

Ammonite Stratigraphy of the Upper Jurassic in Bulgaria. II. Oxfordian: Substages, Zones and Subzones

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И. Г. Сапунов — Аммонитовая стратиграфия верхней юры в Болгарии. II. Оксфордский ярус: подъярусы, зоны и подзоны. Болгарские Ammonitina оксфордского яруса принадлежат к семействам Haploceratidae, Glochiceratidae, Pachyceratidae, Perisphinctidae и Aspidoceratidae. На основании установленных закономерностей в их стратиграфическом распространении на территории Болгарии разработана схема аммонитовых Орпель-зон:

Верхний оксфордский подъярус —

зона *Idoceras planula*

зона *Epipeltoceras bimammatum*

зона *Perisphinctes (Dichotomoceras) bifurcatus*

Средний оксфордский подъярус —

зона *Gregoryceras riasi*

зона *Perisphinctes (Dichotomosphinctes) antecessus*

зона *Perisphinctes (Dichotomosphinctes) episcopalis*

Нижний оксфордский подъярус —

зона *Creniceras renggeri*

зона *Peltomorphites athletoides*

В нижней части зоны *E. bimammatum* выделена подзона *Euaspidoceras hypselum*, а зона *P. (D.) antecessus* расчленена на две подзоны: верхняя — подзона *Perisphinctes (Dichotomosphinctes) dobrogensis* и нижняя — подзона *Perisphinctes (Dichotomosphinctes) rotoides*.

Приведены сведения об индексном виде и номенклатуре (по болгарской литературе) каждого подразделения, определены границы и сообщены характерные виды. Приведены данные о распространении (под)зон в Болгарии, сделаны биокорреляции.

Abstract. The Bulgarian Oxfordian Ammonitina belong to the following families: Haploceratidae, Glochiceratidae, Pachyceratidae, Perisphinctidae and Aspidoceratidae. On the basis of the regularities found in their stratigraphic occurrence in this country, a scheme of ammonite Opel-zones has been elaborated:

Upper Oxfordian —

Idoceras planula Zone

Epipeltoceras bimammatum Zone

Perisphinctes (Dichotomoceras) bifurcatus Zone

Middle Oxfordian —

Gregoryceras riasi Zone

Perisphinctes (Dichotomosphinctes) antecessus Zone

Perisphinctes (Dichotomosphinctes) episcopalis Zone

Lower Oxfordian —

Creniceras renggeri Zone

Peltomorphites athletoides Zone

In the lower part of the *E. bimammatum* Zone the *Euaspidoceras hypselum* Subzone is differentiated, while the *P. (D.) antecessens* Zone is subdivided into two subzones: an upper — *Perisphinctes (Dichotomosphinctes) dobrogensis* Subzone, and a lower — *Perisphinctes (Dichotomosphinctes) rotoides* Subzone.

For each zonal subdivision data are supplied on the index species, the nomenclature (with regard to the Bulgarian literature), the boundaries are defined and the characteristic genera and species are reported. Data are indicated on the distribution of the (sub) zones in Bulgaria and biocorrelations are made.

As already pointed out (Sapunov, 1976), the representatives of Oxfordian Ammonitina in Bulgaria show a certain degree of similarity with the ammonite faunas of the third facies-faunal district (Sapunov & Ziegler, 1976, p. 8). Along with this, however, similarities with the faunas of the fourth facies-faunal district are at hand. While for the third district there exists a well elaborated scheme of Oppel-zones and subzones (e. g. Cariou, Enay & Tintant in Mouterde et al., 1971), outstanding problems in the unification of zoning are at hand in the fourth facies-faunal district, irrespective of the important results obtained by Sequeros (1974) and Duong (1974), dealing with the Middle and Upper Oxfordian.

The scheme of ammonite Oppel-zones and subzones elaborated here reflects the peculiarities in the composition of the Bulgarian Oxfordian Haploceratidae, Glochiceratidae, Pachyceratidae, Perisphinctidae and Aspidoceratidae. In addition, this scheme reflects the taxon-range-zones of selected genera and species in the Bulgarian sections. In certain cases these Bulgarian taxon-range-zones coincide with the taxon-range-zones of the third and fourth facies-faunal districts. In others, the Bulgarian taxon-range-zones are considerably restricted in comparison with the corresponding taxon-range-zones of the two districts. The present-day state of knowledge on the Oxfordian ammonite successions in the Bulgarian sections does not offer an opportunity to elucidate with certainty which of these restricted taxon-range-zones in Bulgaria are controlled by facial factors and which are due to insufficient study. In certain intervals the Bulgarian (sub)zones fully correspond to the standard subdivisions of the third facies-faunal district or to certain very fine local zonal subdivisions within its framework (Brochwiez - Lewinski, 1975). On the other hand, the Bulgarian Middle Oxfordian zones are very similar to the zonal subdivisions of the Subbetic Zone, Spain (Sequeros, 1974). But in the Lower Oxfordian and in the lower part of the Middle Oxfordian the introduction of zonal subdivisions, based on the taxon-range-zones in Bulgaria of certain selected genera or species of Perisphinctidae, Aspidoceratidae and Haploceratidae, owing to the total absence of Cardioceratidae in this country have become necessary.

The ammonite zonal scheme of the Oxfordian in Bulgaria, set forth in this paper, could be considered as a first attempt to evolve a complete zoning of the Oxfordian Stage in this country. There are quite a few blanks and biostratigraphic relationships in it still not elucidated. It is in the future that this scheme will be brought to date, presented in greater detail or corrected. And for this reason, I am inclined to see in it only the starting point for future activity than as a completed investigation.

The Substages, Ammonite Zones and Subzones of the Oxfordian in Bulgaria

The substages of the Oxfordian. The first indications for the presence of substages of the Oxfordian in Bulgaria were put forward by З л а т а р с к и (1908, p. 194). This author noted the presence of Lower Oxfordian in the Javorec Formation near Etropole on the basis of "*Peltocheras arduenensis* d'O r b i g n y" (= *Parawedekindia* sp. indet.) (it was figured by Т о у л а, 1881, pl. 2, fig. 4). He also spoke about Upper Oxfordian near the village of Batkovci (included in the village of Dragovištica at present), District of Sofia. This is based on one specimen from the Javorec Formation, referred to "*Perisphinctes triplicatum albis* Quenst". It was described by Т о у л а (1893, p. 205) as "*Perisphinctes triplicatum* Quenstedt", who believed that this species originated from the "Kimmeridge Gruppe, Schichten mit *Oppelia tenuilobata*". In the course of the revision of this specimen carried out, I established that it belongs to *Orthosphinctes suevicus* (S i e m i r a d z k i, 1898) (see С а р у н о в, 1976). Since this species occurred in the Upper Oxfordian *Idoceras planula* Zone and crossed slightly its upper boundary, it could not be considered as reliable evidence for the Upper Oxfordian. Considerably later, К о е н (1931, p. 40; 1932, pl. 4, figs. 24a, 24b; 1946, p. 124) noted the Upper Oxfordian near the peak of Červen, to the north of Teteven, on the basis of "*Perisphinctes promiscus* B u k o w s k i". It seems that this specimen (which is lost) originated from the lower part of the Javorec Formation. The relatively good figures of it offered the possibility to conclude that it is a crushed fragment which is a specifically indeterminable representative of the genus *Orthosphinctes*, actually showing the presence of the Upper Oxfordian.

The first attempt to evolve a better formulated subdivision of the Oxfordian into substages has been made by С т е ф а н о в in С а з о н о в & С т е ф а н о в (1965, p. 116, Table 1). In accordance with the genera and species quoted in this paper, the Lower Oxfordian corresponds to the *Quenstedtoceras* (*Quenstedtoceras*) *mariae* Zone, the *Cardioceras* (*Cardioceras*) *cordatum* Zone and the *Cardioceras* (*Plasmaticeras*) *tenuicostatum* Subzone of the *Perisphinctes* (*Arisphinctes*) *plicatilis* Zone (table 2). His Upper Oxfordian corresponds to the upper part of the *P. (A.) plicatilis* Zone [*Perisphinctes* (*Dichotomosphinctes*) *antecedens* Subzone], to the *Gregoryceras transversarium* Zone, the *Perisphinctes* (*Dichotomoceras*) *bifurcatus* Zone and the *Epipeltocheras bimammatum* Zone. In a similar manner, the subdivision of the Oxfordian into substages has been done by С а п у н о в et al. (1965, p. 26).

Three years later Н а ч е в (1968, p. 205, 206) again dwells on the Oxfordian substages in Bulgaria. In his paper an original element is lacking, since he makes a repetition of С т е ф а н о в in С а з о н о в & С т е ф а н о в (1965), as well as of С а п у н о в et al. (1965).

A well-balanced scheme of three distinctly defined substages suggested by C a l l o m o n (1964) should have been adopted and used in Bulgaria [every substage is defined in accordance with the zonal scheme of C a r i o u, E n a y & T i n t a n t in M o u t e r d e et al. (1971)]:

- (3) Upper Oxfordian [*Perisphinctes* (*Dichotomoceras*) *bifurcatus* Zone, *Epipeltocheras bimammatum* Zone and *Idoceras planula* Zone];
- (2) Middle Oxfordian [*Perisphinctes* (*Arisphinctes*) *plicatilis* Zone and *Gregoryceras transversarium* Zone];
- (1) Lower Oxfordian [*Quenstedtoceras* (*Quenstedtoceras*) *mariae* Zone and *Cardioceras* (*Cardioceras*) *cordatum* Zone].

The ammonite zones and subzones of the Oxfordian. The successions of the representatives of suborder Ammonitina, found in the Bulgarian sections, provided the possibility to work out a scheme of Oppel-zones and subzones for the Oxfordian Stage in this country. It is given in Table 1.

Table 1

Substages, ammonite zones and subzones of the Oxfordian in Bulgaria

Upper Oxfordian

Idoceras planula Zone

Epipeltoceras bimammatum Zone

Euspidoceras hypselum Subzone

Perisphinctes (Dichotomoceras) bifurcatus Zone

Middle Oxfordian

Gregoryceras riasi Zone

Perisphinctes (Dichotomosphinctes) dobrogensis Subzone

Perisphinctes (Dichotomosphinctes) antedecens Zone

Perisphinctes (Dichotomosphinctes) rotoides Subzone

Perisphinctes (Dichotomosphinctes) episcopalis Zone

Lower Oxfordian

Creniceras renggeri Zone

Peltomorphites athletoides Zone

Lower Oxfordian

This Substage is characterized by the genera *Peltomorphites* and *Peltoceratoides* (Fig. 1), as well as by certain species of *Prososphinctes*, *Properisphinctes*, *Mirosphinctes*, *Parawedekindia*, *Euspidoceras*, *Creniceras* and *Neocampylites* (*Neocampylites*).

In several sections or localities species which prove the presence of the Lower Oxfordian have been found. At this stage of knowledge there exist insufficient data on their connection with the ammonite zones:

Neocampylites (Neocampylites) delmontanus (Oppel, 1863)

N. (N.) villersi freboldi (Haas, 1955)

N. (N.) cf. helveticus (Jeannel, 1951)

Prososphinctes matheyi (de Loriol, 1898)

P. montrivelensis (de Loriol, 1900)

Properisphinctes bernensis (de Loriol, 1898)

Euspidoceras babeianum (d'Orbigny, 1848)

Although no ammonite zones may be differentiated in it, the Lower Oxfordian is present in the section near the village of Erden, District of Mihajlovgrad (Javorec Formation, No. 1 — the lower part); in the section in the Straža Gorge, to the south of the village of Straža, District of Târgoviște (Javorec Formation, No. 1); in the section of borehole R-109, Vranino, District of Tolbuhin (Provadija Formation, 9—10 m above the basement) and in the locality near the village of Plešivec, area of Belogradčik, District of Vidin (Ginci Formation, lower part) (Sapunov, 1976).

Ammonite Zones

Peltomorphites athletoides Zone

Index species. *Peltomorphites athletoides* (Lahusen, 1883) (Pl. I, figs. 6a, b).

Nomenclature. The Zone is here introduced. Probably, the lower part of the "lower unnamed zone" of Стефанов и Сазонов & Стефанов (1965, p. 116, table 1) and the lower part of the "lower unnamed subzone" of the "lower unnamed zone" of Сапунов et al. (1965, p. 26) are synonyms.

Stratigraphy. The lower boundary of the Zone, which represents also the lower boundary of the Oxfordian Stage, is relatively distinctly outlined in the section near the village of Belotinci, area of Belogradčik. It has been defined by Стефанов in Howarth & Стефанов (1965, p. 139). According to this author, it is traced with the first appearance of *Parawedekindia* (nuclei). This is found 40 cm above the very base of No. 12 (Sapunov, 1976). The highest situated specimen of the genus *Kosmoceras* is found 1.60 m below the top of No. 10. Thus, an interval of 2.40 m separates the highest *Kosmoceras* from the lowest *Parawedekindia*. But, since *Parawedekindia* appears as early as the Late Callovian, it is not a certain fact that with the first appearance of *Parawedekindia*, the Oxfordian also begins there. It is more logical to replace this boundary somewhat higher (i. e. at 1 m from the very base of No. 12), where the first specimens of the genus *Peltomorphites* have been found. As is known, this genus existed only in the Early Oxfordian. The upper boundary of the Zone is marked by the appearance of the first *Creniceras renggeri* (Oppel, 1863), accompanied by *Peltoceratoides*, which in Bulgaria coincides with the disappearance of *Peltomorphites*.

The Bulgarian *P. athletoides* Zone coincides with the range-zone of *Peltomorphites* in this country (Fig. 1). It is characterized by the following association: *Peltomorphites athletoides*, *P. eugenii* (Raspail, 1842), and *P. subeugenii* (Arkell, 1944). Occasionally, they are accompanied by specifically indeterminable *Parawedekindia*.

Distribution. The Zone is present in the section of the Belogradčik Cliff, to the north—north-east of Belogradčik (Javorec Formation, No. 1); in the section near the village of Belotinci, area of Belogradčik (Ginci Formation, No. 12, about 1 m above the very base) (Sapunov, 1976).

Correlations. The Bulgarian *P. athletoides* Zone corresponds approximately to the *Quenstedtoceras* (*Quenstedtoceras*) *mariae* Zone of the third facies-faunal district (table 2).

Table 2

Correlation among the Oxfordian ammonite zonal schemes of the first and third facies-faunal districts (according to Carion, Enay & Tintant in Mouterde et al., 1971) and Bulgaria

Substages	Facies-faunal districts (according to Sapunov & Ziegler, 1976)			Bulgaria
	First	Third		
	(sub)zones	(sub)zones		
Upper	<i>Ringstaedia pseudocordata</i>	<i>Epipeltoceras bimammatum</i>	<i>Idoceras planula</i>	<i>Epipeltoceras bimammatum</i>
			<i>T. (Taramelliceras) hauffianum</i>	
	<i>Decipia decipiens</i>	<i>E. bimammatum</i>		
		<i>Euaspidoceras hypselum</i>		
	<i>Perisphinctes (Perisphinctes) cautisnigrae</i>	<i>Perisphinctes (Dichotomoceras) bifurcatus</i>		
Middle	<i>Gregoryceras transversarium</i>		<i>Gregoryceras riasi</i>	
	<i>Perisphinctes (Dichotomosphinctes) antecedens</i>	<i>Perisphinctes (Arisphinctes) plicatilis</i>	<i>Perisphinctes (Dichotomosphinctes) antecedens</i>	<i>P. (D.) dobrogensis</i>
				<i>P. (D.) rotoides</i>
	<i>G. (Vertebriceras) vertebrale</i>		<i>C. (Plasmatoceras) tenuicostatum</i>	<i>Perisphinctes (Dichotomosphinctes) episcopalis</i>
Lower	<i>Cardioceras (Cardioceras) cordatum</i>		<i>Creniceras renggeri</i>	
	<i>Quenstedtoceras (Quenstedtoceras) mariae</i>		<i>Peltomorphites athletoides</i>	

Index species. *Creniceras renggeri* (Oppel, 1863) (Pl. I, fig. 1).

Nomenclature. The Zone is here introduced. Synonyms: probably, the upper part of the "lower unnamed zone" + "middle unnamed zone" of Стефанов in Сазонов & Стефанов (1965, p. 116, Table 1); probably, the upper part of the "lower unnamed subzone" of the "lower unnamed zone" of Сапунов et al. (1965, p. 26); "bed with *Creniceras crenatum* (Bruguière)" of Стефанов in Howarth & Стефанов (1965, p. 139) in the section near the village of Belotinci, area of Belogradčik; "beds with *Parawedekindia*" of J. Стефанов (in labels) (see Сапунов, 1976) in the section Belogradčik Cliff, north — north-east of Belogradčik.

Stratigraphy. The lower boundary of the Zone is defined in the description of the *P. athletoides* Zone (see above). The upper boundary of this Zone, which is also a boundary between the Lower and Middle Oxfordian, is defined by the first appearance of *Taramelliceras* (*Taramelliceras*) and *Perisphinctes* (*Dichotomosphinctes*) which is accompanied by the disappearance of *Prosoosphinctes*, *Properisphinctes* and *Peltoceratoides* (Figs. 1 and 2). In accordance with the data available, also *Neocampylites* (*Neocampylites*)

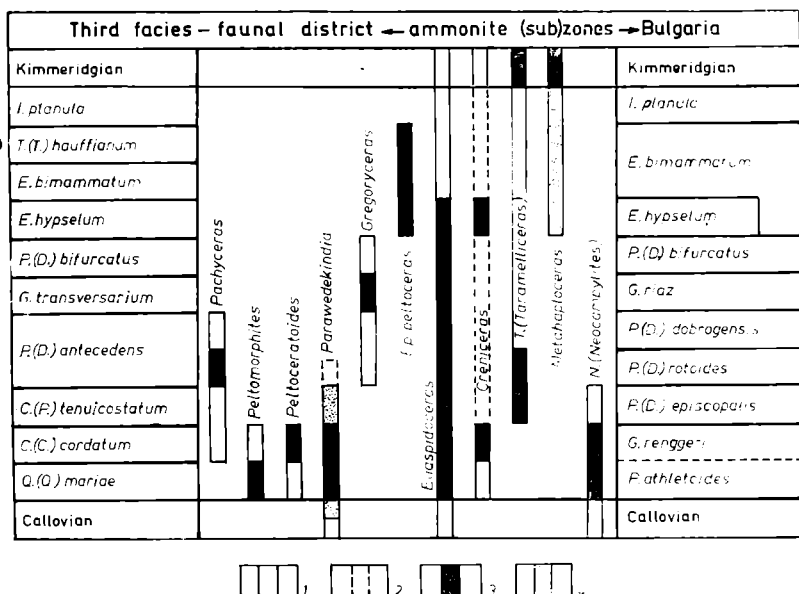


Fig. 1. Stratigraphic occurrence of the genera from the families Pachyceratidae, Aspidoceratidae, Haploceratidae and Glochiceratidae in the Oxfordian

1 — total stratigraphic occurrence in the third and fourth facies-faunal districts, according to Hölder (1955), Enay (1966), Enay, Tintant & Cario (1974), Sequieros (1974), Ziegler (1974a; 1974b), Sapunov & Ziegler (1976) and others; 2 — probable stratigraphic occurrence in the third and fourth facies-faunal districts, according to the same authors; 3 — stratigraphic occurrence in Bulgaria; 4 — probable stratigraphic occurrence in Bulgaria

and *Miosphinctes* disappear somewhere about this boundary in Bulgaria (Figs. 1 and 2).

The Bulgarian *C. renggeri* Zone is based on an association of selected species. The Zone is characterized by *Creniceras renggeri* (which is restricted in its lower part), *Neocampylites* (*Neocampylites*) *ferretensis* (Schirardin, 1957), *Miosphinctes frickensis* (Moesch, 1867), *M. niedzwiedzkii* (Siemiradzki, 1891), *Parawedekindia bodeni* (Priester, 1937), *Parawedekindia* sp. n. 2, *Parawedekindia* sp. n. 3, *Peltoceratoides* sp. indet. ex. gr. *constantii* (d'Orbigny, 1849).

Distribution. The *C. renggeri* Zone is present in the section Belogradčik Cliff, to the north — north-east of Belogradčik (Javorec Formation, No. 2); in the section near the village of Belotinci, area of Belogradčik (Ginci Formation, 2 m below the top of No. 12); in the section of borehole R-79, Makedonka, District of Tolbuhin (Provadija Formation) (Sapunov, 1976).

Correlations. The Bulgarian *C. renggeri* Zone corresponds approximately to the *Cardioceras* (*Cardioceras*) *cordatum* Zone of the third facies-faunal district (Table 2).

Middle Oxfordian

This Substage is characterized by *Perisphinctes* (*Dichotomosphinctes*), *P. (Otosphinctes)*, *P. (Kranaosphinctes)*, *P. (Arisphinctes)*, *Discosphinctes*, *Pachyceras*, *Gregoryceras* (Figs. 1, 2), as well as by some species, belonging to *Taramelliceras* (*Taramelliceras*) and *Euaspidoceras*.

Although no ammonite zones can be differentiated in it, the Middle Oxfordian is present in the lower part of the Ginci Formation in the locality Svinski Kamak, the valley of Kostina River, south of the village of Ribarica, area of Teteven, where *Euaspidoceras tenuispinatum* (Wagen, 1873) (Sapunov, 1976) exists.

Ammonite Zones and Subzones

Perisphinctes (*Dichotomosphinctes*) *episcopalis* Zone

Index species. *Perisphinctes* (*Dichotomosphinctes*) *episcopalis* de Loriol, 1901 (Pl. II, figs. 3a, b).

Nomenclature. The Zone is here introduced. Probably, "the upper unnamed zone" of Стефанов in Сазонов & Стефанов (1965, p. 116, 1) and the "upper unnamed zone" of Сапунов et al. (1976, p. 26) are synonyms.

Stratigraphy. The lower boundary of the Zone is defined in the description of the *C. renggeri* Zone (see above). The upper boundary is marked by the appearance of the first *Perisphinctes* (*Dichotomosphinctes*) *rotoides* Ronchadze, 1917, accompanied by *Perisphinctes* (*Arisphinctes*), and in Bulgaria, also by *P. (Kranaosphinctes)*, *P. (Otosphinctes)* and *Pachyceras* (Figs. 1 and 2).

The Bulgarian *P. (D.) episcopalis* Zone corresponds to the range-zone of the index species in this country, which is also accompanied by *Taramelliceras* (*Taramelliceras*) *pseudoculatum* (Bukowski, 1887).

Distribution. The *P. (D.) episcopalis* Zone is present in the section near the village of Belotinci, area of Belogradčik (Ginci Formation, No. 13, the very base) (Sapunov, 1976).

Correlations. The Bulgarian *P. (D.) episcopalis* Zone corresponds to the *C. (P.) tenuicostatum* Subzone [*P. (A.) plicatilis* Zone] of the third facies-faunal district (Table 2).

Perisphinctes (Dichotomosphinctes) antecedens Zone

Index species. *Perisphinctes (Dichotomosphinctes) antecedens* Salfeld, 1914 (Pl. III, Fig. 1).

Nomenclature. The Zone is here introduced.

Stratigraphy. The lower boundary of the Zone is defined in the description of the *P. (D.) episcopalis* Zone (see above). Its upper boundary is marked by the disappearance of *Perisphinctes (Arisphinctes)* in Bulgaria, accompanied by *P. (Dichotomosphinctes)*. Above that boundary, the first *Gregoryceras* appear in this country (Figs. 1 and 2).

The Bulgarian *P. (D.) antecedens* Zone is based on the range-zone of the index species. *Perisphinctes (Arisphinctes)* occurs in this Zone only. It is characterized by *Perisphinctes (Dichotomosphinctes) antecedens*, *P. (Arisphinctes) helenae* de Riaz, 1898, *Euaspidoceras perarmatum* (J. Sowerby, 1822) and *E. catena* (J. de C. Sowerby, 1823). In the lower part of the Zone there is a sporadic presence of the index species which is represented by specimens, small in size. In the upper part of the Zone the size of this species rapidly increases. This comes to confirm the result obtained by Brochwicz-Lewiński & Rózák (1974) concerning the regularities in the changes in the size of certain Oxfordian Perisphinctidae in the Middle and a part of the Upper Oxfordian in the Polish Jura Chain. The accompanying perisphinctid faunas in the lower and upper part of the Zone in this country indicate similar size changes.

Distribution. The *P. (D.) antecedens* Zone is present in the section near the village of Mitrovci, Mihajlovgrad District (Javorec Formation, No. 1, in the lower part); near the village of Granitovo, area of Belogradčik (Javorec Formation, upper part); to the south of the villages of Beli Osam and Čiflik, area of Trojan (Ginci Formation, lower part), and in the valley of the Černi Vit River, 1.5 km to the south of the village of Polaten, area of Teteven (Javorec Formation, middle part) (Sapunov, 1976).

Correlations. The Bulgarian *P. (D.) antecedens* Zone corresponds to the *P. (D.) antecedens* Subzone [*P. (A.) plicatilis* Zone] of the third facies-faunal district (Table 2). It correlates particularly well with the *P. (D.) antecedens* Subzone near Częstochowa, Poland (Brochwicz-Lewiński, 1975).

Perisphinctes (Dichotomosphinctes) rotoides Subzone

Index species. *Perisphinctes (Dichotomosphinctes) rotoides* Ronchadzé, 1917 (Pl. II, figs. 1a, b).

Nomenclature. The Subzone is here introduced.

Stratigraphy. The lower boundary of the Subzone coincides with the lower boundary of the *P. (D.) antecedens* Zone (see above). Its upper bound-

dary is related with the disappearance of *Perisphinctes* (*Kranaosphinctes*) and *P. (Otosphinctes)* in this country and with the appearance of large-sized *P. (Dichotomosphinctes)* and *P. (Arisphinctes)* (Fig. 2).

The Bulgarian *P. (D.) rotoides* Zone coincides with the range-zone of the index species in this country, which is accompanied by small in size *Perisphinctes* (*Kranaosphinctes*). Moreover, *Taramelliceras* (*Taramelliceras*) *argoviense* Jeannot, 1951, *Perisphinctes* (*Otosphinctes*) *pulvinus* Enay, 1966, *P. (Dichotomosphinctes)* *montfalconensis* de Loriol, 1901 and *Pachyceras* sp. indet. also occur in the Subzone.

Distribution. The Subzone is present in the section Belogradčik Cliff, to the north — north-east of the town of Belogradčik (Javorec Formation, No. 3); and in the section near the village Belotinci, area of Belogradčik (Ginci Formation, No. 13, the lower part, in central position) (Sapunov, 1976).

Correlations. The Bulgarian *P. (D.) rotoides* Subzone corresponds approximately to the lower half of the *P. (D.) antecedens* Subzone [*P. (A.) plicatilis* Zone] of the third facies-faunal district (Table 2). It is an equivalent of the lower horizon of the *P. (D.) antecedens* Subzone [*P. (A.) plicatilis* Zone] of Częstochowa, Poland (Brochwicz-Lewiński, 1975), where *Perisphinctes* (*Dichotomosphinctes*) *rotoides* has the same range-zone as in Bulgaria. It should be noted that in the French Jura the same species occurs throughout the entire *P. (D.) antecedens* Subzone (Enay, 1966).

Perisphinctes (*Dichotomosphinctes*) *dobrogensis* Subzone

Index species. *Perisphinctes* (*Dichotomosphinctes*) *dobrogensis* Simionescu, 1907 (Pl. IV, figs. 1a, b).

Nomenclature. The Subzone is here introduced.

Stratigraphy. The lower boundary of the Subzone is defined in the description of the *P. (D.) rotoides* Subzone, while its upper boundary, in the description of the *P. (D.) antecedens* Zone (see above).

The Bulgarian *P. (D.) dobrogensis* Subzone is based on an association of large-sized perisphinctids, where in addition to the index species (the latter is restricted in the upper part), *P. (Arisphinctes)* *plicatilis* (J. Sowerby, 1817) (in the upper part, too) and *P. (Dichotomosphinctes)* *antecedens* Salfeld, 1914 (in the lower part) are also present.

Distribution. The Subzone is present in the section near the hamlet of Neškovci, to the south of the village of Černi Osam, area of Trojan (Ginci Formation, No. 3, the lower part and in the top of the clay limestones underlying No. 3) (Sapunov, 1976).

Correlations. The Bulgarian *P. (D.) dobrogensis* Subzone corresponds approximately to the upper half of the *P. (D.) antecedens* Subzone [*P. (A.) plicatilis* Zone] of the third facies-faunal district (Table 2). It is an equivalent of the upper horizon of the *P. (D.) antecedens* Subzone [*P. (A.) plicatilis* Zone] in Częstochowa, Poland (Brochwicz-Lewiński, 1975), where just as in Bulgaria *Perisphinctes* (*Dichotomosphinctes*) *antecedens* and *P. (D.) dobrogensis* are also present. In the French Jura, *P. (D.) dobrogensis* occurs throughout the whole *P. (D.) antecedens* Subzone (Enay, 1966). It looks like that the *P. (D.) antecedens* Biozone in the Subbetic Zone, Spain (Sequeiros, 1974) is an equivalent of the Bulgarian *P. (D.) dobrogensis* Subzone.

Index species. *Gregoryceras riasi* (de Grossouvre, 1917) (Pl. V, figs. 1a-c).

Nomenclature. Under the name of "Zone der *Gregoryceras transversarium*" this Zone is introduced by Sapunov & Ziegler (1976, p. 31) based on the presence of "*Gregoryceras fouquei* (Kilian, 1889)". After a recent revision of this specimen, it has been found that it belongs to *Gregoryceras riasi*. The Bulgarian specimen has the features inherent of morphotype "B" of Duong (1974, p. 54). According to this author, morphotype "B" occurs in the *P. (D.) parandieri* Subzone of the *G. transversarium* Zone. That fact lends reliability to the assumption that *G. riasi* (which has been found under conditions of unclarified biostratigraphic relationships with the faunas of *P. (D.) antecedens* and *P. (D.) bifurcatus* Zones), in Bulgaria is located above the upper boundary of the *P. (D.) antecedens* Zone which corresponds to the *G. transversarium* Zone of the third facies-faunal district. Investigations carried out on a number of Mediterranean and Submeterranean areas in the past few years (Enay, 1966; Sapunov, 1973; Duong, 1974; Sequeiros, 1974) show that in the areas in which is developed the fourth facies-faunal district *Gregoryceras transversarium* is absent, on account of *G. riasi* and *G. fouquei*. It is for this reason that *G. riasi* is more suitable for an index species for the fourth facies-faunal district and what is more, this species is found along with *Gregoryceras transversarium* in the third facies-faunal district. In addition, *G. riasi* has already been used as an index species in the Subbtetic Zone, Spain (Sequeiros, 1974).

The *G. transversarium* Zone has been used in some of the older Bulgarian papers, before Sapunov & Ziegler (1976). For instance, Златарски (1908, p. 213) mentions the presence of the Zone, eastward of the town of Trăn (Kraïšte region), on the basis of "*Perisphinctes* cf. *triplex* Quenst. (*Perisph. plicatilis* Sow)". Probably, Златарски interpreted the *G. transversarium* Zone in the original meaning given to it by Oppel (1863). Златарски's pecimen has been lost. But it seems that it has been erroneously identified, since the rocks in which it has been found, belong to the Centralbalkan Flysch Group which is of a considerably younger age there. The mention of the *G. transversarium* Zone by Коен (1931, p. 40; 1932, p. 28, pl. 4, figs. 24a and 24b; 1946, p. 124) is based on a crushed specimen, found in the lower part of the Javorec Formation near the Červen Peak, north of Teteven, identified as "*Perisphinctes promiscus* Bukowski". As I have already noted above, in this case mention is made of a specifically indeterminable fragment of *Orthosphinctes* which comes to prove the presence of the Upper Oxfordian.

The presence of the *G. transversarium* Zone is reported also by Канюнов et al. (1965, p. 26). These authors accept the scope of the Zone in Oppel's (1863) sense, too.

Stratigraphy. The lower boundary of the Zone is defined in the description of the *P. (D.) antecedens* Zone (see above). Its upper boundary, which is also the boundary between the Middle and the Upper Oxfordian, is marked with the appearance of the earliest *Perisphinctes* (*Dichiotomoceras*) (Fig. 2).

The Bulgarian *G. riasi* Zone probably coincides with the range-zone of the genus *Gregoryceras* in this country. This has not been proved in the Bulga-

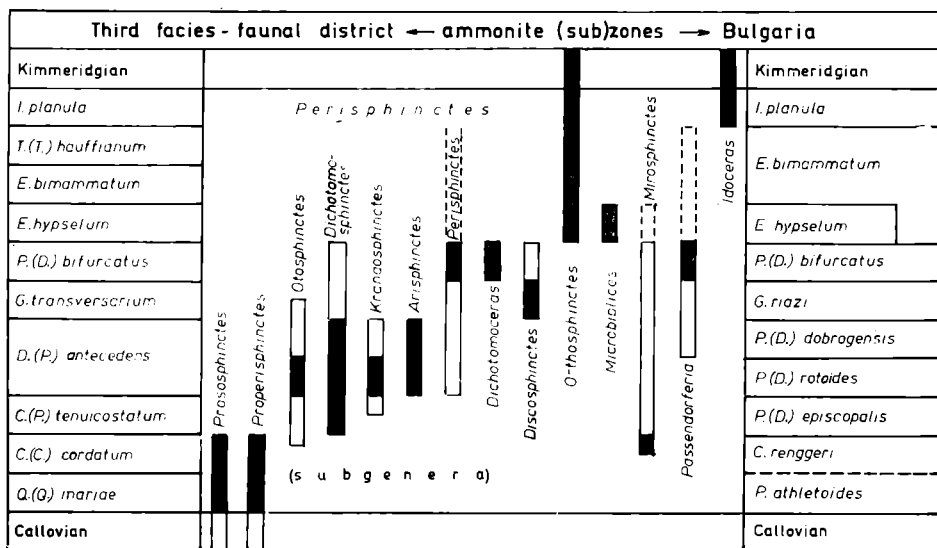


Fig. 2. Stratigraphic occurrence of the genera from the family Perisphinctidae in the Oxfordian

1 — total stratigraphic occurrence in the third and fourth facies-faunal districts, according to Ziegler (1959; 1974a), Enay (1966), Brochwicz-Lewiński (1973), Enay, Tintant & Carion (1974), Sequeiros (1974), Duong (1974), Sapunov & Ziegler (1976) and others; 2 — probable stratigraphic occurrence in the third and fourth facies-faunal districts, according to the same authors; 3 — stratigraphic occurrence in Bulgaria

rian sections since the sparse presence of representatives of this genus have been found without any other ammonite faunas. Yet, the fact that so far not a single *Gregoryceras* has been found both in the *P. (D.) antecessens* and the *P. (D.) bifurcatus* Zones, provides arguments in favour of the assumption made above. The association of the Bulgarian *G. riazi* Zone is represented by *Gregoryceras riazi*, *Gregoryceras* sp. indet. and *Discosphinctes aeneas* (Gemellaro, 1877).

Distribution. The Zone is present in the section on the Belogradčik — Orešec Railway Station road (Javorec Formation, No. 3, in upper position); in the section near the village of Belotinci, area of Belogradčik (Ginci Formation, No. 13, lower part, in upper position), and near the village of Falkovec, eastwards of Belogradčik (Javorec Formation, probably the upper part) (Sapunov, 1976).

Correlations. The Bulgarian *G. riazi* Zone corresponds to the *G. transversarium* Zone of the third facies-faunal district (Table 2). It coincides also with the *G. transversarium* Zone in Cz stochowa, Poland (Brochwicz-Lewiński, 1975). The *G. riazi* Interval-zone in the Subbetic Zone, Spain (Sequeiros, 1974) has a similar scope. However, there the index species is also found in the *P. (D.) bifurcatus* Zone.

Upper Oxfordian

In Bulgaria this Substage is characterized by the presence of *Perisphinctes* (*Dichotomoceras*), *P.* (*Perisphinctes*), *Passendorferia*, *Microbiplices* and *Epipeltoceras* (Figs. 1 and 2), as well as different species of the genera *Metahaploceras*, *Creniceras*, *Idoceras*, *Orthosphinctes* and *Euaspidoceras*.

Even though no ammonite zones may be differentiated in it, the Upper Oxfordian is present in the lower part of the Ginci Formation, in-between the villages of Berende and Svetlja, District of Pernik, where it is proved by *Orthosphinctes* sp. indet. juv. ? aff. *polygyratus* (Reinecke, 1818) (Sapunov, 1976).

Ammonite Zones and Subzones

Perisphinctes (*Dichotomoceras*) *bifurcatus* Zone

Index species. *Perisphinctes* (*Dichotomoceras*) *bifurcatus* (Quenstedt, 1846) (Pl. VI, fig. 1).

Nomenclature. The Zone is here introduced.

Stratigraphy. The lower boundary is defined by the description of the *G. riazii* Zone (see above). Its upper boundary is marked by the appearance of *Epipeltoceras*, *Euaspidoceras hypselum* (Oppel, 1863) and *Orthosphinctes*, which is preceded by the disappearance of *Perisphinctes* (*Dichotomoceras*). The genus *Perisphinctes* does not cross this boundary in Bulgaria (Figs. 1 and 2).

The Bulgarian *P.* (*D.*) *bifurcatus* Zone is based on the range-zone of *Perisphinctes* (*Dichotomoceras*). The representatives of *Passendorferia* and *Perisphinctes* (*Perisphinctes*), found sporadically in this country, occur only in the Zone (Fig. 2). The zonal association is represented by *Perisphinctes* (*Dichotomoceras*) *bifurcatus*, *P.* (*D.*) *bifurcatoides* Enay, 1966, *P.* (*D.*) *crassus* Enay, 1966, *Passendorferia teresiformis* (Brochwicz-Lewiński, 1973), *P. ziegleri* (Brochwicz-Lewiński, 1973), and *Perisphinctes* (*Perisphinctes*) cf. *cautisnigrae* Arkell, 1935.

Distribution. The Zone is present in the section near Magura Cave, to the west of the village of Rabiša, area of Belogradčik (Ginci Formation, No. 2, in the lower part); in the section near the village of Komštica, District of Sofia (Javorec Formation, No. 5, 6 m above the very base), and also near the village of Vărbovo, area of Belogradčik (Ginci Formation, the exact position is unknown) (Sapunov, 1976).

Correlations. The Bulgarian *P.* (*D.*) *bifurcatus* Zone corresponds to the *P.* (*D.*) *bifurcatus* Zone of the third facies-faunal district (Table 2). It correlates with the *P.* (*D.*) *bifurcatus* Zone in Cr. stochowa, Poland (Brochwicz-Lewiński, 1975) and the Subbtetic Zone, Spain (Sequeiros, 1974).

Epipeltoceras bimammatum Zone

Index species. *Epipeltoceras bimammatum* (Quenstedt, 1857). The index species has not been found in Bulgaria. Стефанов's (1962, p. 103, Pl. 2, figs. 3a, b) specimen, described and figured as "*Epipeltoceras bimam-*

matum (Quenstedt)" belongs to *Epipeltoceras treptense* Enay, 1963 (see Pl. VI, figs. 3a, b in this paper).

Nomenclature. This Zone is mentioned by Коен (1946, p. 124) for the first time. According to this author, it is present in the Teteven area on the basis of "*Aptychus latus*, Park.", which cannot be considered as evidence. For this reason it should be accepted that in Bulgaria it has been introduced by Стефанов (1962, p. 104). The *E. bimammatum* Zone of Сапунов et al. (1965, p. 26) embraces also a certain part of the *G. riasi* Zone, because in the composition of the zonal association, in addition to the index species, also "*Gregoryceras fouquei* (Kilian, 1889)" is quoted.

Stratigraphy. The lower boundary of the Zone is defined in the description of the *P. (D.) bifurcatus* Zone (see above). Its upper boundary is marked with the disappearance of the genus *Epipeltoceras* and the appearance of *Idoceras*. That is an assumption, however, in agreement with well-defined mutual relations in the ammonite successions in the third facies-faunal district. So far in Bulgaria no representatives of these two genera have been established in one and the same section.

The Bulgarian *E. bimammatum* Zone coincides with the range-zone of *Epipeltoceras*. It is characterized by *Epipeltoceras treptense* and probably by *Orthosphinctes* sp. n.

Distribution. The Zone is present in the section near the Magura Cave, to the west of the village of Rabiša, area of Belogradčik (Ginci Formation, No. 2, upper part) and probably in the borehole section of R-87, Gurkovo, District of Tolbuhin (Provadija Formation, 2—5 m above the very base) (Сапунов, 1976).

Correlations. The Bulgarian *E. bimammatum* Zone corresponds to the same Zone in the third facies-faunal district (Table 2). It corresponds to the same Zone of Częstochowa, Poland (Brochwicz-Lewiński, 1975). It looks as if the lower, larger part of the *E. bimammatum* Biozone in the Subbetic Zone, Spain (Sequeiros, 1974) corresponds to the Bulgarian Zone.

Euaspidoceras hypselum Subzone

Index species. *Euaspidoceras hypselum* (Oppel, 1863) (Pl. VII, figs. 1a, b).

Nomenclature. The Subzone is here introduced. "Beds with *Creniceras renggeri*" of J. Стефанов (in labels) in the section of the Belogradčik Cliff, to the north — north-east of the town of Belogradčik is a synonym (see Сапунов, 1976).

Stratigraphy. The lower boundary of the Subzone coincides with the lower boundary of the *E. bimammatum* Zone (see above). Its upper boundary is defined by the disappearance of the index species, accompanied by *Creniceras lophotum* (Oppel, 1863).

The Bulgarian *E. hypselum* Subzone coincides with the range-zone of the index species. It is characterized by an association of species, similar to the association of the same Subzone in Southern Germany: *Euaspidoceras hypselum*, *E. eucyphum* (Oppel, 1863) (occurs in the lower part of the Subzone), *Creniceras lophotum* (Oppel, 1863) (occurs in the upper part of the Subzone) and *Microbiplices divergens* (Oppenheim, 1907). It is accompanied

EXPLANATION OF PLATE I

Early Oxfordian ammonites

Fig. 1. *Creniceras renggeri* (O p p e l, 1863). Section near the village of Belotinci, area of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, member of the lower nodular limestones, No. 12, at 2 m below the top (S a p u n o v, 1976, p.29); Lower Oxfordian, *Creniceras renggeri* Zone. Pal. Mus. Univ. Sofia, J333/47—1.×1.0

Figs. 2a, b. *Prososphinctes matheyi* (d e L o r i o l, 1898). Section near the village of Erden, District of Mihajlovgrad (West Forebalkan). Javorec Formation, lower part (the exact position in the section is unclear) (S a p u n o v, 1976, p.30); Lower Oxfordian. Pal. Mus. Univ. Sofia, J293/47—2.×1.0

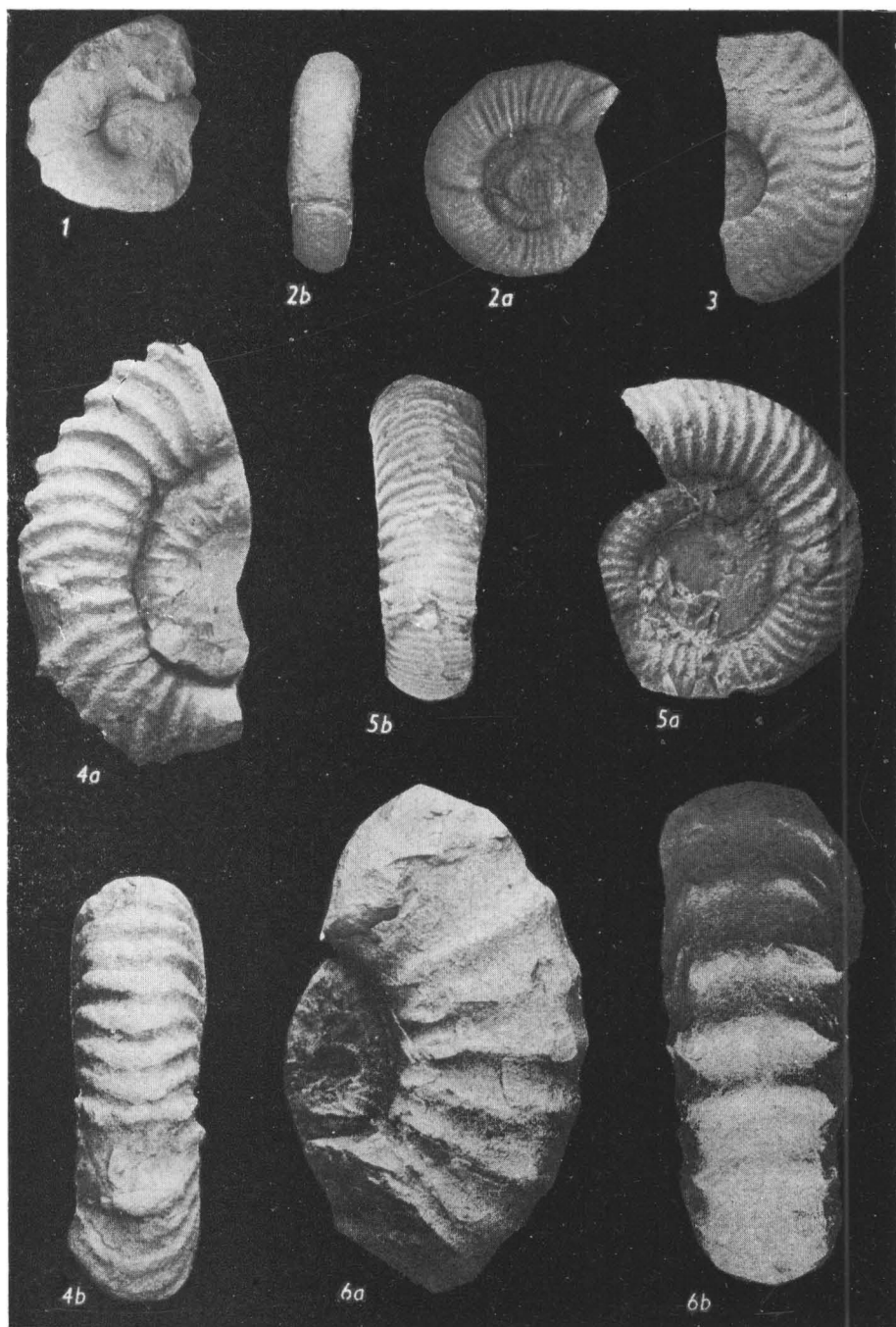
Fig. 3. *Neocampylites* (*Neocampylites*) *delmontanus* (O p p e l, 1863). Section in borehole R-109, Vranino, District of Tolbuhin (eastern part of the Moesian Platform). Provadija Formation, at 10 m above the very base (S a p u n o v, 1976, p.38); Lower Oxfordian. Pal. Mus. Univ. Sofia, J345/47—3.×1.0

Figs. 4a, b. *Parawedekindia bodeni* (P r i e s e r, 1937). Section Belogradčik Cliff, to the north — north-east of Belogradčik, District of Vidin (West Forebalkan). Javorec Formation, No. 2 (S a p u n o v, 1976, p.28); Lower Oxfordian, *Creniceras renggeri* Zone. Pal. Mus. Univ. Sofia, J350/47—4.×1.0

Figs. 5a, b. *Propcrisphinctes bernensis* (d e L o r i o l, 1898). Section near the village of Belotinci, area of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, member of the lower nodular limestones, No. 12, the exact position is unclear (S a p u n o v, 1976, p.29); Lower Oxfordian. Pal. Mus. Univ. Sofia, J294/47—5.×1.0

Figs. 6a, b. *Peltomorphites athletoides* (L a h u s e n, 1883). Section Belogradčik Cliff, to the north — north-east of Belogradčik, District of Vidin (West Forebalkan). Javorec Formation, No. 1 (Sapunov, 1976a, p.28); Lower Oxfordian, *Peltomorphites athletoides* Zone. Pal. Mus. Univ. Sofia, J358/47—6.×1.0

PLATE I

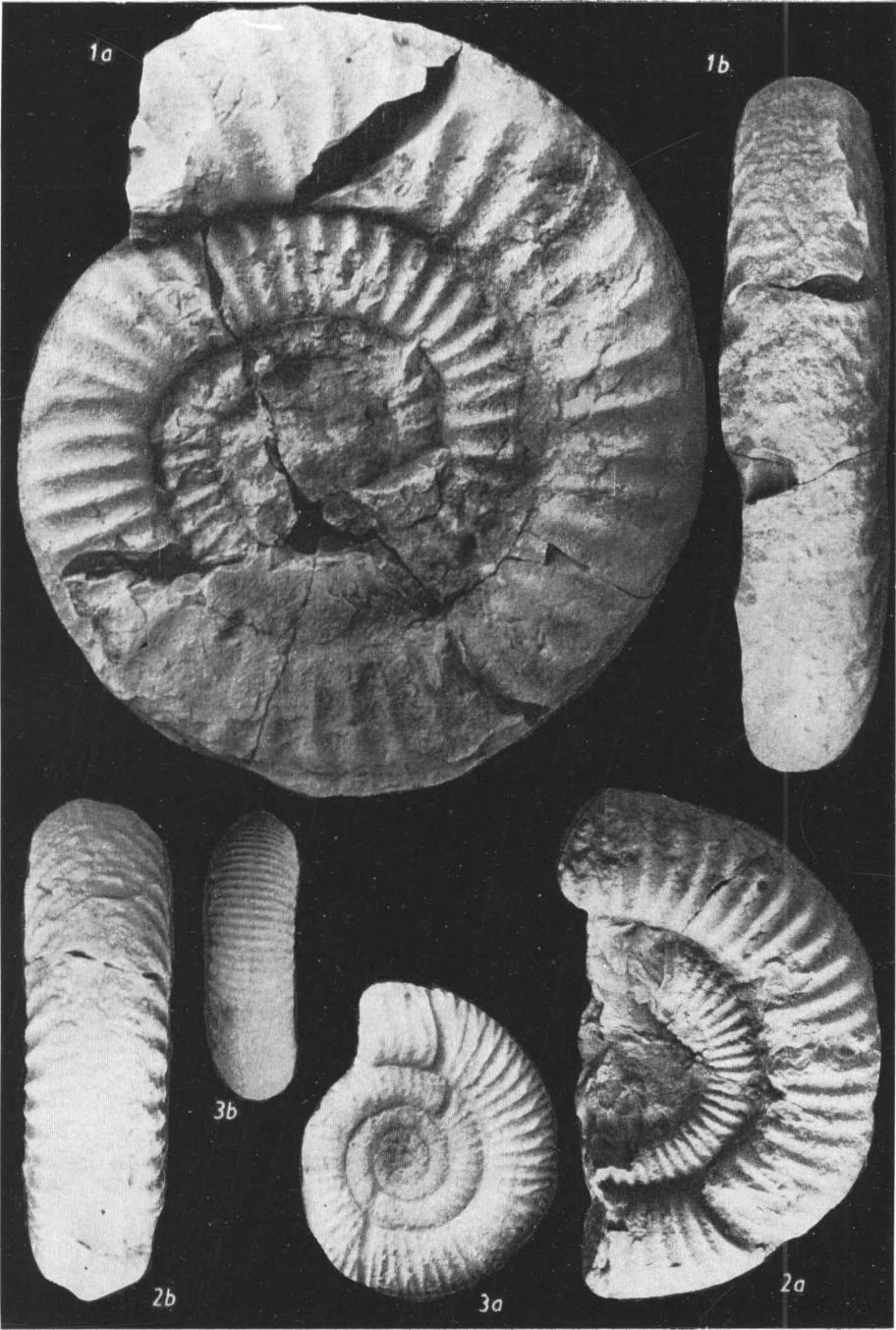


EXPLANATION OF PLATE II
(Middle Oxfordian ammonites)

Figs. 1a, b. *Perisphinctes (Dichotomosphinctes) rotoides* Ronchardzé, 1917. Section near the village of Belotinci, area of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, member of the quarry limestones with flint, No. 13, lower part, in middle position (Sapunov, 1976, p.29); Middle Oxfordian, *Perisphinctes (Dichotomosphinctes) antecessens* Zone, *P. (D.) rotoides* Subzone. Pal. Mus. Univ. Sofia, J290/47—7. $\times 1.0$

Figs. 2a, b. *Perisphinctes (Kranaosphinctes)* sp. indet. (inner whorls). Section near the village of Belotinci, area of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, member of the quarry limestones with flint, No. 13, lower part, in middle position (Sapunov, 1976, p. 29); Middle Oxfordian, *Perisphinctes (Dichotomosphinctes) antecessens* Zone, *P. (D.) rotoides* Subzone. Pal. Mus. Univ. Sofia, J507/47 — 8. $\times 1.0$

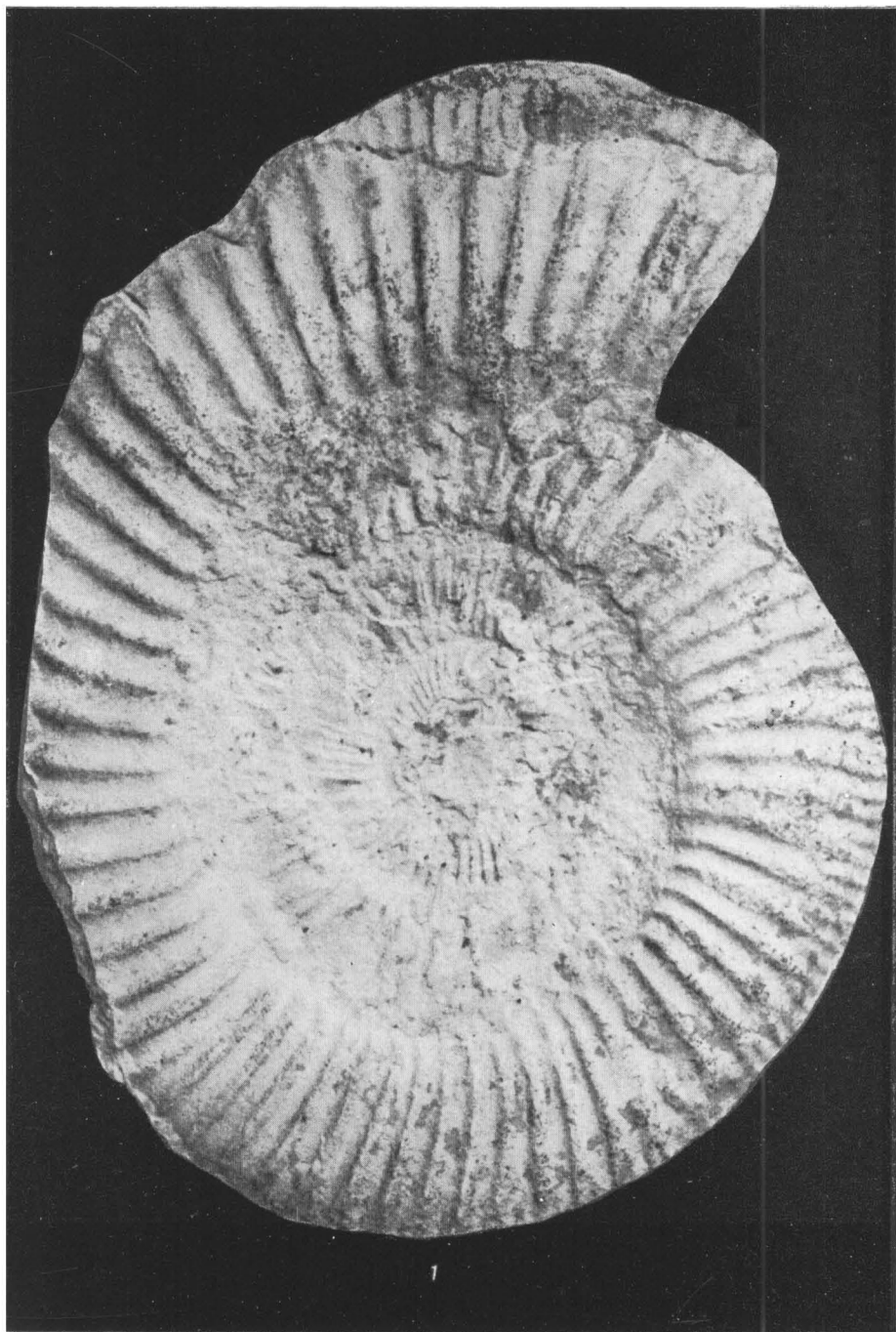
Figs. 3a, b. *Perisphinctes (Dichotomosphinctes) episcopalis* de Loriol, 1901. Section near the village of Belotinci, area of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, member of the quarry limestones with flint, No. 13, lower part, from the very base (Sapunov, 1976, p.29); Middle Oxfordian, *Perisphinctes (Dichotomosphinctes) episcopalis* Zone. Pal. Mus. Univ. Sofia, J292/47—9. $\times 1.0$



EXPLANATION OF PLATE III

(Middle Oxfordian ammonites)

Fig. 1. *Perisphinctes (Dichotomosphinctes) antecessens* S a l f e l d, 1914 (cast). Locality near the hamlet of Neškoyci, to the south of the village of Černi Osâm, area of Trojan, District of Loveč (Central Balkan). Ginci Formation, from the upper part of the clayey limestones, at 2.50 m below the lower boundary of the overlying rose coloured nodular limestones [---No. 3 according to S a p u n o v & Z i e g l e r (1976, p. 27)] (S a p u n o v, 1976, p.35); Middle Oxfordian, *Perisphinctes (Dichotomosphinctes) antecessens* Zone, *P. (D.) dobrogensis* Subzone. Pal. Mus. Univ. Sofia, J270/47—10. \ 1.0

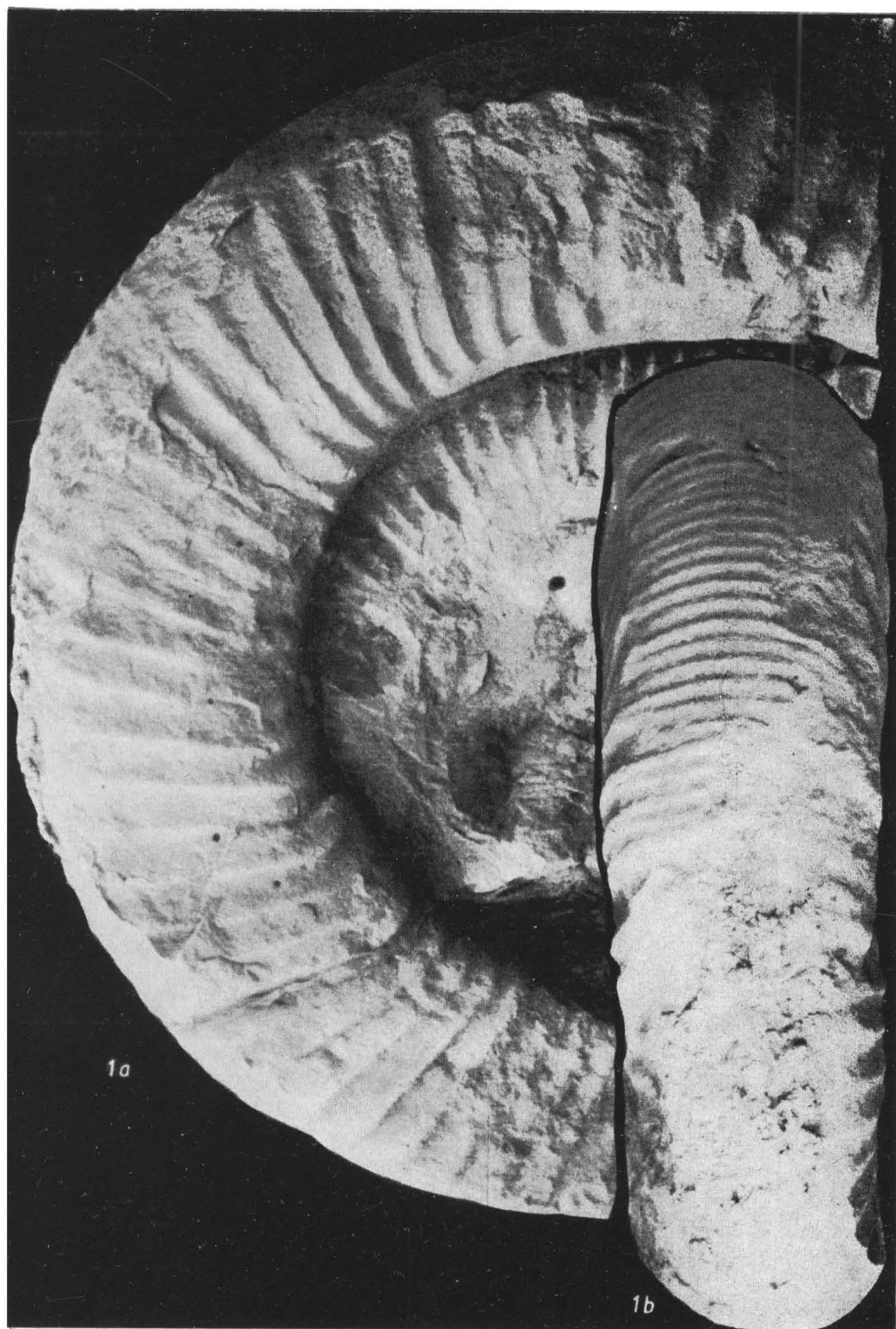


EXPLANATION OF PLATE IV

(Middle Oxfordian ammonites)

Figs. 1a, b. *Perisphinctes* (*Dichotomosphinctes*) *dobrogensis* Simionescu, 1907. Locality near the hamlet of Neškovci, to the south of the village of Černi Osām, area of Trojan, District of Loveč (Central Balkan). Ginci Formation, No. 3 [according to Sapunov & Ziegler (1976, p. 27)], from the lower part (Sapunov, 1976, p.35); Middle Oxfordian, *Perisphinctes* (*Dichotomosphinctes*) *antecedens* Zone, *P. (D.) dobrogensis* Subzone. Specimen of Sapunov & Ziegler (1976, pl. 3, figs. 1a, b) figured as "*Dichotomosphinctes* sp.". Pal Mus. Univ. Sofia, J268/46—8 (old number J6491). × 1.0

PLATE IV

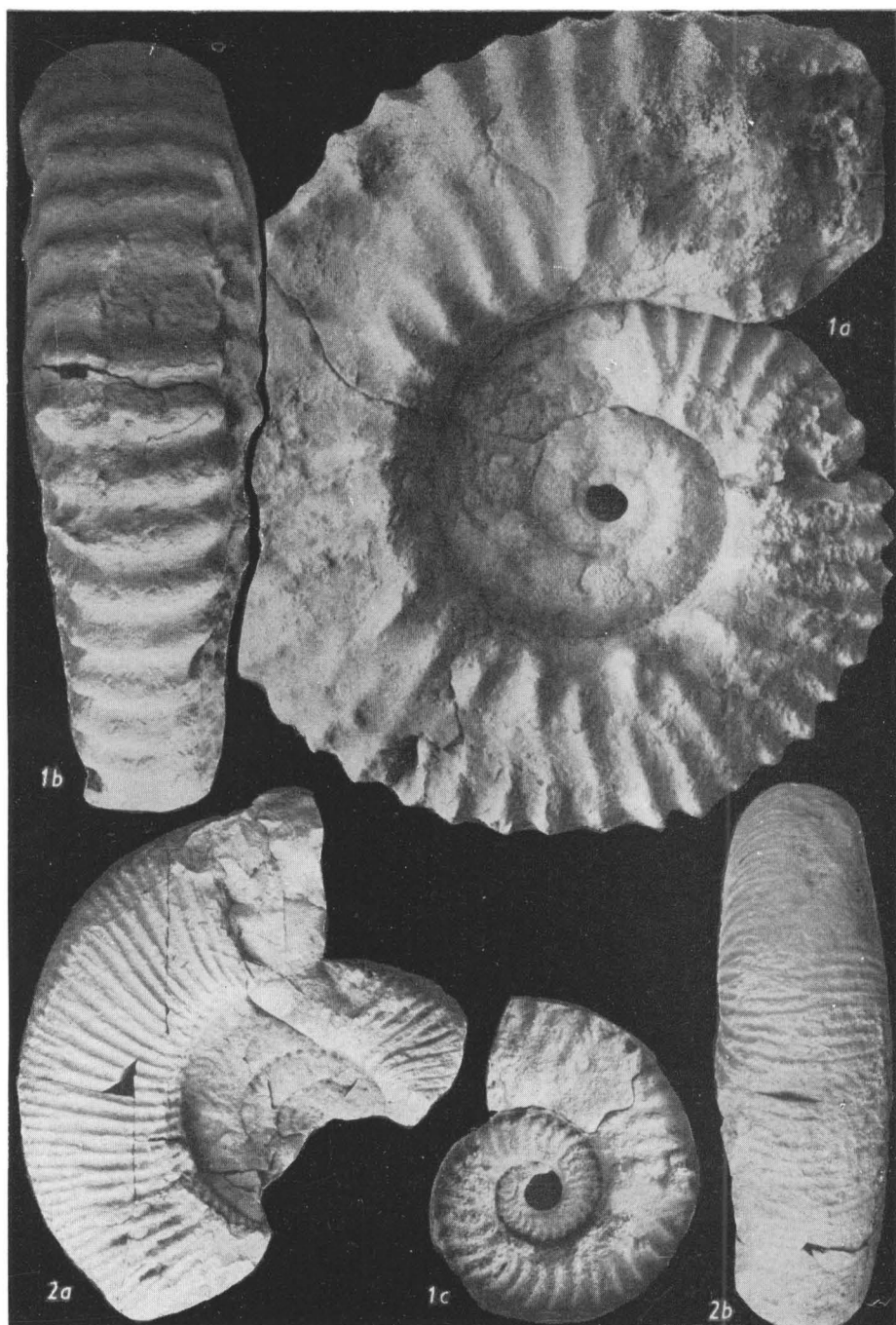


EXPLANATION OF PLATE V
(Middle Oxfordian ammonites)

Figs. 1a-c. *Gregoryceras riazi* (d e G r o s s o u v r e, 1917). Section along the Belogradčik-Orešec Railway Station road, District of Vidin (West Forebalkan). Javorec Formation, No. 3, from the upper 2.10 m, in higher position (not in situ) (S a p u n o v, 1976, p.27); Middle Oxfordian, *Gregoryceras riazi* Zone. Specimen of С т е ф а н о в (1962, p. 101, pl. 2, figs. 1a, b; pl. 3, figs. 1a, b), described and figured as "*Gregoryceras fouquei* (K i l i a n)". Pal. Mus. Univ. Sofia, J355/32—2 (old number J718). $\times 1.0$

Figs. 2a, b. *Discosphinctes aeneas* (G e m m e l l a r o, 1877). Section near the village of Belotinci, area of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, member of the quarry limestones with flint, No. 13, lower part, in upper position (S a p u n o v, 1976, p.29); Middle Oxfordian, *Gregoryceras riazi* Zone. Pal. Mus. Univ. Sofia, J295/47—fl, $\times 1.0$

PLATE V



EXPLANATION OF PLATE VI

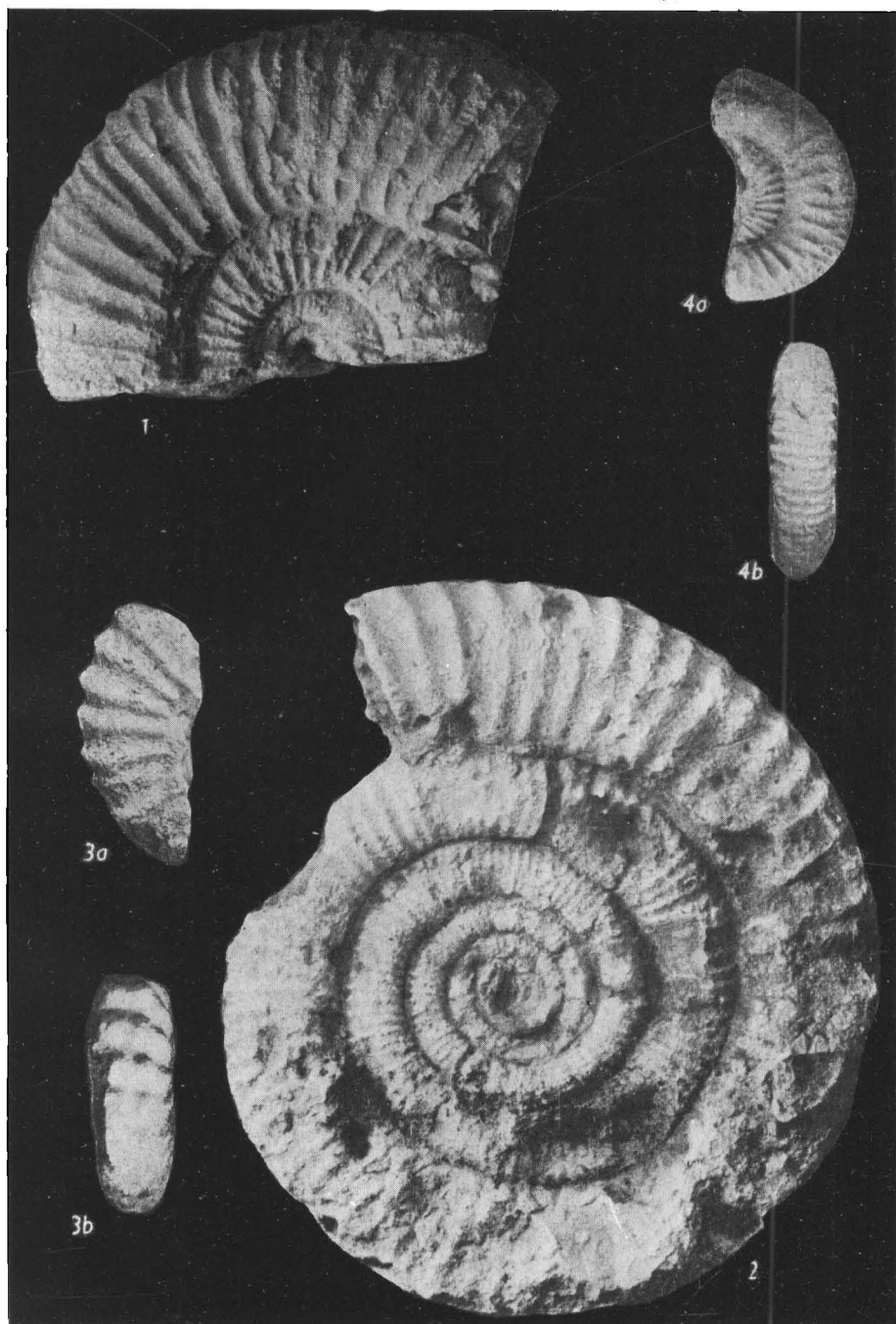
(Late Oxfordian ammonites)

Fig. 1. *Perisphinctes (Dichotomoceras) bifurcatus* (Q u e n s t e d, 1846). Section near the Magura Cave, to the west of the village of Rabiša, area of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, No. 2, from the lower part (S a p u n o v, 1976, p.27); Upper Oxfordian, *Perisphinctes (Dichotomoceras) bifurcatus* Zone. Pal. Mus. Univ. Sofia, J280/47—12. $\times 1.0$

Fig. 2. *Passendorferia zieglerei* (B r o c h w i c z - L e w i ŋ s k i, 1973). Locality to the north of the village of Vărbovo, area of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, the position in the section is unknown (S a p u n o v, 1976, p.30); Upper Oxfordian, *Perisphinctes (Dichotomoceras) bifurcatus* Zone. Pal. Mus. Univ. Sofia, J260/47—13. $\times 1.0$

Figs. 3a, b. *Epipeltoceras treptense* E n a y, 1963. Section near the Magura Cave, to the west of the village of Rabiša, area of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, No. 2, from the upper part (S a p u n o v, 1976, p.27); Upper Oxfordian, *Epipeltoceras bimammatum* Zone. Specimen of С т е ф а н о в (1962, p. 103, pl. 2, figs. 3a, b), described and figured as "*Epipeltoceras bimammatum* (Q u e n s t e d t)". Pal. Mus. Univ. Sofia, J364.32—5 (old number J01125). $\times 1.0$

Figs. 4a, b. *Microbiplices divergens* (O p p e n h e i m e r, 1907). Section near the Javorec Peak, village of Bov, Sofia District (West Balkan). Ginci Formation, No. 5, from the lower part (S a p u n o v, 1976, p.32); Upper Oxfordian, *Epipeltoceras bimammatum* Zone, *Euaspidoceras hypselum* Subzone. Pal. Mus. Univ. Sofia, J300/47—18. $\times 1.0$



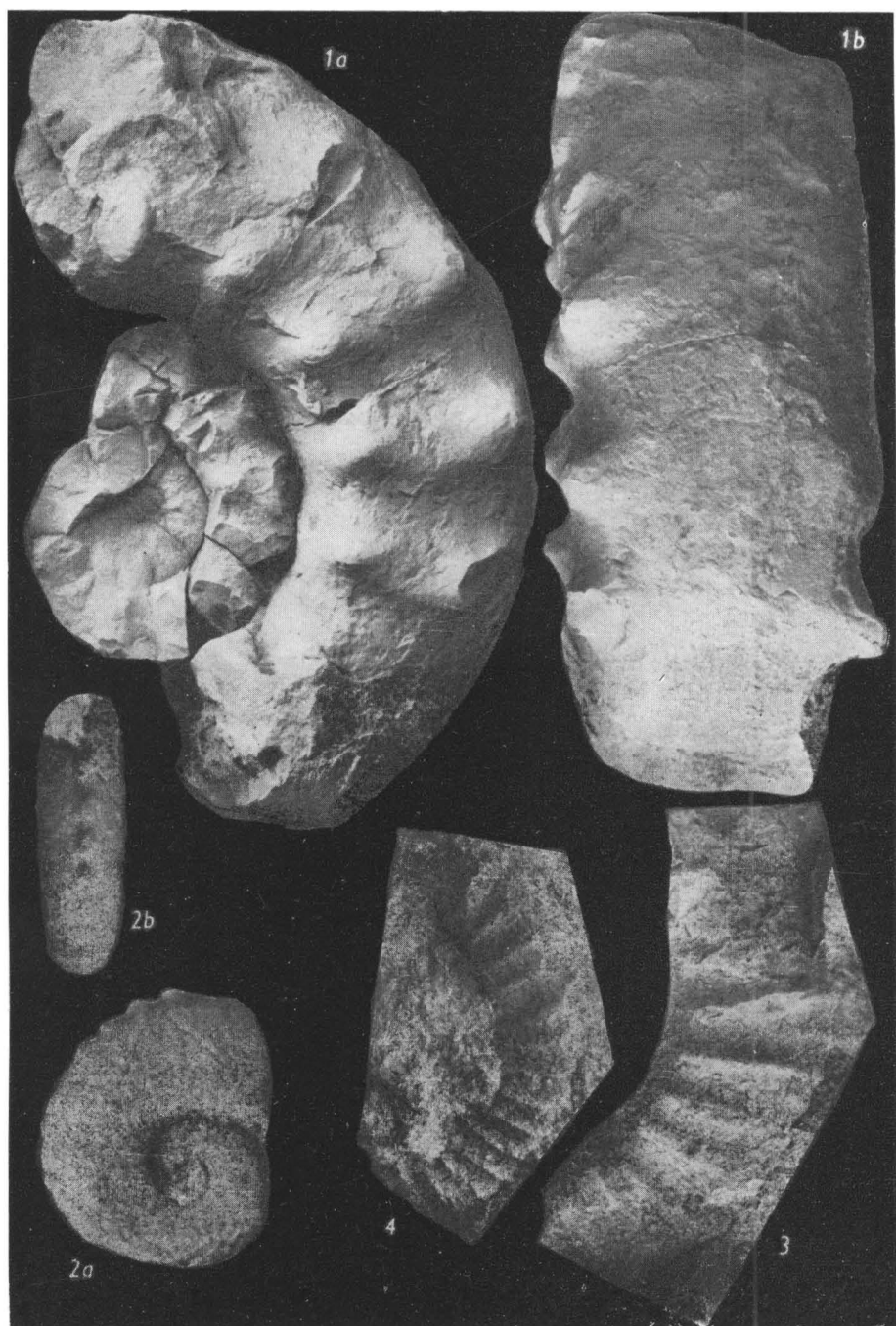
EXPLANATION OF PLATE VII
(Late Oxfordian ammonites)

Figs. 1a, b. *Euspidoceras* aff. *hypselum* (O p p e l, 1863). Section Belogradčik Cliff, to the north — north-east of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, No. 5 (S a p u n o v, 1976, p.28); Upper Oxfordian, *Epipeltoceras bimammatum* Zone, *Euspidoceras hypselum* Subzone. Pal. Mus. Univ. Sofia, J371/47—14. $\times 1.0$

Figs. 2a, b. *Creniceras lophotum* (O p p e l, 1863). Section Belogradčik Cliff, to the north — north-east of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, No. 5 (S a p u n o v, 1976, p. 28); Upper Oxfordian, *Epipeltoceras bimammatum* Zone, *Euspidoceras hypselum* Subzone. Pal. Mus. Univ. Sofia, J340/47—15. $\times 1.31$

Figs. 3, 4. *Idoceras* cf. *planula* (H e h l i n Z i e t e n, 1830). Locality near the village of Plešivec, area of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, probably from the middle part (S a p u n o v, 1976, 1976, p. 30); Upper Oxfordian, *Idoceras planula* Zone. The specimens are figured by B r o c h w i c z - L e w i ŋ s k i & R ó z a k (1976, Pl. 36, figs. 2a, b). Pal. Mus. Univ. Sofia, J515/47—16 (fig. 3), J516/47—17 (fig. 4). $\times 1.0$

PLATE VII



by species, known for their wider stratigraphic occurrence, yet they have been found only in the *E. hypselum* Subzone in Bulgaria so far: *Orthosphinctes mogosensis* (Choffat, 1893), *O. delgadoi* (Choffat, 1893) and *Euaspidoceras* cf. *varioornatum* (Dorn, 1930).

Distribution. The Subzone is present in the section Belogradčik Cliff, to the north — north-east of the town of Belogradčik (Ginci Formation, Nos. 4 and 5); in the section near the Javorec Peak, to the east of the village of Bov, District of Sofia (Ginci Formation, No. 5, the lower part) and in the section in the Straža Gorge, to the south of the village of Straža, District of Târgoviște (Ginci Formation, No. 2) (Sapunov, 1976).

Correlations. The Bulgarian *E. hypselum* Subzone corresponds to the same Subzone in the third facies-faunal district (Table 2).

Idoceras planula Zone

Index species. *Idoceras planula* (Hehlin Zieten, 1830) Pl. VII, fig. 3, 4).

Nomenclature. The Zone is here introduced.

Stratigraphy. The lower boundary is defined in the description of the *E. bimammatum* Zone (see above). Its upper boundary is marked by the appearance of the earliest representatives of the subgenus *Ataxioceras* (*Parataxioceras*) in this country, which is accompanied by *Decipia* in Bulgaria (Fig. 2). It represents also the boundary between the Oxfordian and the Kimmeridgian.

The Bulgarian *I. planula* Zone is based on the presence of the index species, as well as on *Idoceras*(?) sp. n.

Distribution. The Zone is present near the village of Plešivec, area of Belogradčik, District of Vidin (Ginci Formation, the exact position in the section is unknown, possibly in the middle part of the Formation); in the section of borehole R-109, Vranino, District of Tolbuhin (Provadija Formation, 14.80 m above the very base) (Sapunov, 1976).

Correlations. The Bulgarian *I. planula* Zone corresponds to the same Zone in the third facies-faunal district (Table 2).

Phylloceratina and Lytoceratina in the Oxfordian of Bulgaria

In the Oxfordian sediments of Bulgaria the representatives of Phylloceratina and Lytoceratina are relatively rare. Species, belonging to the genera *Sowerbyceras* and *Holcophylloceras* are found: *Sowerbyceras helios* (Noetling, 1887) (Lower Oxfordian), *S. tortisulcatum* (d'Orbigny, 1849) (Upper Oxfordian, *E. bimammatum* Zone, *E. hypselum* Subzone), *Holcophylloceras mediterraneum* (Neumayr, 1871) (Oxfordian). Lytoceratina are represented by single indeterminable specimens.

Oxfordian Ammonite Species of Uncertain Stratigraphic Occurrence

In this study the following species of Perisphinctidae, Aspidoceratidae and Haploceratidae, whose stratigraphical distribution in Bulgaria could not be clarified with precision, are listed below:

(1) *Paraweidokindia* sp. n. 1 —? Lower Oxfordian (*C. renggeri* Zone) —? Middle Oxfordian (*P. (D.) eposcopalis* Zone) (the section along the Belogradčik — Gara Orešec road; Javorec Formation, No. 3, in a lower position);

(2) *Euaspidoceras crebricostis* (Arkell, 1927) —? Middle Oxfordian (*G. riazi* Zone) —? Upper Oxfordian (the section Belogradčik — Gara Orešec; Ginci Formation, No. 4, in the lower part);

(3) "*Perisphinctes*" cf. *bocconii* Gemmellaro, 1872-82 —? Middle Oxfordian (*G. riazi* Zone) —? Upper Oxfordian (*E. bimammatum* Zone) (borehole section of R-109, Vranino, District of Tolbuhin; Provadija Formation, 12 m above the very base);

(4) *Metahaploceras kobyi* (Choffat, 1893) —? Upper Oxfordian (*E. bimammatum* Zone) —? Lower Kimmeridgian, lower part (section near the village of Mitrovci, District of Mihajlovgrad; Javorec Formation, No. 1, from the top);

(5) *M. rigidum* (Wegeler, 1929) —? Upper Oxfordian (*I. planula* Zone) —? Lower Kimmeridgian, lower part (section near the Javorec Peak, to the east of the village of Bov, District of Sofia; Ginci Formation, No. 5, from the middle part);

(6) *M. litoceras* (Oppel, 1863) —? Upper Oxfordian —? Lower Kimmeridgian, lower part (borehole section of R-1, Varna; Provadija Formation, 29.50 m above the very base);

(7) *Orthosphinctes suevicus* (Siemiradzki, 1898) —? Upper Oxfordian (*I. planula* Zone) —? Lower Kimmeridgian, lower part [locality near the village of Batkovci (at present merged with the village of Dragovištica), to the east of Beledie Han, District of Sofia; Javorec Formation] (Sapunov, 1976).

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