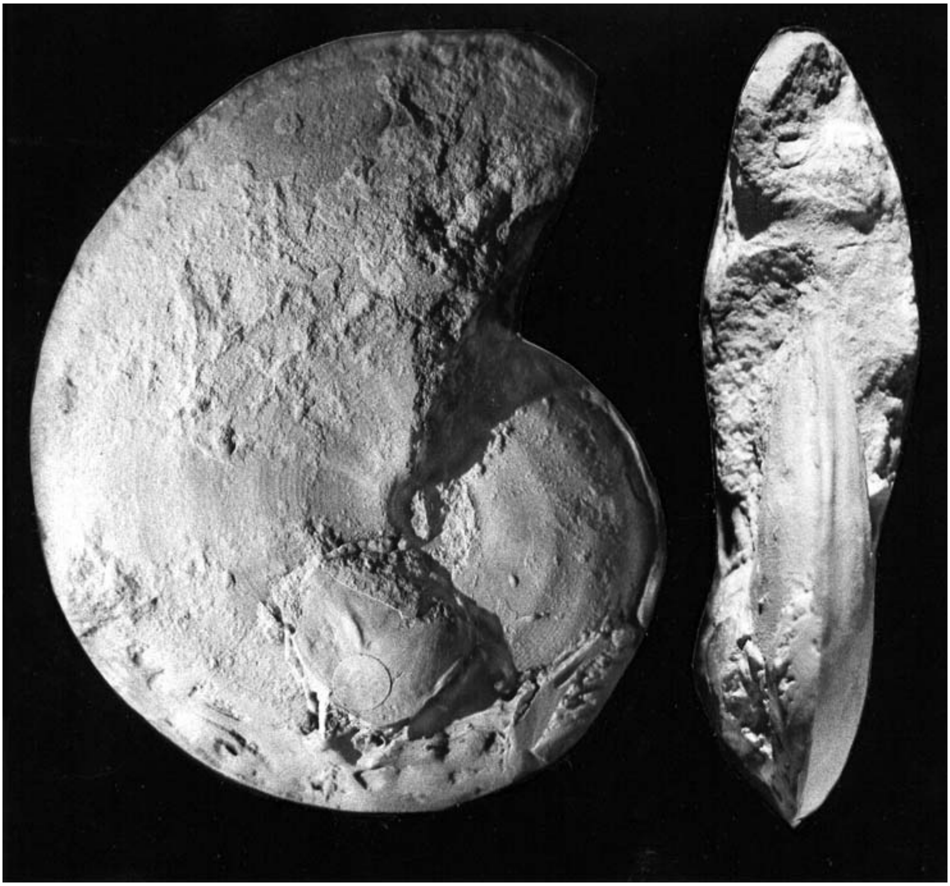

Fig. 25. *Strigoceras callomoni* n. sp., holotype, lateral and ventral views; St. Honorine-des-Pertes, Calvados, France; "Couches de Passage", most probably middle limestone bed, Lower Bathonian, Zigzag Zone, Macrescens Subzone, for stratigraphy see DUGUÉ et al. (1998, figs. 28, 31); SMNS 65380 (leg. A. & D. BERGER). – ×1.

semble *S. callomoni* n. sp. by their almost unribbed striate shell. The fourth lateral depression is unknown in other *Strigoceras* species. Only one specimen is available so we can say nothing about its intraspecific variability.

The juvenile specimen figured by FERNÁNDEZ LÓPEZ (2000, pl. 1, fig. 8) as "*Phlycticeras dorsocavatum*" lacks lateral spiral grooves but exhibits broad falcoid ribs. It most likely represents a *Strigoceras* rather than a *Phlycticeras*. In respect of its stratigraphical position (Parvum Subzone of Early Bathonian) this specimen could belong to *S. callomoni* n. sp., but it is not comparable with the holotype because of its minute size.

Measurements

	d	h	w	u	r/2	h/d	w/d	u/d
SMNS 65380 (holotype)	105.5	60.3	28.0	5.8	–	0.57	0.27	0.05

4. The phenomenon of dwarfism in adult macroconchs

The maximum adult size of macroconch strigoceratids is difficult to estimate because according to our observations to date not a single adult specimen has been found with an intact mouth border. However, there is evidence that surprisingly large specimens occur in almost all chronospecies. This is not only true for *S. truellei* from the Parkinsoni Zone of which large examples have been obtained quite frequently and more commonly than from other stratigraphical levels. We have studied very large specimens of *S. truellei* with diameters up to 290 mm that are still completely septate. This gives estimates of final adult diameters in these specimens of c. 500 mm. The main phyletic trend recognizable in *Strigoceras* is the predominance of broader specimens within the variation of the younger chronospecies, a phenomenon remarkably analogous in *Phlycticeras* (SCHWEIGERT & DIETZE 1998). Specimens with maximum ratios of width to diameter occur just prior to the extinction of the genus. The latest known chronospecies to date, *S. callomoni* n. sp., is the only example that contradicts this phyletic trend, but nothing is known about variation in size of this at present monotypic taxon.

Within a *Strigoceras* population that can be considered to be more or less isochronous some of the specimens show adult features but remain remarkably small, often skipping the second sculptural stage of ontogeny what is irregularly polyschizotome. Their final, smooth sculptural stage is the same as that of the large specimens. In the dwarf adults the suture lines are more complex at equal diameters to large adults and their umbilicus is extremely narrow. This observation led BUCKMAN (1924: 7) to distinguish several different genera within Strigoceratidae. In some faunas the number of dwarfs is very high, whereas in others the normal-size specimens dominate. Individuals therefore attain adulthood at very different sizes. In the micromorphic adults the rate of ontogenetic development appears accelerated, possibly as the result of local environmental changes. In early studies on strigoceratids this phenomenon was not recognized and small and large adult specimens were placed in different morphospecies or phyletic lineages (e. g. SANDOVAL 1985). Morphospecies taxonomically based on dwarf or small adults are *S. languidum* (BUCKMAN), *S. pseudostrigifer* MAUBEUGE, *S. bessinum* BRASIL, *S. egertense* OHMERT, GASSMANN, SCHATZ & STETTER, and *S. septicarinatum* BUCKMAN. The lectotype of *S. paronai* (TRAUTH) is a very small specimen that is not representative of the adult stage of this taxon (see above). Within a chronospecies there are adult forms varying from extremely small to very large supporting the idea that this phenomenon is more likely to be intraspecific variability than sexual polymorphism or specific diversification.

5. Shell structure of *Strigoceras*

Compared to *Phlycticeras*, stratigraphically younger representatives of *Strigoceras* do not show the spiral longitudinal striation on moulds. Only in a few cases is the striation superimposed on the mould during early diagenesis. Since most material is preserved in micritic limestones or ferrugineous oolites, the original aragonitic shell is very rarely preserved. If the shell is present, it mostly consists of re-crystallised calcite, thus few examples with partial aragonitic shell preservation could be studied. The spiral striation in *Strigoceras* is restricted to the medium nacreous layer of the shell but is lacking both in the inner and outer prismatic layers. In the inner prismatic layer, there are rows of minute tubercles arranged more or less radially, but in an irregular pattern. In calcite preservation the inner prismatic layer is usually recrystallised and welded to the nacreous layer. The distance between the rows of tubercles on the inner prismatic layer is the same as the width of the striae in the nacreous layer. This nacreous layer is striate, with dense striae each of equal size. The grooves between the striae fit exactly with the underlying tubercles of the inner prismatic layer. The nacreous layer is the thickest and hence often preserved. The outer prismatic layer is smooth. Originally it was covered by an organic periostracum that is never preserved due to a lack of specimens from bituminous shales. The outer prismatic layer was not preserved in the specimens studied by SCHEURLEN (1928), so this author erroneously observed *Strigoceras* to have only two shell layers.

The shell structure of *Strigoceras* does not differ principally from that of *Phlycticeras*; only the striate nacreous layer is more accentuated in the latter, so that the relatively thin inner and outer prismatic layers also takes on a striate overprint.

6. Possible phyletic descendants of *Strigoceras*

CALLOMON (in DONOVAN et al. 1981) interpreted the unique *Vastites vastus* ARKELL, 1951 from the Lower Bathonian of Doulting in Somerset as a late strigoceratid. To our knowledge, *Vastites* has never been recorded elsewhere besides the holotype. In the inner whorls the shell bears a striation (pers. comm. J. H. CALLOMON, London) not visible in the photographs provided by ARKELL (1951), and the cross-section shows a high, floored (septicarinate) keel. In addition, the ornament consisting of faint radial lirae resembles that of a lytoceratid. This may represent remains of the innermost shell layer (see above). The suture line is much simpler than that of *Strigoceras*. Lateral furrows are not developed on the flanks in the adult stage, but we cannot say anything of the nature of the inner whorls. A striation-like shell structure superficially resembling that of *Strigoceras* also occurs in other Middle Jurassic ammonite lineages (cf. SCHEURLEN 1928; JAWORSKI 1926, pl. 3, figs. 1c, 11; DORN 1935, pl. 23, fig. 2). ARKELL (1951) and MAUBEUGE (in ARKELL 1951) both suggested a sonniniid ancestry of *Vastites*. For the moment, the systematic position of *Vastites* within strigoceratids must remain doubtful.

The genus *Strungia* ARKELL, 1952 was indeed polyphyletic already when established. Its striate type species, *Oppelia redlichi* POPOVICI-HATZEG, represents an early offshoot of *Phlycticeras* in the Middle Bathonian and clearly belongs to Phlycticeratinae (SCHWEIGERT et al. 2003). Another "*Strungia*" described from Central Arabia (ARKELL 1952) exhibits falcoid ribbing. This unique "*Strungia*" *arabica* ARKELL displays a relatively wide umbilicus and hardly resembles a strigoceratid. It may be better interpreted as a microconch of the co-occurring genus *Micromphalites*. Also the Callovian species "*Strungia*" *voultensis* LISSAJOUS differs significantly from the characteristics of *S. redlichi* (see ELMI 1967) and represents a hecticoceratid.

In the Late Bajocian, or little earlier, the *Strigoceras* stock gave rise to the enigmatic genus *Granulochetoceras* GEYER, 1960 (Type species: *Ammonites uracensis* DIETLEN) via *Granulochetoceras oppeliisculptum* n. sp. from the Garantiana Zone, as demonstrated below. As a consequence, the stratigraphic range of Strigoceratinae extends from the Middle Aalenian to the Late Kimmeridgian, much longer than supposed in all previous phyletic trees of oppeliid relatives (e. g., ELMI 1967; DONOVAN et al. 1981).

Genus *Granulochetoceras* GEYER, 1960 [M]

Type species: *Ammonites uracensis* DIETLEN, 1911, by original designation.
Species included: *Ammonites argonautoides* MAYER, 1871; *Ammonites uracensis* DIETLEN, 1911; *Ochetoceras cristatum* DIETERICH, 1940; *Oppelia (Petitclercia ?) hungarica* LÓCZY, 1915 (Fig. 26B); *Granulochetoceras oppeliisculptum* n. sp. (Fig. 26A, this paper); *Ochetoceras ornatum* BERCKHEMER & HÖLDER, 1959; *Granulochetoceras undulatum* HÖROLDT, 1964).

Emended diagnosis. – Small to medium-size oxyconic ammonite; shell with spiral strigation; narrow umbilicus; steep umbilical wall; rounded umbilical edge; one or two lateral furrows; falcoid ribbing, primaries starting from nodules at umbilical edge; secondaries starting from strong bases; ribs do not reach keel; serrate, partly undulating septicarinate keel.

Granulochetoceras oppeliisculptum n. sp.
Fig. 26A

v pars 1974 *Strigoceras languidum* (BUCKMAN). – DIETL, table 1.

Holotype: Specimen illustrated in Fig. 26A, SMNS 65379 (leg. G. DIETL).
Derivation of name: After the ribbing style of the pre-mature growth stage strongly resembling that of an oppeliid.
Type locality: Aldea del Pinar, Keltiberian Ranges, NE Spain (see DIETL 1974).
Type horizon: Bajocian, Garantiana Zone, probably Dichotoma Subzone.
Stratigraphic range: Only recorded from the type horizon.
Studied material: Only holotype.
Records: Spain.

Diagnosis. – Oxyconic strigoceratid with oppeliid premature ribbing stage, low septicarinate keel with serrate venter; adult stage with polyschizotome ribbing.

Description. – The holotype is an internal mould of the phragmocone with remains of the shell. Its matrix consists of a light brown limestone with scattered small ferrugineous ooids. The keel is relatively low and laterally unsculptured, similar to typical *Strigoceras*, but at the beginning of the last whorl it is discernible that the shell covering the venter was serrate. The latter feature contradicts the diagnosis of *Strigoceras*. Therefore, it is included here in *Granulochetoceras*. This enigmatic genus was originally described from the Early Kimmeridgian of Southern Germany and Eastern France (see p. 48).

The inner whorls of the holotype are not visible because of the extremely narrow umbilicus. In all ontogenetic stages the conch is oxyconic. Up to a diameter of c. 50 mm falcoid ribs are developed, the primaries being relatively weak, the secondaries starting at mid-height of the flank. The bases of the secondaries are little swollen. In the ventral part of the flank each secondary is followed by two or three tertiary ribs. The ribs never reach the keel. At larger diameters the ribbing changes gradually to a more polyschizotome style as in coeval *Strigoceras*. On the flank two weak lateral

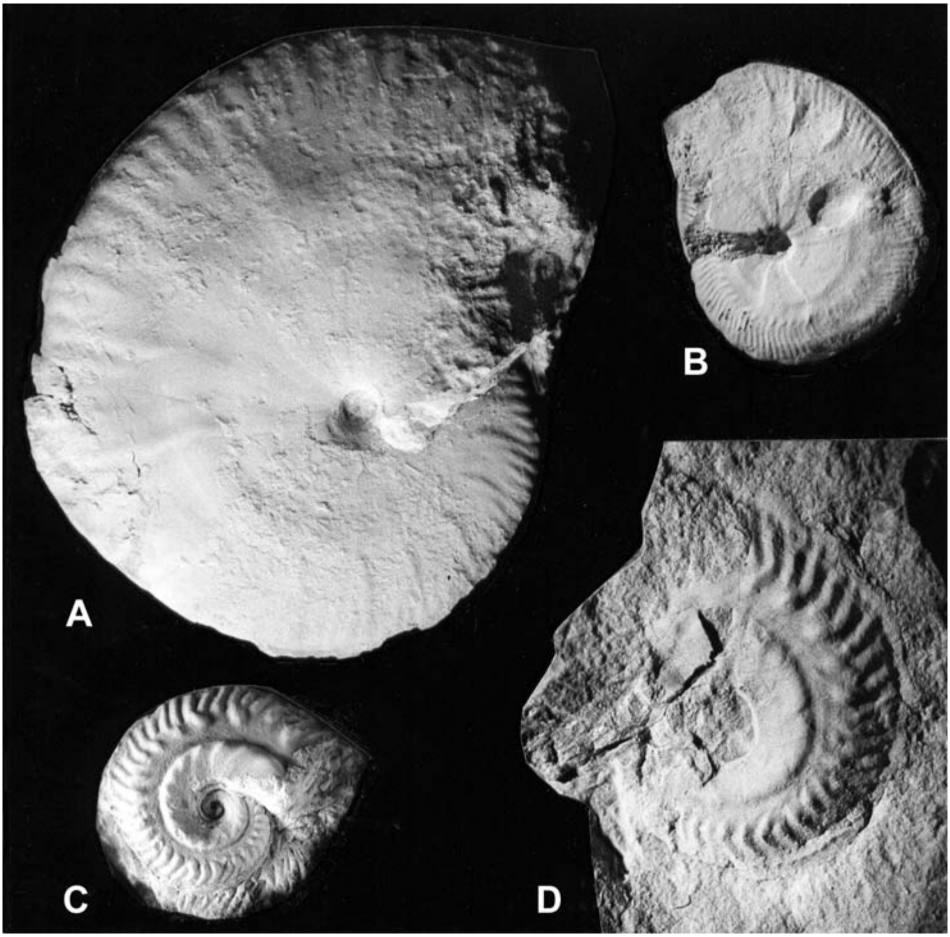

Fig. 26. A. *Granulochetoceras oppeliisculptum* n. sp., holotype, lateral view; Aldea del Pinar, NE Spain (for locality see DIETL 1974); Upper Bajocian, Garantiana Zone, probably Dichotoma Subzone; SMNS 65379 (leg. G. DIETL). **B.** *Granulochetoceras hungaricum* (LÓCZY), lateral view; Herznach iron mine, Herznach, Switzerland; "Anceps-Athleta-Schichten", Upper Callovian, Athleta Zone; NHMB J 19643 (leg. F. JENNY). **C.** *Granulochetoceras argonautoides* (MAYER), lateral view; Wasserberg near Schlat, E Swabia, SW Germany; Lacunosamergel Formation, Lower Kimmeridgian, Divisum Zone; SMNS 65359. **D.** *Granulochetoceras argonautoides* (MAYER), lateral view, showing the striation on the flank; Gruibingen, E Swabia, SW Germany; Lacunosamergel Formation, Lower Kimmeridgian, probably Divisum Zone; IFGT 1905-1. – A–C: ×1; D: ×1.5.

furrows or depressions are developed, the inner one being slightly stronger than the outer. A further shallow depression is also developed between the umbilical wall and the inner lateral furrow. The umbilical wall is rather steep, but rounded. The phragmocone bears a longitudinal striation. The suture line is very complicate even in the premature stage.

Comparisons. – If the pre-mature "oppeliid" ribbing stage or the keel is preserved, *S. oppeliisculptum* n. sp. cannot be misidentified. The mature stage resembles some slender morphospecies of *Strigoceras*, like *S. symplectum* (Buckman), which might represent a phyletic forerunner. The oppeliid sculpture strongly resembles that of true *Oppelia*, like *O. pleurifer* (Buckman), but it is equally developed in *Granulochetoceras*.

Discussion and remarks. – At first sight it seems strange to place the roots of *Granulochetoceras* in *Strigoceras*. According to previously published data, *Granulochetoceras* is restricted to the Late Jurassic, ranging from the Planula Zone to the Beckeri Zone of the Kimmeridgian. The stratigraphically youngest known record of this genus is a specimen of *G. ornatum* (Berckhemer & Hölder) reported from the middle Ulmense Subzone of the Beckeri Zone (Schweigert 1998, pl. 3, fig. 4). However, typical specimens of *Granulochetoceras* are rare in the basal Athleta Zone of western France (oral communication of P.-Y. Baloge, Angers) and in eastern Switzerland (Fig. 26B, from the Herznach iron mine) thus bridging the absence of this lineage between the Bajocian and the basal Kimmeridgian. The taxon from the Late Callovian was first recorded and described from Villány (Hungary) by Lóczy (1915: 341, pl. 3, fig. 18) as "*Oppelia* (*Petitclercia* ?) *hungarica*", but not recognized as a *Granulochetoceras* until this study. A striation is developed only in some well preserved specimens of *Granulochetoceras*, like in the figured examples of *G. argonautoides* (Mayer) from the Lower Kimmeridgian (Divisum Zone) of eastern Swabia (Fig. 26C, D). To date this has not been recorded in previous literature. As in *Strigoceras*, the striation is only visible in specimens with preserved shell or in internal moulds on which the shell ornamentation is superimposed. The microconch partners of these forms are tentative. It is likely that the unique "?*Cymaceras* (?) sp." illustrated from the Upper Jurassic of northern Iran (Seyed-Emami et al. 1998, pl. 1, fig. 1) represents such a microconch partner. A Kimmeridgian offshoot of *Granulochetoceras*, the genus *Cymaceras* Quenstedt, 1887, also exhibits both a spiral striation and lateral spiral grooves (Kuhn 1933; Schairer & Schlampp 1991), thus indicating its affiliation to Strigoceratinae. In *Cymaceras* the corresponding microconchs are well-known and described as a separate genus or subgenus *Trochiskioceras* (Schairer & Schlampp 1991; Schick 2004).

The serration and undulation of the keel of *Granulochetoceras* also resembles that of *Phlycticeras*, but since most other features (lateral furrows, narrow umbilicus, and rounded umbilical edge) are never seen in early species of *Phlycticeras* this serration must be a convergence. However, in a closely related group and in the same beds as the new species *G. oppeliisculptum* the enigmatic genus *Diplesioceras* Buckman, 1920 is recorded which also exhibits an undulating keel. A detailed review study of the genus *Granulochetoceras* is in progress.

Measurements

	d	h	w	u	r/2	h/d	w/d	u/d
SMNS 65379 (holotype)	87.0	52.5	(~20)	4.0	~35	0.60	0.23	0.05
dito	65.5	40.0	16.0	3.0	35	0.61	0.24	0.05

7. Other taxa previously included in *Strigoceras*

Prior to the recent revision of the genus *Phlycticeras* Hyatt, 1900 (Schweigert & Dietze 1998), some early representatives of this genus have often been included in the striate genus *Strigoceras*, despite the significantly differing keel, their lack of

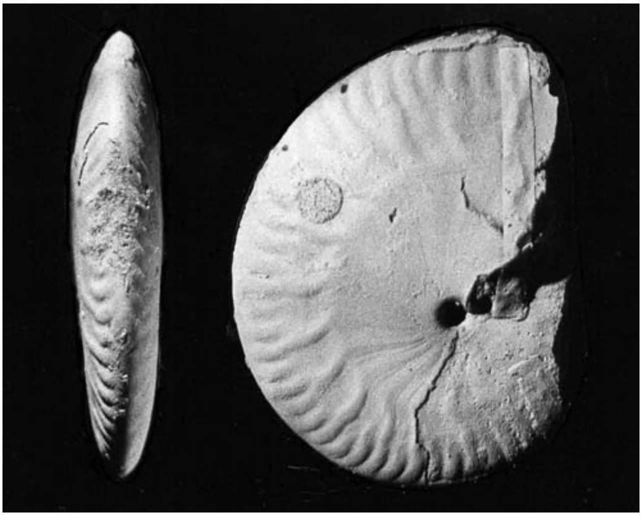

Fig. 27. *Hebetoxyites incongruens* BUCKMAN, holotype, ventral and lateral views; Sandford Lane near Sherborne, S England; Inferior Oolite, Fossil Bed, *Brocchii* Bed of BUCKMAN 1893, Lower Bajocian, Laeviuscula Zone; BGS GSM 47539. – ×1.

lateral furrows, and different dimorphic partners (*Oecoptychius* versus *Cadomoceras*).

Stringoceras pustuliferum introduced by DOUVILLÉ (1916) is a *Micromphalites*, an ammonite genus of still uncertain phyletic derivation but of assumed Arabian origin that exhibits a simplified suture line (ENAY et al. 2001; SCHLÖGL & RAKÚS 2004).

When erecting *Ammonites fissilobatus*, the type species of *Fissilobiceras* BUCKMAN, WAAGEN (1867) suggested a close relation to *Ammonites truellei* D'ORBIGNY (see also DORN 1935: 57). In his illustrated specimen, a striation is evident. This is due to a drawing technique and not present in the original specimen. Although the suture line of *Strigoceras* is almost as complex as in *Fissilobiceras*, the lateral lobes differ strongly in the two genera, and we interpreted *Fissilobiceras* as a late offshoot of hammatoceratids (see DIETZE et al. 2005).

The monotypic *Kleistoxyites protrusus* BUCKMAN, 1922, included either in *Strigoceras* by IMLAY (1964) or in *Praestrigites* of CALLOMON & CHANDLER (1990), lacks both a striation and a septicarinate keel. The genus *Kleistoxyites* BUCKMAN, 1922 must be excluded from Strigoceratidae. It is most likely an early representative of the *Oxycerites* lineage of Oppeliidae. The same must be said from the holotype of *Hebetoxyites clypeus* BUCKMAN. This was erroneously assigned to *Strigoceras* by SADKI et al. (1986). *Hebetoxyites incongruens* BUCKMAN, 1924 is another closely related form which strongly resembles *Strigoceras* in its ribbing style, but also totally lacking both keel and spiral striation (Fig. 27). The type species of *Hebetoxyites*, *H. hebes* BUCKMAN, 1924, also lacks these features and surely does not belong to strigoceratids.

Liroxyites IMLAY, 1961, is another genus homoeomorphic with *Strigoceras*. Originally described from the Bajocian of Alaska (IMLAY 1961), *Liroxyites* lacks a septicarinate keel, a longitudinal striation, and any secondary ribbing. In contrast, it shows a somewhat eccentric coiling of the bodychamber. Nevertheless, this genus was treated as a subgenus of *Strigoceras* by SANDOVAL & WESTERMANN (1986). The specimens referred to this genus from Mexico by these authors, however, in fact represent true *Strigoceras* (see p. 25).

A strigoceratid ammonite from the Aalenian of Hungary figured by PRINZ (1904), re-figured by GÉCZY (1967, pl. 26, fig. 2) as *Praestrigites subaspidoides* (VACEK), is most probably correctly identified at specific level but belongs to *Csernyeiceras* (see SCHWEIGERT et al. 2000). This specimen differs from *Praestrigites* (or *Strigoceras*, respectively) in details of the suture line, a relatively wide umbilicus, and especially in the presence of a high and razor-sharp septicarinate keel.

BRASIL (1895) tentatively included *Ammonites mirabilis* GROSSOUVRE, 1891, the later type species of *Petitclercia* ROLLIER, 1909, in *Strigoceras*. Most probably *Petitclercia* represents an offshoot of Phlycticeratinae, in respect of its three longitudinal rows of nodules on the flanks reflecting homologous sculpture characters of the Early Callovian *Phlycticeras mexicanum* (SANDOVAL & WESTERMANN) (see SCHWEIGERT et al. 1999). The dimorphism in *Petitclercia* is still unclear. *Oppelia (Petitclercia ?) hungarica* LÓCZY, 1915 is reinterpreted here to be a Callovian chronospecies of *Granulochetoceras* (see p. 48).

8. *Cadomoceras*, the presumed microconch partner of *Strigoceras*

Following our previous studies on dimorphism in *Phlycticeras*/*Oecoptychius* (SCHWEIGERT & DIETZE 1998, 1999; SCHWEIGERT et al. 2003) we here follow the suggestion of STURANI (1971) who interpreted the microconchiate genus *Cadomoceras* as representing the partner of *Strigoceras*. In support of our arguments and those put forward by earlier authors (see STURANI 1971) we have observed a weak spiral striation in a few specimens of *Cadomoceras* where the shell is preserved. Collectors surely often overlooked the small and poorly sculptured shells of *Cadomoceras*; consequently the studied material is much less than that of the corresponding macroconchs. A preservational bias is also considered, e. g. by dissolution of small shells in the Tethyan Ammonitico Rosso lithology, whereas they are well represented in the coeval neptunian dykes (e. g., WENDT 1971), where early cementation processes prevented the fragile shells from dissolution.

Genus *Cadomoceras* MUNIER-CHALMAS, 1892 [m]

Type species: *Ammonites cadomensis* DEFRANCE in DE BLAINVILLE, 1840, by original designation of MUNIER-CHALMAS (1892).

Species included: *Ammonites cadomensis* DEFRANCE in DE BLAINVILLE, 1840; *Cadomoceras costellatum* BUCKMAN, 1923; *Cadomoceras carinatum* BUCKMAN, 1923; *Ammonites sullyense* BRASIL, 1895; *Cadomoceras nepos* PARONA, 1896. Synonymous taxa are excluded from this list.

Diagnosis. – Small microconch with eccentric bodychamber, large spatulate apophyses, ventral rostrum, shell smooth or occassionally with falcoid secondaries, venter carinate or rounded.

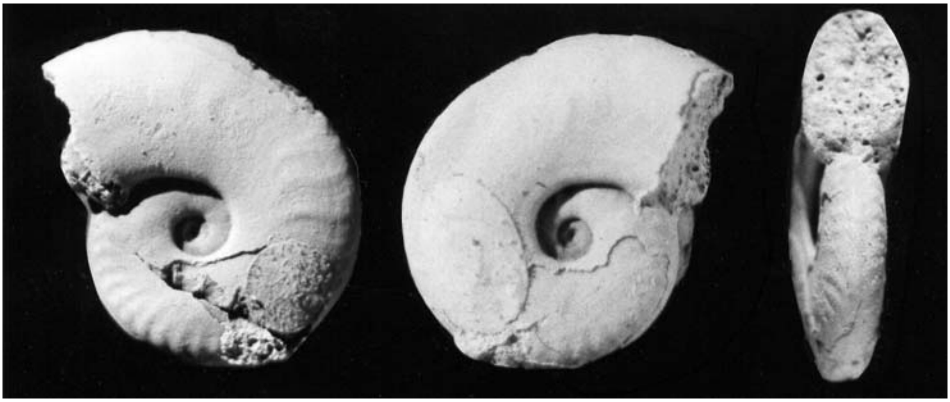

Fig. 28. *Cadomoceras costellatum* BUCKMAN, holotype, lateral and ventral views; Sandford Lane near Sherborne, S England; Inferior Oolite, Fossil Bed, middle *Brocchii* Bed of BUCKMAN 1893, Lower Bajocian, Laeviuscula Zone; BGS GSM 37307. – ×2.

Cadomoceras costellatum BUCKMAN, 1923
Fig. 28

v * 1923 *Cadomoceras costellatum*, nov. – BUCKMAN, pl. 457.
? pars 1968 *Sonninia (Peocilomorphus) boweri minima* (HILTERMANN). – HUF, pl. 4, fig. 6 only.
v 1971 *Cadomoceras carinatum* BUCKMAN. – WENDT, pp. 156f.
1983 *Cadomoceras* cfr. *costellatum*. – PAVIA, pl. 7, fig. 3.
1983 *Cadomoceras* sp. – SANDOVAL, p. 117.
1985 *Cadomoceras ellipticum* BUCKMAN, 1923. – FERNÁNDEZ LÓPEZ, p. 147, pl. 13, fig. 7.
1985 *S. (Cadomoceras)* cf. *costellatum*. – SANDOVAL, pl. 1, figs. 11–12.
1986 *Cadomoceras costellatum*. – SADKI et al., tab.-fig. 4.
1986 *Cadomoceras* cf. *costellatum*. – SANDOVAL, p. 446.
v 1990 *Cadomoceras costellatum*. – CALLOMON & CHANDLER, p. 98.
pars 1994 *Cadomoceras*. – SADKI, tab.-fig. 3. – [1994a].
1994 *Cadomoceras costellatum*. – SADKI, tab.-fig. 4. – [1994a].
1996 *Cadomoceras*. – SADKI, p. 140, text-figs. 13, 46.

Holotype: BUCKMAN (1923, pl. 457) BGS GSM 37307; re-figured herein as Fig. 28.
Type locality: Sandford Lane, Dorset, England.
Type horizon: Inferior Oolite, Sandford Lane Fossil Bed, "*Brocchi* Bed" (Early Bajocian, late Laeviuscula Zone).
Stratigraphic range: Discites Zone to Laeviuscula Zone; cf.-specimens were recorded from the Discites Zone and Ovale Zone of Spain and Morocco (SANDOVAL 1990: 145; SADKI 1994a: text-figs. 3–4, pl. 28; SADKI 1996, tab.-figs. 13, 46). The stratigraphically oldest unequivocal specimen is recorded from Sicily by WENDT (1971). It comes from an ammonite assemblage recovered from a neptunian dyke of early Discites Zone age, according to the co-occurrence of *Rhodaniceras prosphues* (BUCKMAN), *Eudmetoceras* sp. and *Haplopleuroceras* sp. indicative of this level (cf. SADKI 1994a, fig. 2, 1994b, fig. 3).
Studied material: 7 specimens.
Records: England, Spain, Western Alps, Sicily, Morocco, ? NW Germany.

Diagnosis. – Small, almost unsculptured species of *Cadomoceras* with short carinate stage.

Description. – The holotype of *C. costellatum* is a complete specimen with the shell intact bearing large lappets at its aperture. The venter is carinate in the medium ontogenetic stage. In the last whorl, this keel fades out, and the venter becomes rounded. On the ventrolateral part of the flanks, a weak striation is developed in the holotype. Ribbing sculpture is usually lacking. The eccentric bodychamber is typical for the whole genus, and not restricted to this chronospecies only.

Remarks. – A small microconch ammonite from the Bajocian Laeviuscula Zone of NW Germany illustrated by Huf (1968, pl. 4, fig. 6) most probably represents a *Cadomoceras*. It differs from co-occurring microconch sonniniids by an eccentric bodychamber and the absence of a keel. The latter specimen, however, is extremely small and not representative for the average morphology of the chronospecies *C. costellatum*.

Measurements

	d	h	w	u	h/d	w/d	u/d
GSM 37307 (holotype)	23.2	11.0	6.8	4.5	0.47	0.29	0.19

Cadomoceras carinatum Buckman, 1923
Figs. 29–31

v * 1923 *Cadomoceras carinatum*, nov. – Buckman, pl. 456.
v 1923 *Cadomoceras ellipticum*, nov. – Buckman, pl. 455, figs. 1–3.
v 1971 *Cadomoceras ellipticum* Buckman. – Wendt, p. 157.
v 1975 *Cadomoceras carinatum* Buckman. – Hinkelbein, p. 149, tab.-fig. 11.
1977 *Cadomoceras*. – Fernández López, p. 52.
1979 *Cadomoceras carinatum*. – Parsons, p. 148, table 4.
1979 *C. ellipticum*. – Parsons, p. 148, table 4.
1983 *Cadomoceras* sp. – Sandoval, tab.-fig. 77A.
1983 *Cadomoceras ellipticum*. – Pavia, pl. 7, fig. 7.
v 1984 *Dorsetensia* sp. – Dietl et al., p. 310, text-fig. 2.3.
1988 *Cadomoceras ellipticum* Buck. – Fernández López et al., p. 55.
1990 *Cadomoceras ellipticum*. – Sandoval, p. 148.
1996 *Cadomoceras ellipticum* Buckman. – Sadki, pp. 141, 183, text-fig. 46, pl. 5, fig. 9.
1996 *Cadomoceras carinatum* Buck. – Sadki, pp. 84, 142, tab.-fig. 46.
1996 *Cadomoceras costellatum*. – Sadki, tab.-fig. 14.
v 2006 *Cadomoceras* sp. – Chandler et al., tab.-fig. 2.

Holotype: Buckman (1923, pl. 456), BGS GSM 37306; re-figured here as Fig. 29.
Type locality: Dundry Hill, near Bristol, Avon, England.
Type horizon: Inferior Oolite, bed 10b of South Main Road Quarry (Bajocian, Sauzei Zone), see Parsons (1979: 148).
Stratigraphic range: Sauzei Zone.
Studied material: 10 specimens.
Records: England, Spain, Morocco, Southern Alps, Sicily, SW Germany, NW Germany (this study, Fig. 31D).

Diagnosis. – Small, weakly ribbed species of *Cadomoceras* with long-persisting carinate stage.

Description. – The holotype of *C. carinatum* Buckman is an almost complete adult specimen; only the lappets are partly broken. The second half of the bodychamber still has the shell on which in oblique view fine spiral striae are visible. Otherwise the shell is unsculptured. In the first half of the last whorl the venter is cari-

Fig. 29. *Cadomoceras carinatum* BUCKMAN, holotype, lateral and ventral views; Dundry, Somerset, S England; Inferior Oolite, Ironshot Bed, Lower Bajocian, Sauzei Zone; BGS GSM 37306. – ×2.

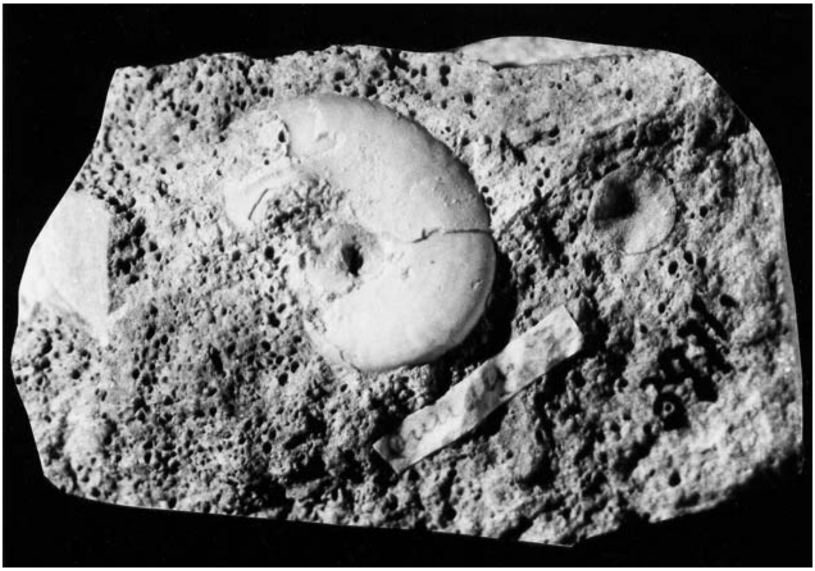

Fig. 30. *Cadomoceras carinatum* BUCKMAN (= original specimen of *Cadomoceras ellipticum* BUCKMAN, 1923, pl. 455, fig. 3), lateral view; Dundry, Somerset, S England; Inferior Oolite, Ironshot Bed, Lower Bajocian, Sauzei Zone; BGS GSM 37305. – ×2.

nate after which it becomes rounded. *C. ellipticum* BUCKMAN (Fig. 30) does not differ significantly from *C. carinatum* BUCKMAN and also exhibits the typical carinate venter. Both type specimens come from the same bed and horizon and must be regarded as conspecific. The date of erection of the two taxa was the same and we pre-

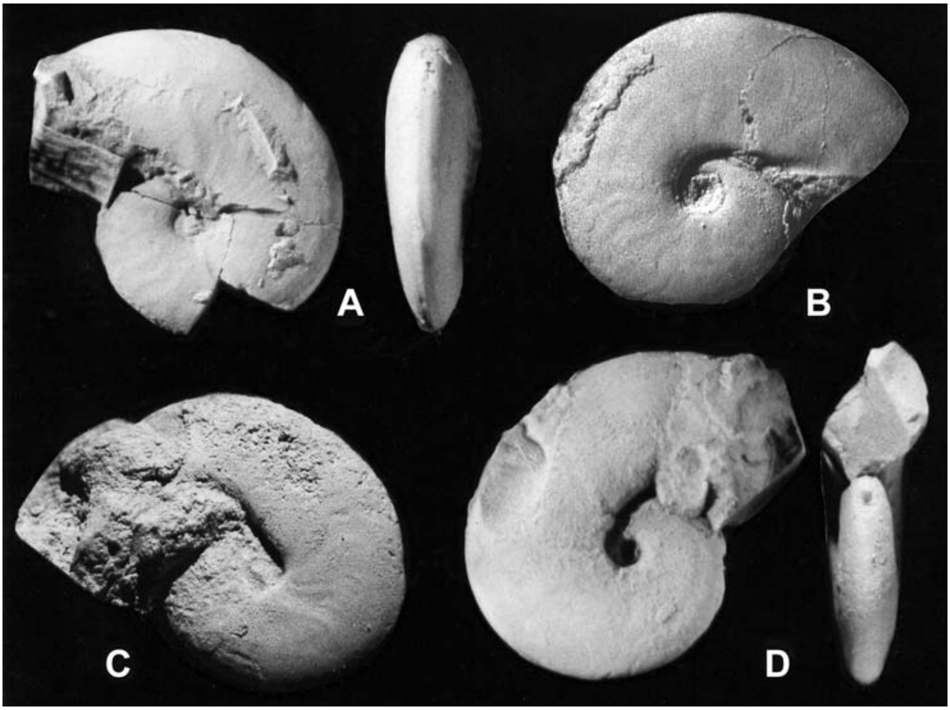

Fig. 31. *Cadomoceras carinatum* BUCKMAN. **A**. Lateral and ventral views; Albarracín, Keltiberian Ranges, E Spain; bed 18d in section A of HINKELBEIN (1975, fig. 11), Chelva Formation, Lower Bajocian, Sauzei Zone; SMNS 65384 (Coll. K. HINKELBEIN). **B**. Lateral view; Sandford Lane near Sherborne, Dorset; Inferior Oolite, Lower Bajocian, bed 6b, Sauzei Zone (horizon Bj-11 of CALLOMON 1995); SMNS 67160 (ex coll. V. DIETZE). **C**. Lateral view; Talheim am Lupfen, SW Germany; basal Humphriesioolith Formation, Lower Bajocian, Sauzei Zone; SMNS 65386 (leg. W. LUDWIG). **D**. Lateral view; Gerzen, NW Germany; "Coronatenschichten" Formation (section see HUF 1968: 16), Lower Bajocian, Sauzei Zone, Pinguis-Subzone; IFGT 1905-2. – ×2.

fer here to use *C. carinatum* instead of *C. ellipticum* on grounds of preservation of the holotypes.

Comparisons. – *C. carinatum* differs from other chronospecies of the genus in its well-developed long persisting carinate stage of the adult bodychamber combined with weak ribbing sculpture.

Measurements

	d	h	w	u	h/d	w/d	u/d
GSM 37306 (holotype)	24.0	11.2	6.8	4.5	0.46	0.28	0.19
GSM 37305 (Fig. 30)	19.5	9.5	–	3.3	0.49	–	0.17
IFGT 1905-2 (Fig. 31D)	20.0	10.0	6.2	3.0	0.50	0.31	0.15
SMNS 65384 /Fig. 31A)	~24	10.0	6.1	3.0	0.41	0.25	0.12

Fig. 32. *Cadomoceras sullyense* (BRASIL), lateral and ventral views; Villel, Keltiberian Ranges, E Spain; bed 17 in section E of HINKELBEIN (1975, fig. 12), Chelva Formation, Lower Bajocian, Humphriesianum Zone; SMNS 65387 (Coll. K. HINKELBEIN). – ×2.

Cadomoceras sullyense (BRASIL, 1895)
Fig. 32

* * 1895 *Ammonites Sullyense* nov. sp. – BRASIL, p. 41, pl. 4, figs. 8–9.
* 1918 *Cadomoceras sullyense* BRASIL. – COEMME, p. 48, pl. 6, figs. 1–3.
* 1929 *Haploceras* sp. – GREPPIN & TOBLER, p. 542.
* 1964 *Cadomoceras sullyense*. – HÖLDER, p. 90.
* 1964 *Cadomoceras sullyense*. – RIOULT, p. 245.
* 1964 *Cadomoceras sullyense* BRASIL. – STURANI, p. 26, pl. 4, fig. 7. – [1964b].
* 1964 *Cadomoceras nepos*. – STURANI, p. 25. – [1964b].
* 1964 *Cadomoceras cadomense*. – STURANI, p. 25. – [1964b].
* 1971 *Cadomoceras sullyense* BRASIL. – STURANI, p. 122, pl. 5, figs. 1–5.
* 1971 *Cadomoceras* n. sp. aff. *sullyense*. – STURANI, p. 123, pl. 5, fig. 6.
* 1976 *S. (Cadomoceras) sullyense* BRASIL. – PARSONS, p. 126.
* 1976 *S. (Cadomoceras)* sp. – PARSONS, pp. 126, 131.
* v 1980 *Cadomoceras*. – DIETL & RIEBER, p. 65.
* 1985 *Cadomoceras cadomense* (DEFRANCE) 1846. – FERNÁNDEZ LÓPEZ, p. 140, pl. 13, fig. 6.
* 1985 *Cadomoceras sullyense* BRASIL, 1893. – FERNÁNDEZ LÓPEZ, p. 142, pl. 13, fig. 7.
* 1989 *Cadomoceras*. – ALVARO et al., p. 82.
* 1993 *Cadomoceras cadomense*. – ELMI & RULLEAU, p. 155.
* pars 1994 *Cadomoceras* sp. – FERNÁNDEZ LÓPEZ & MOUTERDE, p. 122. – [1994a].
* v 1995 *Strigoceras (Cadomoceras) sullyense* BRASIL. – OHMERT et al., p. 73, pl. 4, fig. 5.
* pars 1996 *Cadomoceras* sp. – SADKI, tab.-fig. 46.
* v 1999 *Cadomoceras sullyense*. – SCHWEIGERT & DIETZE, p. 54.
* v 2000 *Cadomoceras sullyense* (BRASIL). – HUXTABLE, p. 105.
* v 2006 *Strigoceras (Cadomoceras) sulleyensis* (BRAZIL). – HUXTABLE, p. 82.

Lectotype: Specimen figured by BRASIL (1895, pl. 6, fig. 8) probably in the collections of the University of Caen, France.

Type locality: Sully, Normandy.

Type horizon: Oolithe Ferrugineuse de Bayeux (Bajocian, Humphriesianum Zone, probably Romani Subzone, horizon à *Dorsetensia edouardiana*).

Stratigraphic range: Humphriesianum Zone.

Studied material: 15 specimens.

Records: France, Spain, Morocco, England, SW Germany, Southern Alps.

Diagnosis. – Poorly sculptured species of *Cadomoceras* with rounded venter in the adult stage.

Description. – See BRASIL (1895: 41). The lectotype of *C. sullyense* (BRASIL) is a complete specimen intact with shell and well-developed lappets. The shell is almost smooth. Ventrally, a keel is developed only in the inner whorls, sometimes persisting to the first half of the outer whorl. In the eccentric bodychamber, the venter becomes rounded.

Comparisons. – Compared with other chronospecies of *Cadomoceras*, *C. sullyense* is rather slender and lacking any significant sculpture. The carinate stage may persist to the first half of the bodychamber, thus fading earlier than in the preceding *C. carinatum* BUCKMAN.

Measurements

	d	h	w	u	h/d	w/d	u/d
Lectotype (after photograph)	14.5	6.5	3.0	~4	0.45	0.21	0.27
SMNS 65386	18.7	8.5	5.3	2.0	0.45	0.28	0.11

Cadomoceras nepos PARONA, 1896
Figs. 16G–I, 33–34

* 1896 *Cadomoceras nepos* n. f. – PARONA, p. 15, pl. 1, fig. 13.
1896 *Oecotraustes minor* n. f. – PARONA, p. 15, pl. 1, fig. 12.
1918 *Cadomoceras cadomense* var. *acostatum* nob. – COEMME, p. 47. – [objective synonym of *C. nepos*]
v 1920 *Cadomoceras costatum*, nov. – BUCKMAN, pl. 189.
v 1923 *Cadomoceras simulacrum*, nov. – BUCKMAN, pl. 458 [Fig. 33A].
1962 *Oecotraustes* nov. sp. – SATO, p. 69, pl. 3, fig. 7.
1971 *Cadomoceras nepos* PARONA. – STURANI, p. 123, pl. 5, fig. 7 (= refiguration of lectotype), figs. 8–10.
1971 *Cadomoceras* cf. *cadomense* (DEFR.). – STURANI, p. 125, pl. 5, fig. 11.
1971 *Cadomoceras cadomense* (DEFR.). – STURANI, p. 125, pl. 5, figs. 12–15.
v 1971 *Cadomoceras* sp. – WENDT, p. 158.
v 1975 *Cadomoceras cadomense* (BLAINVILLE). – HINKELBEIN, p. 155, tab.-figs. 11–12.
1976 *Cadomoceras simulacrum*. – PARSONS, p. 120, table 2.
1976 *S. (Cadomoceras) sullyense*. – PARSONS, pp. 126, 129–130.
1976 *S. (Cadomoceras) nepos*. – PARSONS, pp. 126, 129–130.
1979 *Cadomoceras nepos* PARONA. – LINARES & SANDOVAL, p. 286, tab.-fig. 2, pl. 2, fig. 6.
1979 *Cadomoceras cadomense* (DEFRANCE). – LINARES & SANDOVAL, p. 287, pl. 2, fig. 7.
1983 *Cadomoceras* sp. – SANDOVAL, p. 122, tab.-fig. 77A.
1983 *C. nepos* (PARONA). – SANDOVAL, p. 122, tab.-fig. 77A.
1983 *C. cadomense* (DEFRANCE). – SANDOVAL, p. 122, tab.-fig. 77A.
1985 *Cadomoceras nepos* PARONA, 1896. – FERNÁNDEZ LÓPEZ, p. 143, pl. 13, fig. 9.
1985 *Cadomoceras minor* (PARONA), 1896. – FERNÁNDEZ LÓPEZ, p. 145, pl. 13, fig. 10.
1985 *S. (Cadomoceras) nepos* (TRAUTH, 1922). – SANDOVAL, p. 104, pl. 1, figs. 13–14, pl. 2, figs. 1–2.
1990 *Cadomoceras cadomense* (DEFRANCE). – SANDOVAL, p. 151.
1990 *Cadomoceras nepos* PARONA. – SANDOVAL, p. 151, pl. 3, fig. 6.
v 1993 *Cadomoceras cadomense*. – BESNOSOV & MITTA, p. 26, pl. 1, figs. 8–9.
v 1998 *Strigoceras (Cadomoceras) cadomense*. – BESNOSOV & MITTA, pl. 8, fig. 1.
v 2000 *Strigoceras (Cadomoceras) cadomense* (DEFRANCE, 1840). – BESNOSOV & MITTA, pp. 13, 51, pl. 1, figs. 7–8.

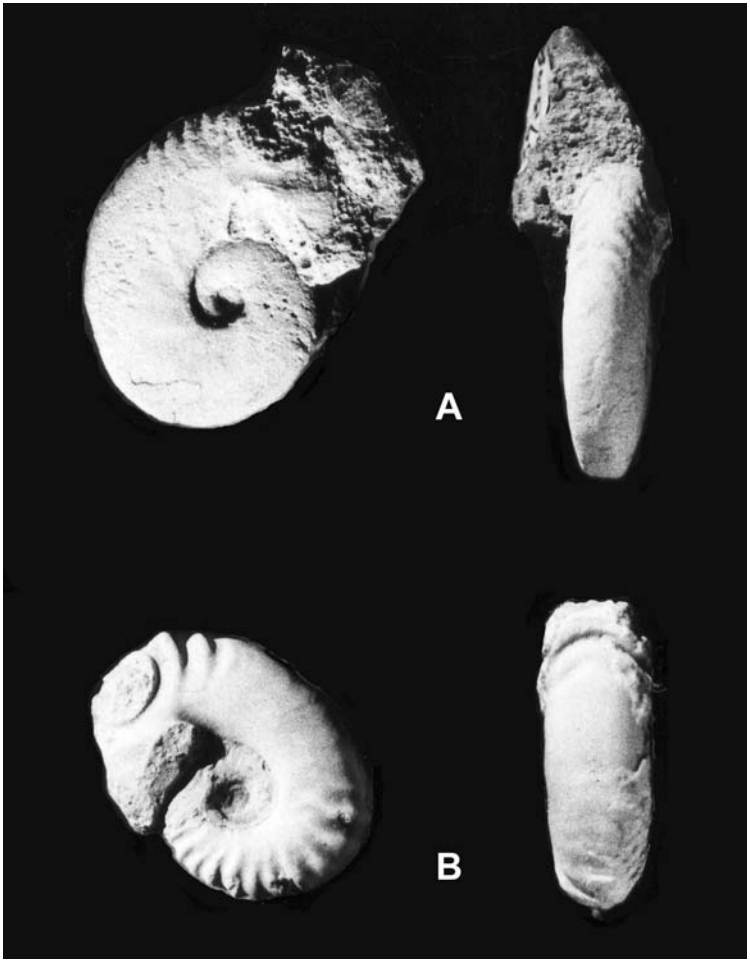

Fig. 33. **A**. *Cadomoceras nepos* PARONA (= holotype of *Cadomoceras simulacrum* BUCKMAN), lateral and ventral views; Sherborne, "Combe", S England; Inferior Oolite, Upper Bajocian, Niortense Zone; BGS GSM 37308. **B**. *Cadomoceras nepos* PARONA var. *costatum* BUCKMAN (=holotype of *Cadomoceras costatum* BUCKMAN),lateral and ventral views; Burton Bradstock, Dorset, S England; Inferior Oolite, White Bed, Upper Bajocian, Niortense Zone; BGS GSM 47105. – ×2.

Lectotype: Designated by STURANI (1971, pl. 5, fig. 7) from the PARONA collection, collection of the Museo di Geologia e Paleontologia of the University of Padova, Italy.

Type locality: Monte Meletta near Gallio, Altopiano di Asiago, Southern Alps, Italy.

Type horizon: Lumachella à *Posidonia alpina* Beds (Bajocian, Niortense Zone).

As type horizon of the conspecific *C. simulacrum* BUCKMAN, PARSONS (1976) indicated bed 6d of Frogden quarry, Oborne, Dorset, the age of which is Baculata Subzone of Niortense Zone.

Stratigraphic range: Niortense Zone.

Studied material: Ca. 20 specimens.

Records: England, France, Spain, Southern Alps, Sicily, Caucasus, Turkmenistan, Dagestan, Japan.

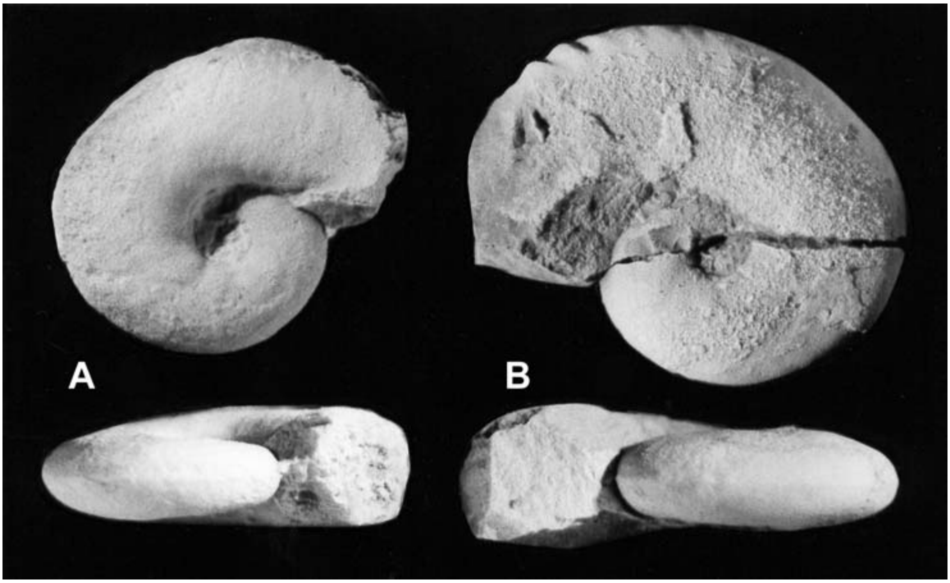

Fig. 34. A–B. *Cadomoceras nepos* PARONA, lateral and ventral views; Albarracín, Keltiberian Ranges, E Spain; bed 30 l in section A of HINKELBEIN (1975, fig. 11), Chelva Formation, Upper Bajocian, Niortense Zone, Baculata Subzone; SMNS 65383/1–2 (Coll. K. HINKELBEIN). – ×2.

Diagnosis. – Medium-size species of *Cadomoceras* with a stage showing strong ventrolateral ribbing just behind the aperture.

Description. – See STURANI (1971). In *C. nepos* ventrolateral ribbing is usually developed just behind the lappeted aperture and also in the first half of the last whorl which shows a strongly eccentric coiling. Within the variation of this chronospecies, some extremely broad and coarse-ribbed specimens occur (*C.* "*costatum*" BUCKMAN), corresponding to similar macroconch specimens. The taxon *costatum* introduced by BUCKMAN (1923) is therefore treated here as a variety of *C. nepos* (Fig. 33B).

Comparisons. – *C. nepos* is characterized by a long persistent smooth stage of the adult bodychamber followed by scarce ribbing behind the aperture. There are transitions between *C. nepos* and the younger *C. cadomense*. In the latter species the genus reaches its largest widths.

Measurements

	d	h	w	u	h/d	w/d	u/d
Lectotype	19.2	8.4	5.6	4.8	0.44	0.29	0.25
GSM 47105 (Fig. 33B)	19.5	8.0	7.3	6.3	0.41	0.37	0.32
SMNS 65383/1 (Fig. 34A)	20.0	9.3	7.6	5.7	0.46	0.38	0.29
GSM 37308 (Fig. 33A)	21.3	8.5	5.2	4.5	0.40	0.24	0.21
SMNS 65383/2 (Fig. 34B)	24.5	12.0	8.5	5.8	0.49	0.35	0.24

Cadomoceras cadomense (DEFRANCE in DE BLAINVILLE, 1840)
Fig. 35

1830 [Ammonite de Caen]. – DEFRANCE, pl. (2)18, fig. 1.
* 1840 *Ammonites cadomensis*. – DE BLAINVILLE, p. 153.
1845 *Ammonites cadomensis*. – D'ORBIGNY, pl. 129, figs. 4–6.
1909 *Ammonites cadomensis* DEFRANCE. – DOUVILLÉ, pl. 134, fig. C1.
1918 *Cadomoceras cadomense* DEFRANCE. – COEMME, p. 44, pl. 6, figs. 4–8.
1938 *Cadomoceras cadomense* DEFR. – ROMAN, pl. 16, fig. 166.
1951 *Cadomoceras cadomense*. – ARKELL, p. 49.
1957 *Cadomoceras cadomense* (DEFRANCE in DE BLAINVILLE). – ARKELL, p. L 273, fig. 315.6.
cf. 1963 *Oecotraustes nodifer* BUCKMAN. – KRYMHOLTZ & STANKEVITCH, p. 113, pl. 1, fig. 8.
1964 *Cadomoceras cadomense*. – HÖLDER, pp. 90–91.
1968 *Cadomoceras cadomense*. – PAVIA & STURANI, p. 314.
1973 *Cadomoceras* cfr. *cadomense*. – PAVIA, table 3.
1975 *Cadomoceras cadomense*. – PARSONS, p. 9.
1982 *Cadomoceras nepos* PARONA. – FERNÁNDEZ LÓPEZ, tab.-fig. 2, pl. 1, fig. 5.
1982 *Cadomoceras cadomense*. – FERNÁNDEZ LÓPEZ, tab.-fig. 2.
1988 *Cadomoceras nepos* PARONA. – FERNÁNDEZ LÓPEZ, p. 77.
1988 *Cadomoceras* sp. – FERNÁNDEZ LÓPEZ & AURELL, tab.-fig. 4.
v 1990 *Cadomoceras* sp. – DIETZE & STOLMAR, p. 167 top.
1994 *Cadomoceras cadomense* (BLAINVILLE, 1840). – RIOULT in FISCHER, p. 114, pl. 50, figs. 3 (= reproduction of the lectotype)–4.
1995 *Cadomoceras* cf. *costatum*. – GAUTHIER et al., p. 322.
1997 *Cadomoceras cadomense*. – RIOULT et al., p. 52.
1997 *Cadomoceras cadomense*. – FERNÁNDEZ LÓPEZ et al., tab.-fig. 12.
1997 *Cadomoceras nepos*. – FERNÁNDEZ LÓPEZ et al., tab.-fig. 12.
1998 *Cadomoceras cadomense*. – FERNÁNDEZ LÓPEZ et al., tab.-fig. 11.
1998 *Cadomoceras nepos*. – FERNÁNDEZ LÓPEZ et al., tab.-fig. 11.

Lectotype: Specimen from the E. DESLONGCHAMPS collection, photograph in DOUVILLÉ (1909, pl. 134, fig. C1), see ARKELL (1951: 49); according to RIOULT (in FISCHER 1994) destroyed in 1944 during World War II.
Type locality: Bayeux, Calvados, France.
Type horizon: Oolithe ferrugineuse de Bayeux (Late Bajocian, Parkinsoni Zone, probably Truellei Subzone).
Stratigraphic range: Garantiana Zone to Zigzag Zone, Convergens Subzone.
Studied material: 5 specimens.
Records: France, England, Spain, Southern and Western Alps, Dagestan.

Diagnosis. – *Cadomoceras* with relatively stout shell and ventrolateral ribbing occurring at the beginning of the last whorl, and again behind the aperture, with a plain unsculptured region inbetween.

Description. – See RIOULT (in FISCHER 1994: 114). Because the lectotype of *C. cadomense* is destroyed, a better description of this taxon may be obtained from topotypes, e.g. the specimen figured by RIOULT (in FISCHER 1994, pl. 50, fig. 4). Usually, the ventrolateral ribbing appears at the beginning of the last whorl, then almost fades out, reappearing for a short distance in the bend of the bodychamber. Sparse ribs are often present just behind the lappeted aperture as in the older chronospecies *C. nepos* PARONA. The venter on the last whorl is rounded. In general, the whorl widths of *C. cadomense* are the biggest of the genus.

Comparisons. – *C. cadomense* is very close to *C. nepos*, but has stronger ribbing in the bend of the bodychamber. It commonly has a broader cross section, the broadest in the genus.

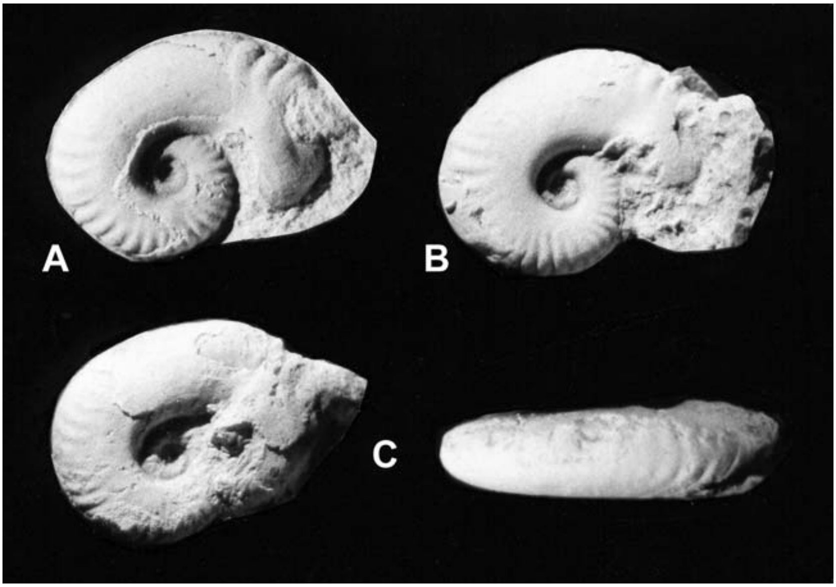

Fig. 35. *Cadomoceras cadomense* (DEFRANCE in DE BLAINVILLE). **A**. Lateral view; Burton Bradstock, Dorset, beach exposure; Inferior Oolite, Truellei Bed (bed 13 b of CALLOMON & CHANDLER 1994), Upper Bajocian, Parkinsoni Zone, Truellei Subzone, *Parkinsonia parkinsoni* β horizon; SMNS 65382 (leg. G. ERMER). **B**. Lateral view; Port-en-Bessin, France; Oolithe ferrugineuse de Bayeux, Upper Bajocian, Parkinsoni Zone, probably Acris Subzone; SMNS 67161 (ex coll. V. DIETZE). **C**. Lateral and ventral views; Burton Bradstock, Dorset, beach exposure; Inferior Oolite, Truellei Bed (bed 13 b of CALLOMON & CHANDLER 1994), Upper Bajocian, Parkinsoni Zone, Truellei Subzone, *Parkinsonia parkinsoni* β horizon; SMNS 67162 (ex coll. V. DIETZE). – ×2.

Measurements

	d	h	w	u	h/d	w/d	u/d
D'ORBIGNY specimen MNHM B. 46072	22.0	11.0	8.0	10.0	0.50	0.36	0.45
SMNS 67162 (Fig. 35C)	16.5	6.5	6.3	4.5	0.39	0.38	0.27
SMNS 65382 (Fig. 35A)	17.2	7.5	–	4.5	0.44	–	0.26

9. Phyletic history of *Strigoceras/Cadomoceras*

The microconch ammonites included in *Cadomoceras* strongly resemble the late Early Jurassic genus *Onychoceras* WUNSTORF, 1907, which extends up to the early Middle Jurassic (SCHWEIGERT et al. 2000). They are either smooth or widely-spaced ribbed forms, in contrast to more finely ribbed and thicker *Oecoptychius*. In both dimorphic partners *Phlycticeras/Oecoptychius* and *Strigoceras/Cadomoceras* the size ratio between macroconchs and microconchs is enormous, as much as 10–15 : 1. The same can be true for their presumed ancestors. *Phlycticeras* is phyletically linked with the Middle Jurassic genus *Csernyeiceras* GÉCZY, 1966, and its late Early Jurassic relative *Esericeras* BUCKMAN, 1920, and *Phlyseogrammoceras* BUCKMAN, 1901, as already discussed by SCHWEIGERT et al. (2000). Cladistic analysis by MOYNE & NEIGE (2004) identified strigoceratids ('*Praestrigites*'), early oppeliids s. str. *(Brad-*

fordia) and *Csernyeiceras* as closely allied, but lumped them together into a hammatoceratid ancestry. Strigoceratinae must have split from their Phlycticeratinae ancestors in the earliest Middle Jurassic. The diagnostic features for separation of *Strigoceras* from Phlycticeratinae are a very narrow umbilicus, a rounded umbilical wall, absence of umbilical or lateral nodules, and a low, smooth floored keel instead of a razor-sharp keel. Such features are fully developed in the earliest chronospecies known so far, *Strigoceras praenuntium* from the Middle Aalenian (see p. 9). More data than presently available are required for a better understanding of the earliest phyletic history of *Strigoceras*.

The dimorphic pair *Strigoceras/Cadomoceras* persists into the Early Bathonian, where to date *S. callomoni* n. sp. represents its youngest member. The most reliable records published prior to this study come from the Betic Cordilleras of southern Spain (Sandoval 1983: 123, text-fig. 77A) and from the Catalan Basin of southeastern Spain (Fernández López 2000). A Bathonian age for *Strigoceras kuznetsovi* Krymholtz & Stankevitch, 1963, from Dagestan was questioned by Sturani (1971: 125). The ammonite assemblage containing *Strigoceras kuznetsovi* also yields *Pseudocosmoceras michalskii* (Borissjak), and was tentatively correlated with the Convergens Subzone of the Early Bathonian (Besnosov & Mitta 1993: 15). The Early Bathonian age of *Pseudocosmoceras michalskii* (Borissjak) is still unconfirmed. New examples of endemic *P. michalskii* occuring with *S. kuznetsovi* make a Late Bajocian age for the assemblage more likely (Mitta 2004).

Another *Strigoceras* specimen said to come from the Upper Bathonian of Lechstedt near Hildesheim, northwestern Germany (Westermann 1958: 54, pl. 17, fig. 6), most likely comes from a much older stratigraphical level at another Middle Jurassic locality in northwestern Germany; the clay-pit of Gerzen, where claystones of the Lower Bajocian were quarried. This specimen is preserved as a pyritic mould with aragonitic remains of the shell, therefore reworking of the specimen can be excluded. The slender cross section and ribbing sculpture of this specimen better related to a *Strigoceras* chronospecies of the Sauzei/Humphriesianum zones. From the (?)Sauzei Zone of Gerzen a corresponding *Cadomoceras carinatum* Buckman is recorded and illustrated herein for the first time (Fig. 31D). Similarly Kumm (1952) mentioned *Strigoceras truellei* from the latest Bajocian and from the Bathonian. He did not illustrate this material, and most likely the specimens represent either *Phlycticeras*, or the proposed finding levels were erroneous.

Krystyn (1971, 1972) reported a single specimen of *Strigoceras truellei* from an ammonite bed containing a Middle to Late Bathonian fauna. This specimen was interpreted as derived. Other "*Strigoceras* sp." were recorded from the Late Bathonian Retrocostatum Zone of Monte Kumeta, W Sicily, but not illustrated (Di Stefano et al. 2002: 289). Photographs of the two specimens provided by courtesy of A. Galácz (Budapest) allow them to be identified as nuclei and placed in *Phlycticeras* sp.

Our present knowledge records the extinction of *Strigoceras/Cadomoceras* in the Zigzag Zone, the youngest known record coming from the Macrescens Subzone (see above; Table 1). From this time onwards, the dimorphic pair *Phlycticeras/Oecoptychius* becomes significantly more abundant suggesting that it replaced *Strigoceras/Cadomoceras* ecologically.

10. Conclusions

The dimorphic couple *Strigoceras*/*Cadomoceras* forms a remarkably conservative lineage within Haploceratoidea, ranging from the Middle Aalenian to the Early Bathonian. The separation of Strigoceratinae and Phlycticeratinae from a common ancestor must have occurred at least in the Early Aalenian. *Strigoceras* is widely distributed in the western Tethys and adjacent areas, but absent in the Boreal Realm. In contrast to Phlycticeratinae it is also absent in the southern Pacific.

Within an isochronous population, macroconchs of Strigoceratinae show a wide variation in ontogeny, with specimens attaining adult characters at small diameters alongside others that reach gigantic size. In small individuals the suture line is remarkably more complex than in the contemporary large examples at equal diameters. In addition the development of the sculpture appears accelerated in small specimens. A trend observed in *Strigoceras* is the shifting of the centre of morphological variation during phylogeny leading to stouter morphs. Later in the Middle Jurassic a similar trend is observed in the *Phlycticeras* lineage of Strigoceratidae (cf. SCHWEIGERT & DIETZE 1998). The reasons for these evolutionary trends are unknown.

The only direct descendant we included in Strigoceratinae is *Granulochetoceras* GEYER, 1960, which is linked with *Strigoceras* by a transitional form described here as *Granulochetoceras oppeliisculptum* n. sp. Another early species of *Granulochetoceras* is *G. hungaricum* (LÓCZY, 1915) (see p. 48), recorded as an extreme rarity from the Late Callovian of France, Hungary, and Switzerland. Thus, the recorded stratigraphical range of *Granulochetoceras* extends now from the Late Bajocian to the Late Kimmeridgian.

In accordance with our data and previous studies, the following haploceratoid genera are included in Strigoceratinae: *Strigoceras* QUENSTEDT, 1886 [M], *Cadomoceras* BUCKMAN, 1923 [m], *Granulochetoceras* GEYER, 1960 [M], *Cymaceras* QUENSTEDT, 1887 [M], and *Trochiskioceras* SCHAIRER & SCHLAMPP, 1991 [m].

The following genera are now included in Phlycticeratinae: *Phlycticeras* HYATT, 1900 [M], *Oecoptychius* NEUMAYR, 1878 [m], *Csernyeiceras* GÉCZY, 1966 [M], *Phlyseogrammoceras* BUCKMAN, 1901 [M], *Esericeras* BUCKMAN, 1920 [M], *Onychoceras* WUNSTORF, 1907 [m], *Strungia* ARKELL, 1952 [M], *Petitclercia* ROLLIER, 1909 [M], *Oxydiscites* DACQUÉ, 1934 [M], and *Sphaerodomites* ROLLIER, 1909 [m].

Diplesioceras BUCKMAN, 1920 and *Vastites* ARKELL, 1951, are very rare and still poorly understood genera. They may also belong to Strigoceratidae but more material will be needed for further discussion.

11. References

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