

Turonian ammonites from Breznik area (Southwestern Bulgaria)

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В. Минеv — Туронские амониты из района города Брезник (Юго-Западная Болгария). Представлены 6 туронских амонитных видов из района между городами Брезник и Трън: *Lewesiceras peramplum* (Mantell), *Collignoniceras woolgari* (Mantell), *C. carolinum* (d'Orbigny), *C. bravaisianum* (d'Orbigny), *Subprionocyclus neptuni* (Geinitz) и *Scaphites geinitzii* (d'Orbigny). Они принадлежат к 4 родам и 3 семействам подотрядов Ammonitina и Ancyloceratina. Два из них, *C. bravaisianum* и *S. neptuni*, описываются впервые в Болгарии. Все установленные виды имеют важное значение для стратиграфии верхнего мела. *Collignoniceras woolgari* и *Subprionocyclus neptuni* являются индексными для стандартных одноименных зон турона.

Abstract. Six Turonian ammonite species from the region between the towns of Breznik and Trăn are determined: *Lewesiceras peramplum* (Mantell), *Collignoniceras woolgari* (Mantell), *C. carolinum* (d'Orbigny), *C. bravaisianum* (d'Orbigny), *Subprionocyclus neptuni* (Geinitz) and *Scaphites geinitzii* (d'Orbigny). They belong to 4 genera and 3 families of Ammonitina and Ancyloceratina suborders. Two of them, *C. bravaisianum* and *S. neptuni*, are described for the first time in Bulgaria. All of the established species are important for the Upper Cretaceous stratigraphy, especially *Collignoniceras woolgari* and *Subprionocyclus neptuni*, which are zonal indexes of the standard Middle and Upper Turonian ammonite zones of the same names.

Introduction

The ammonite stratigraphy of the Upper Cretaceous sediments in the region between the towns of Breznik and Trăn was done in the middle of the century almost entirely by Цанков et al. (1960), Цанков, Бакалова (1962) and Цанков (1968). Some ammonites of Late Cretaceous age were found near the village of Košarevo (Йолкичев, Карагулева, 1962), an area out of the study region. The greatest part of Tzankov's specimens was described and illustrated by Цанков (1982) and is kept in the Museum of Palaeontology, Sofia University.

The objectives of the present study are to describe and figure the new specimens, obtained from the region and to revise part of Tzankov's material. There is high variability of some Collignoniceratid species often veiling the limits between them and thus complicating the detailed Turonian stratigraphy. So, it is important first to consider the recent concept of the species and to outline the criteria differentiating them one from another. The detailed lithology of the sections and the stratigraphic results will be shown in another publication.

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Material

Five Upper Cretaceous sections in the region between Breznik and Trân have been fully described and analyzed for macrofauna, foraminifera and sporomorphs. In two of them near the villages of Izvor and Ljalinci (Fig. 1) rich, relatively various and considerably well preserved ammonite fauna of Turonian age was found (Minev, 1994). Characteristic forms are those of family Collignoniceratidae Wright & Wright. The representatives of this family predominate and show considerable species diversity. Scaphitid ammonites are presented by one species with four specimens. Family Pachydiscidae Späth is represented by one, large and very well preserved *Lewesiceras peramplum* (Mantell).

All of the determined species are important for the Upper Cretaceous stratigraphy, especially two of them — *Collignoniceras woollgari* and *Subprionocyclus neptuni*, which are zonal indexes of the standard Middle and Upper Turonian ammonite zones of the same names (Kennedy, 1984; 1985). The whole material is held at the Museum of Palaeontology, Sofia University.

Brief description of the sections

The Turonian sequence in the section near the village of Izvor is represented by two packets (No. 2-1) (65.00 m).

2. (50.00 m) Irregular flyshoidal alternation of clayey to sandy limestones and marls. The following ammonite taxa were found: from 39.00 to 50.00 m — *Subprionocyclus neptuni* (Geinitz) and *Collignoniceras bravaisianum* (d'Orbigny); from 12.00 to 21.00 m — *C. bravaisianum* (d'Orbigny), *C. woollgari* (Mantell), *C. carolinum* (d'Orbigny) and *Scaphites geinitzii* (d'Orbigny); from 3.00 to 6.00 m — *C. woollgari* (Mantell), *C. carolinum* (d'Orbigny) and *Lewesiceras peramplum* (Mantell).

1. (15.00 m) Yellowish and sheeted sandy marls, intercalated by thin (0.20 m) limestone beds. They comprise the ammonite taxa *Collignoniceras woollgari* (Mantell) and *C. carolinum* (d'Orbigny).

In the Turonian part of the sequence near the village of Ljalinci three packets can be recognized (No. 3-1) (above 45.00 m).

3. (27.00 m) Yellowish sandy limestones with rare intercalations of marls. They have yielded the following ammonite taxa: from 23.00 to 25.00 m — *Subprionocyclus neptuni* (Geinitz) and *Collignoniceras bravaisianum* (d'Orbigny); from 12.00 to 20.00 m — *C. woollgari* (Mantell) and *C. carolinum* (d'Orbigny).

2. (16.00 m) Gray, sandy marls, interbedded by limestones of various thickness. At 3.00 m one specimen of *Collignoniceras woollgari* (Mantell) and one of *C. carolinum* (d'Orbigny) were found.

1. (above 2.00 m) Conglomerate bed. The matrix is red and sandy with glauconite.

Systematic description

Measurements. Made in the manner of Kennedy, Wright (1981) and Futakami (1990) and given in millimeters, where D=diameter, Wb=whorl breadth, Wh=whorl height, U=umbilicus, UT=number of umbilical tubercles per whorl, VT=number of ventral tubercles per whorl (X — UT or VT per half of a whorl).

Suborder **AMMONITINA** Hyatt, 1889

Superfamily **DESMOCERATACEAE** Zittel, 1895

Genus **Lewesiceras** Spath, 1939

Type species. *Ammonites peramplum* Mantell, 1822, p. 200 by original designation from Turonian of Sussex, England.

Description (by Wright, Kennedy, 1981). *Lewesiceras* includes both large and small species, all characterized by a more or less rounded whorl section, strong but somewhat irregular ribbing on the early whorls, with umbilical tubercles and constrictions. The ornament declines at maturity and may disappear completely. The suture has wide, open elements and shallower incisions than most later members of the family.

Occurrence. Cenomanian to Turonian; Europe, North Africa, Southern India, Japan, Texas.

Lewesiceras peramplum (Mantell, 1822)

Pl. I, figs. 1a, b

1822. *Ammonites peramplum* Mantell; J. Sowerby, p. 79, pl. 357
 pars 1853. *Ammonites peramplum* Mantell; Sharpe, p. 26, pl. 10, figs. 1a, b; non figs. 2, 3
 1857. *Ammonites Lewesiensis* Mantell; Sharpe, p. 46, pl. 21, figs. 1a-c
 1871. *Ammonites Lewesiensis* Mnt.; Schluter, p. 23, pl. 8, figs. 5, 6 (non 7)
 1872. *Ammonites Lewesiensis* Mnt.; Schluter, pl. 9, fig. 7
 1887. *Pachydiscus peramplum* Mantell sp., Laube & Bruder, p. 225, text-figs. 3a, b
 1887. *Pachydiscus Lewesiensis* Mantell sp., Laube & Bruder, p. 226, text-figs. 4a-c
 1887. *Pachydiscus juvenis* Laube & Bruder, p. 228, pl. 29, fig. 1
 1951. *Lewesiceras peramplum* (Mantell); Wright & Wright, p. 20
 1951. *Lewesiceras lewesiense* (Mantell); Wright & Wright, p. 20
 1951. *Lewesiceras sharpei* Spath; Wright & Wright, p. 20
 1959. *Lewesiceras peramplum* (Mantell); Найдин & Шиманский, p. 185, pl. 12, fig. 4; pl. 13, fig. 4
 1967. *Lewesiceras peramplum* (Mantell); Housa, p. 10, pls. 1-3; pl. 4, figs. 1, 2; text-fig. 3
 1978. *Lewesiceras peramplum* (Mantell); Kennedy & Hancock, pl. 24, figs. 1a-c
 1978. *Lewesiceras lewesiense* (Mantell); Kennedy & Hancock, p. V, 19
 1981. *Lewesiceras peramplum* (Mantell); Wright & Kennedy, p. 29, pl. 2, figs. 1-3; pl. 3; text-figs. 9-12
 1981. *Lewesiceras peramplum* (Mantell); Kennedy & Wright, p. 495, pl. 74; pl. 75, figs. 1-7; text-figs. 1, 2
 V 1982. *Lewesiceras peramplum* (Mantell); Цанков, p. 34, pl. 14, fig. 5

Nomenclature. Lectotype, designated by Amedro (in Robaszynski et al., 1980, p. 254); BMNH 8108, one of Mantell's (1822) syntypes from Lewes, Sussex; refigured by Wright, Kennedy (1981, Text-fig. 11).

Material. One large and very well preserved specimen.

Dimensions.

Specimen	(D)	Wb	Wh	Wb:Wh	U
BM 015	215	78	97	0.80	60 (28 %)
Cr ₂ 1147	89	41	25	0.61	20 (22 %)

Description. Large, moderately involute shell with 13 ribs on the outer whorl. The ribs are only main and arise from umbilical tubercles. The secondary ribs completely disappear by a diameter of 100-120 mm. The primaries are weak or absent on the venter. The umbilicus is middle wide. Suture line is not observed.

My specimen is closely similar to BMNH 44454 from the Middle Chalk of Kent and to those from Tuffeau of Ponce, France, which were illustrated by Wright, Kennedy (1981, Text-figs. 9, 12). The specimen of Tzankov (Цанков, 1982, p. 34,

pl. 14, fig. 5) is of medium size and not very typical. Therefore he compared it only with one of the Housa's specimens (1967, pl. 3, fig. 4).

Remarks. The full discussion of the species was given by Housa (1967, p. 10) on the basis of 186 specimens from Czechia and Slovakia. Using 3 specimens from British Museum of Natural History, London, and some from the other collections Wright, Kennedy (1981, p. 32) decided that *L. peramplum* (Mantell) is well distinguished from its Upper Turonian successor *L. mantelli* Wright & Wright at the most growth stages. The former has much greater size, more height and compression in middle stages and less prominent and spinose umbilical tubercles.

Occurrence. Turonian *Mammites nodosoides* and *Collignonicerias woollgari* Zones in England, France, Germany, Czechia and Slovakia. Lower-Middle Turonian in the section near the village of Izvor, No. 2, m 3.50 — BM 015 and "southern of the village of Srednogorec" (Цанков, 1982, p. 34).

Superfamily **ACANTOCARATACEAE** de Grossouvre, 1894

Family **COLLIGNONICERATIDAE** Wright & Wright, 1951

Subfamily **COLLIGNONICERATINAE** Wright & Wright, 1951

Genus *Collignonicerias* Breistroffer, 1947

Type species. *Ammonites woollgari* Mantell, 1822, p. 197, pl. 21, fig. 16; pl. 22, fig. 7, by original designation of Meek, 1876, p. 453 as type species of *Prionotropis* Meek 1876 (non Fieber, 1853) for which Breistroffer (1947, unpag.) proposed *Collignonicerias* as nomen novum; Turonian of England.

Description (by Wright, Kennedy, 1981). Medium-sized, moderately involute to evolute ammonites. Early whorls compressed, parallel-sided, ornamented by crowded or sparse, prorsiradiate, straight or flexuous ribs, mostly long, with weak to strong umbilical bullae. All ribs bear in the early stages outer ventrolateral tubercles in addition to siphonal clavi.

This style of ornament is, in some species, retained to maturity. In most species, however, the ribs coarsen, become widely spaced, with strong to weak umbilical tubercles (which migrate progressively outwards from the umbilical margin), prominent inner and outer ventrolateral tubercles which may fuse into a massive horn or flared rib, from which commonly arise pairs of low ribs joining siphonal clavi more numerous than the ventrolateral and linked into a more or less continuous keel. Rarely the ornament is greatly reduced on the body whorl. Sutures little incised, with massive saddles.

Discussion. The genus *Collignonicerias* Breistroffer is very similar to some other genera of the same subfamily and especially to *Prionocyclus* Meek, *Subprionocyclus* Shimizu and *Subprionotropis* Base. The differences between them have been fully discussed by many authors like Wright (1957, 1979); Matsumoto (1959, 1965, 1971); Kennedy, Wright, Hancock (1980); Wright, Kennedy (1981); Futakami (1990, 1991).

I'll try to point out the most considerable distinctions between *Collignonicerias* and the other 3 genera.

Collignonicerias differs from *Prionocyclus* in that the latter has very fine dense, irregular ribs through most or all of its ontogeny and a broader venter with an entire or serrated keel (Wright, Kennedy, 1981, p. 102). Other differences were discussed by Matsumoto (1965, p. 19). He mentioned that in *Prionocyclus* the fine serration of the keel is more numerous than the ribs, while in *Collignonicerias* it is coarse and high, and corresponds exactly in number with the ribs. The keel looks more continuous in the former and it is accompanied by shallow grooves on its sides.

Futakami (1990, p. 237) provisionally distinguished *Collignonicerias* from *Subprionocyclus* in that the former has prorsiradiate ribs and siphonal clavi on the ou-

ter whorl in comparison with paired or alternated long and short sigmoidal ribs and a continuous and persistent keel in the latter.

Subprionotropis is intimately allied to *Collignonicer*as and the differences may be reduced to its small size, more involute whorls, absence of a high siphonal keel and having ribs arising in pairs from umbilical bullae.

There are some difficulties connected the out of use name *Selwynoceras*. It was introduced by Warren, Stelck (1940). They had proposed the genus *Selwynoceras* with *Prionocyclus borealis* Warren as type species. Wright (1957) regarded it as a subgenus of *Collignonicer*as. Following an application by Matsumoto and Wright in 1966, the International Commission on Zoological Nomenclature ruled in 1968 (Option 861) that *Collignonicer*as Breistroffer should be given priority over *Selwynoceras* Warren & Stelck, by those who regard two as synonyms.

Occurrence. *Collignonicer*as is widespread in the middle of the Turonian stage, the classic *woollgari* Zone; it overlaps *Mammiles nodosoides* Zone in the low Turonian and ranges well on into the high Turonian. There are records from England, France, Germany, Czechia, Slovakia, Poland, Rumania, Bulgaria, Russian, Turkestan, Japan, USA, Canada, Colombia, North Africa and Northern Australia.

***Collignonicer*as *woollgari* (Mantell, 1822)**

Pl. II, figs. 1-4

1828. *Ammonites Woollgari* Mantell; J. de C. Sowerby, p. 165, pl. 587, fig. 1 non 1841. *Ammonites woollgari* Mantell; d'Orbigny, p. 352, pl. 108, figs. 1-3
1855. *Ammonites Woollgari* Mantell; Sharpe, p. 27, pl. 11, figs. 1, 2
pars 1872. *Ammonites Woollgari* Mantell; Schluter, p. 25, pl. 9, figs. 1-5; non pl. 12, figs. 5, 6
1872. *Ammonites Woollgari* Mantell; Geinitz, p. 148, pl. 33, figs. 1, 2 (?), non 4, 5
1887. *Acanthoceras woollgari* (Mantell); Laube & Bruder, p. 235, text-fig.
1887. *Acanthoceras Schluterianum* Laube & Bruder, p. 236, pl. 29, figs. 2, 3
1951. *Collignonicer*as *woollgari* (Mantell); Wright & Wright, p. 30
1957. *Collignonicer*as (*Collignonicer*as) *woollgari* (Mantell); Wright, p. L 426, text-fig. 547, 3a, b
1958. *Prionotropis woollgari* (Mantell); Лыпнов & Дрышину, p. 122, pl. 60, figs. 1a-c
1959. *Collignonicer*as *woollgari* (Mantell); Matsumoto, p. 105, text-figs. 55-57
1963. *Selwynoceras mexicanum* (Bose); Powell, p. 1225, pl. 166, figs. 2-7; pl. 167, figs. 1, 3-8; pl. 168, fig. 4; text-figs. 2-4
1963. *Collignonicer*as cf. *woollgari* (Mantell); Wright, p. 610, pl. 86, fig. 3; pl. 89, fig. 4
1965. *Collignonicer*as *woollgari* (Mantell); Matsumoto, p. 11, pl. 1, figs. 1-6; pl. 2, figs. 1-3; pl. 3, figs. 1, 2; text-fig. 6
1971. *Collignonicer*as *woollgari* (Mantell); Matsumoto, p. 130, pl. 21, figs. 4; test-fig. 1
1972. *Collignonicer*as *woollgari* (Mantell); Cobban & Scott, p. 94, pl. 14, fig. 5; pl. 30, fig. 1, pl. 37, figs. 9, 10
1978. *Collignonicer*as *woollgari* (Mantell); Kennedy & Hancock, p. v. 19, pl. 17, figs. 1a-c
1980. *Collignonicer*as *woollgari* (Mantell); Kennedy, Wright & Hancock, p. 560, pls. 62-67; pl. 69, figs. 3, 4; pl. 71, figs. 1-3; text-figs. 1A, 2-4
1981. *Collignonicer*as *woollgari* (Mantell); Wright & Kennedy, p. 103, pl. 28, figs. 1-3; pl. 29, figs. 1-7; pl. 30, figs. 1-3
V 1982. *Collignonicer*as (*Collignonicer*as) *woollgari* (Mantell); Цанков, p. 48, pl. 33, figs. 1-3
V 1982. *Collignonicer*as (*Selwynoceras*) *schluterianum* (Laube & Bruder); Цанков, p. 49, pl. 24, fig. 1
pars 1982. *Prionocyclus acutisiphonatus* sp. n. Цанков, p. 50, pl. 24, figs. 4, 5, 8; non figs. 2, 3, 6, 7
pars 1982. *Collignonicer*as (*Collignonicer*as) *carolinum* (d'Orbigny); Цанков, p. 49, pl. 23, figs. 4, 6, 7; non fig. 5
1982. *Collignonicer*as *woollgari* (Mantell); Robaszyński et al., p. 134, pl. 5, fig. 1
1982. *Collignonicer*as *woollgari* (Mantell); Балан, p. 220, pl. 22, fig. 5-7
1985. *Collignonicer*as *woollgari* (Mantell); Cobban, p. 81, fig. 6 J K; fig. 7 I K L
1990. *Collignonicer*as *woollgari* (Mantell); Cobban, p. B9, pl. 5, Figs. 6-13
1990. *Collignonicer*as *woollgari* (Mantell); Futakami, p. 237, pl. 1, figs. 1-3, 6

Nomenclature. Lectotype, designated by Wright, Wright, 1951, p. 35; BMNH 5682, from the Middle Chalk of Lewes, Sussex, refigured by Kennedy,

Wright, Hancock (1980, pl. 62, figs. 1, 2; pl. 63, fig. 9) and by Wright, Kennedy (1981, pl. 28, figs. 3a, b; pl. 29, fig. 5). The same authors presumed two additional specimens from Mantell's collection to be paralectotypes (Kennedy, Wright, Hancock, 1980, pl. 69, figs. 3, 4; Wright, Kennedy, 1981, pl. 29, figs. 6, 7).

Material. 27 specimens and a lot of fragments.

Dimensions.

Specimen	D	Wh	VT	UT	U
BM 002	15.3	5.0	—	—	4.6 (30 %)
BM 003	13.4	4.9	32	32	4.8 (36 %)
BM 004	14.5	6.1	X 16	X 13	5.2 (36 %)
BM 016	24.5	10.4	—	—	8.6 (35 %)
BM 017	26.2	9.0	X 20	X 17	11.3 (43 %)
BM 018	47.7	17.5	X 22	X 17	18.4 (29 %)
BM 020	45.2	16.3	X 22	X 17	17.2 (38 %)
BM 023	26.3	10.2	38	38	9.5 (36 %)
BM 026	25.6	10.2	X 17	X 17	9.7 (38 %)
BM 027	31.5	12.3	X 21	X 19	11.6 (37 %)
BM 031	16.4	5.1	X 15	X 15	6.2 (38 %)
BM 032	18.1	8.8	28	26	4.9 (27 %)
BM 033	10.0	4.3	X 16	X 13	3.3 (33 %)
BM 034	16.4	6.9	X 19	X 16	5.4 (33 %)
BM 035	22.5	7.8	X 16	X 13	9.3 (41 %)
BM 037	27.5	9.0	X 17	X 17	12.4 (42 %)
BM 038	29.6	11.7	—	—	11.8 (40 %)
BM 039	27.3	9.6	X 18	X 15	10.5 (38 %)
BM 058	14.8	5.8	X 14	X 14	5.6 (38 %)
BM 086	21.7	8.5	X 14	X 14	9.4 (43 %)
BM 089	21.7	7.5	—	—	8.2 (38 %)
BM 090	22.1	8.7	—	—	9.0 (41 %)
BM 091	33.8	12.3	X 19	X 14	14.6 (43 %)
BM 093	25.1	9.6	X 17	X 14	9.8 (39 %)
BM 095	27.4	9.5	—	—	10.1 (37 %)
BM 097	21.1	7.5	X 15	X 15	7.2 (34 %)
BM 098	22.0	8.8	X 14	X 14	8.4 (38 %)
Cr ₂ 1218	38.2	15.6	36	28	14.3 (37 %)

Description. A detailed description was given by Matsumoto (1965) and by Kennedy, Wright, Hancock (1980). Matsumoto's diagnosis is quite interesting when undertaken with the Bulgarian material. He had examined large number of small specimens comparable to those obtained in the present study and had recognized six kinds of variation (A-F) within them. My material could be generally assigned to Group B, C and F (Matsumoto, 1965, p. 15-16).

Group B may be regarded as representing the most typical *C. woollgari*. The ribs are simple, almost equally long, but some are stronger than the others and provided with umbilical bullae. In the distantly costate stage the intercalated rib may remain as a much reduced, faint riblet (Matsumoto, 1965, p. 15). The serration of the keel becomes high and the ribs — quickly distant in diameters above 20 mm. This group is shown on Pl. II, fig. 4.

Group C foretells *Prionocyclus hyatti* (Stanton), of a higher zone (Matsumoto, 1965, p. 16). This group is characterized by ribs of unequal intensity, being at first faint and then moderately strong, separated by interspaces of the same width (Pl. II, figs. 1, 3). Later the interspaces become broader and weaker secondary ribs or faint riblets are intercalated between the strong primaries. They are free from umbilical bullae but some of them have small ventrolateral tubercles.

Group F foreshadows *Subprionocyclus branneri* (Anderson) [= *S. cristatum* (Billinghurst)] of the Upper Turonian (Matsumoto, 1965, p. 16). The

difference between young and late stages is not so remarkable in this group. The ribs are all simple, less prorsiradiate than in group B, almost equally long and strong (Pl. II, fig. 2). The serration of the keel is moderately high.

On the basis of the above criteria I am inclined to transfer some of *Prionocyclus acutisiphonatus* Цанков (1982, pl. 24, figs. 4, 5, 8) and most of his *Collignoniceras carolinum* (d'Orbigny) (Цанков, 1982, pl. 33, figs. 4, 6, 7) to *C. woollgari*. I think so because the range of variation in *C. woollgari* is greater than the differences between that specimens and the Matsumoto's ones. I don't doubt that Tzankov's *Collignoniceras* (*Selwynoceras*) *schluterianum* (Laube & Bruder) is *C. woollgari*, too (Цанков, 1982, pl. 24, fig. 1).

Occurrence. Lower and especially Middle Turonian (classic *C. woollgari* Zone) in Europe, Russian West to Transcaspia, Japan, USA, Mexico, Northern Australia. Middle Turonian, section near the village of Izvor, No. 2, middle part (m 12.00-21.00) — BM 058, No. 2, lower part (m 3.00-6.00) — BM 016, BM 017, BM 018, BM 020, BM 023, BM 026, BM 027, BM 031, BM 032, BM 033, BM 034, BM 035, BM 037, BM 038 and BM 039, No. 1 (m 10.00) — BM 002, BM 003 and, BM 004; section near the village of Ljalinci, No. 3 (m 12.00-20.00) — BM 089, BM 090, BM 091, BM 093, BM 095, BM 097 and BM 098, No. 1 (m 3.00) — BM 086.

Collignoniceras carolinum (d'Orbigny, 1841)

Pl. II, figs. 5-7

1841. *Ammonites carolinus* d'Orbigny, p. 310, pl. 91, figs. 5, 6

1872. *Ammonites carolinus* d'Orbigny; Schluter, p. 27, pl. 9, fig. 6

1887. *Acanthoceras Carolinum* d'Orbigny; Laube & Bruder, p. 232, pl. 27, fig. 1

pars 1978. *Selwynoceras carolinum* (d'Orbigny); Kennedy & Hancock, pl. 26, fig. 3 (only)

1980. *Collignoniceras carolinum* (d'Orbigny); Kennedy, Wright & Hancock, p. 574, pl. 68, figs. 1-11; pl. 76, figs. 1, 2; text-figs. 1b, 5.

1981. *Collignoniceras carolinum* (d'Orbigny); Wright & Kennedy, p. 106, pl. 30, figs. 4, 5

pars 1982. *Collignoniceras* (*Collignoniceras*) *carolinum* (d'Orbigny); Цанков, p. 49, pl. 23, fig. 5 (only)

pars 1982. *Prionocyclus acutisiphonatus* sp. n. Цанков, p. 50, pl. 24, figs. 3, 7; non figs. 2, 4-6, 8

1982. *Collignoniceras carolinum* (d'Orbigny); Robaszynski et al., pl. 5, fig. 4

Nomenclature. Lectotype, designated by Kennedy, Wright, Hancock, 1980, p. 574; MNHP 6778a, one of d'Orbigny's specimens from Calcaire a Cephalopodes of Martrous, near Rochefort, France and refigured by them in pl. 68, figs. 4-8.

Material. 11 specimens and few pieces.

Dimensions.

Specimen	D	Wh	VT	VT	U
BM 001	16.2	6.8	—	—	7.2 (44%)
BM 012	25.0	8.2	36	36	11.6 (46%)

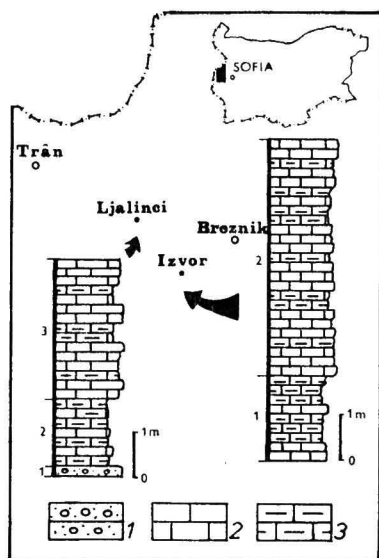


Fig. 1. Sketch-map of the study region with Turonian sequences of the investigated sections; 1 — conglomerates; 2 — limestones; 3 — marls

BM 029	22.9	8.3	—	—	9.4 (41 %)
BM 030	—	—	X 20	X 20	—
BM 036	27.5	10.0	—	—	11.6 (43 %)
BM 040	14.1	5.5	X 18	X 18	6.0 (43 %)
BM 042	22.8	8.5	—	—	9.8 (43 %)
BM 043	27.5	9.6	39	39	11.3 (41 %)
BM 085	30.0	9.8	X 22	X 22	13.7 (45 %)
BM 072	24.3	8.9	—	—	10.5 (43 %)
BM 094	18.8	5.6	—	—	7.7 (41 %)
Cr ₂ 1216	30.0	11.4	44	44	11.8 (40 %)

Description. The species is adult at small diameters. The whorls are compressed with about 30-40 rather low, rounded, prorsiradiate ribs, arising at the umbilical shoulder without bullae. Matsumoto (1971, p. 131) upheld the view that *C. carolinum* is immature example of *C. woollgari*. In fact these two species are very different. *C. carolinum* is finely and densely ribbed and at comparable diameters the ribbing is much more subdued and the venter tuberculation finer. It never develops the coarse umbilical bullae and ribs, the massive ventrolateral horns or the complex looped ventral ribbing and tubercles of *C. woollgari*. The finely ribbed forms like these of Group B of *C. woollgari* (Matsumoto, 1965) are distinguished from the type of *C. carolinum* in always developing relatively coarse ribs at a diameter of 20 mm or less and by ribs that are sharp rather than subdued, straight rather than flexuous (Wright, Kennedy, 1981).

Everything said so far enables me to refer two of *Prionocyclus acutisiphonatus* Tzankov (Цанков, 1982, pl. 24, figs. 3, 7) to *C. carolinum*.

Occurrence. Middle Turonian, *Collignoniceras woollgari* Zone in England, Germany, France, Bohemia and Turkestan. Middle Turonian; section near the village of Izvor, No. 2, middle part (m 12.00-21.00) — BM 072, No. 2, lower part (m 3.00-6.00) — BM 012, BM 029, BM 030, BM 036, BM 040, BM 042 and BM 043, No. 1 (m 10.00) — BM 001; section near the village of Ljalinci, No. 3 (m 12.00-20.00) — BM 094, No. 2 (m 3.00) — BM 085.

Collignoniceras bravaisianum (d'Orbigny, 1841)

Pl. II, figs. 8-10

1841. *Ammonites bravaisianus* d'Orbigny, p. 308, pl. 91, figs. 3, 4
 1855. *Ammonites Bravaisianus* d'Orbigny; Sharpe, p. 52, pl. 23, figs. 8, 9
 1965. *Collignoniceras woollgari bakeri* (Anderson) Matsumoto, p. 16, pl. 3, figs. 3, 4
 1965. *Subprionocyclus branneri* (Anderson) Matsumoto, p. 50, pl. 13, figs. 2a, b
 1971. *Subprionocyclus bravaisianus* (d'Orbigny) Matsumoto, p. 137, pl. 21, fig. 3
 pars 1982. *Prionocyclus acutisiphonatus* sp. n. Цанков, pl. 24, figs. 2, 6; non figs. 3-5, 7, 8
 1983. *Subprionocyclus percarinatus* (Hall & Meek) Cobban, p. 18, pl. 5, figs. 26-37; pl. 15, figs. 5, 6
 1990. *Collignoniceras bravaisianum* (d'Orbigny); Futakami, p. 238, pl. 1, figs. 4, 5, 7; pl. 2, figs. 1-14; pl. 3, fig. 1; pl. 4, figs. 2, 4, 5

Nomenclature. Lectotype, designated by Matsumoto, Noda (1966), the d'Orbigny's original (1841, pl. 91, figs. 3, 4) from Calcaire a Cephalopodes of Martrous, near Rochefort, France.

Discussion. The species was established as *Ammonites bravaisianus* by d'Orbigny (1841, pl. 308, pl. 91, figs. 3, 4). Then Matsumoto, Noda (1966) pointed out that *bravaisianus* is referred to *Subprionocyclus* and is closely allied to *S. neptuni* in various respects. After that Hancock et al. (1977) and Wright (1979, p. 320) have regarded *S. bravaisianus* as a synonym of *S. neptuni*. Futakami (1990, p. 240) considered that this species has an intermediate feature between *C. woollgari* and *S. neptuni* in ornamentation of the shell. Namely, ribs are sometimes

paired of alternately long and short like in *Subprionocyclus*, but such ribbing is also observable on some species belonging to *Collignoniceras* in some growth stages. Futakami (1990, p. 243) was inclined to conclude that this species is better placed in the genus *Collignoniceras* because of the general similarity in features of the keel, ribbing and sutural elements to *C. woollgari* rather than to *S. neptuni*.

Material. 13 specimens and several pieces.

Dimensions

Specimen	D	Wh	VT	UT	U
BM 022	25.1	9.8	X 22	X 17	8.9 (35 %)
BM 052	25.0	11.0	X 27	X 21	9.5 (34 %)
BM 056	24.5	10.4	X 24	X 18	8.1 (33 %)
BM 057	14.2	5.4	X 21	X 17	4.6 (32 %)
BM 059	34.8	12.4	X 28	X 22	12.4 (35 %)
BM 060	24.6	10.1	—	—	9.1 (37 %)
BM 069	26.4	9.1	—	—	9.8 (37 %)
BM 070	27.0	10.6	X 21	X 16	10.1 (37 %)
BM 078	23.9	9.6	X 18	X 17	8.8 (37 %)
BM 080	26.4	11.1	X 17	X 14	10.1 (38 %)
BM 099	21.2	9.3	X 20	X 13	7.5 (35 %)
BM 101	15.2	5.6	—	—	5.3 (35 %)
BM 105	18.7	8.1	—	—	6.9 (37 %)
Cr ₂ 1215	26.7	10.0	42	34	9.1 (34 %)

Description. *C. bravaisianum* is characterized by a compressed whorl, wide umbilicus, persistency of the crowded and numerous ribs and siphonal clavi at the late growth stage. Ribs on the septate whorl are mostly simple, prorsiradiate and sometimes intercalated, but in the late part of body chamber they are flexuous (Futakami, 1990, p. 239). Occasionally there are some ribs branching from the umbilical bulge on the inner whorl. The most of the ribs have distinct inner and outer ventrolateral tubercles.

Two of *Prionocyclus acutisiphonatus* Tzanov (Цанков, 1982, pl. 24, figs. 2, 6) probably are specimens of the above described species.

Remarks. *C. bravaisianum* is distinguishable from *S. neptuni* in having sharper and more numerous ribs with fewer sigmoidal ones. On the other hand, the ribs seem to be rather simple and prorsiradiate in the middle growth stage as in *C. woollgari*. The morphological character of *C. bravaisianum* closely resembles that of *Ammonites percarinatus* by Hall and Meek (= *S. percarinatus* by Cobban, 1983) and of *Schloenbachia bakeri* Anderson (= *C. woollgari bakeri* by Matsumoto, 1965). That is why Futakami (1990, p. 238) put them in synonymy. *C. bravaisianum* is also similar to *C. carolinum*, *S. hitchinensis* and some others; the differences were given in details by Futakami (1990, pp. 240-244).

Occurrence. Middle to Upper Turonian (upper parts of *C. woollgari* Zone and lower parts of *S. neptuni* Zone) in Europe, USA and Japan. Middle-Upper Turonian; section near the village of Izvor, No. 2, upper part (m 39.00-50.00) — BM 078 and BM 080, No. 2, middle part (m 12.00-21.00) — BM 052, BM 056, BM 057, BM 059, BM 060, BM 069 and BM 070, No. 2 lower part (m 3.00-6.00) — BM 022; section near the village of Ljalinci, No. 3 (m 23.00-25.00) — BM 099, BM 101 and BM 105.

Genus *Subprionocyclus* Shimizu, 1932

Type species. *Prionocyclus hitchinensis* Billingshurst, 1927, p. 516, pl. 16, figs. 1, 2 by original designation from the Upper Turonian of Hertfordshire, England.

Explanations to the plates

PLATE I

Fig. 1. *Lewesiceras peramplum* (Mantell, 1822). 1a — side view and 1b — venter view of BM 015 from the Turonian of the section near the village of Izvor, Breznik area, No. 2, lower part. Reduced $\times 0.60$.

PLATE II

Figs. 1-4. *Collignoniceras woollgari* (Mantell, 1822). 1 — MP-US* BM 020, 2 — MP-US BM 037, 3 — MP-US BM 018, 4 — MP-US BM 032 from the section near the village of Izvor, No. 2, lower part (m 3.00-6.00); Middle Turonian.

Figs. 5-7. *Collignoniceras carolinum* (d'Orbigny, 1841). 5 — MP-US BM 043, 6 — MP-US BM 012 from the section near the village of Izvor, No. 2, lower part (m 3.00-6.00); 7 — MP-US BM 085 from the section near the village of Ljalinci, No. 2; Middle Turonian.

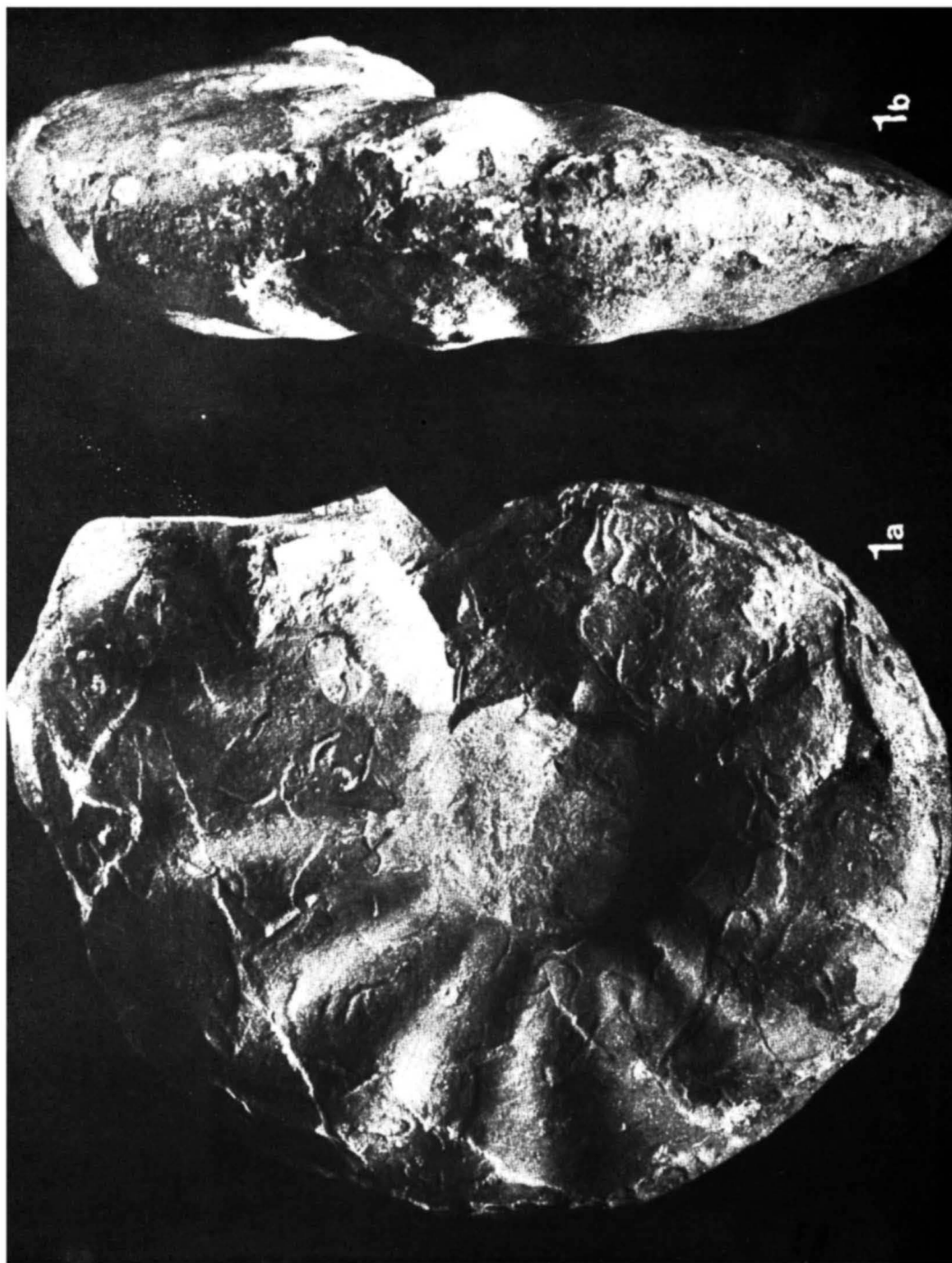
Figs. 8-10. *Collignoniceras bravaisianum* (d'Orbigny, 1841). 8 — MP-US BM 059, 9 — MP-US BM 056, 10 — MP-US BM 052 from the section near the village of Izvor, No. 2, middle part (m 12.00-21.00); Middle-Upper Turonian.

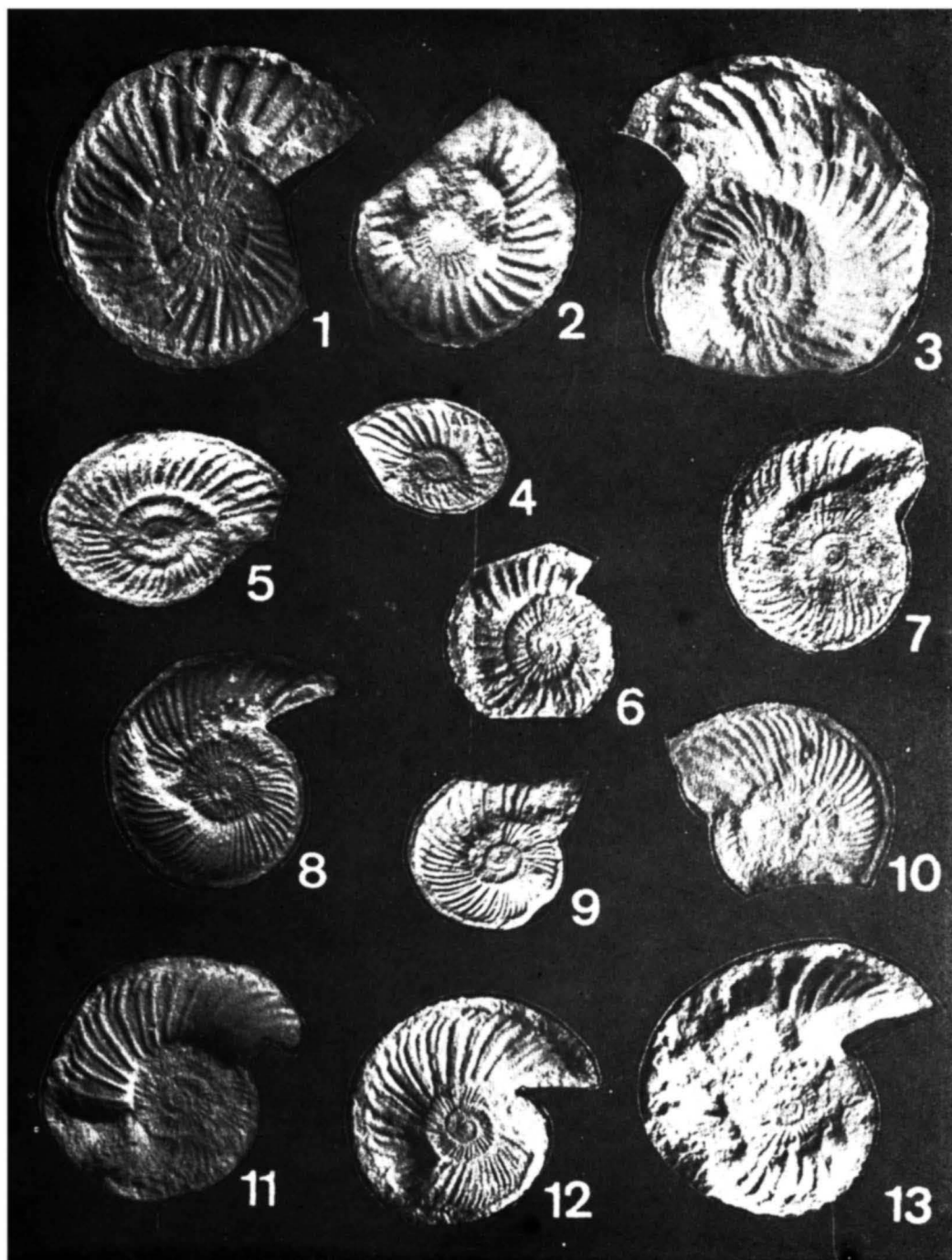
Figs. 11-13. *Subprionocyclus neptuni* (Geinitz, 1850). 11 — MP-US BM 077, 13 — MP-US BM 073 from the section near the village of Izvor, No. 2, upper part (m 39.00-50.00); 12 — MP-US BM 096 from the section near the village of Ljalinci, No. 3, upper part (m 23.00-25.00); Upper Turonian.

All figures are in natural size.

*Museum of Palaeontology, University of Sofia (MP-US)

PLATE I





Description (by Matsumoto, 1959, p. 108). The shell is small or of moderate size. The whorl is considerably involute to moderately evolute and more or less compressed, with a keeled venter. The ribs are fine to moderately coarse, normally springing in pairs from the umbilical bullae or alternately long and short, typically flexuous and prorsiradiate on the flank and projected on the venter.

Remarks. *Subprionocyclus* is distinguished from *Prionocyclus* and *Collignonicer* by his weaker ribs and a distinct serration of the keel. The genus is closely allied to and is probably derived from the Middle Turonian *Collignonicer*. *S. branneri* (= *C. bravaisianum*) may represent an intermediate stage.

Occurrence. Upper Turonian in Europe, North and West Africa, Madagascar, Japan, USA.

Subprionocyclus neptuni (Geinitz, 1850)

Pl. II, figs. 11-13

1872. *Ammonites Neptuni* Geinitz; Schluter, p. 36, pl. 11, figs. 2, 5, 7-9

1872. *Ammonites Neptuni* Geinitz; Geinitz, p. 85, pl. 36, fig. 4

1874. *Ammonites Neptuni* Geinitz; Geinitz, p. 280, pl. 62, fig. 4

1951. *Prionocyclus neptuni* (Geinitz); Wright & Wright, p. 30

1959. *Subprionocyclus neptuni* (Geinitz); Matsumoto, p. 112, pl. 29, figs. 2, 3; pl. 30, figs. 1, 2

1965. *Subprionocyclus neptuni* (Geinitz); Matsumoto, p. 52, pl. 3, fig. 5; pl. 13, figs. 1, 4

1971. *Subprionocyclus neptuni* (Geinitz); Matsumoto, p. 136, pl. 22, fig. 3

1979. *Subprionocyclus neptuni* (Geinitz); Wright, p. 319, pl. 5, figs. 2, 3

1990. *Subprionocyclus neptuni* (Geinitz); Futakami, p. 244, pl. 5, figs. 1, 2; pl. 6, fig. 1

Nomenclature. Lectotype, designated by Matsumoto (1959, p. 112), the original of Geinitz, 1850, pl. 3, fig. 3 from the Upper Turonian of Northern Germany.

Material. 12 specimens and 2-3 fragments.

Dimensions.

Specimen	D	Wh	VT	UT	U
BM 071	22.1	9.9	—	—	8.2 (37 %)
BM 073	39.3	16.5	—	—	13.4 (34 %)
BM 074	17.3	6.0	X 18	X 14	7.5 (43 %)
BM 075	21.5	7.4	X 21	X 17	9.3 (43 %)
BM 076	32.6	12.8	X 24	X 18	13.1 (40 %)
BM 077	38.7	14.4	X 23	X 16	12.7 (34 %)
BM 081	21.9	8.1	X 21	X 17	8.9 (40 %)
BM 082	20.0	7.5	X 17	X 16	8.1 (40 %)
BM 096	30.6	12.8	X 22	X 16	11.3 (37 %)
BM 100	18.3	8.2	X 18	X 17	6.8 (37 %)
BM 102	28.9	10.3	—	—	11.6 (40 %)
BM 104	23.8	10.0	X 19	X 14	8.8 (37 %)

Description. The diagnostic feature was described in details by Matsumoto (1959, p. 112) and Wright (1979, p. 320). The shell is moderately but variably involute, rather compressed. In full-grown stage the shell is of moderate size, but in many cases relatively small specimens are common. The whorl section is higher than wide, the umbilicus is fairly narrow or of moderate size. The earliest ribs are low and rounded, gently sigmoidal and somewhat prorsiradiate, rising in twos or rarely in threes from umbilical tubercles.

Remarks. This species is similar to *S. branneri* (= *C. bravaisianum*), *S. hitchinensis* and *S. normalis*. *S. neptuni* is more involute and has more prorsiradiate, closer and wider ribs than *S. branneri* at corresponding diameters. *S. hitchinensis* and *S.*

normalis are more involute and compressed than *S. neptuni*; *S. normalis* has flatter and more sinkous ribs at all stages.

Occurrence. *S. neptuni* shows the worldwide distribution in Upper Turonian (classic *S. neptuni* Zone) — North and Central Europe, North Africa, Madagascar, Japan, California and Oregon. Upper Turonian; section near the village of Izvor, No. 2, upper part (m 39.00-50.00) — BM 071, BM 073, BM 074, BM 075, BM 076, BM 077, BM 081 and BM 082; section near the village of Ljalinci, No. 3 (m 23.00-25.00) — BM 096, BM 100, BM 102 and BM 104.

Suborder ***Ancyloceratina*** Wiedmann, 1966

Superfamily **SCAPHITACEAE** Gill, 1871

Family **SCAPHITIDAE** Gill, 1871

Subfamily **SCAPHITINAE** Gill, 1871

Genus ***Scaphites*** Parkinson, 1811

Type species. *Scaphites equalis* J. Sowerby, 1813, p. 53, pl. 18, figs. 1-3 from Middle Cenomanian of Southern England; subsequently designated by Meek, 1876, p. 413.

Restricted diagnosis (by Wright, Kennedy, 1981). Compressed to inflated, more or less involute, the shaft short to moderately long, the hook not curved over the phragmocone. The ribs normally branch or a long and short on the spire and may be single or branching. Commonly with ventrolateral tubercles, on shaft and hook.

Occurrence. Cenomanian-Coniacian; Europe, parts of Asia, North Africa and USA.

Scaphites* cf. *geinitzii d'Orbigny, 1850

1872. *Scaphites Geinitzii* d'Orbigny; Schluter, p. 75, pl. 23, figs. 12-22

1874. *Scaphites geinitzii* d'Orbigny; Geinitz, p. 191, pl. 35, figs. 1-4

1959. *Scaphites geinitzii* d'Orbigny; Найдин & Шиманский, p. 195, pl. 7, fig. 3

1974. *Scaphites geinitzii* d'Orbigny; Найдин, p. 170, pl. 58, fig. 1

1979. *Scaphites geinitzii* d'Orbigny; Wright, p. 298, pl. 3, figs. 1-4, 6, 7

1981. *Scaphites (Scaphites) geinitzii geinitzii* d'Orbigny; Wright, Kennedy, p. 117

1982. *Scaphites geinitzii* d'Orbigny; Балан, p. 211, pl. 19, fig. 10

1982. *Scaphites geinitzii* d'Orbigny; Цанков, p. 23, pl. 7, figs. 1-5

Nomenclature. Lectotype, designated by Wright 1979, p. 299, pl. 3, fig. 1; MNHP 7197, d'Orbigny collection; from the Upper Turonian of Strehlen, Saxony, Germany.

Material. 4 bed preserved specimens.

Description. Small (20-60 mm) involute shell with variable whorl width (35-50% of length). The density of the ribbing is variably, too. The primary ribs give rise to 3-5 secondaries on the shaft and hook. The point of branching is raised into a more or less distinct tubercle on the later part of the shaft and on the hook. This tubercles vary from a feeble bulla in the compressed forms to a prominent one in inflated specimens and they are between six and nine. There are no distinct umbilical tubercles.

Occurrence. Middle Turonian up to the Coniacian in England, France, Germany, Czechia, Slovakia and the former USSR. Middle-Upper Turonian; section near the village of Izvor, No. 2, middle part (m 12.00-21.00) — BM 064, BM 065, BM 066 and BM 067.

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