Ammonite Stratigraphy of the Upper Jurassic in Bulgaria. IV. Tithonian: Substages, Zones and Subzones

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И. Г. Сапунов — Аммонитовая стратиграфия верхней юры в Болгарии. IV. Титонский ярус: подъярусы, зоны и подзоны. Болгарские Ammonitina титонского яруса принадлежат к семействам Haploceratidae, Glochiceratidae, Perisphinctidae, Aspidoceratidae, Berrissellidae и Olcostephanidae. На основании установленных закономерностей в их стратиграфическом распространении на территории Болгарии, разработана схема аммонитовых Oppel-зон:

Верхний титонский подъярус — зона Paraulacosphinctes transitorius

Средний титонский подъярус — зона Parapallasiceras spp.
 zona Virgatosimoceras rothpletzi

Нижний титонский подъярус — зонаFranconites vimineus
 zona Subplanitoides schwertschlageri
 zona Hybonoticeras hybonotum

В верхней части зоны H. hybonotum выделена подзона Subplaninites moernsheimensis, а в верхней части зоны F. vimineus выделена подзона Franconites pseudojubatus. Зона P. transitorius расчленена на две подзоны: верхняя — подзона Malbosiceras chaperi и нижняя — подзона Himalayites (Micracanthoceras) microcanthus.

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

Abstract. The Tithonian Ammonitina in Bulgaria belong to the following families: Haploceratidae, Glochiceratidae, Perisphinctidae, Aspidoceratidae, Berrissellidae and Olcostephanidae. On the basis of the regularities found in their successions in this country, the following scheme of Oppel-zones is worked out:

Upper Tithonian — Paraulacosphinctes transitorius Zone

Middle Tithonian — Parapallasiceras spp. Zone
 zona Virgatosimoceras rothpletzi Zone

Lower Tithonian — Franconites vimineus Zone
In the upper part of the H. hybonotum Zone the Subplanites moernsheimensis Subzone is distinguished and in the upper part of the F. vimineus Zone the Franconites pseudojubatus Subzone is separated. The P. transitorius Zone is subdivided into two subzones: an upper — Malbosiceras chaperi Subzone, and a lower — Himalayites (Microcanthoceras) microcanthus Subzone.

For each subdivision information is given on the index species, nomenclature (with regard to the Bulgarian literature), the boundaries are defined and the typical species are given. Data on the distribution of the (sub)zones in Bulgaria are given and biocorrelations are made.

The Lower- and Middle Tithonian Ammonitina in Bulgaria exhibit certain similarities with the corresponding representatives from Southern Germany (Berckhemer & Holder, 1959; Barthel, 1959, 1962; 1964; 1975; Zeiss, 1968; 1975; Barthel & Geyssant, 1973) and Southeastern France (Donze & Enay, 1961) (the third facies-faunal district according to Sapunov & Ziegler, 1976, p. 8). These similarities are expressed not only in the taxonomic composition of Ammonitina but as a rule in the range-zones of the taxa form the generic and specific groups as well. It should be emphasized, however, that Lytoceratina and Phylloceratina are frequently abundant in the faunas in this country which is not typical of this facies-faunal district. In comparing the Bulgarian Lower- and Middle Tithonian Ammonitina with the corresponding representatives from Southern Europe (Enay, 1973; Enay & Geyssant, 1975) (the fourth facies-faunal district) the similarities observed involve primarily those elements which are to be found in the third facies-faunal district as well. This is supported by the fact that no representatives of Pseudolissoceras, Cyrtosiceras, Semiformiceras, Simoceras, Simocosmomceras and Pseudohimalayites (see Enay, 1973, p. 300) have been found so far among the Bulgarian Ammonitina. On the other hand, there are certain differences between the range-zones of some genera (cf. Enay & Geyssant, 1975, Fig. 3, with Figs. 1, 2 in this paper) and species common to Bulgaria and the fourth facies-faunal district.

The Upper-Tithonian Ammonitina in Bulgaria resemble more strongly the faunas with abundant berriasellids, Proniceras and Spiticeras from the border of the Massif Central and the Subalpine ranges (Southeast France) (Le Hegarat, 1973), Crimea and Caucasus (Enay, 1973), the high plains and the Tellian Atlas (Algeria), as well as central Tunisia (Memmi, 1968; Enay, 1973) (third facies-faunal district) rather than the faunas from the fourth facies-faunal district rich in himalayitids (incl. Tithopeltoceras, Djuurdjurioceras and Simoceras (Enay, 1973, p. 303; Sapunov, 1976a). As is known, these faunas occur extensively in the Alps, the Appennines, Sicily, the Balearic Islands, Andalusia, Stramberg, the Rif and Djurdjura. On the other hand, however, the numerous Bulgarian Upper Tithonian berriasellids, Proniceras and Spiticeras occur together with frequent Haploceras, Phylloceratina, Lytoceratina and less frequent Paraulacosphinctes which brings them closer to the faunas from the fourth facies-faunal district.

This discussion shows that in taxonomic composition the Bulgarian Upper-Tithonian ammonite faunas occupy an intermediate position with respect to the faunas from the third and fourth facies-faunal districts. This conclusion may be applied to the Lower- and Middle-Tithonian faunas in this country, too.
The specific features in the composition and stratigraphic occurrence of the Bulgarian Tithonian ammonite faunas discussed here are expressed in the scheme of ammonite Oppel-zones and subzones worked out here for this country. The fact that this scheme is the first attempt at a general zonation of the Tithonian in Bulgaria makes me regard it as the starting point for further detailed research rather than as a finished study.

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

The substages of the Tithonian. The first palaeontological evidence (based primarily on ammonites) for the presence of the Tithonian in Bulgaria go back to the end of the last century. Besides, certain substages are already mentioned in the literature of that time. Thus Toul a (1889, p. 54) notes the presence of the Lower Tithonian in the Ginci Formation (probably in its upper part) in the Klimaški Dol valley (a western tributary of the Černi Vit River, near the place where the Černi Vit and the Beli Vit Rivers flow together, south of the village of Gložene, area of Teteven) on the basis of an ammonite fauna identified by V. Uhl i g (see also Sapunov & Ziegler, 1976, p. 5). Among the several reported genera and species of Phylloceratina, Lytoceratina, Perisphinctidae and Haploceratidae, two are figured as “Haploceras verruciferum Mngh.” (Toul a, 1889, p. 72, pl. 8, fig. 1) (=Haploceras sp. indet.) and “Perisphinctes richteri” Opp. (Toul a, 1889, p. 72, pl. 8, fig. 2) [=Richterella cf. richteri (Oppel, 1865)]. From the viewpoint of the modern subdivision of the Tithonian into substages these ammonite taxa justify the assumption that the corresponding sediments belong to the lower part of the Middle Tithonian. At the same time, however, Toul a also reports some species which probably belong to Orthosphinctes (e.g., “Perisphinctes colubrinus Re i n”). This justifies the conclusion that some of the “Lower-Tithonian” species of Toul a’s prove the presence of the Kimmeridgian. It seems that the ammonites from the Klimaški Dol valley were collected from a wider interval of the Ginci Formation or that the faunas are condensed. Zlatarski (1908, p. 207) likewise notes the presence of the Kimmeridgian there as well in his interpretation of the taxa reported by Toul a.

Vankov (1892, p. 14) had made a comparatively rich collection of ammonites, aptychi and belemnites from the flysch deposits (probably the Zlatarica Formation) near the village of Toleš, southwest of the town of Gabr ovo. This fauna was also identified by V. Uhl i g. The presence of “Perisphinctes” cf. moravicus Opp. (=Berriasella) caused Vankov to refer the respective sediments to the Upper Tithonian. Besides, the presence of Spiticeras (“Holcostephanus cf. grotei O p p e l”) further supports the conclusion that these sediments are of Upper Tithonian Age.

Considerably later Beregov (1935, p. 69) made an attempt to divide the Tithonian into a lower and an upper substage on the basis of his biostratigraphic studies on the formations of the Central-Balkan Flysch Group in the Kraište area. According to this author the Lower Tithonian is proved by “Oppelia steraspis, Oppel” [=Ochetoceras (Ochetocaras) irregularare B e r c k - h e m e r & Hölder, 1959] and “Perisphinctes contiguus, C a t ul lo” (the specimen is lost). The presence of O. (O.) irregularare in the lower part of
the Zlatarica Formation between the villages of Berende and Svetlja, District of Pernik, cannot be considered reliable evidence of the Early Tithonian Age of these sediments since this species occurs both in the Upper Kimmeridgian (Hybonoticeras bekeri Zone) and in the Lower Tithonian (Hybonoticeras hybonotum Zone). According to Берегов the Upper Tithonian is characterized by “Perisphinctes cfr. transitorius Oppel” (the specimen is lost) and “Perisphinctes (Berriasella) calisto d’Orb.” [=Pseudosubplanites (Hegaratella) parameter (Mazenot, 1939)]. It is known, however, that the latter species occurs both in the upper part of the Upper Tithonian and in the Pseudosubplanites (Pseudosub planites) grandis Zone of the Berriasian. In the specific case, however, Берегов’s specimen comes from the Upper Tithonian since it is accompanied by Proniceras pseudonegreli (Djanelidze, 1922).

Стефанов in Сазонов & Стефанов (1965, p. 118, 121, Table 2) has made a considerably better grounded subdivision of the Tithonian in Bulgaria into substages. In accordance with the ammonite species mentioned for the two substages of the Tithonian, the Lower Tithonian of Стефанов corresponds approximately to the Danubian Substage or the so-called Lower Tithonian s.l. (Zeiss, 1965; Enay in Mouterde et al., 1971). The Upper Tithonian corresponds approximately to the Ardescian Substage. The Tithonian substages are similarly understood by Сапунов et al. (1965, p. 26).

Начев (1968, p. 207) is another author who has discussed the subdivision of the Tithonian in Bulgaria into substages. His treatment lacks originality being a repetition of the views of Стефанов in Сазонов & Стефанов (1965) and Сапунов et al. (1965).

Сапунов & Ziegler (1976, p. 23, 31) were the first to prove the presence of the Middle Tithonian in this country on the basis of Virgatosimoceras rothpletzi (Schneider, 1915) found in the upper part of the Ginci Formation in the section near the village of Ginci, District of Sofia. After Middle Tithonian ammonite faunas were recently found in other sections and localities in Bulgaria, too, it has become possible to distinguish three substages in the Tithonian, their stratigraphic scopes corresponding to the Lower, Middle and Upper Tithonian in the sense of Enay (1964), Zeiss (1971), Barthel (1962), Enay in Mouterde et al. (1971), etc., as follows [each substage is defined by the standard Oppel-zones of the third facies-faunal district according to Zeiss (1968; 1975); Barthel (1962; 1975); Enay in Mouterde et al. (1971); Le Hegarat (1973)]:

(3) Upper Tithonian (Paraulacosphinctes transitorius Zone and Berriasella (Berriasella) jacobi Zone)
(2) Middle Tithonian (Pseudolissoceras bavaricum Zone)
(1) Lower Tithonian (Hybonoticeras hybonotum Zone, Usseliceras tagmersheinse Zone, Dorsoplanitoides triplicatus Zone, Usseliceras parvinodosum Zone, Franconites vimineus Zone and Danubisphinctes palatinum Zone)

The ammonite zones and subzones of the Tithonian. The successions of representatives of the suborder Ammonitina found in the Bulgarian sections have made it possible to work out a scheme of Oppel-zones and subzones for the Tithonian in this country. It is shown in Table 1.
Table 1

Substages, ammonite zones and subzones of the Tithonian in Bulgaria

<table>
<thead>
<tr>
<th>Upper Tithonian</th>
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<tbody>
<tr>
<td>Malbosiceras chaperi Subzone</td>
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<tr>
<td>Paraulacosphinctes transitiorius Zone</td>
</tr>
<tr>
<td>Himalayites (Micrancanthoceras) microcanthus Subzone</td>
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<tr>
<th>Middle Tithonian</th>
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<tbody>
<tr>
<td>Parapallasicas spp. Zone</td>
</tr>
<tr>
<td>Virgatosimoceras rothpletzi Zone</td>
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<tr>
<th>Lower Tithonian</th>
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<tbody>
<tr>
<td>Franconites pseudojubatus Subzone</td>
</tr>
<tr>
<td>Franconites vimineus Zone</td>
</tr>
<tr>
<td>Subplanitoides schwertschlageri Zone</td>
</tr>
<tr>
<td>Subplanites moernsheimensis Subzone</td>
</tr>
<tr>
<td>Hybonoticeras hybonotum Zone</td>
</tr>
</tbody>
</table>

Lower Tithonian

This Substage in Bulgaria is characterized by Glochiceras (Paralingulaticeras), Taramelliceras (Fontannesiella), Subplanites, Subplanitoides, Usseliceras, Franconites, Parakeratiniles (Fig. 1, 2), as well as by some species of the genera Hybonoticeras, Ochetoceras and Pachysphinctes.

Ammonite Zones

Hybonoticeras hybonotum Zone

Index species. *Hybonoticeras hybonotum* (Oppe, 1863) (Pl. I, fig. 1).  

Nomenclature. The Zone was introduced by Стефанов in Сазонов АгСтефанов (1965, p. 118).  

Stratigraphy. The lower boundary of the Zone, which is also a boundary between the Kimmeridgian and the Tithonian, is marked by the appearance of the earliest *Hybonoticeras hybonotum* accompanied by Glochiceras (Paralingulaticeras) (Fig. 1). Its upper boundary is defined by the appearance of Usseliceras together with some species of Subplanitoides, which is preceded by the disappearance of Subplanites, Hybonoticeras, Ochetoceras and Taramelliceras (Taramelliceras) (see Figs. 1, 2).

The Bulgarian *H. hybonotum* Zone is based on the range-zone of the index species. The zonal association also includes Glochiceras (Paralingulaticeras)
lithographicum (Oppel, 1863), G. (P.) thoro (Oppel, 1863), Tarmacellaceras (Fontannesiella) discipectandum (Fontannes, 1879), T. (P.) prolithographicum (Fontannes, 1879), T. (Tarmacellaceras) rebouletianum (Fontannes, 1879) (it is restricted to the lower part of the zone), Ochetoceras (Ochetoceras) cf. ornatum Berckhemer & Hölder, 1959, Lithacoceras sp. n., L. cf. ulmense (Oppel, 1863), Subplanitoides ardescicus (Fontannes, 1879), Hybonoticeras sp. n. According to the data available to me, the range-zone of Glochiceras (Glochiceras) carachtheis (Zejszner, 1846) in Bulgaria is restricted within the H. hybonotum Zone. The zonal association also includes species occurring below the lower boundary of the zone, viz. Hybonoticeras mundulum mundulum (Oppel, 1865), Tarmacellaceras (Tarmacellaceras) franciscanum (Fontannes, 1879) and probably Aspidoceras bispinosum (Ziетен, 1831). Aspidoceras cyclotum (Oppel, 1865) probably appears in the zone but occurs above its upper boundary.

Distribution. The Zone is present in the section near the village of Belotinci, District of Vidin (Ginci Formation, No 17, the lower 4 m); near the village of Falkovec, area of Belogradčik, Vidin District (Gložene Formation, the lower part); in the section near the village of Komštica, Sofia District (Ginci Formation, No 12, in the lower 2 m); in the section near the village of Ginci, Sofia District (Ginci Formation, No 7, in the interval between the second and ninth meters of No 7); in the section near the Javorec Peak, east of the village of Bov, Sofia District (Ginci Formation, No 7); southwest of the village of Smolča, Sofia District (Ginci Formation, probably from the middle part); 1.5 km to the east-northeast of the village of Gubeš, Sofia District (Ginci Formation, probably from the middle part); in the valley of the Ljava Vidima River, south of the village of Vidima, Loveč District (Kostel Formation, probably some 500 m or 600 m above the base); near the mountain chalet of Mazalat, in the valley of the River Gabrovnica, area of Kazanlak, District of Stara Zagora (Kostel Formation, about 500 m or 600 m above the base); in the eastern part of the village of Malka Željazna, Loveč District. (Gložene Formation, in the lower 3 or 4 m); in the section of the valley of the Agâlnica River, 3 km to the east of the village of Drenta, District of Veliko Târnovo (Agâlnica Formation, No 3) (see Sapunov, 1976a).

Correlations. The Bulgarian H. hybonotum Zone corresponds entirely to the zone of the same name from the third and fourth facies-faunal districts (see Table 2).

Subplanites moernsheimensis Subzone

Index species. Subplanites moernsheimensis (Schneid, 1915) (Pl. II, figs. 2a, b).

Nomenclature. The Subzone is introduced here.

Stratigraphy. The lower boundary of the Subzone is marked by the appearance of the index species. Its upper boundary coincides with the upper boundary of the H. hybonotum Zone (see above).

The Bulgarian S. moernsheimensis Subzone is characterized by the index species. Taking into account that Pachysphinctes major Späth, 1931 in southern Franconia occurs in the same Subzone (Zeiss, 1968, p. 26), I assume that this species is probably also present in this Subzone in Bulgaria (the only Bulgarian specimen comes from an isolated locality).
Table 2

Correlation among the Tithonian ammonite zonal schemes of the third facies-faunal district (according to Zeiss, 1968, 1975; Enay in Mouterde et al., 1971; Barthel, 1962, 1964, 1975; Le Hégarat, 1973), the fourth facies-faunal district (according to Enay & Geyssant, 1975) and Bulgaria

<table>
<thead>
<tr>
<th>Sub-stages</th>
<th>Facies-faunal districts (according to Sapunov &amp; Ziegler, 1976)</th>
<th>Bulgaria</th>
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<tr>
<td></td>
<td>Third (sub)zones</td>
<td>Fourth (sub)zones</td>
</tr>
<tr>
<td>Berrias.</td>
<td>P. (Pseudosubplanites) grandis</td>
<td>P. (Pseudosubplanties) grandis</td>
</tr>
<tr>
<td></td>
<td>B. (Berriasella) jacobi</td>
<td>P. transitorius</td>
</tr>
<tr>
<td></td>
<td>Paraulacosphinctes transitorius</td>
<td>Pseudovirgatites scruposus</td>
</tr>
<tr>
<td>Ardesian</td>
<td>Pseudolissoceras bavaricum</td>
<td>Isterites palma tus &quot;Micracanthoceras&quot; ponti</td>
</tr>
<tr>
<td></td>
<td>Lemenica ciliata</td>
<td>Semiformiceras fellauxi</td>
</tr>
<tr>
<td>Middle</td>
<td>Danubispinctes palatinum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Franconites vimineus</td>
<td></td>
</tr>
<tr>
<td>Danubian</td>
<td>Usseliceras parvinodosum</td>
<td>Neochetoceras darwini</td>
</tr>
<tr>
<td>Lower</td>
<td>Dorsoplanitoides triplicatus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Usseliceras tagmersheimense</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subplanites moernsheimensis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S. ruepellianus</td>
<td>Hybonoticeras hybonotum</td>
</tr>
<tr>
<td></td>
<td>Lithacoceras riedense</td>
<td></td>
</tr>
<tr>
<td></td>
<td>or Gravesia gigas</td>
<td></td>
</tr>
</tbody>
</table>

Distribution. The Subzone is present in the section near the village of Belotinci, Vidin District (Ginci Formation, No 17, 4.10 m above the base); probably in the Trojan District, the exact locality is unknown (Černiosám Formation, from the lower part) (Sapunov, 1976a).

Correlations. The Bulgarian S. moernsheimensis Subzone corresponds to the same Subzone from the third facies-faunal district (see Table 2).

Subplanitoides schwertschlageri Zone

Index species. Subplanitoides schwertschlageri (Zeiss, 1968) (Pl. I, figs. 3a, b).

Nomenclature. The Zone is introduced here.

Stratigraphy. The lower boundary of the Zone is defined in the description of the H. hybonotum Zone (see above). Its upper boundary is marked by the appearance of the genera Franconites and Parakeratinites, which is connected with the disappearance of Usseliceras, and in Bulgaria of Subplanitoides as well (see Fig. 2).

The Bulgarian S. schwertschlageri Zone is characterized by the index species. It is accompanied by Subplanitoides sp. n., ?Subplanitoides sp. (with ventral groove), Usseliceras aff. franconicum Zeiss, 1968, Aulacostephaninae gen. & sp. n. In this country Aspidoceras pipini (Oppe1, 1863) occurs in the S. schwertschlageri Zone. The zonal association also includes some species occurring below and(or) above the zone, viz. Haploceras elimatum (Oppe1, 1865) (it occurs above the upper boundary of the zone but it is possible that it may be present in the H. hybonotum Zone as well, although this is not proved beyond doubt for this country), Aspidoceras cyclotum (Oppe1, 1965) (it occurs below and above the zone, too).

Distribution. The Zone is present in the section near the village of Belotinci, Vidin District (Ginci Formation, No 17, 7.30 m above the base); in the section near the village of Komstica, Sofia District (Ginci Formation, No 12, probably in the interval between 2 m and 4.50 m above the base of No 12); in the section near the village of Ginci, Sofia District (Ginci Formation, No 7, in the lower part of the upper 9 m of No 7); in the Berende River between the villages of Berende and Svetlja, Pernik District (Zlatarica Formation, the middle part); in the quarry to the north of the village of Gložene, along the road to the Boaza locality, Loveč District (Gložene Formation, about 10 m above the base) (Sapunov, 1976a).

Correlations. The Bulgarian S. schwertschlageri Zone is equivalent to the Neochetoceras mucronatum Superzone (Zeiss, 1975) or to the total of the Usseliceras tagmersheimense Zone, Dorsoplanitoides triplicatus Zone and Usseliceras parvinodosum Zone (Zeiss, 1968) from the third facies-faunal district. It is equivalent to the lower part of the Neochetoceras darwini Zone (Enay & Geyssant, 1975) from the fourth facies-faunal district (see Table 2).

Franconites vimineus Zone

Index species. Franconites vimineus (Schneid, 1915) (Pl. IV, fig. 1).

Nomenclature. The Zone is introduced here.
Stratigraphy. The lower boundary is defined in the description of the S. schwertschlageri Zone (see above). Its upper boundary, which is also a boundary between the Lower and the Middle Tithonian, is marked by the appearance of the first Virgatosisimoceras, Danubisphinctes and probably Richterella in this country, which is connected with the disappearance of Franco­nites and Parakeratinites (see Fig. 2).

The Bulgarian F. vimineus Zone is defined by the range-zones of the genera Franconites and Parakeratinites in this country (Fig. 2). It is characterized by the following association: Franconites vimineus, Franconites sp. indet. and Parakeratinites cf. communis (Zeiss, 1968).

Distribution. The Zone is present in the section near the village of Komstica, Sofia District (Ginci Formation, No 12, in the interval 4.50 m to 7 m above the base of No 12); near the hamlet of Todorceta, southwest of Gabrovo (Zlatarica Formation, lower half, middle part) (Sapunov, 1976a).

Correlations. The Bulgarian F. vimineus Zone is equivalent to the Franconites vimineus and Danubisphinctes palatinum Superzone (Zeiss, 1968).
Franconites pseudojubatus Subzone

Index species. Franconites pseudojubatus (Donze & Enay, 1961) (Pl. III, fig. 1).

Nomenclature. The Subzone is introduced here.

Stratigraphy. The lower boundary of the Subzone is proved by the appearance of some species of the genus Franconites occurring in the upper part of the F. vimineus Zone. Its upper boundary coincides with the upper boundary of the F. vimineus Zone (see above).

The Bulgarian F. pseudojubatus Subzone is based on some species of the genus Franconites. It is characterized by Franconites pseudojubatus and F. tenuisplicatus magnus Zeiss, 1968.

Distribution. The Subzone is present in the section along the valley of the Agalnica River, 3 km east of the village of Drenta, District of Veliko Tarnovo (Agalnica Formation, No 4, probably from the upper half of No 4) (Sapunov, 1976a).

Correlations. The Bulgarian F. pseudojubatus Subzone is equivalent to the Danubisphinctes palatinum Zone (Zeiss, 1968) from the third facies-faunal district (see Table 2).

Middle Tithonian

This Substage in Bulgaria is characterized by the genera Virgatosimoceras, Danubisphinctes, Parapallasiceras and some representatives of Richterella. Besides, it seems probable that the first Berriasellidae represented by the genus Aulacosphinctes will appear in its upper part.

Ammonite Zones

Virgatosimoceras rothpletzi Zone

Index species. Virgatosimoceras rothpletzi (Schneid, 1915) (Pl. IV, fig. 2).

Nomenclature. The zone is introduced here.

Stratigraphy. The lower boundary of the zone is defined in the description of the F. vimineus Zone (see above). Its upper boundary is marked by the disappearance of the representatives of the genera Virgatosimoceras and Danubisphinctes (see Fig. 2).

The Bulgarian V. rothpletzi Zone is based on the range-zone of the genera Virgatosimoceras and Danubisphinctes in this country (see Fig. 2). Besides the index species, the zonal association includes Virgatosimoceras broiliti (Schneid, 1915), Danubisphinctes cf. loeschi (Schneid, 1915), Richterella patruliusi (Abram, 1974), and R. richteri (Oppel, 1865). The presence of Parapallasiceras in the Zone in Bulgaria has not been proved so far though they may possibly be
present considering the faunas from the lower part of the Middle Tithonian near Neuburg, Bavaria (Ba r t h e l, 1975). Haploceras elimatum (O p p e l, 1865) and Aspidoceras cyclotum (O p p e l, 1865) are also present in the zone but they are found above its upper boundary and below its lower boundary as well.

**Distribution.** The Zone is present in the section near the village of Belotinci, Vidin District (Gložene Formation, the Ogosta Member, No 19, in the base); in the section near the village of Ginci, Sofia District (Ginci Formation, No 7, the upper part of the top 9 m); in the Červen Peak, north of the town of Teteven, Loveč District (Ginci Formation, in the interval between the 15th and 30th meter); near the village of Bojkovec (former Ravna), west of the town of Etropole, Sofia District (Černiosăm Formation, the exact position in the section is unknown) (S a p u n o v, 1976a).

**Correlations.** The Bulgarian *V. rothpletzi* Zone is equivalent to the larger portion of the lower part of the *Lemencia ciliata* Zone (Ba r t h e l, 1962; 1964; Z e i s s, 1968) from the third facies-faunal district. It corresponds to the *Sublithacoceras penicillatum* Zone (called also *Virgatosimoceras rothpletzi*).  

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### Fig. 2. Stratigraphic occurrence of the genera from the family Perisphinctidae during the Tithonian

1 — total stratigraphic occurrence in the third and fourth facies-faunal districts according to Berckhemer & Hölter (1959), Barthel (1959; 1962; 1975), Zeiss (1968; 1975); Memmi (1968); Geyer (1969), Enay & Geyssant (1975), 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.
Third and fourth facies-faunal districts — ammonite (sub)zones — Bulgaria

Berriasian

- B. (B.) jacobli
- Durangites
- M. microcanthum

P. intramontanum

- P. durangensis
- S. fallauxi
- S. semiforme
- D. palaflum
- F. vimineus
- U. parviradiosum
- U. trigoniferum
- U. tagmorshiemense

Subgenus Berriasella

- S. melanopus
- S. subformosum
- S. pseudosubformosum
- S. microcanthum
- S. rothpletzi
- F. pseudojubatus
- F. vimineus
- S. schwerlschlumbergeri
- S. maerschelmensch
- I. rodense

Kimmeridgian

Stratigraphic occurrence of the genera from the families Berriasellidae and Olostephanidae during the Tithonian

1 — total stratigraphic occurrence in the third and fourth facies-faunal districts according to Djané, I. d. Zé (1922), Memmi (1968), L. Hégarat (1973), Enay & Geyssant (1975) 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 Zone) from Southeastern France (Enay in Mouterde et al., 1971). The total of the Semiformiceras semiforme Zone and Semiformiceras fallauxi Zone (Enay & Geyssant, 1975) from the fourth facies-faunal district is equivalent to the Bulgarian V. rothpletzi Zone (see Table 2).

Parapallasiceras spp. Zone

Nomenclature. The Zone is introduced here. No index species is given because the representatives of the genus Parapallasiceras in Bulgaria are insufficiently studied.

Stratigraphy. The lower boundary of the Zone is defined in the description of the V. rothpletzi Zone (see above). The upper boundary, which is also a boundary between the Middle and the Upper Tithonian, is marked by the appearance of the earliest Himalayites (Micracanthoceras) and Paraulacosphinctes. In Bulgaria Parapallasiceras does not occur above this boundary (Figs. 2, 3).

The Bulgarian Parapallasiceras spp. Zone is based on the range-zone of the genus Parapallasiceras in this country. In Southern Germany (third facies-
faunal district) Parapallasiceras is present in the lower part of the Middle Tithonian (Bärthel, 1975), while in Southern Spain, as in Bulgaria, individual representatives of the group of *P. praecox* are found in the upper part of this Substage (the "Micracanthoceras" ponti Zone) (Enay & Geyssant, 1975).

The zonal association is represented by *Parapallasiceras* sp. n., *Parapallasiceras* sp. indet. and *P. praecox* (Schnied, 1915). *Haploceras elimateum* (Oppel, 1865) and *Aspidoceras cyclotum* (Oppel, 1865) are present in the Zone, but occur below its lower boundary as well. The representatives of the genus *Aulacosphinctes* occur sporadically in Bulgaria and come from an isolated locality. Thus it is not clear at present if they occur in the *Parapallasiceras* spp. Zone or in the lower part of the Upper Tithonian Himalayites (Micracanthoceras) microcanthus Subzone resting above it (see below the section "Tithonian Ammonite Species of Uncertain Stratigraphic Distribution").

**Distribution.** The Zone is present in the section near the village Komštica, Sofia District (Ginci Formation, No 12, from 10 m to 13.20 m above the base of No 12); north of the hamlet of Jankovo, area of Breznik, Pernik District (Zlatarica Formation, the middle part); near the village of Dolna Sekirna, Pernik District (Černiosám Formation, the middle part) (Sapunov, 1976a).

**Correlations.** The Bulgarian *Parapallasiceras* spp. Zone is equivalent to the uppermost part of the *Lemencia ciliata* Zone and to the *Isterites palmatus* Zone (Bärthel, 1962; 1964; Zeiss, 1968) from the third facies-faunal district. It is equivalent to the "Micracanthoceras" ponti Zone from the the fourth facies-faunal district (Enay & Geyssant, 1975) (see Table 2).

### Upper Tithonian

This Substage coincides with the scope of the Bulgarian *Paraulacosphinctes transitorius* Zone.

**Ammonite Zones and Subzones**

*Paraulacosphinctes transitorius* Zone

**Index species.** *Paraulacosphinctes transitorius* (Oppel, 1865) (Pl. V, fig. 2).

**Nomenclature.** The Zone is introduced here.

**Stratigraphy.** The lower boundary of the Zone is defined in the description of the *Parapallasiceras* spp. Zone. Its upper boundary, which is also a boundary between the Tithonian and Berriasian is marked by the disappearance of *Paraulacosphinctes* together with *Haploceras* and *Protacans thodiscus*, and, in Bulgaria, *Proniceras* as well (see Figs. 2, 3).

The Bulgarian *P. transitorius* Zone is based on the range-zone of *Paraulacosphinctes* (see Fig. 2). The zonal association is characterized by *Paraulacosphinctes transitorius*, *P. senex* (Oppel, 1865) and *Paraulacosphinctes* spp. indet.
Distribution. The Zone is present in the section near the village of Komštica, Sofia District (Gložene Formation, Ogosta Member, No 15, lower half); near the village of Bornarevo (former name Deli Baltin Ciflik), southwest of the town of Radomir, Pernik District (informal marly formation above the Černiosám Formation, from the lower part); in the valley of the Tâža River, area of Kazanlăk, District of Stara Zagora (Kostel Formation, lower half, from the upper part); near the villages of Ugorelec and Lăgăt, south of the village of Stokite, Gabrovo District (Zlatarica Formation, lower half, upper part); in the River Tiča Gorge, south of the village of Preslav, Sumen District (the core of the Preslav anticline) (Tiča Formation, lower half) (Sapunov, 1976a).

Correlations. As pointed out above, the stratigraphic scope of the Bulgarian P. transitorius Zone is equivalent to the Upper Tithonian. Unlike some regions of the third facies-faunal district (Le Hégaret, 1973) where P. transitorius occurs in the lower part of the Upper Tithonian only, in Bulgaria this species is present also in the top levels of the Upper Tithonian, immediately below the faunas of the Pseudosubplanites (Pseudosubplanites) grandis Zone. Therefore, the Bulgarian P. transitorius Zone is equivalent to the total of P. transitorius Zone and Berriasella (Berriasella) jacobi Zone from Southeastern France. It seems that in some regions of the same district P. transitorius occurs only in the upper part of the Upper Tithonian, which has caused Enay in Mouterde et al. (1971) to distinguish two zones in the Upper Tithonian, a lower, Micracanthoceras microcanthum Zone or Pseudovirgatites scruposus Zone, and an upper, P. transitorius Zone or "Berriasella" delphinersis Zone or "Protacanthodiscus" chaperi Zone.

On the other hand, the Bulgarian P. transitorius Zone is equivalent to the total of the M. microcanthum Zone, "Durangites" Zone and Berriasella jacobı Zone from Southern Spain (the fourth facies-faunal district) (Enay & Geyssant, 1975) (see Table 2).

Himalayites (Micracanthoceras) microcanthus Subzone

Index species. Himalayites (Micracanthoceras) microcanthus (Oppel, 1865) (Pl. V, fig. 3).

Nomenclature. The Subzone is introduced here.

Stratigraphy. The lower boundary of the Subzone coincides with the lower boundary of the P. transitorius Zone. Its upper boundary is marked by the appearance of the first Malbosiceras, Pseudosubplanites and Neolissoceras (see Figs. 1, 3). Besides, according to the data available to me, in Bulgaria this boundary is connected with the appearance of Berriasella (Berriasella), B. (Picteticeras), B. (Strambergella), Subalpinites, Dalmasciceras, Protacanthodiscus, Tinovella, Spiticeras and Proniceras. In Bulgaria, Himalayites (Micracanthoceras) disappear below this boundary (Fig. 3).

The Bulgarian H. (M.) microcanthus Subzone is based on the range-zone of Himalayites (Micracanthoceras) in this country (Fig. 3). Besides the index species, H. (M.) fraudator (Zittel, 1868) is also present in the association of the Subzone. The sporadically occurring representatives of the genus Aulacosphinctes in Bulgaria come from an isolated locality and it is not clear at present if they belong to the lower part of the subzone or occur in the Middle-Tithonian Parapallasiceras spp. Zone (see below the section "Tithonian Ammonite Species of Uncertain Stratigraphic Distribution").
The finding of Zaraiskites sp. in the lower half of the Černi ošam Formation near the hamlet of Neškovci, District of Loveč, made by N о w a k (1971, pl. 1), seems to confirm the presence of the Subzone in this locality.

Distribution. The Subzone is present in the section near the village of Komštica, Sofia District (Gložene Formation, the Ogosta Member, No 15, lower half, from the lower part); near the village of Dolna Sekirna, Pernik District (Černi ošam Formation, upper part); near the hamlet of Neškovci District of Loveč (Černi ošam Formation, lower part) (S a p u n o v, 1976a).

Correlations. The Bulgarian H. (M.) microcanthus Subzone is equivalent to the Paraulacosphinctes transitorius Zone (Le Hėgarat, 1973); to the Pseudovirgatites scruposus Zone or to the Micracanthoceras microcanthum Zone (E n a y in M o u t e r d e et al., 1971) from the third facies-faunal district. It is equivalent to the total of the Micracanthoceras microcanthum Zone and the "Durangites" Zone (E n a y & G e y s s a n t, 1975) from the fourth facies-faunal district (see Table 2). It correlates also with the beds containing the so-called "faune propre" or "faune principale" in the Stramberg Limestone, Czechoslovakia (H o u s a, 1975, p. 344, 345) (fourth facies-faunal district).

Malbosiceras chaperi Subzone

Index species. Malbosiceras chaperi (P i c t e t, 1868) (Pl. VI, fig. 2).

Nomenclature. This biostratigraphic unit was introduced by N i k o l o v (1967, p. 729) as a separate zone in the gorge of the Zlatarica River, north of the town of Elena, District of Veliko Tarnovo.

Stratigraphy. The lower boundary of the Subzone is defined in the description of the H. (M.) microcanthus Subzone (see above). Its upper boundary coincides with the upper boundary of the P. transitorius Zone.

The Bulgarian M. chaperi Subzone is based on the range-zones of Subalpinites, Protacanthodiscus and Proniceras in this country (see Fig. 3). The subzone is characterized by an association abundant in species, which, besides the index species, includes also Berriasella (Berriasella) moreli M a z e n o t, 1939, B. (B.) cf. oppeli (K i l i a n, 1889), B. (Delphinella) cf. delphinensis (K i l i a n, 1889), B. (D.) obtusenodosa (R e t o w s k i, 1893), Malbosiceras asper (M a z e n o t, 1939) (wrongly cited as M. aizyensis by S a p u n o v, 1976a, p. 36), Protacanthodiscus andreaei (K i l i a n, 1889), Dalmsiceras subluevis M a z e n o t, 1939, D. subprogenitor (J a c o b) in M a z e n o t, 1939, Spiticeras (Spiticeras) cauleyi (O p p e l, 1863), S. (S.) cf. celsum (O p p e l, 1865), S. (S.) pseudograteanum D j a n é l i d zé, 1922, Proniceras jacobii (D j a n é l i d zé, 1922), P. pseudonegreli (D j a n é l i d zé, 1922), P. simplex (D j a n é l i d zé, 1922). They are accompanied by the following species, whose range-zones in this country, according to the data available to me up to this date, do not exceed the scope of the Bulgarian M. chaperi Zone: Pseudosubplanites (Pseudosubplanites) cf. berriasensis Le Hėgarat, 1971, P. (P.) lorioli (Z i t t e l, 1868), P. (P.) ponticus (R e t o w s k i, 1893), P. (Hegaratella) subirichteri (R e t o w s k i, 1893), Berriasella (Berriasella) jacobii M a z e n o t, 1939, B. (Picteticeras) enayi Le Hėgarat, 1973, B. (P.) oxycostata (J a c o b in M a z e n o t, 1939, B. (Strambergella) carpathica (Z i t t e l, 1868), Dalmsiceras djanelidzei M a z e n o t, 1939, Subalpinites aristidis (K i l i a n, 1895), Tirnovella allobrogenesis (M a z e n o t, 1939), T. beneckei (J a c o b in M a z e n o t, 1939). It seems possible, however,
that further detailed studies of the Tithonian /Berriasian boundary will discover some of these species in the Berriasian of this country, too, as has already happened elsewhere, notably in Southeastern France (Le Hégaret, 1973).

The association of the Bulgarian *M. chaperi* Subzone includes also species which occur outside its boundaries as well: *Pseudosuplanites (Hegaratella) paramacilentus* (Mazenot, 1939) (it occurs above the upper boundary of the Subzone as well), *Berriassella (Picteticeras) chomeracensis* (Toucas, 1890) (it occurs above the upper boundary of the Subzone, too), *Haploceras staszicii* (Zejszner, 1846) (it occurs below the lower boundary of the Subzone), *Neolissoceras grsianum* (d’Orbigny, 1840) (it occurs above the upper boundary of the Subzone).

**Distribution.** The Subzone is present in the section near the village of Komištica, Sofia District (Gložené Formation, Ogosta Member, No 15, lower half, upper part); in the Berende River between the villages of Berende and Svetlja, Pernik District (Zlatarica Formation, upper part); near the village of Priboj, Pernik District (Černiosám Formation, upper part); south of the town of Trojan, Loveč District (Černiosám Formation, lower half, upper part); near the village of Lopjan, Sofia District (Černiošam Formation, lower half, upper part); between the villages of Malka Željažna and Lesidren, Loveč District (Černiosám — Gložene formation, lower half, upper part); near the villages of Šipkovo, Loveč District (Černiosám Formation, lower half, upper part, upper part); in the section in the Straža Pass; south of the village of Straža, Târgoviște District (the core of the Černi-vrăh anticline) (Zlatarica — Černiosám formation, lower half, upper part); near the village of Šipkovo, Loveč District (Černiosám Formation, lower half, upper part, upper part); in the section in the Straža Pass; south of the village of Straža, Târgoviște District (the core of the Preslav Anticline) (Tiča Formation, No 4); south of the village of Kostel, District of Veliko Târnovo (the core of the Bujnovci Anticline) (Kostel Formation, lower half); near the village of Bujnovci, District of Veliko Târnovo (the core of the Bujnovci Anticline) (Kostel Formation, lower half); northeast of the Slatinski-Râg locality, village of Drenta, District of Veliko Târnovo (the core of the Lipovci Anticline) (Kostel Formation, lower half); in the gorge of the Zlatarica River, near the mineral spring, north of the town of Elena, District of Veliko Târnovo (the core of the Elena Anticline) (Zlatarica Formation, lower half) (Sapunov, 1976a).

**Correlations.** The Bulgarian *M. chaperi* Subzone is equivalent to the *Berriassella (Berriassella) jacobi* Zone (Le Hégaret, 1973); to the "*Berriassella" delphinensis" Zone, or to the "*Protacanthodiscus" chaperi" Zone or to the *Paraaulacosphinctes transitorius* Zone (Enay in Mouterde et al., 1971) from the third facies-faunal district. It is also equivalent to the *Berriassella jacobi* Zobe (Enay & Geyssant, 1975) from the fourth facies-faunal district (see Table 2). The young elements in the faunas from the Stramberg Limestone, Czechoslovakia, found in the so-called "exotic boulders" (Housa, 1975, p. 345), correspond probably to the lower part of the Bulgarian Subzone.

Phylloceratina and Lytoceratina in the Tithonian in Bulgaria

The representatives of these two suborders form an appreciable portion of the ammonite faunas in the Tithonian in this country.

Phylloceratina. Species belonging to the genera *Phylloceras*, *Sowerbyceras*, *Holcophylloceras*, *Ptychophylloceras* and *Partschiceras* have been found, as
follows: *Phylloceras* *serum* (Oppel, 1865) (Tithonian), *Sowerbyceras loryi* (Münier-Chalmas in Hebert, 1875) (Lower Tithonian, *H. hybonotum* Zone; it occurs in the Kimmeridgian, too), *Holcophylloceras polyolcum* (Benecke, 1866) (Lower Tithonian; it occurs in the Kimmeridgian, too), *H. silesiacum* (Oppel, 1865) (Tithonian), *Ptychophylloceras ptychoicum* (Quenstedt, 1847) (Tithonian; it occurs in the Kimmeridgian and Berriasian as well), *P. inordinatum* (Toucas, 1890) (Upper Tithonian), *Parischiceras ptychostopoma* (Benecke, 1866) (Upper Tithonian).

Lytoceratina. Species belonging to the genera *Lytoceras* and *Protetragonites* have been found, as follows: *Lytoceras strambergense* Zittel, 1868 (Tithonian; it occurs in the Berriasian as well), *L. liebigi* (Oppel, 1865) (Upper Tithonian; it occurs in the Berriasian as well), *L. sutile* (Oppel, 1865) (Upper Tithonian; it occurs in the Berriasian as well), *Protetragonites quadrisulcatus* (d'Oribigny, 1840) (Tithonian).

**Tithonian Ammonite Species of Uncertain Stratigraphic Occurrence**

During the present study several species belonging to Glochiceratidae, Perisphinctidae, Aspidoceratidae and Berriasellidae have been found, whose stratigraphic distribution in Bulgaria has remained uncertain:

1. *Ochetoceras* *(Ochetoceras)* *irregulare* Berckhemer & Holder, 1959 — ?Upper Kimmeridgian (*H. beckeri* Zone) — ?Lower Tithonian (*H. hybonotum* Zone) (locality in the Berende River between the villages of Berende and Svetlja, Pernik District; Zlatarica Formation, lower part);  
2. *Hybonoticeras* *extraspinatum* Berckhemer & Holder, 1959 — ?Upper Kimmeridgian (*H. beckeri* Zone) — ?Lower Tithonian (*H. hybonotum* Zone) (the eastern ridge of the Ginci Cliff, east of the village of Ginci, Sofia District; Ginci Formation, No 4, according to Sapunov & Ziegler, 1976, p. 24);  
3. *Aspidoceras rogoznicense* (Zejszner, 1846) — ?Lower Tithonian — ?Middle Tithonian (locality to the northwest of the Goljama Glama Peak at the turn of the road to the town of Dimovo, Vidin District; Gložene Formation, lower part);  
4. *Aulacosphinctes linoptychus* (Uhlig, 1910) — ?Middle Tithonian — *(Parapallasiceras* spp. Zone) — ?Upper Tithonian (lower part of the *H. (M.) microcanthus* Subzone) (locality to the north of the village of Sredorek, Kjustendil District; Kostel Formation, probably from the middle part);  
5. *Aulacosphinctes venustus* Collignon, 1960 — ?Middle Tithonian *(Parapallasiceras* spp. Zone) — ?Upper Tithonian (lower part of the *H. (M.) microcanthus* Subzone) (locality to the north of the village of Sredorek, Kjustendil District; Kostel Formation, probably from the middle part);  
The Problem of the Jurassic/Cretaceous Boundary

Present concepts concerning the position of the Jurassic/Cretaceous boundary are controversial which is to be seen from the numerous suggestions made at the International Colloquium on this problem held in Lyon Neuchâtel in September, 1973. They are all more or less justified and probably further suggestions could be made not lacking in justification.

It seems that in order to reach an unambiguous solution of this problem, international cooperation on a wide basis is needed. The carrying out of a long-term project within the scope of the activities of the International Geologic Correlation Programme (UNESCO) in coordination with the Subcommissions on the Jurassic Stratigraphy and the Cretaceous Stratigraphy of the IUGS Commission on Stratigraphy might lead to, or at least might bring us closer to the desired result. The outcome of such a project seems promising, considering the results of the joint international studies on the unification of the boundary between the Silurian and Devonian. Such a study might lead not only to the discovery of fresh facts but might also reveal the possibility of unifying the criteria, on the basis of which an agreement may be reached about the position of the Jurassic/Cretaceous boundary on a global scale.

In accordance with the accepted practice in this country, the boundary between the Jurassic and the Cretaceous Systems is considered as coinciding with the boundary between the Tithonian and Berriasian Stages. It is also a boundary between the *Paraulacosphinctes transitorius* Zone and the *Pseudosubplanites (Pseudosubplanites) grandis* Zone.

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EXPLANATION OF PLATE I
(Early Tithonian ammonites)

Fig. 1. *Hybonoticeras hybonotum* (Oppel, 1863). Section near the village of Komštica, area of Godeč, District of Sofia (West Balkan). Ginci Formation, No. 12, from the lower 2 m (Sapunov, 1976a, p. 31); Lower Tithonian, *Hybonoticeras hybonotum* Zone. Specimen of Стефанов (1959, p. 96, pl. 1, figs. 1, 3), described and figured as "*Hybonoticeras hybonotum* (Oppel)". Pal. Mus. Univ. Sofia, J84/25—1. × 1.0

Fig. 2. *Taramelliceras (?Fontannesiella) prolithographicum* (Fontannes, 1879). Locality in the valley of Gabrovnica River, below the mountain chalet of Mazalat, area of Kazanlák, District of Stara Zagora (Central Balkan). Kostel Formation, at 500—600 m above the very base (Sapunov, 1976a, p. 34). Lower Tithonian, *Hybonoticeras hybonotum* Zone. Pal. Mus. Univ. Sofia, J147/49—1. × 1.0

Figs. 3a, b. *Subplanitoides schwertschlageri* (Zeiss, 1968). Section near the village of Belotinci, area of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, member of the upper nodular limestones, No. 17, at 7.30 m above the base (Sapunov, 1976a, p. 28); Lower Tithonian, *Subplanitoides schwertschlageri* Zone. Pal. Mus. Univ. Sofia, J127/49—2. × 1.0
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EXPLANATION OF PLATE II
(Early Tithonian ammonites)

Fig. 1. *Subplanitoides ardescicus* (Fontannes, 1879). Section near the village of Komštica, area of Godeč, District of Sofia (West Balkan). Ginci Formation, No. 12, from the lower 2 m (Sapunov, 1976a, p. 31); Lower Tithonian, *Hybonoticeras hybonotum* Zone. Specimen of Каменов (1934, p. 38), described as "*Perispinctes ardescicus*, Fontannes — Kimmeridgian". Pal. Mus. Univ. Sofia, J131/8—1.×1.0

Figs. 2a, b. *Subplanites moernsheimensis* (Schneid, 1915). Section near the village of Belotinci, area of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, member of the upper nodular limestones, No. 17, at 4.10 m above the base (Sapunov, 1976a, p. 28); Lower Tithonian, *Hybonoticeras hybonotum* Zone, *Subplanites moernsheimensis* Subzone. Pal. Mus. Univ. Sofia, J123/49—3.×1.0
EXPLANATION OF PLATE III

(Early Tithonian ammonites)

Fig. 1. *Franconites pseudojubatus* (Donze & Enay, 1961). Section in the valley of Agâlnica River, area of Elena, District of Veliko Târnovo (East Forebalkan). Agâlnica Formation, No. 4, probably from the upper half (Sapunov, 1976a, p. 37); Lower Tithonian, *Franconites vimineus* Zone, *Franconites pseudojubatus* Subzone. Pal. Mus. Univ. Sofia, J126/49—4.×1.0

Figs. 2a, b. *Glochiceras* (*Paralingulaticeras*) *lithographicum* (Oppel, 1863). Localit--near the village of Smolča, area of Godeč, District of Sofia (West Balkan). Ginci Forny mation, probably from the middle part (Sapunov, 1976a, p. 32); Lower Tithonian, *Hybonoticeras hybonotum* Zone. Pal. Mus. Univ. Sofia, J141/49—5.×1.0
EXPLANATION OF PLATE IV
(Early & Middle Tithonian ammonites)

Fig. 1. *Franconites vimineus* (Söhneid, 1915). Locality near the hamlet of Todorčeta, to the west of Gabrovo (Central Balkan). Zlatarica Formation, lower half, from the middle part (Sapunov, 1976a, p. 34); Lower Tithonian, *Franconites vimineus* Zone. Pal. Mus. Univ. Sofia. J124/49—6. \( \times 1.0 \)

Fig. 2. *Virgatosimoceras rothpletzi* (Söhneid, 1915). Section near the village of Ginci, District of Sofia (West Balkan). Ginci Formation, No. 7, from the upper 9 m (Sapunov, 1976a, p. 34); Middle Tithonian, *Virgatosimoceras rothpletzi* Zone. Specimen of Sapunov & Ziegler (1976, pl. 2, fig. 7), figured as "*Virgatosimoceras rothpletzi* (Söhneid) mittleres Tithon". Pal. Mus. Univ. Sofia, J120/46—6 (old number J5093). \( \times 1.0 \)

Fig. 3. *Richterella richteri* (Oppel, 1865). Locality near the village Bojkovec (Ravna), to the west of Etropole, District of Sofia (Central Balkan). Cerniosam Formation, the exact position is unknown (Sapunov, 1976a, p. 34); Middle Tithonian, *Virgatosimoceras rothpletzi* Zone. Specimen of Kamensov (1936, p. 112), described as "*Perispinches richteri*". Oppel — Tithonian". Pal. Mus. Univ. Sofia, J16/13—3. \( \times 1.0 \)

Figs. 4a, b. *Richterella patruliusi* (Avram, 1974). Locality near Červen Peak, to the north of Televen, District of Loveč (Central Forebalkan). Ginci Formation, in the interval between 15th—30th m (Sapunov, 1976a, p. 36); Middle Tithonian, *Virgatosimoceras rothpletzi* Zone. Pal. Mus. Univ. Sofia, J136/49—7. \( \times 1.0 \)
EXPLANATION OF PLATE V
(Middle & Late Tithonian ammonites)


Fig. 2. *Paraulacosphinctes transitorius* (Oppel, 1865). Section near the village of Komštica area of Godeč, District of Sofia (West Balkan). Gložene Formation, Ogosta Member, No. 15, from the lower half (Sapunov, 1976a, p. 31); Upper Tithonian, *Paraulacosphinctes transitorius* Zone. Pal. Mus. Univ. Sofia, J65/49—9. × 1.0

Fig. 3. *Himalayites (Micracanthoceras) microcanthus* (Oppel, 1865). Section near the village of Komštica, area of Godeč, District of Sofia (West Balkan). Gložene Formation, Ogosta Member, No. 15, the lower half, from the lower part (Sapunov, 1976a, p. 31); Upper Tithonian, *Paraulacosphinctes transitorius* Zone, *Himalayites (Micracanthoceras) microcanthus* Subzone. Pal. Mus. Univ. Sofia, J57/49—10. × 1.0
EXPLANATION OF PLATE VI
(Middle (?) & Late Tithonian ammonites)


Fig. 2. *Malbosiceras chaperi* (Pictet, 1868). Locality near the hamlet of Katilska, area of Trojan, District of Loveč (Central Balkan). Černiosam Formation, lower half, from the upper part (Sapunov, 1976a, p. 34); Upper Tithonian, *Paraulacosphinctes transitorius* Zone, *Malbosiceras chaperi* Subzone. Pal. Mus. Univ. Sofia, J36/49—12. × 1.0


Fig. 5. *Berriasella (Delphinella) cf. delphinensis* (Kilian, 1889). Locality in the gorge of Zlatarica River, to the north of the town of Elena, District of Veliko Târnovo (East Forebalkan). Zlatarica Formation, from the lower half (Sapunov, 1976a, p. 37); Upper Tithonian, *Paraulacosphinctes transitorius* Zone, *Malbosiceras chaperi* Subzone. Pal. Mus. Univ. Sofia, J38/49—15. × 1.0

Fig. 6. *Proniceras simplex* (Đanjidze, 1922). Locality to the north of Černa Reka river, near the village of Kostel, area of the town of Elena, District of Veliko Târnovo (East Forebalkan). Kostel Formation, from the lower half (Sapunov, 1976a, p. 37); Upper Tithonian, *Paraulacosphinctes transitorius* Zone, *Malbosiceras chaperi* Subzone. Specimen of Dimtrowa (1967, p. 87, pl. 43, fig. 1), described and figured as “*Proniceras simplex* Đanjidze, 1922 — Berriasian?”. Pal. Mus. Univ. Sofia, Cr1842/40—3. × 1.0