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The Upper Albian ammonite succession in the Montlaux section, Hautes-Alpes, France

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ABSTRACT:

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A 100 metre succession of Upper Upper Albian sediments in the Montlaux section (les Gipieres-Champfleury), Alpes-de-Haute Provence, France yielded a series of ammonites that provide unequivocal evidence for a *Mortoniceras* (*Subschloenbachia*) *rostratum* ammonite Zone succeeded by a *Mortoniceras* (*Subschloenbachia*) *perinflatum* ammonite Zone. On this basis, and evidence from successions described previously, the classic Upper Upper Albian *Stoliczkaia dispar* Zone is replaced by a sequence, from oldest to youngest, of *Mortoniceras* (*Mortoniceras*) *fallax*, *Mortoniceras* (*Subschloenbachia*) *rostratum*, *Mortoniceras* (*Subschloenbachia*) *perinflatum* and *Arrhaphoceras* (*Praeschloenbachia*) *briacensis* Zones. The following species are described: *Anagaudryceras sacya* (FORBES, 1846), *Desmoceras latidorsatum* (MICHELIN, 1838), *Puzosia (Puzosia) mayoriana* (D'ORBIGNY, 1841), *Pleurohoplites renauxianus* (D'ORBIGNY, 1840), *Arrhaphoceras* sp., *Discohoplites simplex* WRIGHT & WRIGHT, 1949, *Discohoplites subfalcatus* (SEMENOV, 1899), *Mortoniceras* (*Subschloenbachia*) *rostratum* (J.SOWERBY, 1817), *Mortoniceras* (*Subschloenbachia*) *perinflatum* (SPATH, 1922b), *Stoliczkaia* (*Stoliczkaia*) *dispar* (D'ORBIGNY, 1841), *Stoliczkaia* (*Stoliczkaia*) *clavigera* NEUMAYR, 1875, *Anisoceras armatum* (J.SOWERBY, 1817), *Anisoceras perarmatum* PICTET & CAMPICHE, 1861, *Anisoceras pseudoelegans* PICTET & CAMPICHE, 1861, *Idiohamites elegantulus* SPATH, 1939, *Hamites venetzianus* PICTET, 1847, *Lechites* (*L.*) *gaudini* (PICTET & CAMPICHE, 1861), *Lechites* (*L.*) *moreti* BREISTROFFER, 1936, *Mariella* (*Mariella*) *bergeri* (BRONGNIART, 1822), *Ostlingoceras* (*Ostlingoceras*) *puzosianum* (D'ORBIGNY, 1842), and *Scaphites* (*Scaphites*) sp.

Keywords : Ammonites, Zonation, Cretaceous, Albian, France.

INTRODUCTION

The Montlaux section (les Gipieres-Champfleury), south of the Montagne de Lure in Alpes-de-Haute-Provence, France (Text-fig. 1; LATIL 1995) exposes a more than 100 metre section of green, fine-grained silty marls and better cemented calcareous beds that range from the Upper Upper Albian to Lower Cenomanian. Ammonites are common in the middle part of the section, between 52.5 and 97.5 m: beds 65 to 96 (Text-fig. 2). The presence of *Stoliczkaia* in the lower part of the sec-

tion shows it to already be within the Upper Upper Albian, while the occurrence of *Mortoniceras* (*Subschloenbachia*) *perinflatum* in bed 106 indicates that the base of the Cenomanian lies higher still. The interest of the ammonite fauna lies in the fact that the succession provides unequivocal evidence for the presence of a Zone of *Mortoniceras* (*Subschloenbachia*) *rostratum* below and of *Mortoniceras* (*Subschloenbachia*) *perinflatum* above, thus clarifying the confusion in the faunal succession in the interval equivalent to the now redundant *Stoliczkaia* (*S.*) *dispar* Zone of authors.

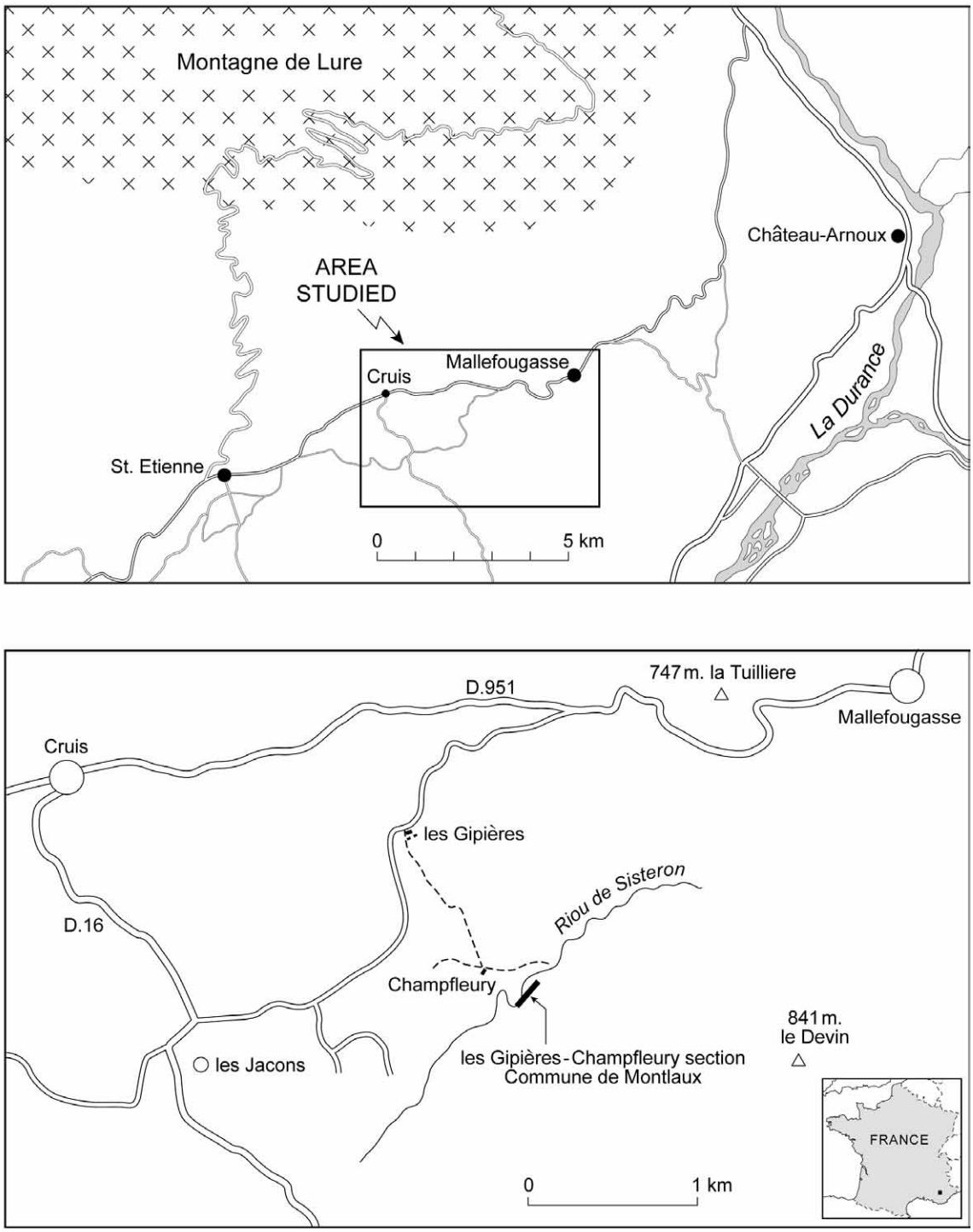

Fig. 1. Location of the Montlaux section, Alpes-de-Haute-Provence, France

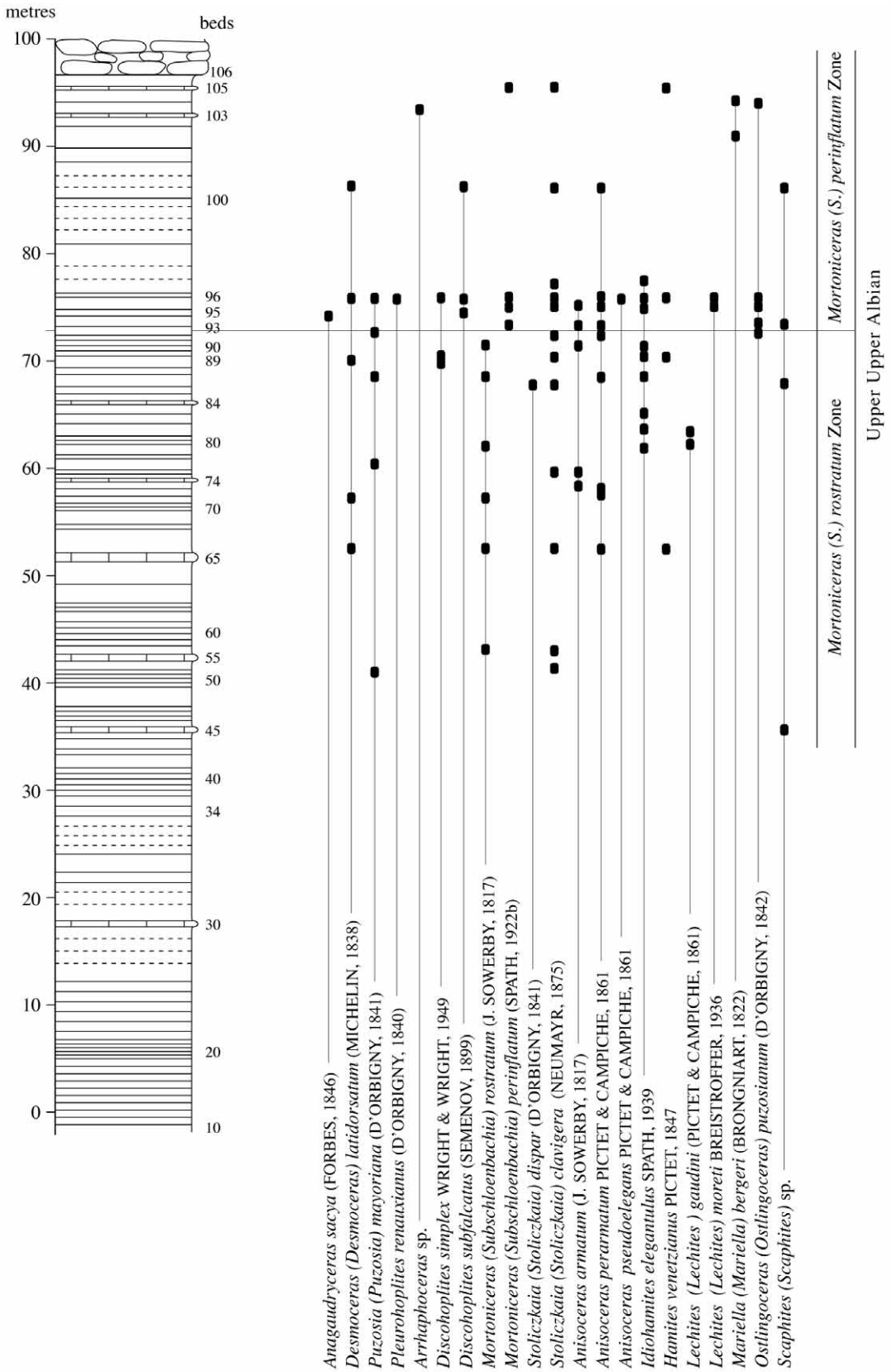

Fig. 2. The upper Upper Albian succession at Monlaux, Alpes-de-Haute-Provence, France

AMMONITE ZONATION OF THE UPPER UPPER ALBIAN

Text-fig. 3 shows the divisions of the upper Upper Albian: the classic *Stoliczkaia dispar* Zone of authors. The index species is confined to a very limited interval within the zone, and we follow AMÉDRO (1992, 2002) who abandoned it, and divided up the interval into a series of zones. He recognised a *Mortoniceras fallax* Zone below, and a *Mortoniceras perinflatum* Zone above, with, latterly, and higher still, an *Arrhaphoceras* (*Praeschloenbachia*) *briacensis* Zone as the equivalents of the broad *dispar* Zone of authors. In contrast, others (as for example OWEN, 1996 1999; OWEN & MUTTERLOSE 2006; LOPEZ-HORGUE & *al*. 1999) recognise a *rostratum* Subzone below, and a *perinflatum* Subzone above, and do not recognise a *fallax* Zone or Subzone. AMÉDRO (2002) rejected *Mortoniceras rostratum* as a zonal fossil because it came from a condensed deposit. But as HANCOCK (2003) noted, this is not the case. The holotype of *M. rostratum* comes from the expanded Upper Greensand of Oxfordshire, and it is *M. fallax*, used as an index fossil by AMÉDRO, that comes from not merely a condensed deposit, but from the Cambridge Greensand, a bed of derived Albian phosphatised fossils, probably of more than one age, that form a basement bed to the Cenomanian Lower Chalk of Cambridgeshire, and are preserved in a matrix of Lower Cenomanian age (HART 1973).

The problem of the stratigraphic relationship between *fallax* and *rostratum* was addressed by LATIL (1995):

"OWEN (1984) suggested that the *dispar* Zone be divided into two Subzones (from bottom to top):
1) *Mortoniceras* (*Mortoniceras*) *rostratum* Subzone
2) *Mortoniceras* (*Durnovarites*) *perinflatum* Subzone

But introduction of these new subdivisions put forward discrepancies in the understanding of the index species, *Mortoniceras rostratum* (J. SOWERBY, 1817) in the literature.

— BREISTROFFER (1940) assumed that *M. rostratum* only occurs in the *perinflatum* Subzone whilst *Mortoniceras fallax* (=*Pervinquieria fallax* BREISTROFFER, 1940) occurs in the lower part of the *dispar* Zone. BREISTROFFER was followed by AMÉDRO (1980), SCHOLZ (1979), and COOPER & KENNEDY (1979).

— OWEN (1975) concluded both species as synonyms and therefore *Mortoniceras rostratum* characterises the lower part of the *dispar* Zone.

After re-examination of the type material of *M. inflatum* (J. SOWERBY, 1818), *M. rostratum* (J. SOWERBY, 1817), *M. fallax* (BREISTROFFER, 1940), *M. pachys* (SEELEY, 1865), and *M. stoliczkai* (KOSSMAT, 1895), and comparative material from south-eastern France, it turns out that true *M. rostratum* only occurs in the *perinflatum* Subzone of the Montagne de Lure (Alpes-de-Haute-Provence) sections, along with *Stoliczkaia dispar*. *Mortoniceras rostratum* is always quadrituberculate on the phragmocone and on the beginning of the body chamber and trituberculate on the terminal part of the body chamber.

M. fallax differs from *M. rostratum* by the appearance of the trituberculation at a younger stage (i.e. before the body chamber) and its larger adult size. Moreover, it is found at an older level.

From the *inflatum* Subzone, *Mortoniceras inflatum* (J. SOWERBY, 1818) shows the first indices of a quadrituberculate stage on the inner whorls. In *Mortoniceras,* transition between tri- and quadrituberculate morphologies seems to be induced by a juvenile innovation that spreads quickly to the outer whorls.

During the *dispar* Zone, this innovation drives quickly to an heterochronic process of progenetic type: after a *fallax* grade in which quadritubercula-

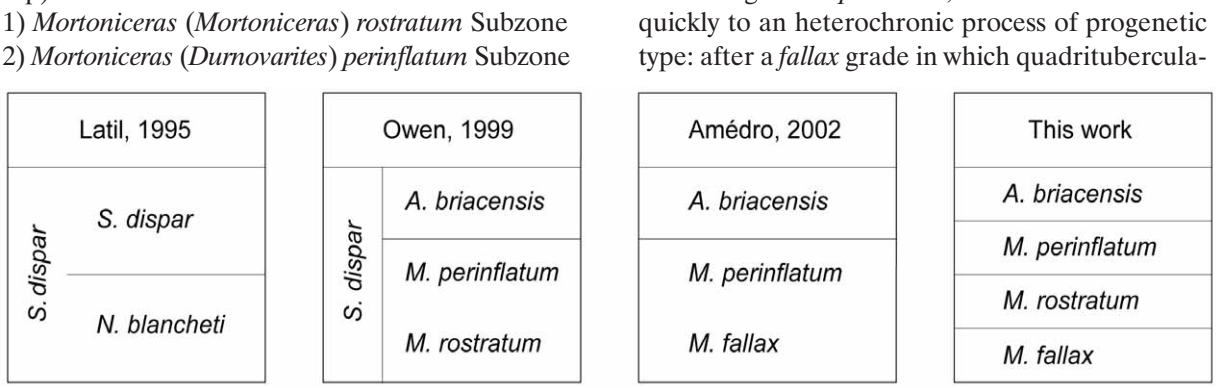

Fig. 3. The Upper Upper Albian zonal succession according to various authors

tion invades the inner whorls toward the vicinity of the body chamber; this process achieves during the *perinflatum* Subzone, the morphology of *M. rostratum* in which trituberculation is only maintained on the outer part of the body chamber. All these ornamental changes seem to be combined with a reduction of the *Mortoniceras* adult size through evolution.

In addition, it is likely that the successive *inflatum*, *fallax* and *rostratum* represent a one single chronospecies, characterised by a strong intraspecific polymorphism. In any case, only *M. fallax* should be used as index species of the lower part of the *dispar* Zone, while *M. rostratum* characterises the middle part of this Zone."

The present re-examination of the ammonites from the Montlaux section described by LATIL (1995) and material collected subsequently shows that *M. perinflatum* succeeds *M. rostratum*, with no overlap. This same sequence has been independently established in Texas (KENNEDY & *al*. 1998, 2005). Furthermore, the ontogeny and other morphological features suggested to KENNEDY & *al*. (1998) that both *rostratum* and *perinflatum* should be referred to the Subgenus *Mortoniceras* (*Subschloenbachia*) SPATH, 1921, which they regarded as the senior synonym of *Durnovarites* SPATH, 1922b. The relative position of *M. fallax* is established on the basis of records from southern England, the distinctive association in the expanded Strépy section (AMÉDRO 2002) and the condensed Salazac section in Gard (LATIL 1995; AMÉDRO 2002). On this basis, a sequence of *Mortoniceras fallax*, *rostratum*, and *perinflatum* Zones can be proposed, succeeded by an *Arrhaphoceras briacensis* Zone, together equivalent to the classic *dispar* Zone of authors (Text-fig. 3).

THE MONTLAUX AMMONITE FAUNA

The ammonite fauna from the Montlaux section, with bed ranges (Text-fig. 2) is as follows:

Anagaudryceras sacya (FORBES, 1846); bed 93.

Desmoceras latidorsatum (MICHELIN, 1838) (Pl. 2, Fig. 1; Pl. 6, Figs 2, 3; Text-fig. 4): beds 60-70 to 100.

Puzosia (Puzosia) mayoriana (D'ORBIGNY, 1841) (Pl. 1, Figs 1-6; Pl. 3, Fig. 10): beds 45-50 to 96.

Pleurohoplites renauxianus (D'ORBIGNY, 1840): bed 96.

Arrhaphoceras sp. (Pl. 4, Fig. 2): bed 103.

Discohoplites simplex WRIGHT & WRIGHT, 1949 (Pl. 4, Fig. 5): beds 87-96.

Discohoplites subfalcatus (SEMENOV, 1899) (Pl. 4, Figs 3, 4, 6): beds 94-100.

Mortoniceras (*Subschloenbachia*) *rostratum* (J.SOWERBY, 1817) (Pl. 2, Fig. 2; Pl. 3, Figs 3, 6-9; Pl. 4, Figs 7, 8): beds 55 to 89.

Mortoniceras (*Subschloenbachia*) *perinflatum* (SPATH, 1922) (Pl. 3, Figs 2, 4, 5): beds 93-106.

Stoliczkaia (*Stoliczkaia*) *dispar* (D'ORBIGNY, 1841 (Pl. 6, Figs 4-6): bed 85.

Stoliczkaia (*Stoliczkaia*) *clavigera* NEUMAYR, 1875 (Pl. 4, Fig. 1; Pl. 5, Figs 1-7; Pl. 6, Fig. 1): beds 50 to above 105.

Anisoceras armatum (J.SOWERBY, 1817) (Pl. 7, Fig. 7; Pl. 10, Figs 11, 14): beds 72-95.

Anisoceras perarmatum PICTET & CAMPICHE, 1861 (Pl. 7, Figs 1-6; Pl. 10, Fig. 12): beds 65-100.

Anisoceras pseudoelegans PICTET & CAMPICHE, 1861 (Pl. 12, Figs 7, 8): bed 96.

Idiohamites elegantulus SPATH, 1939 (Pl. 8, figs 1-7, Pl. 9, Figs 1-3, 5-8): beds 77-98.

Hamites venetzianus PICTET, 1847 (Pl. 9, Fig. 4): beds 65-104.

Lechites (*L.*) *gaudini* (PICTET & CAMPICHE, 1861) (Pl. 10, Figs 6, 7, 10): bed 78 to above bed 80.

Lechites (*L.*) *moreti* BREISTROFFER, 1936 (Pl. 10, Figs 3-5, 8, 9, 15): Beds 95 to 96.

Mariella (*Mariella*) *bergeri* (BRONGNIART, 1822) (Pl. 10, Figs 1, 2, 13): beds 101 to 103.

Ostlingoceras (*Ostlingoceras*) *puzosianum* (D'ORBIGNY, 1842) (Pl. 11, Figs 1-12; Pl. 12, Figs 1-4): beds 91 to 103.

Scaphites (*Scaphites*) (Pl. 12, Figs 5, 6); beds 45-100.

It will be seen that the boundary between *rostratum* and *perinflatum* Zone lies between the last occurrence of *M*. (*M*.) *rostratum* in bed 89, and the first occurrence of *M*. (*S*.) *perinflatum* in bed 93.

CONVENTIONS

The following abbreviations are used to indicate the repositories of specimens mentioned in the text:

BMNH: The Natural History Museum, London.
JL: J.L. LATIL collection, Lazer.
OUM: Oxford University Museum of Natural History.
UD: University of Dijon.
UJF-ID: Université Joseph Fourier, Institut Dolomieu, Grenoble.

Order Ammonoidea ZITTEL, 1884
Suborder Lytoceratina HYATT, 1889
Superfamily Tetragonitoidea HYATT, 1900
Family Gaudryceratidae SPATH, 1927b
Genus *Anagaudryceras* SHIMIZU, 1934

TYPE SPECIES: *Ammonites sacya* FORBES, 1846, p. 113, pl. 14, fig. 9, by the original designation of SHIMIZU, 1934, p. 67.

Anagaudryceras sacya (FORBES, 1846)

1846. *Ammonites Buddha* FORBES, p. 112, pl. 14, fig. 9.
1846. *Ammonites Sacya* FORBES, p. 113, pl. 14, fig. 9.
1979. *Anagaudryceras buddha* (FORBES, 1846); KENNEDY & KLINGER, p. 146, pl. 9, figs 1-3; pl. 10, figs 1-6; pl. 11, figs 1, 2 (with full synonymy).
1984. *Anagaudryceras* cf. *sacya* (FORBES, 1846); WRIGHT & KENNEDY, p. 50, pl. 2, fig. 1; text-fig. 2g.
1995. *Anagaudryceras sacya* (JUKES-BROWNE, 1877); LATIL, pl. 7, fig. 1.
1992. *Anagaudryceras Buddha* (FORBES, 1846); THOMEL, pl. 18, fig. 24.
1996. *Anagaudryceras sacya* (FORBES, 1846); KENNEDY in GALE & *al*., p. 546, figs 10b, h; 13n.

TYPE: The holotype, by monotypy, is the original of FORBES 1846 p. 112, pl. 14, fig. 9, from Verdachellum, south India.

MATERIAL: UD. MON. 1/7. 93, from bed 93.

DISCUSSION: The single Montlaux specimen was figured by LATIL (1995, pl. 1, fig. 1). It is 115 mm in diameter, and shows the typical transition from the lirate, near-smooth juvenile stage to the characteristic adult stage with broad, band-like ribs separated by narrower interspaces. The species is comprehensively revised by KENNEDY & KLINGER, 1979 (p. 146, figs 1-3; pl. 9, figs 1-3; pl. 10, figs 1-6; pl. 11, figs 1, 2), with full synonymy. A comparable specimen from the Upper Albian of Puget-Rostang (Alpes-Maritimes), was figured by THOMEL (1992, pl. 18, fig. 24).

OCCURRENCE: *Anagaudryceras sacya* ranges from Middle Albian to Coniacian. The present specimen is from the *M*. (*S*.) *perinflatum* Zone. The geographic distribution extends from southern England to central and southern Europe, KwaZulu South Africa, Madagascar, south India, Japan, New Zealand, Alaska, British Columbia, and California.

Suborder Ammonitina HYATT, 1889
Superfamily Desmoceratoidea ZITTEL, 1895
Family Desmoceratidae ZITTEL, 1895
Subfamily Desmoceratinae ZITTEL, 1895
Genus and Subgenus *Desmoceras* MICHELIN, 1838

TYPE SPECIES: *Ammonites latidorsatus* MICHELIN, 1838, p. 101, pl. 12, fig. 9, by the subsequent designation of BÖHM, 1895, p. 364.

Desmoceras (*Desmoceras*) *latidorsatum* (MICHELIN, 1838)
(Pl. 2, Fig. 1, Pl. 6, Figs 2, 3; Text-fig. 4)

1838. *Ammonites latidorsatus* MICHELIN, p. 101, pl. 12, fig. 9.
1968. *Desmoceras* (*Desmoceras*) *latidorsatum* (MICHELIN, 1838); WIEDMANN & DIENI, p. 131, pl. 2, figs 2, 6-13, text-fig. 81 (with synonymy).
1990. *Desmoceras* (*Desmoceras*) *latidorsatum* (MICHELIN, 1838); MARCINOWSKI & WIEDMANN, p. 62, pl. 7, figs 2, 3 (with synonymy).
1996. *Desmoceras* (*Desmoceras*) *latidorsatum* (MICHELIN, 1838); KENNEDY in GALE & *al*., p. 551, text-figs 11h-j; 13d, o; 171 (*pars*).
2000. *Desmoceras latidorsatum* (MICHELIN, 1838); ARKADIEV & *al*., p. 107, pl. 9, figs 3-5.
2003. *Desmoceras* (*Desmoceras*) *latidorsatum* (MICHELIN, 1838); KAWABE & HAGGART, p. 315, figs 3-5.

TYPE: The holotype by monotypy is the original of MICHELIN 1838, p. 101, pl. 12, fig. 9, from the Albian Gault Clay of Aube, France.

MATERIAL: UJF-ID.10643, from beds 60-70; UJF-ID.10645, from bed 65; JL17.1654, from bed

Fig. 4. *Desmoceras* (*Desmoceras*) *latidorsatum* (MICHELIN, 1838); JL17.1499, presumably an adult macroconch, 210 mm in diameter, with a 180º sector of body chamber, from beds 60-70

88; JL17.1502, from bed 96; UJF-ID.10644, from bed 100.

DESCRIPTION: UJF-ID.1064 (Pl. 6, Figs 2, 3), UJF-ID.10644 (Pl. 2, Fig. 1) and JL17.1502 are whole or fragmentary small individuals 70-90 mm in diameter. Coiling is very involute, with a tiny umbilicus that comprises an estimated 155 of the diameter. All specimens are crushed, but the original whorl section appears to have been compressed, with broadly rounded inner flanks, convergent outer flanks, and a narrowly rounded venter. Ornament is well preserved on JL17.1502 and UJF-ID.10644. There are very widely spaced constrictions that are markedly concave across the flanks and projected strongly forwards on outermost flanks and ventrolateral shoulders, to cross the venter in a narrow convexity. The constrictions have an adapical collar rib that is strengthened markedly on the ventrolateral shoulders and the venter. The surface of the composite mould between constrictions bears delicate growth lines and striae that parallel the constrictions. UJF-ID.10643 (Text-fig. 4) is a much larger specimen, presumably an adult macroconch, 210 mm in diameter, with a 180º sector of body chamber preserved. Five constrictions and associated collar ribs are preserved on the body chamber, the collar ribs particularly well developed on outer flank, ventrolateral shoulders and venter.

DISCUSSION: The overall proportions, form and spacing of the collar ribs match that of the large *Desmoceras* (*D.*) *latidorsatum* from south India figured by STOLICZKA (1865 pl. 74, fig. 3). See WRIGHT & KENNEDY 1984, p. 62 for a discussion of the species.

THOMEL (1969 p. 71, unnumbered figure) described *Pseudouhligella* (*P.*) sp. aff. *japonica* YABE from the Upper Upper Albian of Saint-Etienne-les-Orgues (Basses-Alpes) and *P. japonica* from the Middle Cenomanian of Chauvac (Drôme). Both are preserved as composite mould and are probably best referred to the present species.

OCCURRENCE: Middle Albian to Upper Cenomanian, southern England, southern France, southern Germany, Switzerland, Hungary, Serbia, Poland, Spain, Sardinia, Crimea, Mozambique, Angola, KwaZulu South Africa, Madagascar, south India, Japan, and Venezuela.

Subfamily Puzosiinae SPATH, 1922b
Genus and Subgenus *Puzosia* BAYLE, 1878

TYPE SPECIES: *Ammonites planulatus* J. DE C. SOWERBY, 1827 p. 134, pl. 570, fig. 5, *non* SCHLOTHEIM 1820, p. 59; = *Ammonites mayorianus* D'ORBIGNY, 1841, p. 267, pl. 79, figs 1-3, by subsequent designation by H. DOUVILLÉ 1879, p. 91.

Puzosia (*Puzosia*) *mayoriana* (D'ORBIGNY, 1841)
(Pl. 1, Figs 1-6; Pl. 3, Fig.1)

1827. *Ammonites planulatus* J. DE C. SOWERBY, p. 597, pl. 570, fig. 5 (non SCHLOTHEIM, 1820, p. 59).
1841. *Ammonites Mayorianus* D'ORBIGNY, p. 267, pl. 79, figs 1-3.
1984. *Puzosia* (*Puzosia*) *mayoriana* (D'ORBIGNY, 1841); WRIGHT & KENNEDY, p. 55, pl. 3 figs 1, 2, 4, 6, 9-12; pl. 4, figs 1, 2, 5-7; text-figs 1a, b, 2c, h, m; 3n-r; 4a-c (with synonymy).
2004. *Puzosia* (*Puzosia*) *mayoriana* (D'ORBIGNY, 1841); KENNEDY & JOLKIČEV, p. 372, pl. 1, figs 4-6 (with additional synonymy).
2005. *Puzosia* (*P.*) *mayoriana* (SOWERBY); REBOULET & *al*., text-fig. 3a.

TYPE: The lectotype, by the subsequent designation of WRIGHT & WRIGHT 1951, p. 35, is BMNH 9381, the original of J. DE C. SOWERBY 1827, pl. 570, fig. 5, from the Cenomanian Lower Chalk of Hamsey, near Lewes, Sussex. See WRIGHT & KENNEDY 1984, p. 56, for a discussion of the complexity of this matter.

MATERIAL: 10 specimens, JL17.1504, from beds 45-50; JL17.1511, from bed 75; UJF-ID.10646 andJL17.1606, from bed 91; UJF-ID.10647, from bed 86; UJF-ID.10648, from bed 91; JL17.5001-2, from bed 96; UJF-ID.10649-50, collected loose.

DESCRIPTION: All specimens are crushed to varying degrees; complete individuals range from 35-150 mm in diameter. Coiling is moderately evolute, with an estimated 50% of the previous whorl being covered. The umbilicus comprises 27% of the diameter in the smallest specimen seen, at a diameter of 33 mm (Pl. 3, Fig. 1), and 32% in the largest specimen, at a diameter of 130 mm (Pl. 1, Figs 4, 5). Specimens typically have 3-4 constric-

tions per half whorl. The constrictions are narrow, straight and prorsiradiate on the inner flank, flexed back and convex at mid-flank, projected forwards on the ventrolateral shoulder, and produced into a convex linguoid peak on the venter. The constrictions are flanked by an adapical collar rib, which coarsens and thickens markedly on the ventrolateral shoulders and venter. The intervals between constrictions and collar ribs bear from 8-15 intercalated ribs. The inner flanks are near smooth in the present specimens, the ribs varying from fine to coarse between individuals. They are concave on the outer flank, and cross the venter in a linguoid peak.

None of the smaller specimens show any evidence in the course of the growth lines or ribs to indicate the onset of maturity and lappet development characteristic of microconchs, even though some have up to 240º of body chamber preserved; accordingly, all are regarded as juvenile macroconchs. A much larger fragment, collected loose (Pl. 1, Fig. 6), has a maximum preserved whorl height of 70 mm, and may be part of an adult macroconch phragmocone. Just over half a whorl is preserved, with traces of two constrictions, and very coarse associated adapical collar ribs.

DISCUSSION: The co-occurrence of individuals with numerous fine, and fewer coarse ribs is seen elsewhere (see for example THOMEL 1992). The largest fragment, presumed to be part of an adult macroconch, differs from *Austiniceras austeni* (SHARPE, 1855) (WRIGHT & KENNEDY 1984, pl. 5, fig. 6) in having the intercalated ribs restricted to the outer flanks only, whereas in the latter the ribs extend to the umbilical shoulder, and are falcoid. Accordingly, we doubt the assertion of LEHMANN 1988, p. 407) that *mayoriana* and *austeni* are a microconch: macroconch pair. See WRIGHT & KENNEDY 1984, p. 57, for a comprehensive discussion of this species.

OCCURRENCE: Upper Albian to Upper Cenomanian, widespread throughout Europe, Africa, south India, and Japan.

Superfamily Hoplitoidea H. DOUVILLÉ, 1890
Family Hoplitidae H. DOUVILLÉ, 1890
Subfamily Hoplitinae H.DOUVILLÉ, 1890
Genus *Pleurohoplites* SPATH, 1921

TYPE SPECIES: *Ammonites renauxianus* D'ORBIGNY, 1840, p. 113 pl. 27, figs 1, 2, by the original designation of SPATH 1921, p. 113.

Pleurohoplites renauxianus (D'ORBIGNY, 1840)

1840. *Ammonites renauxianus* D'ORBIGNY, p. 113, pl. 27, figs 1, 2.
1928. *Pleurohoplites renauxianus* (D'ORBIGNY); SPATH, p. 242, pl. 24, fig. 21; text-fig. 79a, b (with full synonymy).
1995. *Pleurohoplites renauxianus* (D'ORBIGNY, 1840); LATIL, pl. 7, fig. 4.

TYPE: The holotype, by monotypy, is the original of *Ammonites renauxianus* D'ORBIGNY, 1840 p. 113, pl. 27, figs 1, 2, from Bédoin, south of Mont Ventoux, Vaucluse. The original was said by D'ORBIGNY to be in the RENAUX Collection, currently housed in the Laboratoire de Paléontologie des Invertébrés of the Université des Sciences et de Techniques of the Université de Montpellier. It has not been traced.

MATERIAL: UD.MON.4/7.93, from bed 96.

DESCRIPTION: The only specimen known from the Montlaux section is a crushed individual 103mm in diameter, figured by LATIL (1995 pl. 7, fig. 4). Coiling is moderately evolute, the umbilicus comprising 40% of the diameter. Twelve to fourteen strong bullae perch on the umbilical shoulder. They give rise to pairs of strong, narrow ribs, while occasional short ribs intercalate, to give a total of an estimated 34 ribs per whorl at the ventrolateral shoulder. The ribs are straight and proriradiate on the inner flank, flexing forwards on the outer flank where they are markedly concave, and projecting strongly strongly forwards on the ventrolateral shoulder, where they strengthen into blunt, oblique ventrolateral nodes.

DISCUSSION: The present specimen closely resembles the missing holotype of this poorly understood species.

OCCURRENCE: The present specimen is from the *M.* (*S.*) *perinflatum* Zone. There are also records from the Upper Albian of southern England, Germany, and Switzerlaand.

Genus and Subgenus *Arrhaphoceras* WHITEHOUSE, 1927

TYPE SPECIES: *Ammonites woodwardi* SEELEY, 1865 p. 236, pl. 11, fig. 3, by the original designation of WHITEHOUSE, 1927 p. 109.

Arrhaphoceras (*Arrhaphoceras*) sp.
(Pl. 4, Fig. 2)

MATERIAL: UJF-ID.10651, from bed 103.

DESCRIPTION AND DISCUSSION: The specimen is a 90º whorl sector with a maximum preserved whorl height of 10.3 mm. Four coarse bullae perch on the umbilical shoulder, and give rise to pairs of strong ribs that are feebly concave and rursirasdiate, and link to coarse ventrolateral tubercles, either singly, or in pairs, giving a zigzag appearance to the ribbing, as in *Arrhaphoceras helveticum* RENZ, 1968 (p. 33, pl. 4, fig. 3).

OCCURRENCE: As for material.

Genus *Discohoplites* SPATH, 1925

TYPE SPECIES: *Ammonites coelonotus* SEELEY, 1865 p. 237, pl. 10, fig. 2 only, by the original designation of SPATH 1925, p. 83.

Discohoplites simplex WRIGHT & WRIGHT, 1949
(Pl. 4, Fig. 5)

1949. *Discohoplites simplex* WRIGHT & WRIGHT, p. 478, pl. 28, fig. 3.

TYPE: The holotype, by original designation is no. 7320 in the C. W. and E. V. WRIGHT collection, now housed in the Natural History Museum, London.

MATERIAL: JL 17.5040, from bed 87; JL 5041, from bed 88; UJF-ID. 1708, from bed 96.

DESCRIPTION: UJF-ID.10708 (Pl. 4, Fig. 5) is a crushed phragmocone fragment 35.5 mm in diameter. Coiling is involute, the umbilicus comprising 17% of the diameter, shallow, with a flattened wall and sharp umbilical shoulder. Minute crowded bullae perch on the umbilical shoulder. The flanks are ornamented by delicate, near-invisible falcoid growth lines, striae, and lirae that thicken slightly on the ventrolateral shoulder. The other specimens are larger but essentially similar, the flank ornament being somewhat stronger in JL 17.5041, which may be a fragment of an adult body chamber.

OCCURRENCE: *M.* (*M.*) *rostratum* and *perinflatum* Zones; southern England and southeast France.

Discohoplites subfalcatus (SEMENOV, 1899)
(Pl. 4, Figs 3, 4, 6)

1859. *Ammonites falcatus* PICTET & CAMPICHE, non MANTELL, p. 210 (pars), pl. 27, fig. 2 only.
1899. *Hoplites subfalcatus* SEMENOV, p. 130, pl. 5, fig. 5.
1968. *Discohoplites subfalcatus* (SEMENOV); RENZ, p. 23, pl. 2, figs 1-3; text- fig. 8a, c, d; 10 d (with synonymy).
1996. *Discohoplites subfalcatus* (SEMENOV, 1899): KENNEDY in GALE & *al*., p. 552, text-figs 15c, f; 27e.

TYPE: The holotype is the original of PICTET & CAMPICHE, 1859, pl. 27, fig. 2, refigured by RENZ, 1968, pl. 2, fig. 1. The original is no. 39831 in the collections of the Musée Géologique, Lausanne.

MATERIAL: UJF-ID.10706, from bed 94; JL 17.5038-9, from bed 96; UJF-ID.10707, from bed 100.

DESCRIPTION: The earliest growth stages seen are represented by JL. 17.5038, a fragment with a maximum preserved whorl height of 7.3 mm, bearing numerous narrow, wiry ribs that increase by bifurcation and intercalation. UJF-ID. 10706 (Pl. 4, Figs 3, 4) and UJF-ID.10707 (Pl. 4, Figs 6, 7) are fragments of adult body chamber, preserving the outer flank and body chamber only, with an ornament of concave prorsiradiate ribs separated by relatively wide interspaces. UJF-ID.10706 is interpreted as an adult with modified ornament, and is too incomplete for certain identification.

OCCURRENCE: *M.* (*S.*) *perinflatum* Zone, southern England, southeast France, Switzerland, Kazakstan.

Superfamily Acanthoceratoidea
De Grossouvre, 1894
Family Brancoceratidae Spath, 1934
Subfamily Mortoniceratinae H. Douvillé, 1912
Genus *Mortoniceras* Meek, 1876

TYPE SPECIES: *Ammonites vespertinus* Morton, 1834, p. 40, pl. 17, fig. 1, by the original designation of Meek 1876, p. 448.

Subgenus *Subschloenbachia* Spath, 1921
(= *Durnovarites* Spath, 1922b; *Reyericeras* Collignon, 1979, p. 34)

TYPE SPECIES: *Ammonites rostratus* J. Sowerby, 1817 p. 163, pl. 173, by original designation by Spath, 1921 p. 284.

Mortoniceras (*Subschloenbachia*) *rostratum*
(J. Sowerby, 1817)
(Pl. 2, Fig. 2; Pl. 3, Figs 3, 6-9; Pl. 4, Figs 7, 8)

1817. *Ammonites rostratus* J. Sowerby, p. 163, pl. 173.
1976. *Mortoniceras* (*Mortoniceras*) *rostratum* (J. Sowerby, 1817); Marcinowski & Naidin, p. 108, pl. 5, fig. 1; pl. 9, fig. 2 (with synonymy).
1995. *Mortoniceras rostratum* (J. Sowerby, 1818); Latil, pl. 1, fig. 1; pl. 2.
1998. *Mortoniceras* (*Subschloenbachia*) *rostratum* (J. Sowerby, 1817); Kennedy & *al*., p. 17, figs 9-11, 13-18 (with synonymy).
1999. *Mortoniceras* (*Mortoniceras*) *rostratum* (J. Sow.); Barabobshkin, fig. 9.9.
1999. *Mortoniceras* (*Mortoniceras*) *rostratum* (J. Sowerby); Matsumoto, Kawabe, Kawashita & Hagesawa, p. 2, figs 1-4, 6b.
2000. *Mortoniceras rostratum* (J. Sowerby, 1817); Arkadiev, Atabekian, Barabobshkin & Bogdanova, p. 113, pl. 8, figs 1, 2.
2005. *Mortoniceras* (*Subschloenbachia*) *rostratum* (J. Sowerby, 1817); Kennedy & *al*., p. 367, figs 10J, 12,13.

TYPE: The holotype, by monotypy, is OUM K835, the original of J. Sowerby, 1817, p. 163, pl. 173, from the Upper Albian Upper Greensand of Roke, near Benson, Oxfordshire, England, refigured by Kennedy & *al*. 1998, figs 9-11.

MATERIAL: JL17.1492, from bed 55; L17.1481, from bed 65; UJF-ID.10652, from bed 69; JL17.1485 and UJF-ID.10655, from bed 77; UD.MON.1491 and JL17.5003, a juvenile, from bed 86; UJF-ID.10654, from bed 89; JL17.1483 and UJF-ID.10653, collected loose.

DESCRIPTION: The earliest growth stages seen are represented by a juvenile from bed 86, deformed into an ellipse with a maximum diameter of 41 mm. Coiling is very evolute, ornament consisting of predominantly primary ribs that arise at the umbilical seam and strengthen into bullae, perched on the umbilical shoulder. The ribs are prorsirdiate across the flanks, bearing lateral bullae and inner and outer ventrolateral tubercles. UJF-ID.10655 (Pl. 3, Fig. 3) is a further crushed individual, 50 mm in diameter. Ribs arise singly or in pairs from umbilical bullae, and bear weak mid- to outer lateral bullae. The ribs coarsen markedly across the ventrolateral shoulder and bear a coarse inner ventrolateral tubercle and a poorly differentiated outer lateral clavus. UJF-ID.10654 (Pl. 3, Figs 7-9) is a well-preserved juvenile 115 mm in diameter, with a 240° sector of body chamber preserved. The umbilicus comprises 29% of the diameter, with a feebly convex wall and broadly rounded shoulder. The whorl section is compressed, with a whorl breadth to height ratio of 0.75, accentuated by crushing. Sixteen primary ribs arise at the umbilical seam, and strengthen into coarse bullae, perched on the umbilical shoulder. These give rise to pairs of ribs, which with occasional intercalated ribs total an estimated 32 ribs per whorl at the ventrolateral shoulder. The ribs are crowded, coarse, blunt, straight, and prorsiradiate. The primary ribs and the long intercalated ribs all bear a rounded lateral tubercle that strengthens progressively, and moves from a lateral to an outer lateral position. All ribs coarsen markedly on the ventrolateral shoulders and venter, where they are projected forwards to form an obtuse chevron with a siphonal keel at the apex. There is a well-developed, feebly clavate inner ventrolateral tubercle and a scarcely differentiated outer ventrolateral clavus on the phragmocone and adapical part of the body chamber. On the adapertural section of the body chamber, strong, blunt, inner, and high, pinched outer ventrolateral clavi are present. Spiral strigations are well developed all over the surface of the composite mould.

There are six complete, or near-complete adults in the collection. They range from 150-180 mm in diameter at the adult aperture. The best preserved is UD.MON.1491 (Pl. 2, Fig. 2). This specimen has a phragmocone ornament of the type described above, with spiral strigations particularly well developed. The body chamber extends to 240º of the outer whorl, and bears fourteen primary ribs. These arise at the umbilical seam, and are coarse, distant, straight and prorsiradiate on the flanks. At the adapical end of the body chamber they bear umbilical bullae, coarse inner, and high, pinched outer lateral clavi. Inner and outer ventrolateral clavi coalesce into a large pinched clavus on the six ribs adapical of the rostrum, which are thus trituberculate. The final two ribs are markedly prorsiradiate, with effaced bullae. The adapical of the pair has an effacing lateral bulla and no ventrolateral tubercles. The final rib lacks tubercles. These ribs sweep back on the outer flank, accompanied by numerous growth lines and striae, becoming markedly convex, and fusing together to produce the spiral rostrum. This extends back in a 180º arc, coiled adapically, the termination in contact with the ventral keel. A short section of shell bearing strong growth lines and striae immediately precedes the aperture.

DISCUSSION: *Mortoniceras* (*Subschloenbachia*) *rostratum* can be separated from *M*. (*S*.) *perinflatum* on the basis of its consistently less depressed whorl section. See discussion in KENNEDY & *al*. 1998.

OCCURRENCE: *M*. (*S*.) *rostratum* Zone. Widespread in southern England, France, Spain, Germany, Hungary, Romania, the Crimea, Lesser Caucasus, Kopet Dag, Iran, Turkmenistan, Texas, and Japan.

Mortoniceras (*Subschloenbachia*) *perinflatum*
(SPATH, 1922b)
(Pl. 3, Figs 2, 4, 5)

1860. *Ammonites inflatus* PICTET & CAMPICHE (*non* J. SOWERBY), p. 178, pl. 21, fig. 5; pl. 22, fig. 3.
1922b. *Inflaticeras* (*Subschloenbachia*) *perinflata* SPATH, p. 113.
1976. *Mortoniceras* (*Durnovarites*) *perinflatum* (SPATH, 1922); MARCINOWSKI & NAIDIN, p. 109, pl. 6, figs 1, 2 (with synonymy).
1979. *Mortoniceras* (*Durnovarites*) *perinflatum* (SPATH, 1922); COOPER & KENNEDY, p. 269, figs 3g, 61, 62d-i, 63, 64 (with synonymy).
1996. *Mortoniceras* (*Durnovarites*) *perinflatum* (SPATH, 1922); KENNEDY in GALE & *al*., p. 557, text-figs 15p; 16e-h.
1996. *Mortoniceras* (*Durnovarites*) *quadratum* SPATH, 1933; KENNEDY in GALE & *al*., p. 557, text-figs 15p; 16e-h.
1998. *Mortoniceras* (*Subschloenbachia*) *perinflatum* (SPATH, 1922); KENNEDY & *al*., p. 15, fig. 12.
? 2000. *Mortoniceras* cf. *perinflatum* (SPATH, 1922); ARKADIEV & *al*., p. 113, pl. 9, fig. 1.
2005. *Mortoniceras* (*Subschloenbachia*) *perinflatum* (SPATH, 1922b); KENNEDY & *al*., p. 365, figs 10A, 11A-F.
2005. *Mortoniceras* (*Durnovarites*) *perinflatum* (SPATH); REBOULET & *al*., text-fig. 3l.

TYPE: The holotype, by monotypy, is the original of PICTET & CAMPICHE 1860, pl. 22, fig. 3, in the collections of the Muséum d'Histoire Naturelle, Geneva, from the Upper Albian of La Vraconne, Saint Croix, Switzerland. It was refigured by RENZ (1968, pl. 9, fig. 1) and WIEDMANN & DIENI (1968, pl. 14, fig. 4).

MATERIAL: UJF-ID.10656, from bed 93; JL17.1482, from bed 95; UJF-ID.10657-8, from bed 96; JL17.5004, from bed 106.

DESCRIPTION: The smaller specimens, to a diameter of 35 mm, show evolute coiling, with a broad umbilicus that comprises up to 37% of the diameter. The smallest fragment, JL17.1482 consists of a 120º whorl fragment with a maximum preserved whorl height of 9 mm. There are nine ribs preserved on the fragment, all primaries. They arise either singly or in pairs from sharp umbilical bullae. All ribs bear conical inner, and clavate outer ventrolateral tubercles. There is a strong siphonal keel. UJF-ID.10657 (Pl. 3, Fig.4) is a crushed individual 26 mm in diameter with occasional intercalated ribs; there is no lateral tubercle. UJF-ID.10658 (Pl. 3, Fig. 2) is also crushed, and 35 mm in diameter. There are an estimated 18 ribs on the outer half whorl. The ribs arise either singly or in pairs from the umbilical bullae, with some additional intercalated ribs. The ribs are straight and prorsiradiate on the inner flank, and flex back and are rursiradiate on the

outer flank. There are small lateral tubercles from a diameter of 20 mm. Sharp inner and outer ventrolateral clavi are present throughout the preserved parts of the outer whorl.

UJF-ID.10656, from bed 93 (Pl. 3, Fig. 5) is a fragment of a much larger individual with a maximum preserved whorl height of 23.5 mm. The ribs arise either singly or in pairs from umbilical bullae, or intercalate. They are crowded, prorsiradiate on the inner flanks, flexed back and convex at mid-flank, and recti- to feebly rursiradiate on the outer flank. There are coarse mid-lateral bullae, rounded inner, and clavate outer ventrolateral tubercles, and a strong siphonal keel. A much larger fragment from bed 106 is 130 mm in diameter, with a maximum preserved whorl height of 51 mm. Seven coarse bullae per half whorl perch on the umbilical shoulder, and give rise to pairs of very coarse recti- to rursiradiate ribs that bear a coarse lateral bulla, coarse bullate to feebly clavate inner ventrolatral tubercle and a strong outer ventrolateral tubercle.

DISCUSSION: Difference between *M*. (*S*.) *rostratum* and *M*. (*S*.) *perinflatum* are discussed above. The small specimens, with an initial trituberculate stage with umbilical bullae, inner add outer ventrolateral tubercles, followed by a quadrituberculate stage with addition of a lateral bulla correspond to specimens referred to *Mortoniceras* (*Durnovarites*) *subquadratum* SPATH, 1933 (see RENZ 1968 p. 55, pl. pl. 7, figs 8, 10; pl. 10, figs 1-4, 7, 8; text-fig. 17.f$_1$, 17.f$_2$, with synonymy). The larger fragments differ in no significant respects from specimens referred to *M*. (*D*.) *perinflatum* (SPATH, 1933)(see RENZ 1968, p. 51, pl. 8, figs 3, 5, 8; pl. 9, figs 1, 2; text-figs 17a, 18c, 19c, f, with synonymy) COOPER & KENNEDY (1979), and SCHOLZ (1979). The last-named showed *quadratum* of SPATH (1922b, p. 115, based on *Ammonites inflatus* SOWERBY var. of PICTET & CAMPICHE, 1860 p. 180 (*pars*), pl. 21, fig. 5) to be based on a juvenile *perinflatum*. COOPER & KENNEDY (1979) regarded *depressum* SPATH, 1922b (p. 114, fig. B, 2a-d), as a possible synonym, and *postinflatum* SPATH, 1933 (p. 433, pl. 40, figs 3-5; pl. 46, figs 3, 7; pl. 47, fig. 6), *adkinsi* YOUNG, 1957 (p. 6, pl. 1, figs 3, 6) and *vraconense* RENZ, 1968 (p. 54, pl. 7, figs 6-7, 11) as no more than intraspecific variants. The Texas species *adkinsi* was separated from *perinflatum* on the basis of its slightly rounder ribs, less tumid flanks and denser ribbed inner whorls, but these are differences of individuals, not species. COOPER & KENNEDY (1979) and KENNEDY in GALE & *al*. (1996) kept *M*. (*S*.) *perinflatum* and *M*. (*S*.) *subquadratum* SPATH, 1933 (p. 435, pl. 37, fig. 6; pl. 42, figs 5, 9; pl. 43, fig. 7; pl. 44, fig. 6; pl. 45, fig. 5; pl. 47, figs 2-4; pl. 48, figs 2, 4) separate, noting the smaller size, wider umbilicus, and less depressed whorl section of *subquadratum*, but raised the possibility that *perinflatum* and *subquadratum* might be based on macroconchs and microconchs respectively. This view is accepted here, and the species are placed in synonymy.

OCCURRENCE: *M*. (*S*.) *perinflatum* Zone, southern England, southeast France, Switzerland, Hungary, Romania, ?Crimea, Lesser Caucasus, Iran, Angola, KwaZulu South Africa, and Texas, USA.

Family Lyelliceratidae SPATH, 1921
Subfamily Stoliczkaiinae BREISTROFFER, 1953

DISCUSSION: The Stoliczkaiinae are placed in Lyelliceratidae following WRIGHT (1996). They are closely allied to the Mantelliceratinae, and may be better referred to the Acanthoceratidae.

Genus and Subgenus *Stoliczkaia* NEUMAYR, 1875

TYPE SPECIES: *Ammonites dispar* D'ORBIGNY, 1841, p. 142, pl. 45, figs 1, 2, by the subsequent designation of DIENER 1925, p. 179.

*Stoliczkai*a (*Stoliczkaia*) *dispar* (D'ORBIGNY, 1841)
(Pl. 6, Figs 4-6)

1841. *Ammonites dispar* D'ORBIGNY, p. 142, pl. 45, figs 1, 2.
1994. *Stoliczkaia* (*Stoliczkaia*) *dispar* (D'ORBIGNY, 1841); WRIGHT & KENNEDY, p. 574, figs 4a-c; 5b; 11h-j, n-p, s-v; 12a-d; 13d-e (with full synonymy).
1995. *Stoliczkaia dispar* (D'ORBIGNY, 1840); LATIL, pl. 10, fig. 1.
2002. *Stoliczkaia* (*Stoliczkaia*) *dispar* (D'ORBIGNY); AMÉDRO, pl. 1, fig. 2; pl. 4, fig. 1.

TYPE: The holotype, by monotypy, is the original of D'ORBIGNY 1841, pl. 45, figs 1, 2, from Bédouin,

south of Mont Ventoux, Vaucluse, France. It is in the RENAUX collection, housed in the Faculté des Sciences, Montpellier, and was refigured by WRIGHT & KENNEDY 1994, fig. 4a-c.

MATERIAL: UD.MON.1/10.93, from bed 85.

DESCRIPTION: The specimen is an adult 135 mm in diameter, with an estimated 180º of body chamber preserved. Coiling becomes increasingly more evolute around the outer whorl, where the umbilicus reaches a maximum 26% of the diameter. On the phragmocone the umbilical wall is low and convex; on the body chamber it becomes distinctly concave. The whorl section is compressed, with a whorl breadth to height ratio of 0.5, accentuated by crushing, with feebly convex inner flanks, flattened, convergent outer flanks, the ventrolateral shoulders rounded, and the venter rounded-obtusely fastigiate. There are 21 ribs on the adapical half of the outer whorl. On the phragmocone, primary ribs arise at the umbilical seam, and strengthen into long bullae, perched on the umbilical shoulder and inner flank. There are both long and short intercalated ribs. The primary ribs occasionally bifurcate. All ribs strengthen and coarsen on the ventrolateral shoulders and venter, where they are transverse. Ribbing declines markedly on the body chamber, intercalated and secondary ribs are lost, leaving widely separated primaries that weaken progressively across the flanks. Even these are lost on the final sector of the shell, which is near smooth, apart from growth lines and striae.

DISCUSSION: As noted by WRIGHT & KENNEDY (1994, p. 574), the compressed inner whorls, combined with loss of all but the inner flank ornament and convergent flanks at maturity distinguish *S.* (*S.*) *dispar* from co-occurring *S.* (*S.*) *clavigera* NEUMAYR, 1875. This has more robust, parallel-sided early and middle growth stages, and persistent coarse ribs in adults.

OCCURRENCE: Upper Upper Albian, southern England, southeast France, Switzerland, Germany?, Hungary, Bulgaria, Turkmenistan, Tunisia.

Stoliczkaia (*Stoliczkaia*) *clavigera* (NEUMAYR, 1875)
(Pl. 4, Fig. 1; Pl. 5, Figs 1-7; Pl. 6, Fig. 1)

1864. *Ammonites dispar* STOLICZKA, p. 85, pl. 45, fig. 1 only.
1875. *Stoliczkaia clavigera* NEUMAYR, p. 933.
1994. *Stoliczkaia* (*Stoliczkaia*) *clavigera* NEUMAYR, 1875; WRIGHT & KENNEDY, p. 576, figs 5b; 11k-m, q-r; 12e-h, k-n; 13a-c; 14a-c (with full synonymy).
1995. *Stoliczkaia* (*Stoliczkaia*) *clavigera* NEUMAYR, 1875; LATIL, pl. 9, fig 3.
1995. *Stoliczkaia dorsetensis* SPATH, 1931; LATIL, pl. 11, figs 3-6.
1995. *Stoliczkaia clavigera* NEUMAYR, 1875; LATIL, pl. 12, fig. 5, pl. 14, fig. 1.
1996. *Stoliczkaia* (*Stoliczkaia*) *clavigera* (NEUMAYR, 1875); KENNEDY in GALE & *al*., p. 561, figs 17n; 18f-n; 19a-c, e-h.
1999. *Stoliczkaia* (*Stoliczkaia*) *clavigera* (NEUMAYR); LÓPEZ-HORGUE & *al*., fig. 13 c, d, e, f.
1999. *Stoliczkaia* (*Stoliczkaia*) *notha* (SEELEY); LÓPEZ-HORGUE & *al*., fig. 13, g, h.
1999. *Stoliczkaia* (*Stoliczkaia*) aff. *dispar* (D'ORBIGNY); LÓPEZ-HORGUE & *al*., fig. 13 i.
1999. *Stoliczkaia* (*Stoliczkaia*) *clavigera* (NEUM.); BARABOBSHKIN, fig. 9,1.
2004. *Stoliczkaia* (*Stoliczkaia*) *clavigera* (NEUMAYR, 1875); KENNEDY, p. 822, figs 15c, d, p-t; 16a-c.
?2005. *Stoliczkaia* (*S.*) *dispar* NEUMAYR macroconch (morphotype *clavigera*); REBOULET & *al*., text-fig. 3f.

TYPE: the holotype, by monotypy, is the original of STOLICZKA 1864, pl. 45, fig. 1 only, no. 191 in the collections of the Geological Survey of India, Calcutta, and from the Utatur Group of Moraviatoor, south India. A cast of this specimen was figured by DELANOY & LATIL (1988, pl. 5, fig. 1).

MATERIAL: JL17.1466, from bed 50; JL17.1468, from bed 55; UJF-ID.10662, from bed 65; JL17.1475, from bed 74; UJF-ID.10661, from bed 85; JL17.1472 from bed 88, JL17.1476, from bed 91; UJF-ID.10659-60, JL17.1461, 17.1470, 17.1489-90, from bed 95; JL17.1460, 17.1469, 17.1471, 17. 1473, 17.1474, 17.1508, 17.5005-6 from bed 96; JL17.1607, from bed 98; JL17.1507, from bed 98; UJF-ID.10663, from bed 100; JL17.5007, from above bed 105, UJF-ID.10664, collected loose.

DESCRIPTION: The earliest growth stage seen is represented by JL17.1507, a crushed individual 22.1 mm in diameter. Coiling is involute, with high

flanks. Bullate straight, prorsiradiate primary ribs alternate with single long intercalated ribs. All ribs bear small ventrolateral clavi on either side of an obtusely fastigiated venter, with a weak siphonal clavus on all the ribs. There are numerous specimens showing the middle growth stages, all crushed to varying degrees. UJF-ID.10660 (Pl. 5, Fig. 2) is deformed into an ellipse, with a maximum preserved diameter of 47.4 mm. At the smallest diameter visible, bullate primary ribs, some of which bifurcate on the outer flank, are separated by one or two long or short intercalated ribs. All ribs have effacing ventrolateral clavi, but the siphonal clavi are lost. With increasing diameter, the ribs coarsen, are straight and prorsiradiate on the inner flank, but flex back and are feebly rursiradiate on the outer flank, and the ventrolateral tubercles are lost. At the largest preserved diameter this specimen shows a regular alternation of primary and intercalated ribs. UJF-ID.10659 (Pl. 5, Figs 5-7) is a complete adult, deformed into an ellipse with a maximum diameter of 105 mm. Ribbing is coarse on the phragmocone and adapical part of the body chamber, with one or two broad ribs arising from strong umbilical bullae, with one or two ribs intercalated between. The ribs are straight on the inner flank, flex back on the outer flank, and are very coarse on the ventrolateral shoulders and venter, which they cross in a feeble concavity. Ribbing weakens abruptly on the final 90º sector of whorl before the adult aperture, and the terminal 60º sector of the mould is near-smooth. Several specimens show this ontogenetic change on the adult body chamber at diameters of 92-100 mm, and are interpreted as microconchs. A much larger specimen, collected loose, shows this change at a diameter of 135 mm, and is interpreted as a macroconch. Two microconchs, JL17.1468 and UJF-ID.10662 (Pl. 6, Fig. 1), have particularly coarse ribs on the outer adult whorl.

OCCURRENCE: *M.* (*S.*) *rostratum* to *A.* (*P.*) *briacensis* Zones. Southern England, France, Switzerland, Romania, Turkmenistan, Tunisia, Japan, Texas, and South India.

Suborder Ancyloceratina WIEDMANN, 1966
Superfamily Turriilitaceae GILL, 1871
Family Anisoceratidae HYATT, 1900
Genus *Anisoceras* PICTET, 1854

TYPE SPECIES: *Hamites saussureanus* PICTET in PICTET & ROUX 1847, p. 118, pl. 13, figs 1-4, by original designation by PICTET, 1854, p. 705.

Anisoceras armatum (J. SOWERBY, 1817)
(Pl. 7, Fig. 7; Pl. 10, Figs 11, 14)

1817. *Hamites armatus* J. SOWERBY, p. 153, pl. 168.
1979. *Anisoceras* (*Anisoceras*) *armatum* (J. SOWERBY, 1817); COOPER & KENNEDY, p. 200, figs 13a, b; 14d-e; 16a, c, e, i; 17-19 (with full synonymy).
1979. *Anisoceras* (*Anisoceras*) *armatum* (J. SOWERBY); SCHOLZ, p. 25 (pars), pl. 2, figs 1, 5, 7 only.
non 1979. *Anisoceras* sp. aff. *armatum* J. SOWERBY; COLLIGNON, p. 7, pl. 1, fig. 12.
1996. *Anisoceras armatum* (J. SOWERBY, 1817); KENNEDY in GALE & *al*., p. 573, figs 24d-f, h.
2004. *Anisoceras armatum* (J. SOWERBY, 1817); KENNEDY, p. 890, figs 25g, h, q, r, d'; 26 (with additional synonymy).
2005. *Anisoceras armatum* (J. SOWERBY); REBOULET & *al*., text-fig. 3k.

HOLOTYPE: The holotype, by monotypy, is the original of J. SOWERBY 1817, pl. 168, no. K673a, b in the collections of the Oxford University Museum of Natural History, from the Upper Albian Upper Greensand of Roke, 1.5 km (1 mile) NNE of Benson, Oxfordshire, England. It was recently refigured by KENNEDY & *al*. (1998, fig. 30).

MATERIAL: UJF-ID.10665, from bed 72; UJF-ID.10666, from bed 74; JL17.5008, from bed 89; JL17.5009, from bed 93; UJF-ID.10667, and JL17.5010, from bed 95.

DESCRIPTION: A small suite of specimens differs from the numerous individuals referred to *Anisoceras perarmatum* PICTET & CAMPICHE, 1864, described below, in their finer, denser ornament, with substantially weaker tuberculation. The best-preserved and most complete individual is UJF-ID.10667 (Pl. 7, Fig. 7). This comprises two subparallel shafts and the linking curved section; the maximum preserved length is 100 mm. The adapical shaft has a maximum whorl height of 27 mm. The rib index is 14 on the dorsum, and 9 on the flanks. The dorsal ribs link in groups of three at

rounded lower lateral tubercles, which are in turn linked by pairs of straight, transverse ribs to larger rounded to feebly clavate ventral tubercles. Occasional nontuberculate ribs intercalate between. The ventral tubercles are linked across the venter by two or three ribs. On the adapertural shaft, the ribs are markedly rursiradiate on the flanks, with a rib index of 7. The more numerous ribs on the dorsum are relatively coarse and convex, linking in groups of 2 or 3 at small lower flank tubercles. These give rise to one or two ribs with additional nontuberculate ribs between, the ribs linking in pairs at strong ventral clavi that are in turn linked across the venter by a pair of ribs, or intercalating between. UJF-ID.10666 (Pl. 10, Fig. 11) shows very regular alternation of single tuberculate and nontuberculate ribs on one flank, and appears to be a pathological example of the species, lacking the lower flank tubercle.

DISCUSSION: The specimens correspond well with the holotype of *Anisoceras armatum* (KENNEDY & *al*., 1998, fig. 30). They show the diagnostic feature of the species well: looped ribs joining tubercles, with one or two nontuberculate ribs between, the looping becoming less prominent and disappearing on the final shaft. *Anisoceras perarmatum* PICTET & CAMPICHE, 1861, described below, lacks nontuberculate ribs throughout most of its ontogeny, although they develop on the final shaft of the adult body chamber. The two species commonly occur together, and some authors (e.g. SCHOLZ 1979) have regarded them as conspecific.

OCCURRENCE: *M*. (*S*.) *rostratum* to *A*. (*P*.) *briacensis* Zones, also possibly present in the Lower Cenomanian. The geographic range extends from southern England to France, Germany, Switzerland, Hungary, Spain, KwaZulu South Africa, Mozambique, south India and Texas.

Anisoceras perarmatum PICTET & CAMPICHE, 1861
(Pl. 7, Figs 1-6; Pl. 10, Fig. 12)

1861. *Anisoceras perarmatum* PICTET & CAMPICHE, p. 65, pl. 49, figs 1-3, 6, 7.
1979. *Anisoceras perarmatum* PICTET & CAMPICHE, 1861; COOPER & KENNEDY, p. 196, figs 12a-h; 13c-d; 14a-c; 15c-f; 16b (with synonymy).
1995. *Anisoceras perarmatum* PICTET & CAMPICHE, 1861; LATIL, pl. 8, figs 2, 3.
1996. *Anisoceras perarmatum* PICTET & CAMPICHE, 1861; KENNEDY & *al*., p. 35, figs 30, 31, 32a-c, 33d-f, 36f (with additional synonymy).
2000. *Anisoceras perarmatum* PICTET & CAMPICHE, 1861; ARKADIEV & *al*., p. 115, pl. 7, figs 13, 14.

TYPE: Lectotype, by the subsequent designation of RENZ 1968, p. 74, is the original of PICTET & CAMPICHE 1861, pl. 49, fig. 1, no. 21280 in the collections of the Musée Géologique, Lasanne.

MATERIAL: JL17.1528, from bed 65; JL17.1529, from bed 71; UJF-ID.10668, from bed 72; JL17.5011 and UJF-ID.10669, from bed 86; UJF-ID.10670 and 17.1554, from bed 91; JL17.1648, from bed 93; JL 17.1541, 1543, 1546, 1548 and UJF-ID.10672 from bed 95; JL17.1551-4, 1647, from bed 96; JL17.1558, from bed 98; JL17.1560, from bed 100; Jl17.1520 and UJF-ID.10671, collected loose.

DESCRIPTION: A single fragment, JL17.1552, represents the early, helical stages. Very poorly preserved, it comprises a 180° section of a whorl with a maximum preserved whorl height of 12.3 mm. Pairs of ribs are linked at rounded lower flank tubercles, and form a loop joining these to rounded ventral tubercles, in turn linked across the venter by a pair of ribs. There are traces of weak ribs on the dorsum between the looped pairs. The majority of the specimens comprise fragments of the succeeding more or less parallel straight shafts and linking curved sector. All of these specimens are in part or whole body chamber, and fall into two size classes, interpreted as microconchs and macroconchs, the latter numerically dominant. UJF-ID.10671 (Pl. 7, Figs 4, 5) is the best-preserved microconch seen. It is slightly curved at the adapical end, marking the transition between the initial helix and the adapical shaft, is 104.5 mm long, and preserves part of the recurved sector and adapertural shaft. Evenly spaced, delicate, transverse ribs ornament the dorsum of the adapical shaft. Pairs of these ribs strengthen across the dorsolateral margin, and link to coarse, rounded lower flank tubercles and coarse ventral clavi. These are linked across the venter by a pair of ribs, borne on a broad swelling. Single nontuberculate ribs occur at various points on the shaft. On the curved sector

of the mould, the rib direction changes from feebly prorsiradiate to rursiradiate, tubercles weaken, the looping between is lost, with single tuberculate and nontuberculate ribs alternating, before the pattern of looped ribs and tubercles is re-established on the adapertural shaft.

Larger fragments of the adapertural shaft are typically ornamented with fine dorsal ribbing, and a flank ornament of coarse lateral and ventrolateral tubercles, linked by pairs of ribs, either with, or without a single intercalated rib, or with both patterns of ornament on different parts of the same fragment. There is considerable variation in the regularity of rib-tubercle relations. None of the larger specimens preserves the adapical shaft in its entirety. On the curved sector, there is a change from coarse, distant, to more crowded ribbing, with intercalated nontubeculate ribs becoming more prominent. The most complete macroconch, JL17.1338, has well-developed looped ribs and tubercles at the adapical end of the second shaft, followed by a sector with progressive increase in the number of nontuberculate ribs, and a general decline in tubercle strength.

DISCUSSION: Absence of intercalated nontuberculate ribs on the phragmocone and penultimate shaft characterise the lectotype of *Anisoceras perarmatum,* and serve to separate it from the holotype of *A. armatum*, described above. There are, however, specimens referred to *perarmatum* that may have a few intercalated ribs at these growth stages, and are thus intermediate between the two species, which some authors (e.g. SCHLOLZ 1979) have regarded as conspecific.

OCCURRENCE: *M.* (*S.*) *rostratum* to *A.* (*P.*) *briacensis* Zones. Southern England, France, Germany, Hungary, Switzerland, Spain, Romania, Crimea, Lesser Caucasus, Kopet Dag, North Africa, Nigeria, Angola, KwaZulu South Africa, Madagascar, South India, and Texas.

Anisoceras pseudoelegans PICTET & CAMPICHE, 1861
(Pl. 12, Figs 7, 8)

1861. *Anisoceras pseudoelegans* PICTET & CAMPICHE, p. 69, pl. 50, figs 4, 5.
1979. *Anisoceras* (*Anisoceras) pseudoelegans* PICTET & CAMPICHE, 1861; SCHOLZ, p. 28, pl. 4, figs 4-7; pl. 5, figs 1-11; pl. 6, figs 1-4; text-figs 8d-h (with full synonymy).
?1999. *Anisoceras* cf. *pseudoelegans* PICTET & CAMPICHE; LÓPEZ-HORGUE & *al*., fig. 14a, b.
2002. *Anisoceras pseudoelegans* PICTET & CAMPICHE; AMÉDRO, pl. 5, fig. 10.

TYPE: The lectotype, by the subsequent designation of RENZ 1968, p. 79, is the original of PICTET & CAMPICHE, 1861, pl. 50, fig. 5, from the Upper Albian of La Vraconne, Switzerland. It was refigured by RENZ 1968, pl. 14, fig. 12, and is no. L.39999 in the collections of the Musée Géologique, Lausanne.

MATERIAL: UJF-ID.10673, from bed 96.

DESCRIPTION: The specimen is part of the curved sector of a body chamber of a macroconch, with a maximum preserved whorl height of 70 mm. The original whorl section (now distorted by postmortem crushing) was compressed, with broadly rounded dorsum, feebly convex inner, and convergent outer flanks, and a relatively broad venter, convex in intercostal section and near flat in costal section. The dorsum is ornamented by weak, crowded, dense, convex ribs that strengthen on the dorsolateral margin. On the flanks, ornament is of crowded ribs, with an index of 12. There are 22 ribs on the fragment in all. Seven bullae of variable strength are present on the inner flank, and link to one, two, or three of the dorsal ribs. They give rise to pairs of progressively coarsening prorsiradiate ribs, while single nontuberculate ribs intercalate between. Ribs link, either singly or in pairs, to coarse ventral clavi that are linked across the venter by two or three ribs, borne on a broad swelling.

DISCUSSION: This large and highly distinctive fragment is easily distinguished from the other *Anisoceras* in the collection on the basis of both size and ornament. The smaller but equally distinctive specimens of *Anisoceras pseudoelegans* figured by SCHOLZ (1979, pl. 4, figs 4-7; pl. 5, figs 1-11; pl. 6, figs 1-4) link the present specimen to the lectotype. The present specimen bears a remarkable resemblance to the poorly known *Anisoceras cherixi* PICTET & RENEVIER, 1847 (pl. 5, fig. 1) in terms of flank ribbing and ventral ornament, but this presumably Cenomanian species lacks a lateral tubercle.

OCCURRENCE: *M.* (*S.*) *perinflatum* Zone. Southern England, southeast France, Switzerland, Hungary, and Sardinia.

Genus *Idiohamites* SPATH, 1925

TYPE SPECIES: *Hamites tuberculatus* J. SOWERBY, 1818, p. 30, pl. 216, figs 4, 5, by the original designation of SPATH 1925, p. 189.

Idiohamites elegantulus SPATH, 1939
(Pl. 8, Figs 1-7; Pl. 9, Figs 1-3, 5-8)

1939. *Idiohamites elegantulus* SPATH, p. 599, text-fig. 216a-g.
1968. *Idiohamites elegantulus laticostatus* RENZ, p. 73, pl. 11, figs 38, 41, 42; pl. 12, figs 1, 2; text-figs 25m, 26 I-m.
1968. *Idiohamites recticostatus* RENZ, p. 71, pl. 13, figs 1, 2.
1995. *Idiohamites dorsetensis* SPATH, 1939; LATIL, p. 9, fig. 1.

TYPE: The holotype, by original designation, is the original of SPATH 1939, text-fig. 216a-c, BMNH C31542, from the Upper Upper Albian *dispar* Zone ammonite bed in the Upper Greensand of Ringstead, Dorset.

MATERIAL: UJF-ID.10674, from bed 77; UJF-ID.10675, from above bed 75; JL17.5012-3, from above bed 80; UJF-ID.10678), from bed 82; JL.175014-8, UJF-ID.10676, from bed 86; JL.175019-20, from bed 88; JL.17.5021, from bed 89; JL17. 1542 and 1545, from bed 95; UJF-ID.10677, from bed 96; JL17.1559, from bed 98; UJF-ID.10679-83, and JL. 1526, collected loose.

DESCRIPTION: The early whorls are coiled in an open planispire up to an estimated 45 mm in diameter (Pl. 9, Fig. 3). The ribs are weak and effaced on the dorsum, but strengthen across the dorsolateral margin, and on the flanks. The ribs are straight to feebly flexuous, recti- to feebly rursiradiate. Alternate ribs bear tiny ventral tubercles in some specimens; in others, the majority of the ribs are tuberculate.

UJF-ID.10678 is a near-complete macroconch. The initial spire is lacking, the specimen comprising a shaft 100 mm long, feebly sinuous in profile, with a maximum preserved whorl height of 29 mm, linked by a curved sector to the adapertural shaft, which extends to about 30% of the length of the adapical shaft, with the adult aperture preserved; the maximum whorl height is 31 mm approximately. The rib index is 5 on the flanks. The dorsum bears delicate crowded ribs that link in groups of two or three to the much coarser flank ribs. These are straight, distant, and feebly prorsiradiate. They coarsen markedly on the ventrolateral shoulders and venter, and most bear small ventral clavi. These are linked over the venter by a coarse rib that may be feebly divided into a pair of riblets. On the curved sector and terminal shaft, the ribs weaken and round, changing from prorsiradiate to markedly rursiradiate, with a rib index of up to 10. Most but not all ribs bear well-developed ventral clavi. The adult aperture is marked by a strong constriction and associated collar rib, succeeded by a short, feebly ribbed sector of shell before the actual aperture. UJF-ID.10680 (Pl. 8, Figs 5-7) is a large macroconch with a maximum preserved whorl height of 38mm on the adapertural shaft. The adapical shaft has a rib index of 5, all of the ribs bearing ventral tubercles. The rib index is 10 on the adapertural shaft, with up to 3 nontuberculate ribs between tuberculate ones. This same pattern of ornament is also shown by UJF-ID.10675 (Pl. 9, Fig. 7) and JL17.1512-3.

Adult microconch body chambers include UJF-ID.10681-3 (Pl. 8, Figs 3, 4; Pl. 9, Figs 1, 2). These differ from macroconch body chambers in size only, it would appear, with whorl heights of 17-19 mm at the adapertural end of the final shaft.

DISCUSSION: The planispiral initial whorls differ in no significant respects from the type material from southern England, illustrated by SPATH (1939, text-fig. 216). The near-complete macroconch and microconch shafts show, in turn, that *Idiohamites elegantulus laticostatus* RENZ, 1968 (p. 73, pl. 11, figs 38, 41, 42; pl. 12, figs 1, 2; text-figs 25m, 26 I-m) and *Idiohamites recticostatus* RENZ, 1968 (p. 71, pl. 13, figs 1, 2; text-figs 25e, 26c) are based on fragments of the same species. *Idiohamites dorsetensis* SPATH, 1939 (see RENZ 1968, p. 70, pl. 11, figs 39, 40; pl. 12, figs 3, 4; text-figs 25a-d, f; 26a-b) is characterised by having coarse tuberculate ribs separated by one or more nontuberculate ribs throughout the known ontogeny.

OCCURRENCE: *M*. (*S*.) *rostratum* and *perinflatum* Zones. Southern England, Switzerland, southeast France.

Family Hamitidae GILL, 1871
Genus *Hamites* PARKINSON, 1811

TYPE SPECIES: *Hamites attenuatus* J. SOWERBY, 1814, p. 137, pl. 61, figs 4, 5, by the subsequent designation of DIENER 1925, p. 65.

Hamites venetzianus PICTET, 1847
(Pl. 9, Fig. 4)

1847. *Hamites venetzianus* PICTET in PICTET & ROUX, p. 134, pl. 14, fig. 6.
1941. *Hamites* (*Stomohamites*) *venetzianus* PICTET; SPATH, p. 638, pl. 71, figs 11-13; text-fig. 23 (with synonymy).
1965. *Stomohamites venetzianus* (PICTET); CLARK, p. 21, pl. 1, figs 1-6; text-figs 3c, 4 (with full synonymy).
1968. *Hamites* (*Stomohamites*) *venetzianus venetzianus* PICTET; RENZ, p. 67, pl. 11, figs 15, 16; text-figs 23f; 24b (with full synonymy).
1968. *Hamites* (*Stomohamites*) *venetzianus sulcatus* RENZ, p. 67, pl. 11, fig. 27; text-fig. 23n (with synonymy).
2002. *Hamites* cf. *venetzianus* PICTET; AMÉDRO, pl. 3, fig. 6.
2004. *Hamites venetzianus* PICTET, 1847; KENNEDY, p. 892, text-figs 27b, 29g-l, m.

TYPE: The holotype is the original of PICTET in PICTET & ROUX 1847, p. 134, pl. 14, fig. 6 from the Upper Albian of Perte-du-Rhône, Ain, France.

MATERIAL: JL17.1527, from bed 65; JL17.5022 from bed 88; JL17.1556 from bed 96 and JL17.5023, from bed 96; UJF-ID.10684, from bed 104. There is a further doubtful specimen from bed 89.

DESCRIPTION: The best-preserved fragment is UJF-ID.10684 (Pl. 9, Fig. 4). It comprises a 120° sector of an open planispire, with a maximum preserved whorl height of 12 mm. The rib index is 5. The ribs are effaced on the dorsum, strengthen across the dorsolateral margin, are straight and recti- to feebly prorsiradiate on the flanks, and coarsening markedly on the ventrolateral shoulders and venter.

DISCUSSION: The coarse, thick ribs of these fragments are highly distinctive, and correspond to those of the holotype, Swiss, and English specimens. See KENNEDY (2005) for a recent discussion of the species.

OCCURRENCE: *M*. (*S*.) *rostratum* and *perinflatum* Zones. Southern England, southeast France, Switzerland, Poland, and Texas.

Family Baculitidae GILL, 1871
Genus and subgenus *Lechites* NOWAK, 1908

TYPE SPECIES: *Baculites gaudini* PICTET & CAMPICHE, 1861, p. 112, pl. 55, figs 5-9, by the original designation of NOWAK 1908, p. 350.

Lechites (*Lechites*) *gaudini* (PICTET & CAMPICHE, 1861)
(Pl. 10, Figs 6, 7, 10)

1861. *Baculites gaudini* PICTET & CAMPICHE, p. 112, pl. 55, figs 5-7.
1977. *Lechites gaudini* (PICTET & CAMPICHE); COOPER & KENNEDY, p. 644, text-figs 1, 1-38; 2, 1-30; 3; 4,1-18; 5, 1-15; 6; 7; 8, 16-26 (with synonymy).
1978. *Lechites gaudini* (PICTET et CAMP.); SCHOLZ, pl. 3, fig. 8.
1979. *Lechites gaudini gaudini* (PICTET & CAMPICHE, 1861); SCHOLZ, p. 12, pl. 1, figs 1-9; text-fig. 5a, b.
1992. *Lechites gaudini* (PICTET & CAMPICHE); p. 1, pl. 2, fig. 7; pl. 6, fig. 9.
1994. *Lechites gaudini* (PICTET & CAMPICHE, 1861); KENNEDY in GALE & *al*., p. 577, text-figs 22a, c, d; 27e-i, l-o.
2002. *Lechites gaudini* (PICTET & CAMPICHE); WIEDMANN & OWEN, pl. 1, fig. g.
2005. *Lechites* (*L.*) *gaudini* PICTET & CAMPICHE; REBOULET, GIRAUD & PROUX, text-fig. 3l.

TYPE: The lectotype, by the subsequent designation of RENZ 1968, p. 80, is the original of PICTET & CAMPICHE, 1861, pl. 55, fig. 5, no 21271 in the collections of the Musée Géologique de Lausanne, Switzerland, refigured by RENZ 1968, pl. 17, fig. 3.

MATERIAL: UJF-ID.10685, from bed 78; UJF-ID.10686, from above bed 80.

DESCRIPTION: All specimens are crushed, with whorl heights of 8.7 to 10 mm. The whorl expansion rate is low. UJF-ID.10686 (Pl. 10, Figs 6, 7) is a strongly ornamented individual. The rib index is 3-4. The ribs are weak and concave on the dorsum, strengthen over the dorsolateral margin, and are strong, narrow, convex, and prorsiradiate across the flanks. They reach their maximum development on the venter, which they cross in a very broad convexity. UJF-ID.10685 (Pl. 10, Fig. 100) is a comparable but feebler-ribbed variant.

DISCUSSION: See COOPER & KENNEDY (1977) for a comprehensive review of this species, its synonymy, and a discussion of differences from other species referred to the genus.

OCCURRENCE: *M.* (*S.*) *rostratum* to *A.* (*P.*) *briacensis* Zones. Southern England, France, Germany, Switzerland, Hungary, Romania, Sardinia, Algeria, Madagascar, KwaZulu, South Africa, south India, Japan, and Mexico.

Lechites (*Lechites*) *moreti* BREISTROFFER, 1936
(Pl. 10, Figs 3-5, 8, 9, 15)

1861. *Baculites gaudini* PICTET & CAMPICHE; p.112 (pars), pl. 55, figs 10, 11 only.
1936. *Lechites moreti* BREISTROFFER, p. 66.
1969. *Lechites moreti* BREISTROFFER; RENZ, p. 81, pl. 16, figs 10, 12, 13; text-fig. 29a, i (with synonymy).
1979. *Lechites gaudini moreti* BREISTROFFER, 1936; SCHOLZ, p. 14, pl. 1, fig. 10; text-fig. 5c.
1995. *Lechites gaudini moreti* BREISTROFFER, 1936; LATIL, pl. 7, fig. 2.
2002. *Lechites moreti* BREISTROFFER; WIEDMANN & OWEN, pl. 3, fig. e.

TYPE: The lectotype, by the subsequent designation of RENZ 1969, p. 81, is the original of *Baculites gaudini* PICTET & CAMPICHE, 1861, p. 112 (pars), pl. 55, fig. 10, no L 40016 21271 in the collections of the Musée Géologique de Lausanne, Switzerland, refigured by RENZ, 1969, pl. 16, fig. 10; text-fig. 29a, i.

MATERIAL: UJF-ID.10687 and 1514, from bed 95; UJF-ID.10688-90, from bed 96.

DESCRIPTION: All specimens are crushed, with whorl heights of 6.6 to 12.5 mm. All appear to be fragments of body chamber. The whorl expansion rate is very low. The ornament comprises prominent constrictions, 2-3 in a distance equal to the whorl height. These are weak and concave on the dorsum, but strengthen on the dorsolateral margin, and are convex and markely rursiradiate on the dorsal part of the flanks, flexing back on the ventral part of the flanks, to pass near-straight across the venter, where they are at their deepest and most prominent.

DISCUSSION: *Lechites* (*L.*) *moreti* is immediately distinguished from other *Lechites* species by the ornament of narrow constrictions with broad swollen areas of flank between, rather than the ribs more typical of the genus. See RENZ (1968), WIEDMANN & DIENI (1969) and SCHOLZ (1979) for discussion.

OCCURRENCE: *M.* (*S.*) *perinflatum* Zone. Southern England, southeast France, Switzerland, Hungary, Spain, Sardinia, and Algeria.

Genus and subgenus *Mariella* NOWAK, 1916

TYPE SPECIES: *Turrilites bergeri* BRONGNIART, 1822, p. 399, pl. 7, fig. 3, by the original designation of NOWAK 1916, p. 10.

Mariella (*Mariella*) *bergeri* (BRONGNIART, 1822)
(Pl. 10, Figs 1, 2, 13)

1822. *Turrilites bergeri* BRONGNIART, p. 395, pl. 7, fig.3.
1985. *Mariella* (*Mariella*) *bergeri* (BRONGNIART, 1822); ATABEKIAN, p. 27, pl. 2, figs 4, 5; pl. 3, figs 1-11; pl. 4, figs 1-7 (with synonymy).
1987. *Mariella* (*Mariella*) *bergeri* (BRONGNIART, 1822); ATABEKIAN, p. 19, pl. 2, figs 4, 5; pl. 3, figs 1-11; pl. 4, figs 1-7 (with synonymy).
1995. *Mariella bergeri* (BRONGNIART, 1822); LATIL, pl. 7, fig. 5
1996. *Mariella* (*Mariella*) *bergeri* (BRONGNIART, 1822); KENNEDY in GALE & *al*., p. 583, figs 16o; 28a, b, i, j, l, o, p; 29h, i, m.
2000 *Mariella bergeri* (BRONGNIART, 1822); ARKADIEV & *al.*, p. 117, pl. 7, figs 4-7.
2002. *Mariella* (*M.*) cf. *bergeri* (BRONGNIART, 1822); AMÉDRO & ROBASZYNSKI, pl. 2, fig. 7.

TYPE: The holotype, by monotypy is the original of BRONGNIART 1822, pl. 7, fig. 3, from the Montagne de Fiz, Savoie, France. The specimen has not been traced.

MATERIAL: UJF-ID.10692, from bed101; UJF-ID.10693-4, from bed 103.

DESCRIPTION: UJF-ID.10692 (Pl. 10, Fig. 1) and 10693 (Pl. 10, Fig. 2) are crushed juveniles, the latter with a maximum preserved whorl height of 10 mm. UJF-ID.10694) (Pl. 10, Fig. 13) is an external mould of part of three whorls of a much larger specimen. The outer, exposed whorl face bears three rows of coarse, crowded tubercles, borne on a low oblique rib. The upper row of tubercles is transversely elongated, the second and third rows rounded, the tubercles in successive rows displaced adaperturally of the corresponding tubercle in the row above. A further row of small tubercles is concealed in the inter-whorl suture, which is crenulated as a result. The base of the whorl is ornamented by a radial rib that weakens progressively towards the umbilicus.

DISCUSSION: This widely occurring species is represented by rather typical individuals in the present collection. See ATABEKIAN (1985, 1987) for a comprehensive review of the species. None of the present specimens approach the variety *crassitubeculata* of SPATH (1937, p. 413), elevated to specific status by RENZ (1968, p. 86, pl. 18, figs 5, 6; text-figs 31a, 32i).

OCCURRENCE: *M*. (*S*.) *perinflatum* Zone. Southern England, France, Switzerland, Germany, Spain, Sardinia, Hungary, Romania, Crimea, Caucasus, Kopet Dag, Iran, Morocco, Algeria, Tunisia, south India, KwaZulu South Africa, Venezuela and California.

Genus and Subgenus *Ostlingoceras* HYATT, 1900

TYPE SPECIES: *Turrilites puzosianus* D'ORBIGNY, 1842, p. 587, pl. 143, figs 1, 2, from Reposoir, Savoie, France, by the original designation of HYATT 1900, p. 587.

Ostlingoceras (*Ostlingoceras*) *puzosianum*
(D'ORBIGNY, 1842)
(Pl. 11, Figs 1-12; Pl. 12, Figs 1-4)

1842. *Turrilites puzosianus* D'ORBIGNY, 1842, p. 587, pl. 143, figs 1, 2.
1985. *Ostlingoceras* (*Ostlingoceras*) *puzosianum* (D'ORBIGNY, 1842); ATABEKIAN, p. 47, pl. 7, fig. 6; pl. 9, figs 4-7; pl. 12, figs 1-9; pl. 13, figs 1-9; pl. 14, fig. 6 (with synonymy).
1987. *Ostlingoceras* (*Ostlingoceras*) *puzosianum* (D'ORBIGNY, 1842); ATABEKIAN, p. 38, pl. 7, fig. 6; pl. 9, figs 4-7; pl. 12, figs 1-9; pl. 13, figs 1-9; pl. 14, fig. 6 (with synonymy).
1990. *Ostlingoceras* (*Ostlingoceras*) *puzosianum* (D'ORBIGNY, 1842); MARCINOWSKI & WIEDMANN, p. 51, pl. 4, fig. 13.
1995. *Ostlingoceras puzosianum* (D'ORBIGNY, 1840); LATIL, pl. 8, fig. 1
2002. *Ostlingoceras puzosianum* (D'ORBIGNY); AMÉDRO & ROBASZYNSKI, pl. 2, figs 3, 5.
2002. *Ostlingoceras puzosianum* (D'ORBIGNY); AMÉDRO, pl. 4, fig. 3.
2002. *Ostlingoceras puzosianum* (D'ORBIGNY, 1842); ARKADIEV, ATABEKIAN, BARABOBSHKIN & BOGDANOVA, p. 116, pl. 7, figs 9-12.

TYPE: Previous authors have referred to the original of D'ORBIGNY (1842, p. 587, pl. 143, figs 1, 2) as the holotype (RENZ 1968, p. 92; ATABEKIAN, 1985, p. 47; 1987, p. 38). D'ORBIGNY states, however, that PUZOS sent him two specimens from Repousoir, Savoie, and that his figures were based on a specimen in the PUZOS collection. The species is thus base on two syntypes, which we have been unable to trace. There are two specimens in the D'ORBIGNY collection, but they are from Villard de Lans, Isère, and not part of the type species.

MATERIAL: JL17.1563, from bed 91; JL17.1645, from bed 93; JL17.564-17.1572, 17.1574-5, 17.1578-9, 17.1581- 17.1583, and JL17.5024-17.5028, UJF-ID 10695, 10696, 10703, from bed 95; JL17.1568, 17.1581, 17.1584-17.1586, 17.1588-17.1590, 17.1592, 17.1597, 17.1640 – 17.1644, 17.1660, 17.5029-35 and UJF-ID.10697-10702,1074-5, from bed 96; JL17.1602, from bed 103.

DESCRIPTION: The species is strongly dimorphic. Coiling is sinistral with an apical angle that varies between 20º and 30º Microconchs (Pl. 11, Figs 4, 6-10) have whorl heights of 20-23 mm at the adult aperture. The only complete macro-

conch (Pl. 10, Figs 11, 12) has a whorl height of 66 mm at the adult aperture.

The outer, exposed whorl face is flat, with a narrowly rounded shoulder between it and the concave upper whorl face. The lower whorl face is flattened. Numerous primary ribs, 25 to 32 per whorl, are straight to feebly prorsiradiate on the outer, exposed whorl face. Each bears a small, rounded tubercle just above the contact with the succeeding whorl, with a second row of subequal tubercles below, and a third, feebly clavate row concealed by the succeeding whorl, as a result of which the inter whorl suture is feebly crenulated. There are additional intercalated ribs bearing all three rows of tubercles, and occasional ribs bifurcate low on the flank, as a result of which there are more rows of tubercles per whorl than there are primary ribs. The ribs are straight, radial, and weaker on the lower whorl face than on the flanks. In microconchs, maturity is indicated by a progressive weakening and effacement of the ribs, leaving the outer, exposed whorl face near-smooth, although delicate tubercles and ribs persist on the lower whorl face. The translation rate increases, and the final part of the body chamber partially detaches from the preceding whorl. The adult aperture is marked by a pair of coarse, fold-like ribs, with a terminal constriction. One microconch (UJF-ID.10704: Pl. 11, Fig. 10) shows the stage with reduced ornament succeeded by one in which rib strength increases slowly prior to the development of the coarse, fold-like terminal ribs.

The complete adult macroconch (Pl. 11, Figs 11, 12) shows progressive decline in ribs towards the adult aperture. The tubercles decline to a less marked extent. A single flared rib precedes the strongly constricted adult aperture.

DISCUSSION: The present suite of specimens clearly demonstrates the remarkable dimorphism shown by this species. A fine macroconch with adult aperture preserved was also figure by BAYLE (1878, pl. 99, figs 1, 2). *Ostlingoceras* (*O.*) *puzosiforme* SPATH, 1926 (see revision in WRIGHT & KENNEDY 1996, p. 321, pl. 98, figs 9, 22) is very weakly ribbed, with a tubercle in the middle of the outer, exposed whorl face on the phragmocone that migrates to the lower part of the outer whorl face on the body chamber. *Ostlingoceras* (*O.*) *bechii* (SHARPE, 1857) (see revision in WRIGHT & KENNEDY 1996, p. 321, pl. 98, figs 6, 14-16, 23) is immediately distinguished by its convex outer, exposed whorl face, and delicate prorsiradiate ribs. *Ostlingoceras* (*O.*) *sublaevigatum* WIEDMANN & DIENI (1968, p. 79, pl. 15, fig. 4) was regarded as a synonym of *puzosianum* by SCHOLZ (1979, p. 43). It has very weak ribbing on the outer, exposed whorl face, and only two rows of tubercles.

OCCURRENCE: *M.* (*S.*) *rostratum* and *perinflatum* Zones, southern England, France, Sardinia, Switzerland, Austria, Hungary, Poland, Spain, Romania, Crimea, North Caucasus, Iran, Georgia, Turkmenistan, Madagascar.

Superfamily Scaphitoidea GILL, 1871
Family Scaphitidae GILL, 1871
Subfamily Scaphitinae GILL, 1871
Genus and subgenus *Scaphites* PARKINSON, 1811

TYPE SPECIES: *Scaphites equalis* J. SOWERBY, 1813, p. 53, pl. 18, figs 1-3, by the subsequent designation of MEEK, 1876 p. 413.

Scaphites (*Scaphites*) sp.
(Pl. 12, Figs 5, 6)

MATERIAL: UJF-ID.10710, from bed 45; UJF-ID.10709, from bed 85; JL. 17.5037, from bed 93; JL 17.1496, from bed 100.

DESCRIPTION AND DISCUSSION: Fragments of a large *Scaphites* (*Scaphites*) have whorl heights of up to 24 mm on the shaft (Pl. 12, Fig. 6). The flank ornament is not seen. Ventrolateral and ventral ornament comprises wiry ribs that increase by branching and intercalation on the ventrolateral shoulder, with small ventrolateral bullae on the shaft. The adult aperture is preceded by a marked constriction. These large *Scaphites* may be macroconchs of *Scaphites* (*S.*) *meriani* PICTET & CAMPICHE, 1861 (p. 16, pl. 40, figs 1-4, 8 only), as revised by WIEDMANN (1965, p. 426, pl. 54, fig. 6; pl. 57, figs 3, 4; text-figs 5a-c), RENZ (1968, p. 94, text-fig. 33a), and SCHOLZ (1979, p. p. 44, pl. 1, figs 26-28).

OCCURRENCE: *M.* (*S.*) *rostratum* and *perinflatum* Zones, in the Montlaux section.

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PLATES 1-12

PLATE 1

1-6 – *Puzosia* (*Puzosia*) *mayoriana* (D'ORBIGNY, 1841); 1-2 – UJF-ID.10649, collected loose; 3 – UJF-ID.10648, from bed 91; 4-5 – UJF-ID.10646, from bed 82; 6 – UJF-ID.10650, collected loose.

All specimens are from the Upper Albian of the Montlaux section, Alpes-de-Haute-Provence, France.

All figures are × 1


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PLATE 2

1 – *Desmoceras* (*Desmoceras*) *latidorsatum* (MICHELIN, 1838); UJF-ID.10644, from bed 100.

2 – *Mortoniceras* (*Subschloenbachia*) *rostratum* (J. SOWERBY, 1817); UD.MON.1491, from bed 86.

All specimens are from the Upper Albian of the Montlaux section, Alpes-de-Haute-Provence, France.

All figures are × 1


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PLATE 3

1 – *Puzosia* (*Puzosia*) *mayoriana* (D' ORBIGNY, 1841); UJF-ID.10647, from bed 86.

2, 4, 5 – *Mortoniceras* (*Subschloenbachia*) *perinflatum* (SPATH, 1922); 2 – UJF-ID.10658, from bed 96; 4 – UJF-ID.10657, from bed 96; 5 – UJF-ID.10656, from bed 93.

3, 6-9 – *Mortoniceras* (*Subschloenbachia*) *rostratum* (J. SOWERBY, 1817); 3 – UJF-ID.10655, from bed 77; 6 – UJF-ID.10652, from bed 69; 7-9 – UJF-ID.10654, from bed 89.

All specimens are from the Upper Albian of the Montlaux section, Alpes-de-Haute-Provence, France.

All figures are × 1


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PLATE 4

1 – *Stoliczkaia* (*Stoliczkaia*) *clavigera* NEUMAYR, 1875; UJF-ID.10663, from bed 100.

2 – *Arrhaphoceras* (*Arrhaphoceras*) sp.; UJF-ID.10651, from bed 103.

3, 4, 6 – *Dischoplites subfalcatus* (SEMENOW, 1899); 3-4 – UJF-ID.10706, from bed 94; 6 – UJF-ID.10707, from bed 100.

5 – *Discohoplites simplex* WRIGHT & WRIGHT, 1949; UJF-ID.10708, from bed 96.

7-8 – *Mortoniceras* (*Subschloenbachia*) *rostratum* (J. SOWERBY, 1817); UJF-ID.10653, collected loose.

All specimens are from the Upper Albian of the Montlaux section, Alpes-de-Haute-Provence, France.

Figures 1, 3-8 are × 1; figure 2 is × 2


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PLATE 5

1-7 – *Stoliczkaia* (*Stoliczkaia*) *clavigera* NEUMAYR, 1875; 1 – UJF-ID.10664, collected loose; 2 – UJF-ID.10660, from bed 95; 3-4 – UJF-ID.10661, from bed 85; 5-7 – UJF-ID.10659, from bed 95.

All specimens are from the Upper Albian of the Montlaux section, Alpes-de-Haute-Provence, France.

Figure 1 is × 2, figures 2-7 are × 1

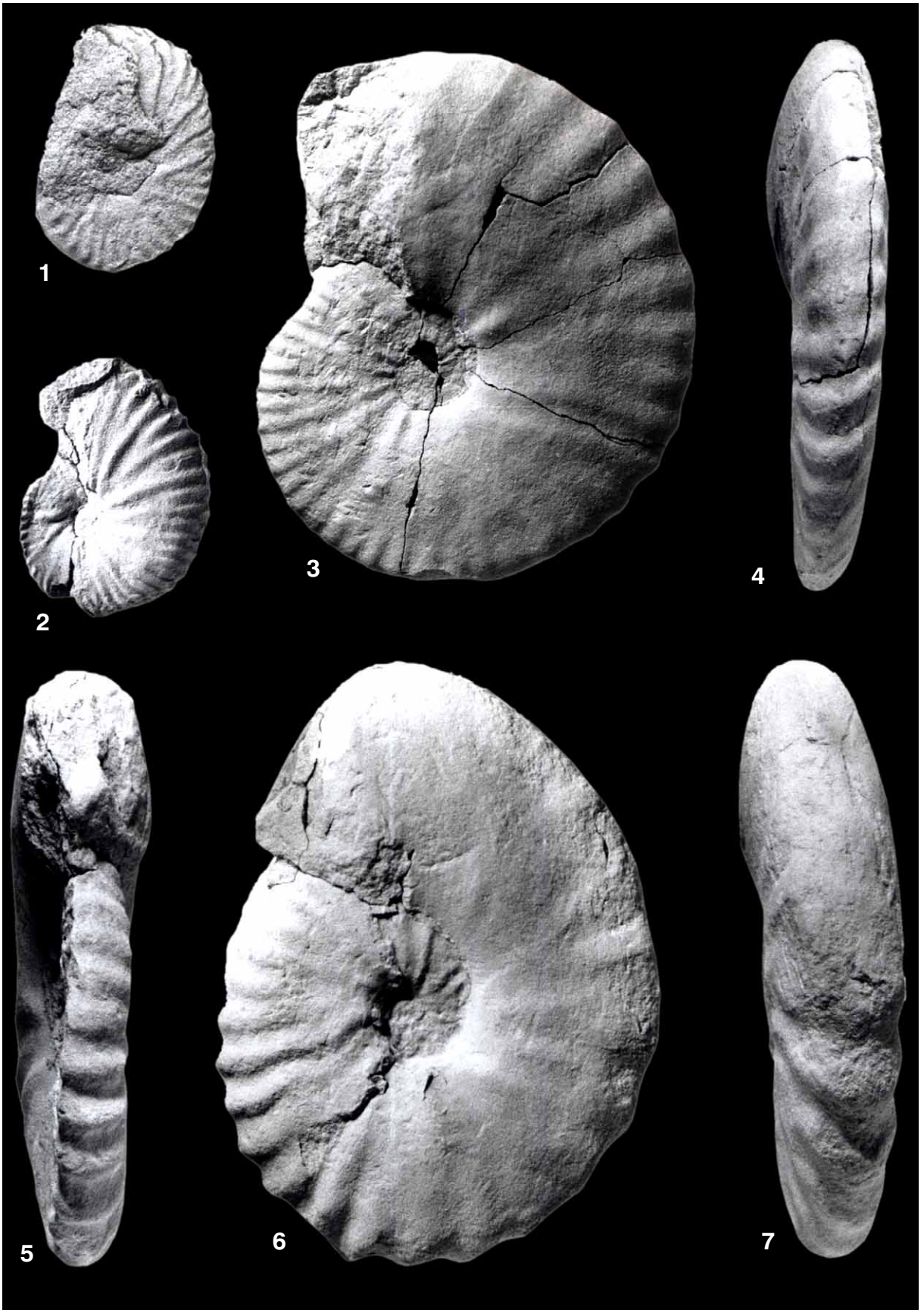
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PLATE 6

1 – S*toliczkaia* (*Stoliczkaia*) *clavigera* NEUMAYR, 1875; UJF-ID.10662, from bed 65.
2, 3 – *Desmoceras* (*Desmoceras*) *latidorsatum* (MICHELIN, 1838); UJF-ID.10645, from bed 63.
4-6 – *Stoliczkaia* (*Stoliczkaia*) *dispar* (D' ORBIGNY, 1841); UD.MON.1/10.93, from bed 86.

All specimens are from the Upper Albian of the Montlaux section, Alpes-de-Haute-Provence, France.

All figures are × 1


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PLATE 7

1-6 – *Anisoceras perarmatum* PICTET & CAMPICHE, 1847; 1-2 – UJF-ID.10669, from bed 86; 4-5 – UJF-ID.10671, a microconch, collected loose; 3 – UJF-ID.10668, a macroconch, from bed 72; 6 – UJF-ID.10670, from bed 91.

7 – *Aniosoceras armatum* (J. SOWERBY, 1817); UJF-ID.10667, from bed 95.

All specimens are from the Upper Albian of the Montlaux section, Alpes-de-Haute-Provence, France.

All figures are × 1

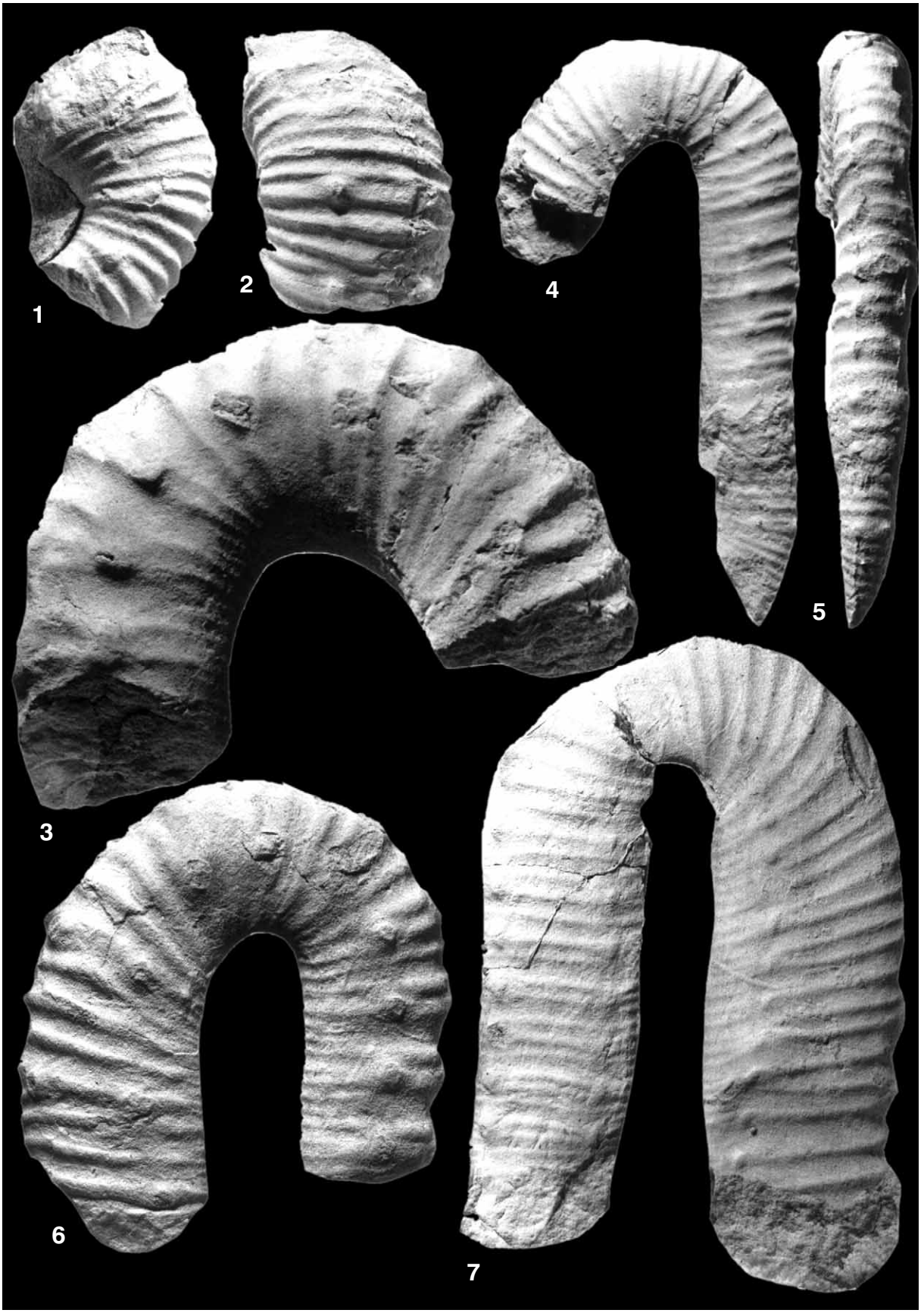
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PLATE 8

1-7 – *Idiohamites elegantulus* SPATH, 1939; 1-2 – UJF-ID.10679, a macroconch; 3 – UJF-ID.10683; 4 – JL17.1524 UJF-ID.10682; 5-7 – UJF-ID.10680, all specimens were collected loose.

All specimens are from the Upper Albian of the Montlaux section, Alpes-de-Haute-Provence, France.

All figures are ×1

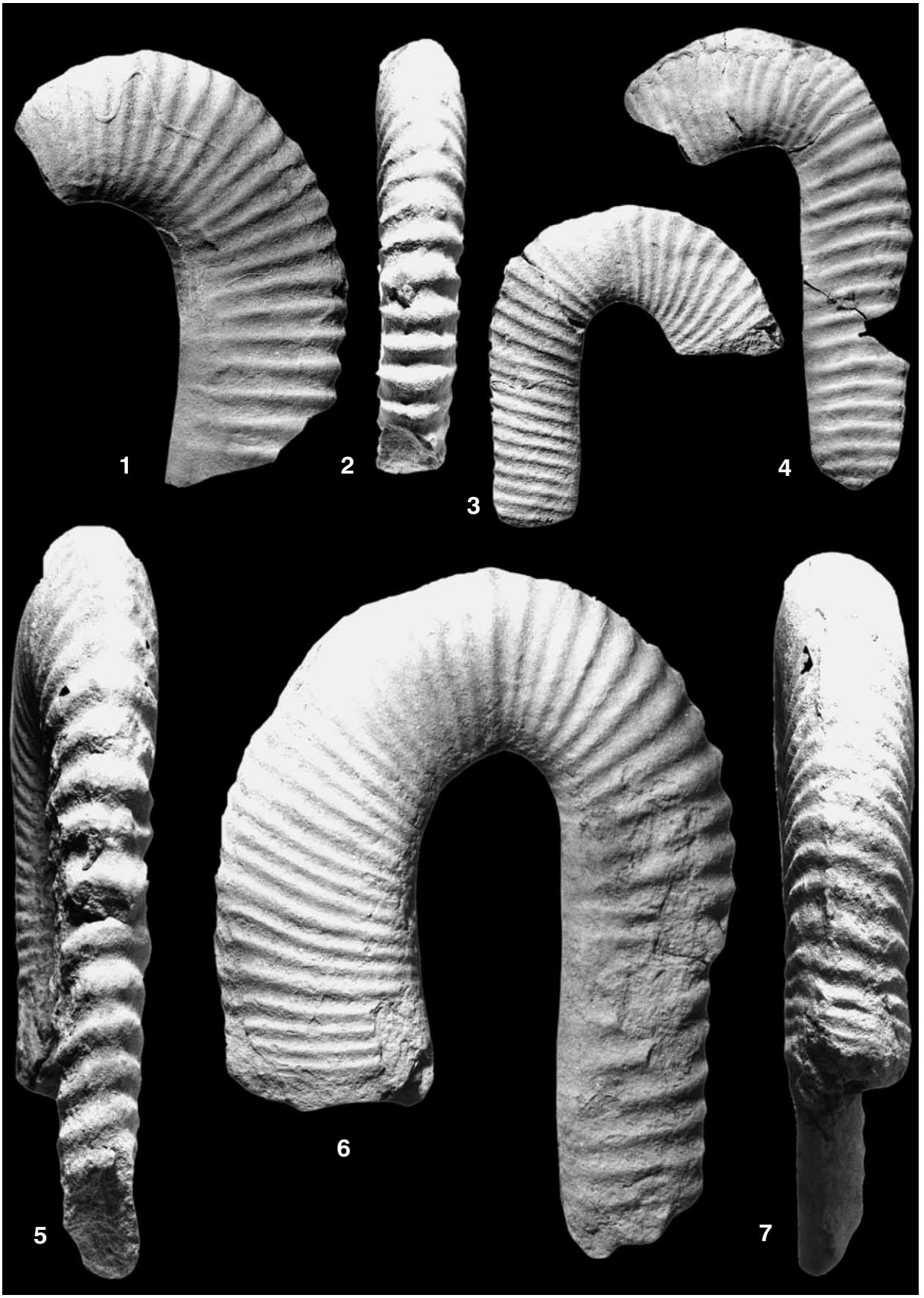
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PLATE 9

1-3, 5-8 – *Idiohamites elegantulus* SPATH, 1939; 1-2 – UJF-ID.10681, a microconch, collected loose; 3 – UJF-ID.10677, from bed 96; 5 – UJF-ID.10674, a macroconch, from bed 77; 6 – UJF-ID.10676, collected loose; 7 – UJF-ID.10675, a macroconch, from above bed 75; 8 – UJF-ID.10678, from bed 82.

4 – *Hamites venetzianus* PICTET, 1847; UJF-ID.10684, from bed 104.

All specimens are from the Upper Albian of the Montlaux section, Alpes-de-Haute-Provence, France.

All figures are × 1

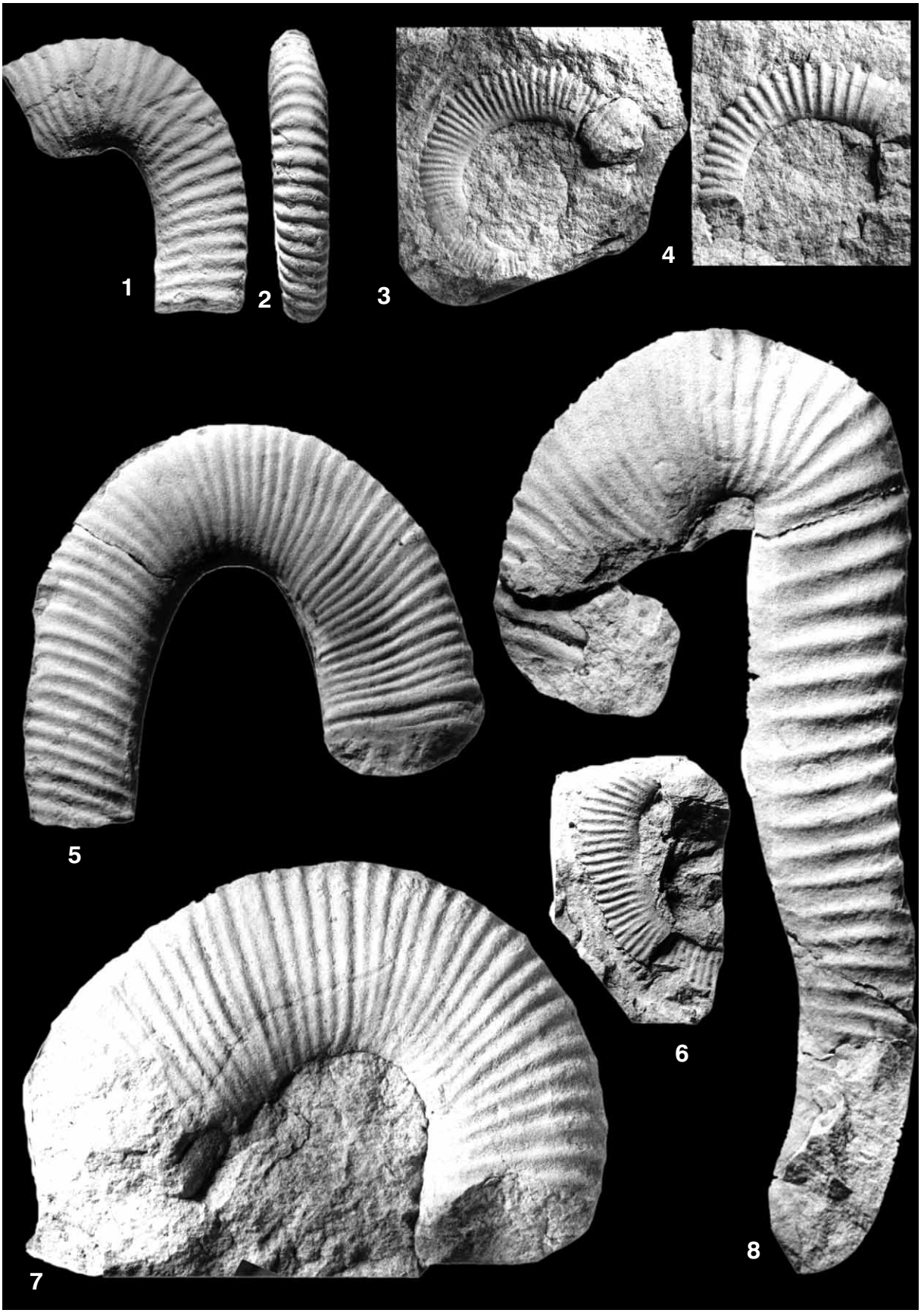
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PLATE 10

1, 2, 13 – *Mariella* (*Mariella*) *bergeri* (BRONGNIART, 1822); 1 – UJF-ID.10692, from bed 101; 2 – UJF-ID.10693, from bed 103; 13 – UJF-ID.10694, from bed 103.

3-5, 8, 9, 15 – *Lechites (Lechites) moreti* BREISTROFFER, 1936; 3 – UJF-ID.10687, from bed 95; 4-5 – UJF-ID.10691, from bed 96; 8 – UJF-ID.10688, from bed 96; 9 – UJF-ID.10690, from bed 96; 15 – UJF-ID.10689, from bed 96.

6, 7, 10 – *Lechites (Lechites) gaudini* (PICTET & CAMPICHE, 1861); 6-7 – UJF-ID.10686, from above bed 80; 10 – UJF-ID.10685, from bed 78.

11, 14 – *Anisoceras armatum* (J. SOWERBY, 1817); 11 – UJF-ID.10666, from bed 74; 14 – UJF-ID.10665, from bed 72.

12 – *Anisoceras perarmatum* PICTET & CAMPICHE, 1861; JL UJF-ID.10672, from bed 95.

All specimens are from the Upper Albian of the Montlaux section, Alpes-de-Haute-Provence, France.

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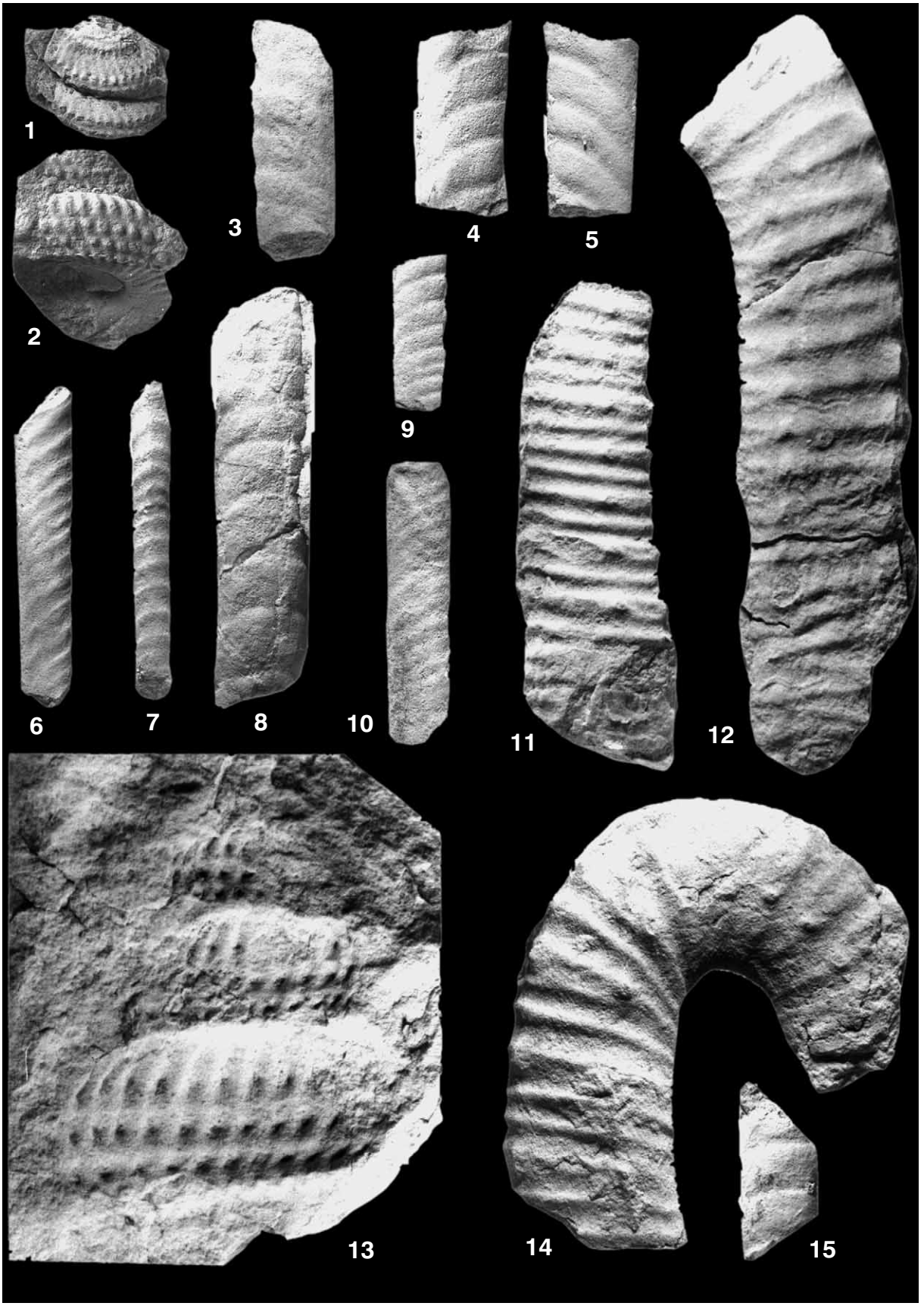
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PLATE 11

1-12 – *Ostlingoceras* (*Ostlingoceras*) *puzosianum* (D'ORBIGNY, 1842); 1-2 – juvenile, UJF-ID.10705, from bed 96; 3 – juvenile, UJF-ID.10697, from bed 96; 4, 8 – UJF-ID.10702, microconch, from bed 1646; 5 – juvenile macroconch, JUJF-ID.10700, from bed 96; 6-7 – microconch, UJF-ID.10698 from bed 96; 9 – micrconch, UJF-ID.10695, from bed 95; 10 – microconch, UJF-ID.10704, from bed 93; 11-12 – UJF-ID.10701, from bed 96.

All specimens are from the Upper Albian of the Montlaux section, Alpes-de-Haute-Provence Hautes-Alpes, France.

All figures are × 1

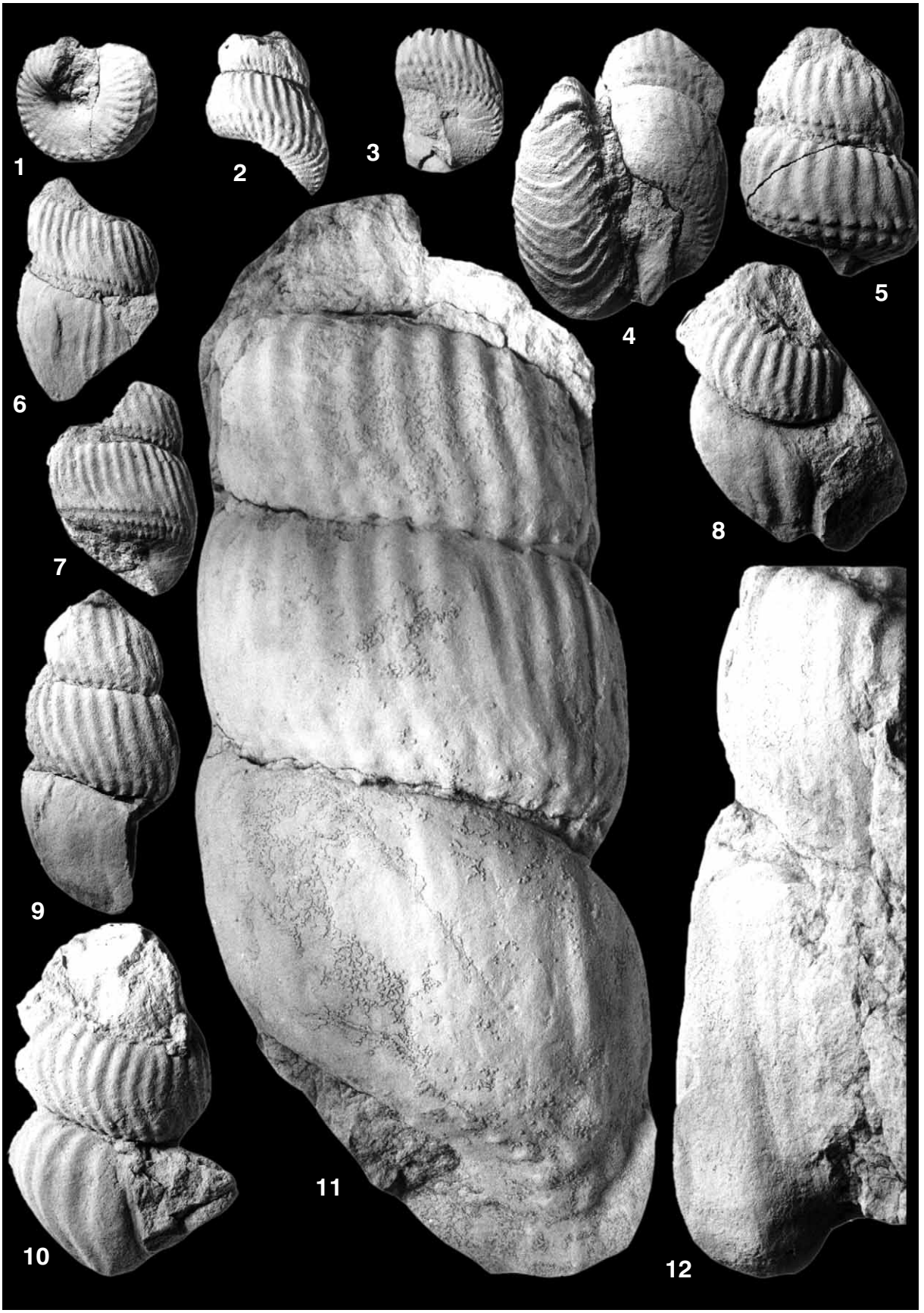
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PLATE 12

1-4 – *Ostlingoceras* (*Ostlingoceras*) *puzosianum* (D'ORBIGNY, 1842); 1 – juvenile macroconch, UJF-ID.10699; 2 – juvenile macroconch, UJF-ID.10696, from bed 95; 3 – micrococh, UJF-ID.10695, from bed 95; 4 – juvenile macroconch, UJF-ID.10703, from bed 96.

5, 6 – *Scaphites* (*Scaphites*) sp.; 5 – UJF-ID.10709, from bed 85; 6 – UJF-ID.10710, from bed 45.

7, 8 – *Anisoceras pseudoelegans* PICTET & CAMPICHE, 1861; UJF-ID.10673, from bed 96.

All specimens are from the Upper Albian of the Montlaux section, Alpes-de-Haute-Provence, France.

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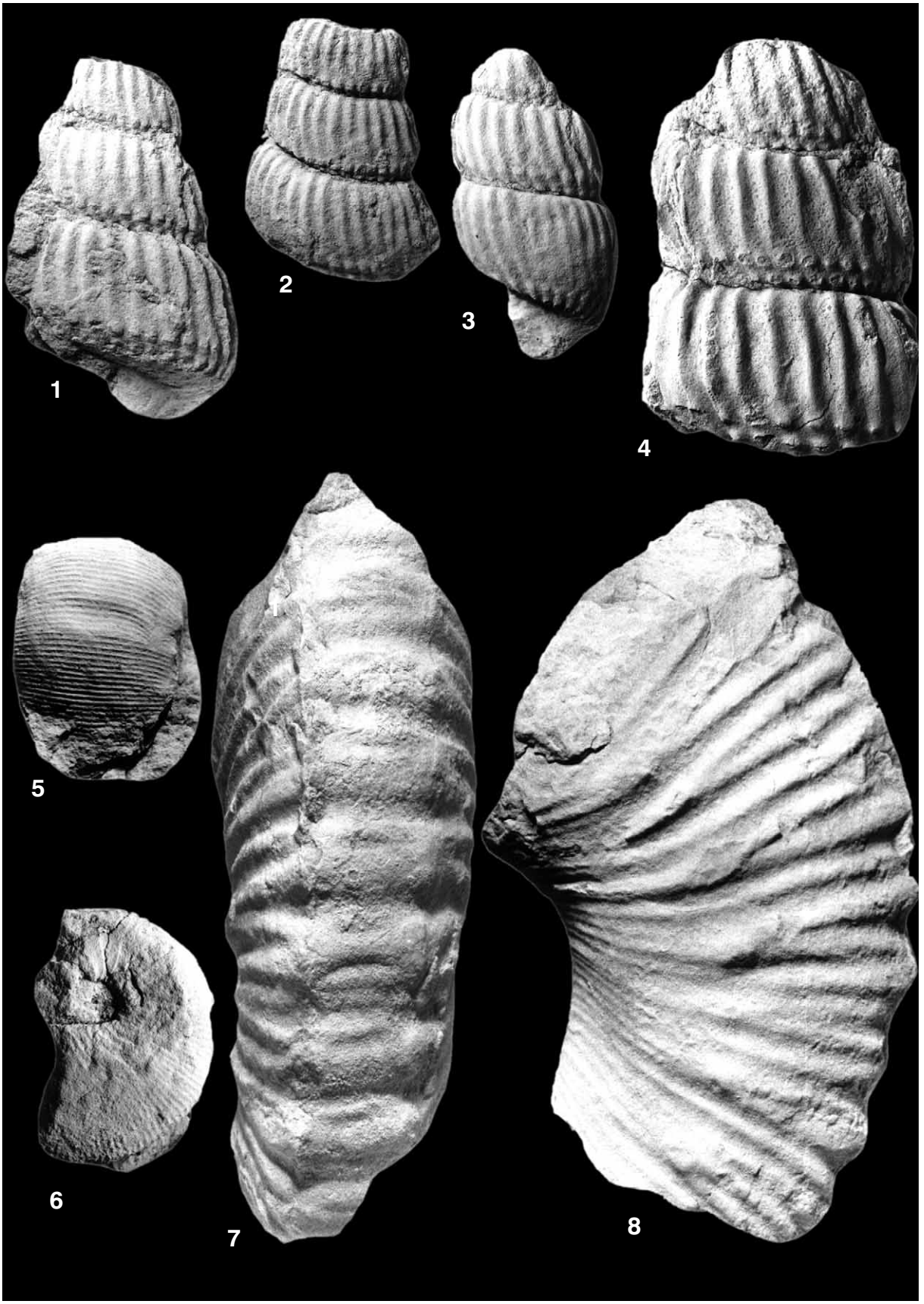
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