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Ammonite Stratigraphy of the Upper Jurassic in Bulgaria. III. Kimmeridgian: Substages, Zones and Subzones

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И. Г. Сапунов — Аммонитовая стратиграфия верхней юры в Болгарии. III. Кимериджский ярус: подъярусы, зоны и подзоны. Болгарские Ammonitina кимериджского яруса принадлежат к семействам Haploceratidae, Glochiceratidae, Perisphinctidae и Aspidoceratidae. На основании установленных закономерностей в их стратиграфическом распространении на территории Болгарии разработана схема аммонитовых Oppel-зон и одна интервальная зона (interval-zone):

Верхний кимериджский подъярус —
зона *Hybonoticeras beckeri*
Средний кимериджский подъярус —
зона *Aspidoceras sesquinodosum*
интервальная зона *Crussoliceras/Aspidoceras sesquinodosum*
Нижний кимериджский подъярус —
зона *Crussoliceras divisum*
зона *Ataxioceras (Ataxioceras) hypselocyclum*
зона *Ataxioceras (Parataxioceras) desmoides*

Зона *H. beckeri* расчленена на две подзоны: верхняя — подзона *Virgataxioceras setatum* и нижняя — подзона *Sutneria subeumela.*

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 Kimmeridgian Ammonitina belong to the following families: Haploceratidae, Glochioceratidae, Perisphinctidae and Aspidoceratidae. On the basis of the regularities found in their stratigraphic occurrence in this country, a scheme consisting of ammonite Oppel-zones and an Interval-zone is worked out, as follows:

Upper Kimmeridgian —
Hybonoticeras beckeri Zone
Middle Kimmeridgian —
Aspidoceras sesquinodosum Zone
Crussoliceras/Aspidoceras sesquinodosum Interval-zone
Lower Kimmeridgian —
Crussoliceras divisum Zone

Ataxioceras (Ataxioceras) hypselocyclum Zone
Ataxioceras (Parataxioceras) desmoides Zone
The *H. beckeri* Zone is subdivided into two subzones: an upper — *Virgataxioceras setatum* Subzone, and a lower — *Sutneria subeumela* Subzone.

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

The Kimmeridgian Ammonitina in Bulgaria often exhibit considerable similarities with the representatives of this suborder from the third faciesfaunal district (S a p u n o v & Z i e g l e r, 1976, p. 8). This is valid for some intervals in the lower part of the Stage and particularly for its upper part. In Bulgaria, the presence of the (sub) zones of the third district has been established in these intervals according to the standard schemes of E n a y, T i n t a n t & R i o u l t in M o u t e r d e et al. (1971) and S a p u n o v & Z i e g l e r (1976) (Table 2).

In an earlier paper (S a p u n o v, 1976a) I have pointed out that representatives of *Aulacostephanus* are totally absent from the faunas of this country, and *Ataxioceras* are found only sporadically. The former fact has posed difficult problems in the ammonite zonation of the middle part of the Kimmeridgian in Bulgaria since non-characteristic and more extensively occurring representatives of *Aspidoceras, Taramelliceras* and *Nebrodites,* accompanied by *Orthosphinctes* predominate in this interval (Kimmeridgian IV+V; see Table 2). The faunas in Andalusia are of a similar nature (S a p u n o v & Z i e g l e r, 1976, p. 23). The ammonites from the middle part of the Kimmeridgian in this country come either from the Ginci, or from the Neškovci Formation. In the former case most of the specimens are more or less dissolved, which is typical of the Upper Jurassic nodular limestones. In the latter case the specimens are crushed. This complicated the palaeontological study and interfered with the reliable identifications, particularly of *Aspidoceras.* Nonetheless, I have ventured to make specific identifications of several specimens of this genus with clear positions in the sections. This made it possible to separate a Bulgarian Oppel-zone which corresponds to Kimmeridgian V. In so far as the Kimmeridgian IV is concerned, however, not a single *Aspidoceras acanthicum* (O p p e l, 1863) has been found among the Bulgarian specimens. That is why at the present state of research an interval-zone was separated for the Kimmeridgian IV in Bulgaria. For the basal part of the Kimmeridgian (Kimmeridgian I) a Bulgarian Oppel-zone based on the range-zone of *Ataxioceras (Parataxioceras)* in this country was separated. The index species was selected among the representatives of this subgenus because of the total absence of *Sutneria* from this interval of the Kimmeridgian Stage in Bulgaria.

The ammonite zonal scheme offered here for the Kimmeridgian in Bulgaria is the first attempt towards a general subdivision of this stage in this country. That is why it is incomplete and not all biostratigraphic relationships are made clear. I regard this scheme as the starting point for further research, rather than as a finished study.

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

The substages of the Kimmeridgian. In the past, Златарски (1908, p. 195) and Стефанов (1959) were the first to attempt a subdivision of the Kimmeridgian in Bulgaria. According to the first author, there are two 'horizons' in the Kimmeridgian. The 'lower horizon' is represented by darker limestones with sporadic fossils, and the 'upper horizon' is lighter and more clayey with abundant ammonite faunas. Obviously, this subdivision is based primarily on lithological features. Considerably later, Стефанов divides the Kimmeridgian in West Bulgaria into a 'lower' and an 'upper' one on the basis of some representatives of the genus *Hybonoticeras*. His 'Lower Kimmeridgian' is based on *H. harpephorum* (Neumayr, 1873) but it is known that this species occurs in the Upper Kimmeridgian. His 'Upper Kimmerdgian' is based on the presence of *H. hybonotum* (Oppel, 1863). This species, however, characterized the basal zone of the Tithonian Stage. Later, the author revised that view (see Стефанов in Сазонов & Стефанов, 1965).

A notoriously difficult problem is that of unifying the Kimmeridgian substages. It is linked with the controversy over the scope of the Kimmeridgian Stage in Europe. This problem cannot be solved as long as the upper boundary of the Kimmeridgian in Southern England (first facies-faunal district) lies in a higher stratigraphic position than the upper boundary of the Kimmeridgian in Central and Southern Europe (third and fourth facies-faunal districts); in other words, until the Tithonian, Volgian and Portlandian are given an equivalent stratigraphic meaning. Twenty years ago Arkell (1956) suggested the name of Lower+Middle Kimmeridgian for the Kimmeridgian from the third and fourth facies-faunal districts in order to facilitate correlations between them and the substages in Southern England [the name 'Lower Kimmeridgian' or 'Crussolian' has also been used by some authors (Zeiss, 1965) to designate the Kimmeridgian from the third and fourth districts]. After being used for some time, this term was soon dropped by the stratigraphers working in Central and Southern Europe (see also Ziegler, 1964). Neverthelass, in order to avoid confusion, the use of Kimmeridgian substages in the English sense should be accompanied by explanatory notes (Sapunov & Ziegler, 1976, p. 10, 24) (see Table 2).

In recent years, the Kimmeridgian from the third facies-faunal district is divided in two ways as follows: (1) Lower and Upper Kimmeridgian (Enay, Tintant & Rioult in Mouterde et al., 1971), and (2) Lower, Middle and Upper Kimmeridgian (Zeiss, 1971). The scheme consisting of three substages seems to me the better balanced one and better suited for Bulgaria. As defined by the standard ammonite Oppel-zones for the third facies-faunal district (according to Enay, Tintant & Rioult in Mouterde et al., 1971; Sapunov & Ziegler, 1976), the three substages of the Kimmeridgian have the following scopes:

(3) Upper Kimmeridgian (*Hybonoticeras beckeri* Zone);
(2) Middle Kimmeridgian (*Aspidoceras acanthicum* Zone and *Aulacostephanus eudoxus* Zone);
(1) Lower Kimmeridgian (*Sutneria platynota* Zone, *Ataxioceras (Ataxioceras) hypselocyclum* Zone, and *Crussoliceras divisum* Zone).

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

Table 1

Substages, ammonite zones and subzones of the Kimmeridgian in Bulgaria

Upper Kimmeridgian
Hybonoticeras beckeri Zone — *Virgataxioceras setatum* Subzone
Hybonoticeras beckeri Zone — *Sutneria subeumela* Subzone
Middle Kimmeridgian
Aspidoceras sesquinodosum Zone
Grussoliceras/Aspidoceras sesquinodosum Interval-zone
Lower Kimmeridgian
Crussoliceras divisum Zone
Ataxioceras (Ataxioceras) hypselocyclum Zone
Ataxioceras (Parataxioceras) desmoides Zone

Lower Kimmeridgian

This Substage is characterized by the genera *Ataxioceras* (subgenera *Ataxioceras* and *Parataxioceras*), *Crussoliceras* and *Garnierisphinctes*. Besides, the genera *Decipia, Orthaspidoceras* and *Streblites* have so far been found in Bulgaria only in the Lower Kimmeridgian (Figs. 1, 2).

Without being possible to divide this Substage into zones, the Lower Kimmeridgian is present in the Ginci Formation near the village of Čemiš, east of the village of Mitrovci, District of Mihajlovgrad; near the village of Ravna, area of Godeč, District of Sofia; as well as in the holostratotype of the Agălnica Formation (No. 1) to the east of the village of Drenta, District of Veliko Tărnovo, where it is proved by *Taramelliceras (Taramelliceras) trachinotum* (O p p e l, 1863) (Sapunov, 1976a).

Ataxioceras (Parataxioceras) desmoides Zone

Index species. *Ataxioceras (Parataxioceras) desmoides* Wegele, 1929 (Pl. I, fig. 1).

Nomenclature. The Zone is introduced here. Sapunov & Ziegler (1976, p. 31) have pointed out that 'Kimmeridgien I (Zone der *Sutneria platynota*)' has not been identified in this country. This standpoint was based on the fact that the index species was not found in Bulgaria. I refer the ammonite figured by the authors (Sapunov & Ziegler, 1976, pl. 3, fig. 2) as '*Ataxioceras (Parataxioceras)* sp.' from the upper part of the Ginci Formation near the hamlet of Neškovci, District of Loveč, to *A. (P.) desmoides*. In the course of further investigations, other representatives of *Ataxioceras (Parataxioceras)* together with *Decipia* were also found in the same level of this section. No *Ataxioceras (Ataxioceras)* has been found so far among this ammonite association. All this justifies the assumption that faunas with *Ataxioceras (Parataxioceras)* form a zone at the base of the Kimmeridgian which is equivalent to the standard *S. platynota* Zone. The absence of representatives of the genus *Sutneria* from the Bulgarian Lower Kimmeridgian makes it impossible for me to use *Sutneria platynota* (Reinecke, 1818) as index of the lowest zone of the Kimmeridgian in this country.

Stratigraphy. The lower boundary of the zone, which is also a boundary between the Oxfordian and the Kimmeridgian, is marked by the first appearance of *Ataxioceras (Parataxioceras)*. Its upper boundary is connected with the appearance of the earliest *Ataxioceras (Ataxioceras)*.

The Bulgarian *A. (P.) desmoides* Zone is based on the range-zone of *Ataxioceras (Parataxioceras)* and of *Decipia* in this country (see Fig. 2). The zonal association is characterized by *Ataxioceras (Parataxioceras) desmoides, A. (P.) inconditum* (Fontannes in Dumortier & Fontannes, 1876), *Decipia pseudobreviceps* (Simionescu, 1907), *Metahaploceras wegelei* (Schairer, 1972).

Distribution. The Zone is present in the section near the hamlet of Neškovci, District of Loveč (Ginci Formation, No 3, in the upper part); near the village of Galata to the NE of the village of Glożene, Loveč District (the lower part of the Ginci Formation) (Sapunov, 1976a).

Correlations. The Bulgarian *A. (P.) desmoides* Zone is equivalent to the *S. platynota* Zone from the third facies-faunal district (Table 2).

Ataxioceras (Ataxioceras) hypselocyclum Zone

Index species. *Ataxioceras (Ataxioceras) hypselocyclum* (Fontannes, 1879). The index species has not been found in Bulgaria so far.

Nomenclature. The presence of this zone in Bulgaria has been tentatively mentioned by Sapunov & Ziegler (1976, p. 31) on the basis of a 'fraglicher *Ataxioceras*'. Actually, it is a case of a specimen from the section near the village of Neškovci, figure of which is given in that paper and which I refer to *A. (P.) desmoides* (see above the explanation in the description of the *A. (P.) desmoides* Zone in the section 'Nomenclature'). Therefore, the zone should be regarded as being introduced here.

Stratigraphy. The lower boundary is defined in the description of the *A. (P.) desmoides* Zone. Its upper limit is marked by the appearance of the earliest representatives of *Crussoliceras* and *Garnierisphinctes*. Moreover, in in Bulgaria, the first *Nebrodites, Progeronia, Aspidoceras, Orthaspidoceras* and *Streblites* appear above this boundary (Figs. 1, 2). It is connected with the disappearance of *Ataxioceras*.

The Bulgarian *A. (A.) hypselocyclum* Zone is based on the range-zone of *Ataxioceras (Ataxioceras)* in this country. According to the scanty data available to me, it seems that *Ataxioceras (Parataxioceras)* is not found above the lower boundary of the *A. (A.) hypselocyclum* Zone in this country. However, the fact that in the third facies-faunal district *Ataxioceras (Ataxioceras)* is accompanied by some representatives of *A. (Parataxioceras)* (Geyer, 1961b; Karvé-Corvinus, 1966; Enay, Tintant & Rioult in Mouterde et al., 1971) justifies the assumption that in future studies in Bulgaria analogous relationships may possibly be established in the stratigraphic occurrence of these two subgenera. The Bulgarian *A. (A.) hypselocyclum* Zone is proved by *Ataxioceras (Ataxioceras) lautum* Schneid, 1944.

Distribution. The Zone is present near the village of Cărvenjano, District of Kjustendil (Ginci Formation) (see Sapunov, 1976a).

Correlations. The Bulgarian *A. (A.) hypselocyclum* Zone corresponds to the same zone of the third facies-faunal district (Table 2).

Crussoliceras divisum Zone

Index species. *Crussoliceras divisum* (Quenstedt, 1888). The index species has not been found in Bulgaria so far.

Nomenclature. The Zone was introduced by Sapunov & Ziegler (1976). The 'Schichten der *Oppelia tenuilobata*' of Toula (1893, p. 199) in the section near the village of Ginci, District of Sofia, is a synonym.

Stratigraphy. The lower boundary of the Zone is defined in the description of the *A. (A.) hypselocyclum* Zone (see above). Its upper boundary, which is also a boundary between the Lower and the Middle Kimmeridgian, is marked by the disappearance of *Crussoliceras, Garnierisphinctes* and *Idoceras*. Besides, in Bulgaria *Orthaspidoceras* and *Streblites* do not occur above this boundary (Figs. 1, 2).

The Bulgarian *C. divisum* Zone is based on the range-zone of the genus *Crussoliceras*. Besides, *Garnierisphinctes* also occurs in the zone although it is not possible for the present to specify its position among the representatives of the zonal association. The range-zones of *Streblites* and *Orthaspidoceras* in this country are restricted within the *C. divisum* Zone (Figs. 1, 2). The zonal association is represented by *Crussoliceras aceroides* (Geyer, 1961), *Crussoliceras* sp. n., *Garnierisphinctes* sp. n., *Orthaspidoceras uhlandi* (Oppel, 1863), *Idoceras balderum* (Oppel, 1863), *Nebrodites (Nebrodites) rhodanensis* Ziegler in Hölder & Ziegler, 1959, *Taramelliceras (Taramelliceras) bulgaricum* (Toula, 1893), *Haploceras* sp. n. Besides, *Streblites tenuilobatus* (Oppel, 1858), *Nebrodites (Nebrodites) hospes* (Neumayr, 1873), *N. (Mesosimoceras) cavouri* (Gemmellaro, 1872) and *Progeronia breviceps* (Quenstedt, 1888) occur only in the *C. divisum* Zone in this country.

All of them are accompanied by species which occur below its lower boundary or above its upper one. Thus, *Taramelliceras (Taramelliceras) trachi-*

notum (O p p e l, 1863) is probably present below its lower boundary. On the other hand, *Taramelliceras (Taramelliceras) compsum compsum* (O p p e l, 1863), *T. (T.) compsum holbeini* (O p p e l, 1863) and *Nebrodites (Nebrodites) agrigentinus* (G e m m e l l a r o, 1872) appear in the *C. divisum* Zone and extend above its upper boundary; *N. (N.) heimi* (F a v r e, 1877) and *N. (N.)*

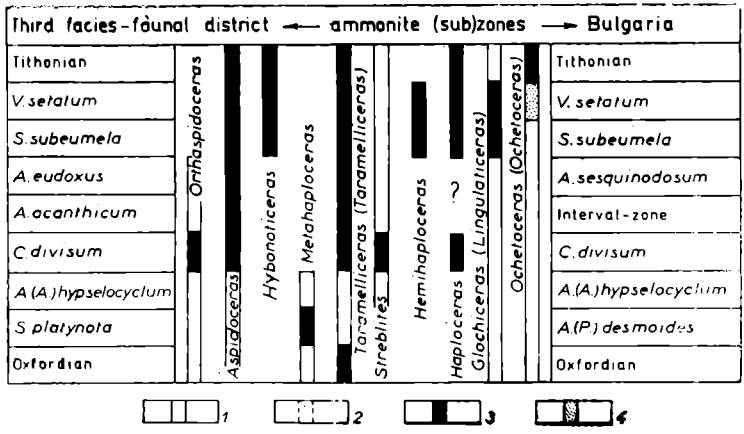

Fig. 1. Stratigraphic occurrence of the genera from the families Aspidoceratidae, Haploceratidae and Glochiceratidae in the Kimmeridgian

1 — total stratigraphic occurrence in the third facies-faunal district according to H ö l d e r (1955), Z i e g l e r (1958a; 1958b; 1974a; 1974b), H o l d e r & Z i e g l e r (1959), B e r c k h e m e r & H ö l d e r (1959), G e y e r (1961b), H ö r o l d t (1964), B a n t z (1970), S a p u n o v & Z i e g l e r (1976) and others; *2* — probable stratigraphic occurrence in the third facies-faunal district according to the same authors; *3* — stratigraphic occurrence in Bulgaria; *4* — probable stratigraphic occurrence in Bulgaria

macerrimus (Q u e n s t e d t, 1888) appear in the *C. divisum* Zone too and probably extend above its upper boundary. The presence of *T. (T.) trachinotum* together with some of these species determines concurrent-range-zones which can prove the presence of the *C. divisum* Zone even when the diagnostic genera and species are absent. In Bulgaria, the first *Aspidoceras* spp. indet. appear in the *C. divisum* Zone.

D i s t r i b u t i o n. The Zone is found in the section Belogradčik — Orešec Railway Station, District of Vidin (Ginci Formation, No 4, its upper part); in the section near the Orešec Railway Station, Vidin District (Ginci formation, No. 1, the lower part of the grey nodular limestones); in the section of the Belogradčik Cliff, District of Vidin (Ginci Formation, No. 2); in the section near the village of Mitrovci, District of Mihajlovgrad (Ginci Formation, No 2, the lower part); probably in the section near the village of Erden, District of Mihajlovgrad (Ginci Formation, No. 2); in the section near the village of Ginci, Sofia District (Ginci Formation, No. 4, with exception of the topmost 1.5 m); to the west of the village of Ginci, Sofia District (Ginci Formation, at the base) (see S a p u n o v, 1976a).

C o r r e l a t i o n s. The Bulgarian *C. divisum* Zone corresponds fully to the standard Zone of the same name from the third facies-faunal district (see Table 2). In some localities of this district a subzone based on *Idoceras*

balderum and *Orthaspidoceras uhlandi* is distinguished in the upper part of the *C. divisum* Zone (see Enay, Tintant & Rioult in Mouterde et al., 1971). On the other hand, it seems that their range-zones in Southern Germany do not coincide (Sapunov & Ziegler, 1976, text-figs. 6, 7). *I. balderum* there occupies the upper half of the *C. divisum* Zone, while *O. uhlandi* occurs in the lower part of this Zone as well. The distribution of these two species in the Bulgarian *C. divisum* Zone is not yet sufficiently clear. Therefore, at the present state of knowledge, it will be insufficiently justified to distinguish an *Idoceras balderum* Subzone in Bulgaria.

Middle Kimmeridgian

In Bulgaria this Substage is characterized by some species belonging to *Nebrodites, Aspidoceras* and *Orthasphinctes.* They are accompanied also by some noncharacteristic species of the subgenus *Taramelliceras (Taramelliceras).*

Without being possible to divide it into zones, the Middle Kimmeridgian is present in the section near the Orešec Railway Station (Ginci Formation, No 1, from the upper part of the grey nodular limestones) where it is proved by *Nebrodites (Nebrodites)* cf. *gigas* (Quenstedt, 1888), and in the section near the hamlet of Neškovci, District of Loveč (Neškovci Formation, 11 m to 15 m above the base), where it is proved by *Orthosphinctes roubyanus* (Fontannes, 1879) (in this country, this species occurs only in the Middle Kimmeridgian) (Sapunov, 1976a).

Ammonite Zones

Crussoliceras /Aspidoceras sesquinodosum Interval-zone

This Interval-zone is limited from below by the biohorizon of the disappearance of the genus *Crussoliceras* (=the upper boundary of the *C. divisum* Zone). Its upper boundary coincides with the biohorizon of the appearance of *Aspidoceras sesquinodosum* (Fontannes in Dumortier&Fontannes, 1876) (=the lower boundary of the *Aspidoceras sesquinodosum* Zone). It comprises the lower part of the Middle Kimmeridgian (Kimmeridgian IV).

In the *Crussoliceras/A. sesquinodosum* Interval-zone, *Nebrodites (Nebrodites) cafisii* (Gemmellaro, 1872) is present in this country. *N. (N.) agrigentinus* (Gemmellaro, 1872) is present too, but it occurs below its lower boundary. *N. (N.) heimi* (Favre, 1877) and *N. (N.) macerrimus* (Quenstedt, 1888) are probably present in this Interval-zone, but their occurrence below its lower boundary is proved in this country. With rare specimens, *Taramelliceras (Taramelliceras) pugile* (Neumayr, 1871) probably appears in the Interval-zone, extending above its upper boundary. *T. (T.) compsum compsum* (Oppel, 1863) and *T. (T.) compsum holbeini* (Oppel, 1863) are present in this Interval-zone, but occur below its lower and above its upper boundary as well.

Distribution. *The Crussoliceras/A. sesquinodosum* Interval-Zone is present in the section near the village of Ginci, Sofia District (Ginci Formation, No. 4 — the upper 1.50 m, Nos. 5, 6); in the section near the Orešec Railway Station, Vidin District (Ginci Formation, No. 1, approximately in

the middle part of the grey nodular limestones); 1 km north of the village of Kovačevci, Pernik District (Neškovci Formation, the lower part); south of the village of Beli Osăm, Loveč District (Ginci Formation, the upper part); west of the village of Ginci, Sofia District (Ginci Formation, the lower part) (see Sapunov, 1976a).

Correlations. The Bulgarian *Crussoliceras/A. sesquinodosum* Interval-Zone is equivalent to the *Aspidoceras acanthicum* Zone from the third facies-faunal district (see Table 2).

* * *

Remarks on the use of the term 'Beds (Zone) with *Aspidoceras acanthicum*' in Bulgaria. Toula (1877, p. 45), on the basis of an ammonite fauna collected by him in the sediments of the Ginci Formation near the village of Vărbovo, area of Belogradčik, Vidin District, was the first to note the presence of 'Schichten mit *Aspidoceras acanthicum*' there. If not lost, the ammonites of Toula should be in the Natural History Museum in Vienna. Fortunately, figures of some of them are given in the same publication which enabled me to carry out certain interpretations: '*Perisphinctes polyplocus* Rein. spec.' (pl. 5, fig. 4) (= *Progeronia* sp.); '*Perisphinctes* cf. *colubrinus* Rein. spec.' (pl. 5, fig. 5) (= *Orthosphinctes* sp. indet.); '*Simoceras doublieri* d'Orbigny spec.' (pl. 5, fig. 6) (=*Nebrodites (Nebrodirtes) hospes* (Neumayr, 1873); '*Oppelia holbeini* Oppel sp.' (pl. 5, fig. 7) [=Taramelliceras (Taramelliceras) sp. juv. ? cf. *compsum holbeini* (Oppel, 1863)]; '*Aspidoceras orthocera* d'Orb.' (pl. 6, fig. 1) (=*Orthaspidoceras* sp. indet.); '*Phylloceras* (cf. *isotypum* Benecke sp.)' (pl. 6, fig. 2) [=*Phylloceras isotypum* (Benecke, 1866)]. If we assume that the specimens of Toula were collected from a single level, we should conclude that this association of species proves the *C. divisum* Zone. Indeed, this is more or less confirmed by Toula himself who later (Toula, 1881, p. 45) corrected his statement concerning the age of ammonite-bearing rocks near the village of Vărbovo pointing out that they may belong both to 'Schichten mit *Aspidoceras acanthicum* Opp.', and to 'Schichten mit *Oppelia tenuilobata* Opp.'. These reflections of Toula's show that by 'Schichten mit *Aspidoceras acanthicum*' he meant something much closer to the idea of the modern *Aspidoceras acanthicum* Zone than to the classical acceptance of this term (see Neumayr, 1873; Ziegler, 1964). In the later Bulgarian literature (С. Бончев, 1930; Е. Бончев, 1940, 1955) this term designates the nodular limestones in the Bulgarian Upper Jurassic (at present included in the Ginci Formation). They used to be called 'flame limestones' (= the German Rote Knollenkalke or the Italian ammonitico rosso superiore) (С. Бончев, 1930, p. 47); also 'Acanthicus Zone' (Е. Бончев, 1940, p. 195); 'Zone of *Aspidoceras acanthicus* Opp.' or 'acanthicus limestones' (Е. Бончев, 1955, p. 154). Regardless of how they were called, the nodular limestones were regarded as a single 'zone' or 'horizon' in the middle of the Kimmeridgian in Bulgaria. Unlike Toula, С. Бончев and Е. Бончев used the term in a sense quite close to the classical idea of Neumayr (1873). That is justifiable from the viewpoint of a purely lithostratigraphic interpretation. On the other hand, however, these authors had an erroneous idea about the age of the nodular limestones. In this respect their views differ considerably from that of Neumayr (1873).

I should like to emphasize once again here that the species *Aspidoceras acanthicum* (O p p e l, 1863) has not been found in Bulgaria so far. All cases (and there are quite a number of them) when this species is mentioned in Bulgarian publications are the result of incorrect specific identifications of specimens of the genus *Aspidoceras*.

Aspidoceras sesquinodosum Z o n e

I n d e x s p e c i e s. *Aspidoceras sesquinodosum* (F o n t a n n e s in D u m o r t i e r & F o n t a n n e s, 1876) (Pl. III, figs. 3a, b).

N o m e n c l a t u r e. The Zone is introduced here.

S t r a t i g r a p h y. The lower boundary is marked by the appearance of the earliest representatives of *Aspidoceras sesquinodosum*. The upper boundary, which is a boundary between the Middle and the Upper Kimmeridgian, is marked by the appearance of the first *Hybonoticeras*, accompanied by *Sutneria subeumela* S c h n e i d, 1915, which probably coincides with the disappearence of *Progeronia* in this country (Fig. 2).

The Bulgarian *A. sesquinodosum* Zone is based on the range-zone of the index species. *Aspidoceras* cf. *haynaldi* H e r b i c h in N e u m a y r, 1873 is also present in the upper part of this Zone. Moreover, *Aspidoceras longispinum* (J. d e C. S o w e r b y, 1825) and probably of *Nebrodites (Mesosimoceras)*

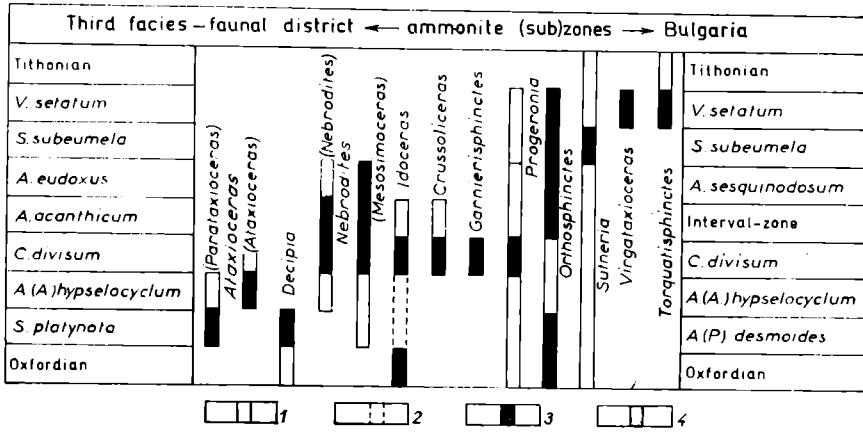

Fig. 2. Stratigraphic occurrence of the genera from the family Perisphinctidae in the Kimmeridgian

1 — total stratigraphic occurrence in the third facies-faunal district according to Z i e g l e r (1958a; 1959; 1974a), B a r t h e l (1959), H ö l d e r & Z i e g l e r (1959), B e r c k h e m e r & H ö l d e r (1959), E n a y (1959), G e y e r (1916b; 1969), S e e g e r (1961), Z e i s s (1968), B a n t z (1970), N i t z o p o u l o s (1974), S a p u n o v & Z i e g l e r (1976) and others; *2* — probable stratigraphic occurrence in the third facies-faunal district, according to the same authors; *3* — stratigraphic occurrence in Bulgaria; *4* — probable stratigraphic occurrence in Bulgaria

cf. *torcalensis* (K i l i a n, 1889) in this country are restricted within the *A. sesquinodosum* Zone. The zonal association comprises also *Taramelliceras (Taramelliceras) pugile* (N e u m a y r, 1871) occurring below its lower and above its upper boundary; *T. (T.) compsum* (O p p e l, 1863) occurring below its lower boundary as well; *T. (T.) franciscanum* (F o n t a n n e s, 1879)

appearing probably in this Zone and extending above its upper boundary. In Bulgaria *Orthosphinctes subdolus* (F o n t a n n e s, 1879) and *O. vandellii* (C h o f f a t, 1893) appear in this Zone and occur above its upper boundary as well.

D i s t r i b u t i o n. The Zone is present in the section near the village of Komštica, Sofia District (Ginci Formation, No 6); in the section near the village of Ginci, Sofia District (Ginci Formation, No 7, the lower 2 m); in the valley of the Kostina River, to the south of the village of Ribarica, Loveč District (Neškovci Formation, in the bottom 50 cm); in the valley of the Zavodna River, to the south of the village of Ribarica, Loveč District (Neškovci Formation, at the very base); in the section near the Koznica Waterfall, to the south of the town of Teteven (Ginci Formation) (S a p u n o v, 1976a).

C o r r e l a t i o n s. The Bulgarian *A. sesquinodosum* Zone is equivalent to the *Aulacostephanus eudoxus* Zone from the third facies-faunal district (see Table 2).

Upper Kimmeridgian

This Substage coincides with the scope of the *Hybonoticeras beckeri* Zone.

Ammonite Zones and Subzones

Hybonoticeras beckeri Z o n e

I n d e x s p e c i e s. *Hybonoticeras beckeri* (N e u m a y r, 1873) (Pl. V, figs. 2a, b).

N o m e n c l a t u r e. The Zone was introduced by S a p u n o v & Z i e g l e r (1976, p. 31).

S t r a t i g r a p h y. The lower boundary of the Zone is defined in the description of the *A. sesquinodosum* Zone (see above). Its upper boundary is also a boundary between the Kimmeridgian and the Tithonian. It is marked by the appearance of *Hybonoticeras hybonotum* (O p p e l, 1863) and *Glochiceras (Paralingulaticeras)* in this country, which is connected with the disappearance of *H. beckeri, Virgataxioceras* and *Orthosphinctes* (see Figs. 1, 2).

The Bulgarian *H. beckeri* Zone is characterized by the index species which predominates in its upper part. The zonal association includes also *Hybonoticeras harpephorum* (N e u m a y r, 1873) (occurring throughout the zone), *H. mundulum attenuatum* B e r c k h e m e r & H ö l d e r 1959 and *Hemihaploceras nobile* (N e u m a y r, 1873) (occurring throughout the zone). *Glochiceras (Lingulaticeras) pseudocerachtheis* (F a v r e, 1880) (the only specimen of this species is found near the Ledenika Cave, and not 'near the Magura Cave' as wrongly mentioned by S a p u n o v, 1976a, p. 33) and *Orthosphinctes stenocyclus* (F o n t a n n e s, 1879) are present within the *H. beckeri* Zone. Besides, the following species, whose stratigraphic occurrence extends outside its boundaries, are also present in the Zone: *Taramelliceras (Taramelliceras) pugile* (N e u m a y r, 1871) (occurring below its lower boundary); *Orthosphinctes vandellii* (C h o f f a t, 1893) (occurring below its lower boundary); *O. subdolus* (F o n t a n n e s, 1879) (occurring below its lower boundary) and *Hybonoticeras mundulum mundulum* (O p p e l, 1865) (found above its upper boundary)

Distribution. The Zone is present in the section near the village of Belotinci, Vidin District (Ginci Formation, No 16, middle and upper part); in the section near the village of Erden, Mihajlovgrad District (Ginci Formation, No 3, upper part); near the village of Târgovište, Vidin District (Ginci Formation); in the section near the village of Komštica, Sofia District (Ginci Formation. Nos. 8—10); in the section near the Javorec Peak, to the east of the village of Bov, Sofia District (Ginci Formation, No 6); near the village of Bov, Sofia District (the exact locality is unknown) (Ginci Formation, probably from the middle part); near the Čenov Vrăh Peak, in the vicinity of the Ledenika Cave, south of the town of Vraca (Ginci Formation, from the upper part); in the Podgrada locality, to the south of the village of Lopjan, Sofia District (Neškovci Formation, in the base); north of the village of Gorno Šipkovo, Loveč District (Neškovci Formation) (Sapunov, 1976a).

Correlations. The Bulgarian *H. beckeri* Zone corresponds to the zone of the same name from the third facies-faunal district (see Table 2).

Sutneria subeumela Subzone

Index species. *Sutneria subeumela* Schneid, 1915 (Pl. VI, fig. 1).

Nomenclature. The Subzone is introduced here.

Stratigraphy. The lower boundary of the Subzone coincides with the lower boundary of the *H. beckeri* Zone (see above). The upper boundary is marked by the appearance of the earliest *Virgataxioceras* (Fig. 2) which is connected with the disappearance of *Hybonoticeras pressulum* (Neumayr, 1871) and *H. ciliatum* Berckhemer & Hölder, 1959.

In Bulgaria the index species has been found so far in the lower part of the Subzone only. The association of the Subzone includes also *Hybonoticeras pressulum, H.* cf. *knopi* (Neumayr, 1873) and *H. ciliatum*. The range-zone of *Taramelliceras (Taramelliceras)* sp. n. in this country is restricted within the Subzone. Besides, in its lower part the index species is accompanied by *Sutneria eumela* (d'Orbigny, 1850). Some noncharacteristic representatives of the genus *Orthosphinctes* occurring in the Subzone are discussed in the description of the *H. beckeri* Zone.

Distribution. The Subzone is present in the section near the village of Komštica, Sofia District (Ginci Formation, No 8); in the valley of the Kostina River, to the south of the village of Ribarica, Loveč District (Neškovci Formation, one to fifty metres above the base); near the village of Lăga, to the north of the town of Etropole, Sofia District (Neškovci Formation, 58.50 m above the base); north of the Šipkovo Mineral Baths, area of Trojan, Loveč District (Neškovci Formation); in the Pločaka locality, to the south of the Vasiljov Peak, area of Teteven, Loveč District (Neškovci Formation) (Sapunov, 1976a).

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

Virgataxioceras setatum Subzone

Index species. *Virgataxioceras setatum* (Schneid, 1915) (Pl. VI, fig. 2).

Nomenclature. The Subzone is introduced here.

Table 2

Correlation among the Kimmeridgian ammonite zonal schemes of the first and third facies-fanual districts (according to Enay, Tintant & Rioult in Mouterde et al., 1971; Sapunov & Ziegler, 1976) in Bulgaria

Substages according to different authors			Subdivisions (Ziegler, 1964)	Facies-faunal districts (according to Sapunov & Ziegler, 1976)			Bulgaria
				First	Third		
				Zones	(Sub)zones		(Sub)zones
Lower (or Lower + Middle) (sensu anglico)	Upper	Upper	Kimm. VI	*Aulacostephanus autissiodorensis*	*Virgataxioceras setatum* / *Sutneria subeumela*	*Hybonoticeras beckeri*	*Virgataxioceras setatum* / *Sutneria subeumela*
		Middle	Kimm. V	*Aulacostephanus eudoxus* (or *A. pseudomutabilis*)			*Aspidoceras sesquinodosum*
			Kimm. IV	*Aulacostephanus mutabilis* (or *Aspidoceras acanthicum*)			*Crussoliceras*/*Aspidoceras sesquinodosum* Interval-zone
	Lower	Lower	Kimm. III	*Rasenia cymodoce*	*Streblites tenuilobatus*	*Crussoliceras divisum*	
			Kimm. II			*Ataxioceras (Ataxioceras) hypselocyclum*	
			Kimm. I	*Pictonia baylei*	*Sutneria platynota*		*Ataxioceras (Paratoxioceras) desmoides*

Stratigraphy. The lower boundary of the Subzone is defined in the description of the *S. subeumela* Subzone (see above). Its upper boundary coincides with the upper boundary of the *H. beckeri* Zone (see above).

The Bulgarian *V. setatum* Subzone is based on the range-zone of the index species (Fig. 2). In the zonal association it is accompanied by *Virgataxioceras setatoides* (Berckhemer in Berckhemer & Hölder, 1959) (occurring in the lower part of the Subzone) and *Torquatisphinctes* (?) (occurring in the upper part of the Subzone). *Aspidoceras bispinosum* (Zieten, 1831) is present in its upper part, extending probably above its upper boundary as well. Besides these species, some noncharacteristic representatives of genus *Orthosphinctes* are also to be found in the association of the Subzone. They are discussed in the description of the *H. beckeri* Zone.

Distribution. The Subzone is present near the village of Drugan (the hamlet of Staro Selo) to the southeast of the town of Radomir, Pernik District (Neškovci Formation); near the village of Lopjan, Sofia District (Černi-Osăm Formation, the lower 80 m); near the village of Bojkovec (Ravna), area of Etropole, Sofia District (Neškovci Formation, the lower part); in the section near the Koznica waterfall, to the south of the town of Teteven, Loveč District (Neškovci Formation, No 2) (Sapunov, 1876a).

Correlation. The Bulgarian *V. setatum* Subzone corresponds to the Subzone of the same name from the third facies-faunal district (see Table 2).

Phylloceratina and Lytoceratina in the Kimmeridgian of Bulgaria

In the Kimmeridgian rocks the representatives of Phylloceratina and Lytoceratina often form an appreciable portion of the ammonite faunas. Species belonging to the genera of *Phylloceras, Sowerbyceras, Ptychophylloceras* and *Holcophylloceras* have been found, as follows: *Phylloceras consanguineum* Gemmellaro, 1877 (Lower Kimmeridgian), *P. saxonicum* Neumayr, 1871 (Lower Kimmeridgian, *C. divisum* Zone), *P. isotypum* (Benecke, 1866) (Kimmeridgian), *Sowerbyceras loryi* (Munier-Chalmas in Hebert, 1875) (Lower Kimmeridgian, *C. divisum* Zone — Lower Tithonian, *H. hybonotum* Zone), *Ptychophylloceras ptychoicum* (Quenstedt, 1847) (Middle Kimmeridgian—Berriasian), *Holcophylloceras polyolcum* (Benecke, 1866) (Kimmeridgian — Lower Tithonian).

Lytoceratina. *Lytoceras polycyclum* Neumayr, 1871 (Middle and Upper Kimmeridgian) has been found.

Kimmeridgian Ammonite Species of Uncertain Stratigraphic Occurrence

During the present study several species belonging to Perisphinctidae, Aspidoceratidae, Haploceratidae and Glochiceratidae have been found, whose stratigraphic occurrence has remained insufficiently elucidated:

(1) *Metahaploceras kobyi* (C h o f f a t, 1893) — ?Upper Oxfordian (*E. bimammatum* Zone) — ?Lower Kimmeridgian (*A. (P.) desmoides* Zone) (the section near the village of Mitrovci, Mlihajlovgrad District; Javorec Formation, No 1, from the top);

(2) *M. rigidum* (W e g e l e, 1929) — ?Upper Oxfordian (*E. bimammatum* Zone) — ?Lower Kimmeridgian (*A. (P.) desmoides* Zone) (the section near the Javorec Peak, to the east of the village of Bov, Sofia District; Ginci Formation, No 5, from the middle part);

(3) *M. litocerum* (O p p e l, 1863) — ?Upper Oxfordian — ?Lower Kimmeridgian (*A. (P.) desmoides* Zone) (borehole section of R-1, Varna; Provadija Formation, 29.50 m above the base);

(4) *Nebrodites (Nebrodites) peltoideus* (G e m m e l l a r o, 1872) — ?Lower Kimmeridgian (*C. divisum* Zone) — ?Middle Kimmeridgian (the section near the Javorec Peak, to the east of the village of Bov, Sofia District; Ginci Formation, No 5, the upper part);

(5) *Nebrodites (Mesosimoceras) teres* (N e u m a y r, 1871) — ?Lower Kimmeridgian (*C. divisum* Zone) — ?Middle Kimmeridgian (*A. sesquinodosum* Zone, lower part) (locality to the west of the village of Ginci, Sofia District; Ginci Formation, the lower part, the exact position is unknown);

(6) *Orthosphinctes suevicus* (S i e m i r a d z k i, 1898) — ?Upper Oxfordian (*I. planula* Zone) — ?Lower Kimmeridgian (*A. (P.) desmoides* Zone) (near the village of Batkovci, at present merged with the village of Dragovištica, to the east of the Beledie Han, Sofia District; Javorec Formation);

(7) *Ochetoceras (Ochetoceras) irregulare* B e r c k h e m e r & H ö l d e r, 1959 — ?Upper Kimmeridgian (*H. beckeri* Zone, *V. setatum* Subzone) — ?Lower Tithonian (*H. hybonotum* Zone) (locality on the Berenderska River, between the villages of Berende and Svetlja, Pernik District; Zlatarica Formation, the lower part);

(8) *Hybonoticeras extraspinatum* B e r c k h e m e r & H ö l d e r, 1959 — ?Upper Kimmeridgian (*H. beckeri* Zone) — ?Lower Tithonian (*H. hybonotum* Zone) (the eastern edge of the Ginci Cliff, to the east of the village of Ginci, Sofia District; Ginci Formation, No 4, according to S a p u n o v & Z i e g l e r, 1976, p. 24) (S a p u n o v, 1976a).

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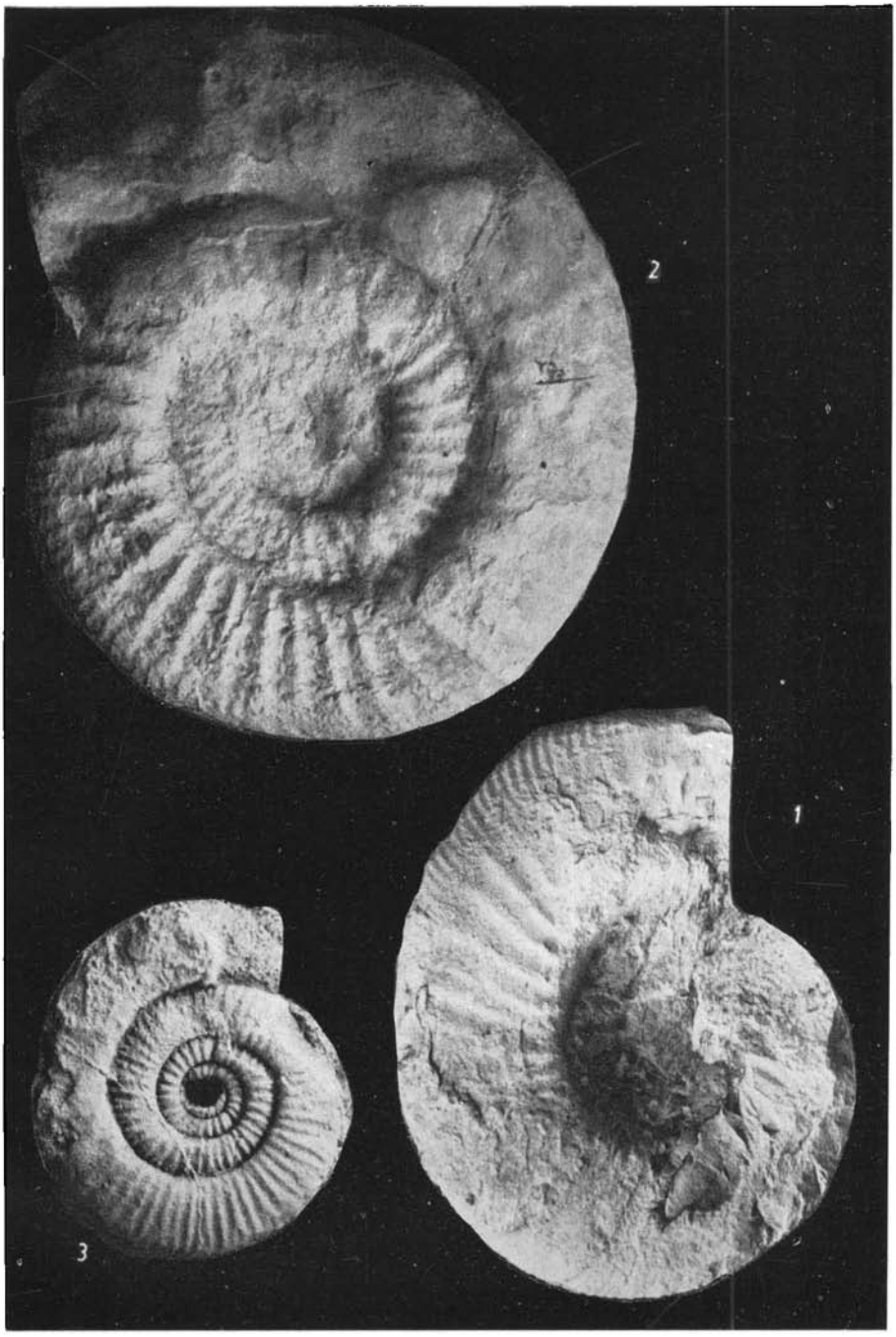
EXPLANATION OF PLATE I

(Early Kimmerdgian ammonites)

Fig. 1. *Ataxioceras (Parataxioceras) desmoides* W e g e l e, 1929. Locality near the hamlet of Neškovci, to the south of the village of Černi Osăm, area of Trojan, District of Loveč (Central Balkan). Ginci Formation, No. 3 [according to S a p u n o v & Z i e g l e r (1976 p. 27)], from the upper part (the grey nodular limestones) (S a p u n o v, 1976a, p. 35); Lower Kimmeridgian, *Ataxioceras (Parataxioceras) desmoides* Zone. Specimen of S a p u n o v & Z i e g l e r (1976, pl. 3, fig. 2), figured as '*Ataxioceras (Parataxioceras)* sp.'. Pal. Mus. Univ. Sofia, J264/46—9 (old number J5095). × 1.0.

Fig. 2. *Ataxioceras (Parataxioceras) inconditum* (F o n t a n n e s in D u m o r t i e r & F o n t a n n e s, 1876). Same locality, stratigraphic position and age (see above). Pal. Mus. Univ. Sofia, J265/48—1. × 1.0.

Fig. 3. *Nebrodites (Nebrodites) hospes* (N e u m a y r, 1873). Section near the village of Ginci, District of Sofia (West Balkan). Ginci Formation, No. 4 (S a p u n o v, 1976, p. 32); Lower Kimmeridgian, *Crussoliceras divisum* Zone. Pal. Mus. Univ. Sofia, J248/48—2. × 1.0.



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EXPLANATION OF PLATE II

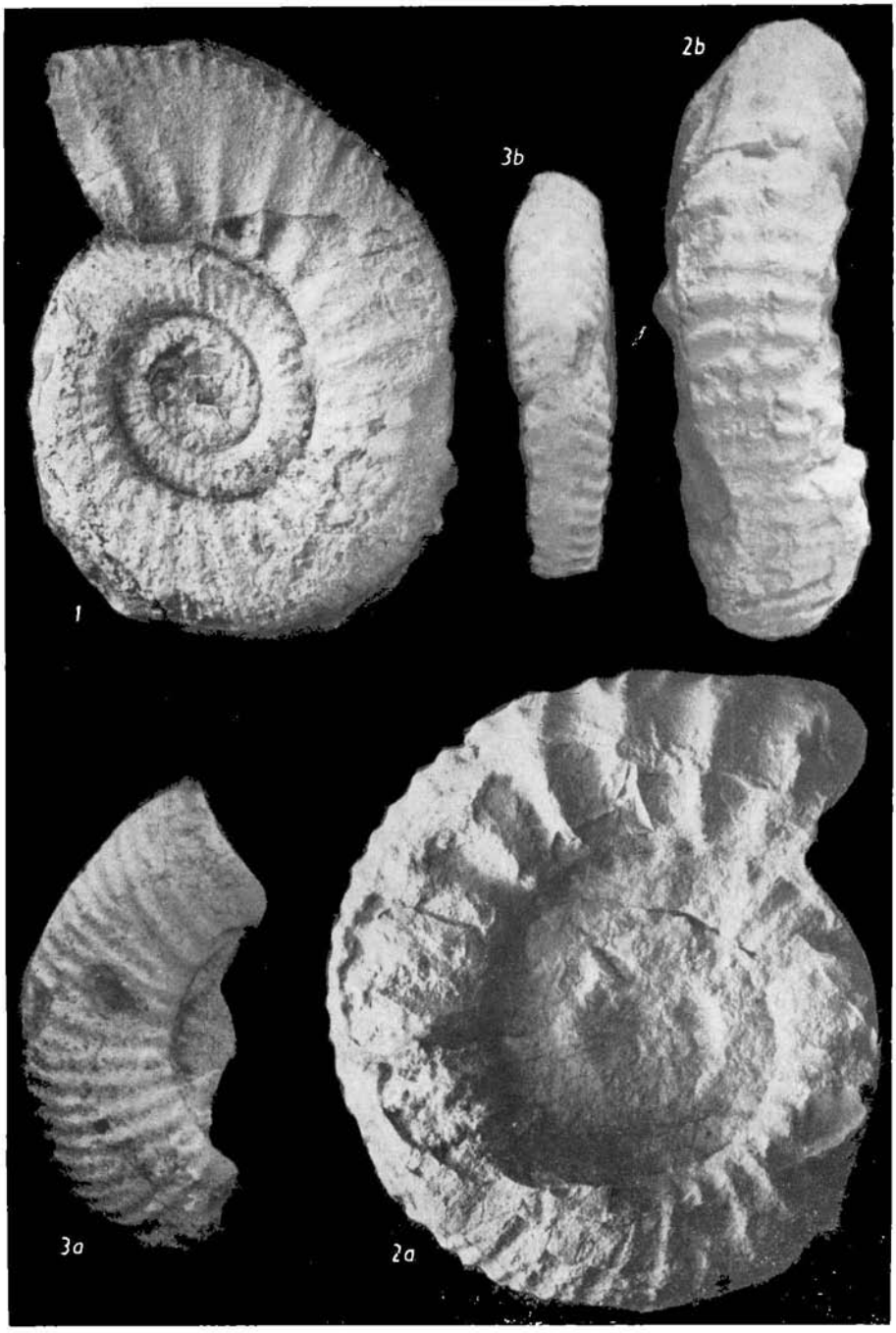
(Early Kimmeridgian ammonites)

Fig. 1. *Ataxioceras (Ataxioceras) lautum* S c h n e i d, 1944. Locality near the village of C rvenjano, District of Kjustendil (Kraištids). Ginci Formation, the position in the section is unclear (S a p u n o v, 1976a, p. 34); Lower Kimmeridgian, *Ataxioceras (Ataxioceras) hypselococyclum* Zone. Pal. Mus. Univ. Sofia, J309/48—3.× 1.0.

Figs. 2a, b. *Crussoliceras* sp. n. Section near the Orešec Railway Station, to the north of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, No. 1, from the lower part of the grey nodular limestones (S a p u n o v, 1976a, p. 28); Lower Kimmeridgian, *Crussoliceras divisum* Zone. Pal. Mus. Univ. Sofia, J262/48—4.× 1.0.

Figs. 3a, b. *Idoceras balderum* (O p p e l, 1863). Section near the village of Ginci, District of Sofia (West Balkan). Ginci Formation, No. 4 (S a p u n o v, 1976a, p. 32); Lower Kimmeridgian, *Crussoliceras divisum* Zone. Specimen of T o u l a (1893, p. 204, pl. 2, figs. 5a, b), described and figured as '*Simoceras* nov. sp.'. Pal Mus. Univ. Sofia, J256' 4—5.× 1.0.

PLATE II



EXPLANATION OF PLATE III

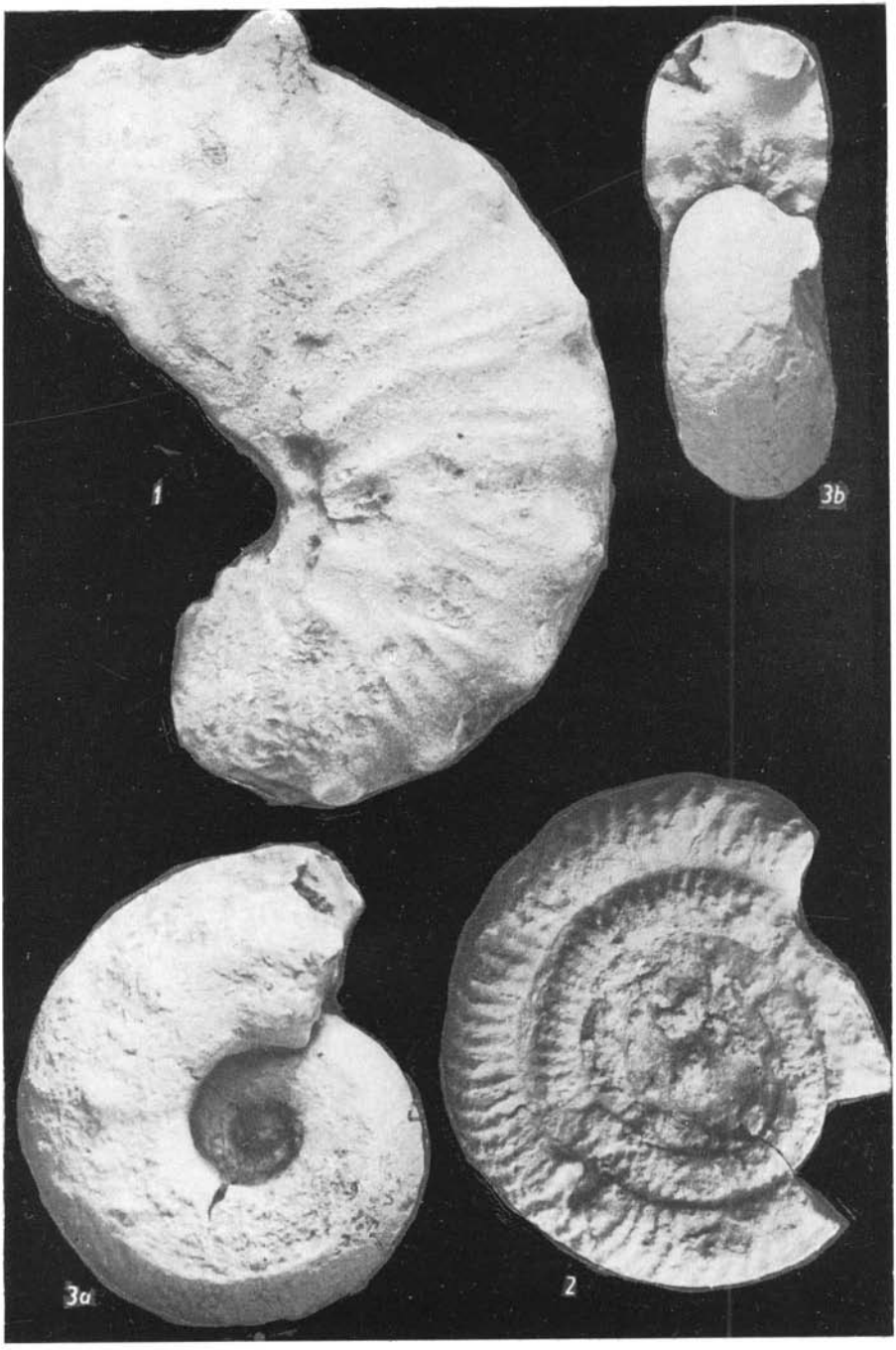
(Early & Middle Kimmeridgian ammonites)

Fig. 1. *Taramelliceras (Taramelliceras) trachinotum* (O p p e l, 1863). Locality near the village of Ravna, area of Godeč, District of Sofia (West Balkan). Ginci Formation, probably from the lower part (S a p u n o v, 1976a, p. 33); Lower Kimmeridgian,? *Ataxioceras (Ataxioceras) hypselocyclum* Zone — ?*Crussoliceras divisum* Zone. Pal. Mus. Univ. Sofia, J155/48—5. × 1.0.

Fig. 2. *Nebrodites (Mesosimoceras) cavouri* (G e m m e l l a r o, 1872). Locality to the west of the village of Ginci, District of Sofia (West Balkan). Ginci Formation, from the very base (S a p u n o v, 1976a, p. 33); Lower Kimmeridgian, *Crussoliceras divisum* Zone. Pal. Mus. Univ. Sofia, J254/48—6. × 1.0.

Figs. 3a, b. *Aspidoceras sesquinodosum* (F o n t a n n e s in D u m o r t i e r & F o n t a n n e s, 1876). Section near the village of Komštica, area of Godeč, District of Sofia (West Balkan). Ginci Formation, No. 6 (S a p u n o v, 1976a, p. 31). Middle Kimmeridgian, *Aspidoceras sesquinodosum* Zone. Pal. Mus. Univ. Sofia, J204/48—7. × 1.0.

PLATE III



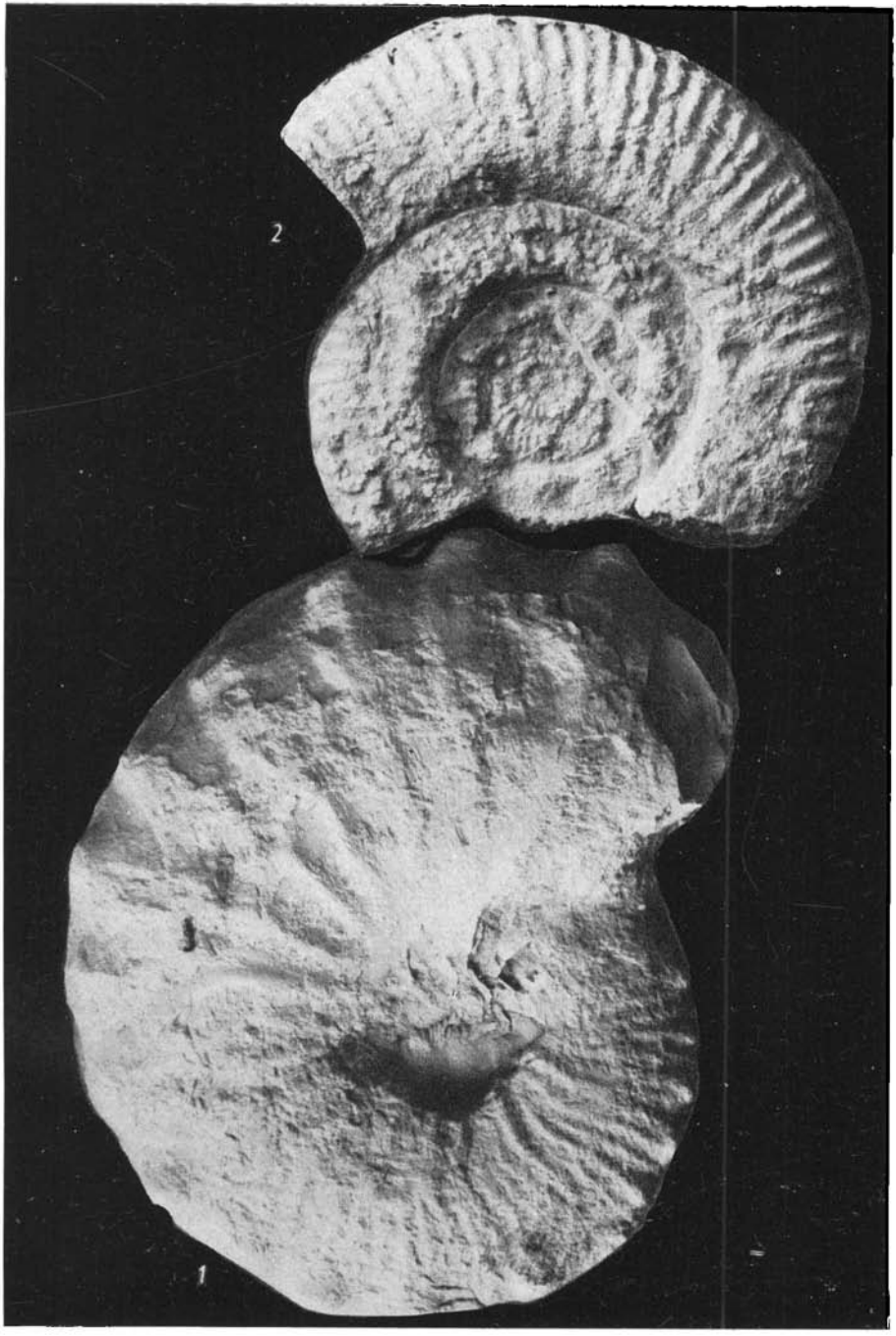
EXPLANATION OF PLATE IV

(Early(?) & Middle Kimmeridgian ammonites)

Fig. 1. *Taramelliceras (Taramelliceras) compsum compsum* (O p p e l, 1863). Section near the village of Erden, District of Mihajlovgrad (West Forebelkan). Ginci Formation, No. 3, from the lower part (S a p u n o v, 1976a, p. 30); Middle Kimmeridgian. Pal. Mus. Univ. Sofia, J158/48—8. × 1.0.

Fig. 2. *Nebrodites (Nebrodites) heimi* (F a v r e, 1877). Section near the Orešec Railway Station, to the north of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, No. 1, grey nodular limestones, the exact position is unclear (S a p u n o v, 1976a, p. 28); ?Lower Kimmeridgian, *Crussoliceras divisum* Zone — ?Middle Kimmeridgian, *Crussoliceras/Aspidoceras sesquinodosum* Interval-zone. Pal. Mus. Univ. Sofia, J240/48—9. × 1.0.

PLATE IV



EXPLANATION OF PLATE V

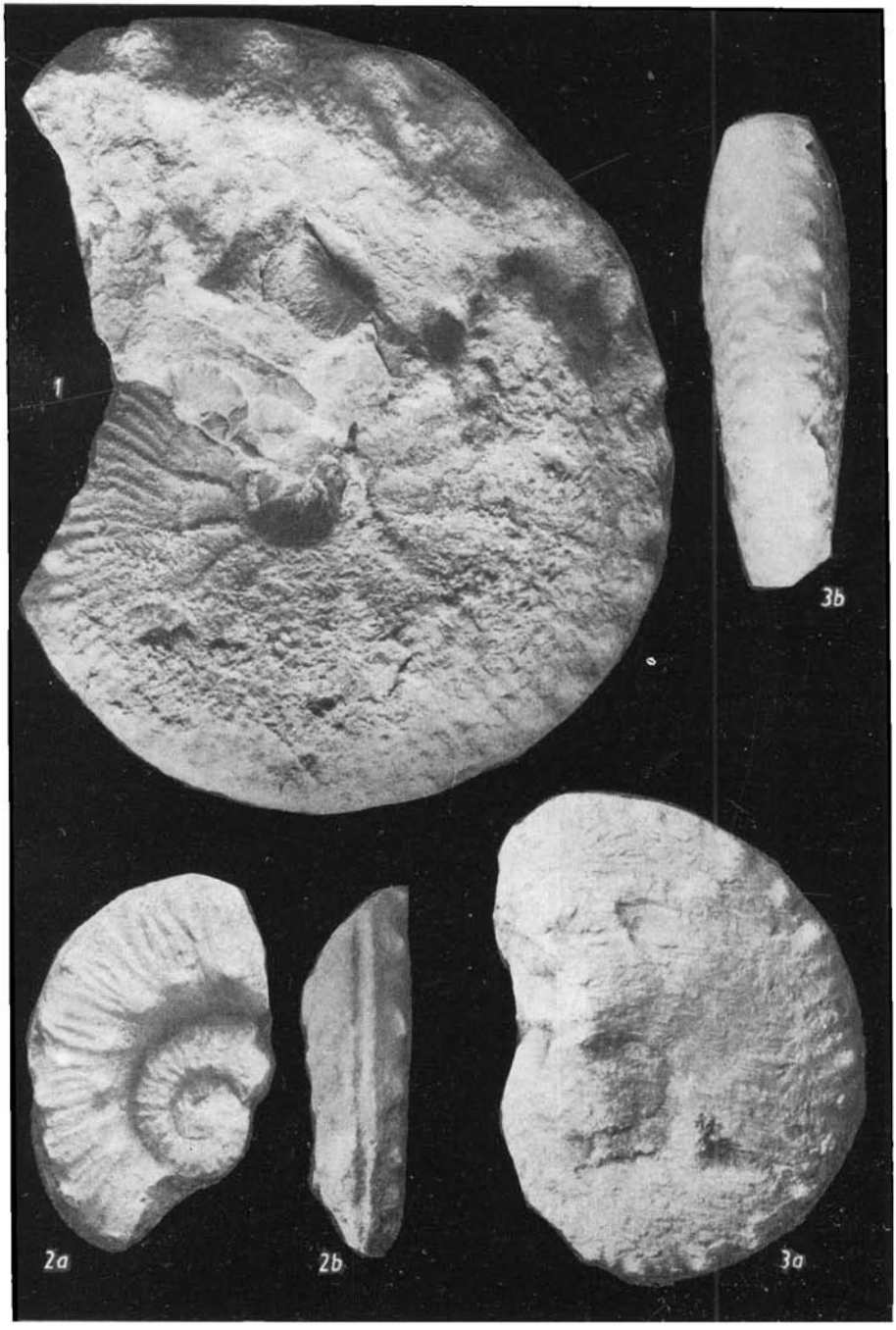
(Middle & Late Kimmeridgian ammonites)

Fig. 1. *Taramelliceras (Taramelliceras) compsum holbeini* (O p p e l, 1863). Section above the Koznica Waterfall, to the south of Teteven, District of Loveč (Central Forebalkan). Ginci Formation, No. 1 (S a p u n o v, 1976a, p. 37); Middle Kimmeridgian, *Aspidoceras sesquinodosum* Zone. Pal. Mus. Univ. Sofia, J160/48—10. × 1.0.

Figs. 2a, b. *Hybonoticeras beckeri* (N e u m a y r, 1873). Section near the village of Komštica area of Godeč, District of Sofia (West Balkan). Ginci Formation, No. 10 (S a p u n o v, 1976a, p. 31); Upper Kimmeridgian, *Hybonoticeras beckeri* Zone. Pal. Mus. Univ. Sofia, J90/48—11. × 1.0.

Figs. 3a, b. *Taramelliceras (Taramelliceras) pugile* (N e u m a y r, 1871). Section near the village of Belotinci, area of Belogradčik, District of Vidin (West Forebalkan). Ginci Formation, member of the upper nodular limestones, No. 14, at 1 m above the very base (S a p u n o v, 1976a, p. 29); Middle Kimmeridgian. Pal. Mus. Univ. Sofia, J192/48—12. × 1.0.

PLATE V



EXPLANATION OF PLATE VI

(Late Kimmeridgian ammonites)

Fig. 1. *Sutneria subeumela* S c h n e i d, 1915. Locality in the valley of Kostina River, to the south of the village of Ribarica, area of Teteven, District of Loveč (Central Balkan). Neškovci Formation, at 1 m above the very base (S a p u n o v, 1976a, p. 35); Upper Kimmeridgian, *Hybonoticeras beckeri* Zone, *Sutneria subeumela* Subzone. Pal. Mus. Univ. Sofia, J233/48—13. × 2.05.

Fig. 2. *Virgataxioceras setatum* (S c h n e i d, 1915). Section above the Koznica Water fall, to the south of the town of Teteven, District of Loveč (Central Forebalkan). Neškovci Formation, No. 2, from the upper part (S a p u n o v, 1976a, p. 37); Upper Kimmeridgian, *Hybonoticeras beckeri* Zone, *Virgataxioceras setatum* Subzone. Pal. Mus. Univ. Sofia, J223/48—14. × 1.0.

Figs. 3a, b. *Hybonoticeras harpephorum* (N e u m a y r, 1873). Section near the village of Erden, District of Mihajlovgrad (West Forebalkan). Ginci Formation, No. 3, from the upper part (S a p u n o v, 1976a, p. 29); Upper Kimmeridgian, *Hybonoticeras beckeri* Zone. Pal. Mus. Univ. Sofia, J102/48—15. × 1.0.

Fig. 4. *Hemihaploceras nobile* (N e u m a y r, 1873). Section near the village of Komštica, area of Godeč, District of Sofia (West Balkan). Ginci Formation, Nos. 8—10, the exact position is unclear (S a p u n o v, 1976a, p. 31). Upper Kimmeridgian, *Hybonoticeras beckeri* Zone. Pal. Mus. Univ. Sofia, J180/48—16. × 1.0.

PLATE VI