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The ammonite zones of the Bathonian in Bulgaria

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Abstract. A scheme of nine ammonite zones for the Bathonian in Bulgaria is described herein. The stratigraphical distribution of the Bathonian ammonites has been revised through new collecting and re-examination of older collections and fields. It has become evident that the criteria for zonal discrimination applied in NW Europe are relevant for Bulgaria to a limited extent, and we cannot compare directly our successions with those from the NW European areas as done in earlier work. Also, many traits of typically Submediterranean dispersal have been found to take a considerable part of the ammonite associations. Therefore, a composite Submediterranean–NW European zonation seems to be applicable to the Bathonian ammonite successions in Bulgaria. The ammonite zonal scale used in previous Bulgarian accounts has been retained, but several changes have been made to attain a more balanced sequence. This scale can be subject to further confirmation and modification, as not enough biostratigraphically well-constrained specimens have yet become available to characterize the ranges and variability of the zones.

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INTRODUCTION

The marine sediments of the Bathonian in Bulgaria are developed in two main facies: shallower (ooidal-crinoidal-bioclastic limestones and calcareous sandstones) and deeper-marine (mudstone-marlstone deposits). The shallower facies corresponds to the Polaten Formation and has yielded well-preserved ammonites, mostly from the highly condensed stratigraphic intervals in NW Bulgaria (*e.g.*, Sacharieva-Kowatcheva, 1956; Stephanov, 1961, 1966, 1972). The deeper-marine facies refers to the marlstone-limestone successions of the Bov Formation and crops out in West and central North Bulgaria. It is less known regarding the ammonites (*e.g.*, Stephanov, 1963) but, being developed in more expanded ammonite-bearing sequences, it has good potential for biostratigraphical studies. Our attempts over recent years to find new diagnostic ammonite associations in the deeper-marine sediments were partly rewarded as we have identified stable successions in superposition, but also a number of condensation events and gaps. The ammonites from this facies are seldom well-preserved and therefore problematic for the purposes of biostratigraphical classification. Thus, in the Bathonian ammonite record in Bulgaria, there is a serious imbalance. Many ammonites were well studied from taxonomic viewpoint, mainly due to the dedicated research of July Stephanov, but the stratigraphical distribution of the identified taxa still remains unclear. After the death of Stephanov in 1966, the studies of Bulgarian Bathonian ammonites ceased and to date there has been little further contribution. We retain the Bathonian ammonite zonal scale published by Sapunov and Stephanov (1964) and Stephanov (1966, 1972), with several changes, both of which can be subject to further confirmation and modification. These alterations are necessary for attaining a more balanced zonal sequence, as compared with that of previous works, which followed the scheme of Arkell's monograph *The English Bathonian ammonites*. This report includes reduced faunal and reference lists and will be presented in more details elsewhere.

THE BATHONIAN AMMONITES IN BULGARIA

The Jurassic ammonite faunas of Bulgaria exhibit a marked transition in the Bathonian, from Northwest European to Submediterranean appearance. Accord-

ingly, the NW European criteria for zonal discrimination, applied for instance in the UK, Germany and Northern France (*e.g.*, Cope *et al.*, 1980; Schlegelmilch, 1985; Mangold *et al.*, 1994), are relevant for that of Bulgaria to a limited extent, and we cannot compare directly our successions with those from the NW European areas as done in earlier work. We propose a Bathonian ammonite scheme, having NW European elements but also including traits of Submediterranean dispersal, which are close to some coeval faunas recorded in Spain, SE France, SW England, Italy and Hungary (*e.g.*, Sandoval, 1983; Page, 1996; Géczy and Galácz, 1998; Mangold *et al.*, 2012) and hence comparable with the Submediterranean zonation proposed by Mangold and Rioult (1997). A number of the European Submediterranean faunas are, however, not known in Bulgaria so far, which leads us to believe that such missing elements have only local significance and do not hinder our correlation. In view of current knowledge, it is impossible to assess satisfactorily the validity of the generic (subgeneric) names for Bulgarian Bathonian ammonites. Therefore, this account comprises generic names taken from past Bulgarian literature, but also previously used subgenera raised to the rank of genera alongside reclassified species now assigned to other genera, in accordance with new data.

The lower boundary of the Bathonian in Bulgaria is drawn at the appearance in numbers of the ammonite genera *Lobosphinctes* and *Planisphinctes,* followed up-section by *Siemiradzkia*, as well as at the advent of the genera *Morphoceras* and *Ebrayiceras*. It roughly coincides with the increased diversification of the genera *Oxycerites* and *Oecotraustes* (*O. geniculatis* Waagen, the type-species of the latter taxonomic group, is a microconch of *Oppelia*; cf. Fernández-López, 1985, p. 229). The decline of the parkinsoniids, such as *Parkinsonia* and *Gonolkites*, has been recorded near the base of the stage. The upper boundary of the Bathonian is drawn below the mass incoming of *Macrocephalites* (*sensu lato*). Regardless of their low stratigraphical value, it should be noted that the ammonites of the genus *Lissoceras* are fairly common. It should be also noted that the Phylloceratina appear in increased numbers, in contrast to the rocks from older Jurassic stages, where they are extremely rare. The threefold subdivision of the Bathonian in Bulgaria, first applied by Sapunov and Stephanov (1964), is followed herein (Table 1), and our views on the extent of the Bathonian substages are supported by details for each of the constituent ammonite zones.

LOWER BATHONIAN AMMONITE ZONES

The lower Bathonian in Bulgaria corresponds to the combined stratigraphical distribution of the following ammonite genera: *Lobosphinctes*, *Planisphinctes*, *Siemiradzkia*, *Morphoceras*, *Ebrayiceras*, *Cadomites* and *Polyplectites*. The latter two genera continued ranging from the upper Bajocian but evolved into new species. The lower Bathonian also includes the main occurrence of the genus *Oecotraustes*, as well as of two groups of the genus *Oxycerites*: *O.* gr. *aspidoides* (Oppel) and *O.* gr. *fallax* (Guéranger). *Paroecotraustes* probably appears around the middle of the substage. The first *Bullatimorphites* appears near the top. Three ammonite zones have been distinguished: *Gonolkites convergens*, *Morphoceras macrescens* and *Siemiradzkia repljanensis* (Table 1). The former two zones cover the extent of the *Convergens* and the *Multiforme* subzones, respectively, of the *Zigzag* Zone *sensu* Sapunov and Stephanov (1964), whereas the *S. repljanensis* Zone substitutes the *Fallax* Subzone of the *Zigzag* Zone (Stephanov, 1972). Since the genus *Zigzagiceras* has never been found in Bulgaria, the *Zigzag* Zone was abandoned. The absence of a stratigraphical link between the associations of the former subzones motivated us to promote these subzones to the rank of zones.

Gonolkites convergens Zone

This zone corresponds to the *Convergens* Subzone of the *Zigzag* Zone as used by Stephanov (1972). We retain the name, although we opine that this taxon is unsuitable for index species, because it has never been recorded and the genus *Gonolkites* is uncommon in Bulgaria. We could offer as local index for this association some of the known species of the genera *Lobosphinctes* and *Planisphinctes*, since these ammonites are widespread at the very base of the Bathonian. The genus *Lobosphinctes*, as interpreted herein, includes ammonites previously assigned to *Procerites* (Stephanov, 1961), whereas *Planisphinctes* includes species formerly classified as a subgenus of the genus *Siemiradzkia* (Stephanov, 1972). The ranges of these genera have not been defined properly in more expanded successions to date. No alternatives from the co-occurring ammonites of the association are available, as the rest of our material consists of ancillary elements in the form of rare *Cadomites* and *Polyplectites*, and scarce *Oxycerites* and *Oecotraustes*, none of which is yet sufficiently well known to be a reliable guide species. We consider that the *G. convergens* Zone in Bulgaria approximates the *Morphoceras parvum* Subzone of the *Zigzagiceras zigzag* Zone proposed in the Submediterranean scheme of Mangold and Rioult (1997), as the record from this association includes enough characteristic species that often occur in abundance. The revision of the type-section of the Bov Formation, including some newly excavated sections in the type-area of this formation, has recently extended our knowledge of the Bathonian deposits to the Bulgarian/Serbian border region in West Bulgaria (Gubesh–Komshtitsa villages area) and in East Serbia (Senokos Village area), and allowed the reconstruction of a biostratigraphically reliable sequence. Hence, the association of the *G. convergens* Zone was seen in a

few decimetre-thick fossiliferous beds, with numerous *Lobosphinctes tmetolobus* (Buckman), *L. subprocerus* (Buckman), *Planisphinctes incognitus* Stephanov, *P. planilobus* (Buckman) and *P. donovani* (Stephanov), associated with less common *Cadomites*, *Polyplectites* and *Gonolkites*. In addition, from other known localities in Bulgaria, this zone also includes scattered ammonites of the genus *Parkinsonia*. Thus, the Bulgarian *G. convergens* Zone comprises a reasonable composition in comparison to the GSSP for the base of the Bathonian Stage (see Pavia *et al.*, 2008; Fernández-López *et al.*, 2009).

Table 1

Correlation between the Bulgarian Bathonian ammonite zones and the standard zones and subzones of the NW European and Submediterranean provinces (after Mangold and Rioult, 1997)

SUBSTAGE	Submediterranean Province		Bulgaria		NW European Province		SUBSTAGE
	Zone	Subzone	Ammonites*	Zone	Subzone	Zone	
UPPER BATHONIAN	*Clydoniceras discus*	*Clydoniceras discus*		*Clydoniceras discus*	*Clydoniceras discus*	*Clydoniceras discus*	UPPER BATHONIAN
		Clydoniceras hollandi/*H. (P.) anguli-costatum*			*Clydoniceras hollandi*		
	Hecticoceras (Prohecticoceras) retrocostatum	*B. (K.) hannovera-nus*/*(E. histricoides)*		*Oxycerites oppeli*	*B. (K.) hannoveranus*	*Oxycerites oppeli*/*(orbis)*	
		H. (P.) blanazense/*(H. julii)*			*H. (P.) blanazense*		
MIDDLE BATHONIAN	*Cadomites bremeri*	*Wagnericeras fortecostatum*		*Procerites hodsoni*	*Procerites hodsoni*		
		Bullatimorphites bullatimorphus					
	Morrisiceras morrisi			*Morrisiceras morrisi*	*Morrisiceras morrisi*		MIDDLE BATHONIAN
	Tulites subcontractus			*Tulites subcontractus*	*Tulites subcontractus*		
	Procerites progracilis	*Procerites progracilis*		*Procerites progracilis*	*Procerites progracilis*		
		Cadomites orbignyi					
LOWER BATHONIAN	*Procerites (Siemi-radzkia) aurigerus*	*Asphinctes tenuiplicatus*		*Siemiradzkia repljanensis*	*Asphinctes tenuiplicatus*		LOWER BATHONIAN
		Asphinctes recinctus			*Oxycerites yeoviliensis*	*Zigzagiceras zigzag*	
	Zigzagiceras zigzag	*Morphoceras macrescens*		*Morphoceras macrescens*	*Morphoceras macrescens*		
		Morphoceras parvum		*Gonolkites convergens*	*Gonolkites convergens*		

*Diagnostic and ancillary species: *a*) *Lobosphinctes tmetolobus* (Buckman); *b*) *Planisphinctes donovani* (Stephanov); *c*) *Morphoceras macrescens* (Buckman); *d*) *Siemiradzkia procera* (von Seebach); *e*) *Siemiradzkia repljanensis* Stephanov; *f*) *Oxycerites* gr. *fallax* (Guéranger); *g*) *Siemiradzkia britanica* Stephanov; *h*) *Siemiradzkia irregularis* Stephanov; *i*) *Cadomites orbignyi* (de Grossouvre); *j*) *Siemiradzkia strungensis* Stephanov; *k*) *Siemiradzkia pseudorjazanensis* (Lissajous); *l*) *Siemiradzkia matisconensis* (Lissajous); *m*) *Rugiferites rugifer* (Buckman); *n*) *Siemiradzkia davitashvilii* Stephanov; *o*) *Paroecotraustes prevalensis* (Stephanov); *p*) *Procerites* gr. *wattonensis* Arkell; *q*) *Procerites magnificus* Arkell; *r*) *Wagnericeras lissajousi* (Beznosov); *s*) *Prevalia pseudoperspicua* (Stephanov); *t*) *Homoeoplanulites mouterdei* Mangold, Martin & Prieur; *u*) *Traxites haemussensis* (Stephanov); *v*) *Choffatia vicenti* Mangold; *w*) *Oxycerites oppeli* Elmi; *x*) *Clydoniceras discus* (J. de C. Sowerby); *y*) *Choffatia richei* Mangold; *z*) *Choffatia arisphinctoides* (Arkell).

Morphoceras macrescens Zone

The zone includes the stratigraphical distribution of the ammonite genera *Morphoceras* and *Ebrayiceras*. As stated above, it corresponds to the *Multiforme* Subzone of the *Zigzag* Zone as established by Stephanov (1972), who used *Morphoceras multiforme* Arkell as a guide fossil, assuming that it is more common in Bulgaria than *Morphoceras macrescens* (S. Buckman). However, numerous specimens of *M. macrescens* have been recorded during the last years, showing that this species is common enough and its presence is a sufficient indication to denote the zone in which it occurs. The stratigraphical relationship between the *multiforme* and *macrescens* faunas is unclear in Bulgaria, but there are indications that *Morphoceras* emerges later than the earliest record of the genus documented elsewhere (*e.g.*, Pavia *et al*., 2008; Fernández-López *et al.*, 2009). The *M. macrescens* Zone is typified by the index-species and *M. multiforme*, as well as by much less-common *Ebrayiceras pseudoanceps* (Ebray) and *E.* gr. *sulcatum* (Zieten). Frequent *Oxycerites* gr. *posterus* (Wetzel), *O. yeoviliensis* Rollier and *Polyplectites linguiferus* (d'Orbigny) are also associated with this zone. Some of the ammonites assigned by Stephanov (1966) to *Oecotraustes nodifer* Buckman and *O. costiger* Buckman are probably related to this association, but their exact occurrence is not clear, due to imperfect preservation in condensed beds. The zonal association provides the earliest record of the genera *Siemiradzkia* and *Paroecotraustes*, including *Siemiradzkia* gr. *procera* (von Seebach) and *Paroecotraustes* spp. Regardless of the paucity of the assemblage list, we suggest that the *M. macrescens* Zone in Bulgaria is equivalent to the *M. macrescens* Subzone of the *Z. zigzag* Zone in the Submediterranean zonal scale of Mangold and Rioult (1997).

Siemiradzkia repljanensis Zone

This zone replaces the *Fallax* Zone from the earlier scheme of Sapunov and Stephanov (1964) and the *Fallax* Subzone of the *Zigzag* Zone of Stephanov (1972). We prefer this index to *Oxycerites fallax* (Guéranger). The latter is not a suitable index as very similar *Oxycerites* species occur in the lower Bathonian and their exact stratigraphic position is not precisely known. Therefore, it would be better to use the local index-species *Siemiradzkia repljanensis* Stephanov, since the presence of the possibly coeval *S. aurigera* (Oppel), which is widely used abroad, is doubtful in Bulgaria (see Stephanov, 1972, pp. 52, 53). We assume a wider development of the *S. repljanensis* Zone than that adopted by previous authors in Bulgaria. It was thought that the zonal association is incomplete due to the lack of ammonites related to the upper part of the zone. However, we have recently discovered several fragments of "*Asphinctites*" spp., "*Procerites*" gr. *imitator* (Buckman) and *Bullatimorphites* gr. *latecentratus* (Quenstedt) that give us reason to conclude that the *S. repljanensis* Zone includes at least some of the missing members of this association. The main content of the zone corresponds to the index-species itself, as well as to *Siemiradzkia* faunas, such as *S. irregularis* Stephanov, *S. procera* (von Seebach) and *S. britanica* Stephanov. These species were carefully studied by Stephanov (1972) but all were from condensed deposits. Our confidence to classify them biostratigraphically now comes from the new sequences of the Bov Formation, in which we found good matches. Conditionally, we assign to this zone *Oxycerites fallax* and *O. seebachi*. In view of these considerations, it is believable that the *S. repljanensis* Zone is an equivalent of the Submediterranean *Procerites* (*Siemiradzkia*) *aurigerus* Zone (Mangold and Rioult, 1997).

MIDDLE BATHONIAN AMMONITE ZONES

The middle Bathonian in Bulgaria corresponds to the combined occurrence of species from the ammonite genera *Procerites*, *Siemiradzkia* and *Cadomites*. The *Bullatimorphites*, *Tulites*, and *Oxycerites* gr. *oxus* (Buckman) also occur, but sporadically. *Morrisiceras* are virtually absent. We propose three ammonite zones to be in use: *Procerites progracilis*, *Tulites subcontractus* and *Morrisiceras morrisi* (Table 1). The zones retain the names as used by Sapunov and Stephanov (1964). However, these labels stay behind ammonite assemblages that remain poorly defined. In practice, it is often not possible to distinguish reliable material. Neither the indices nor the ammonite zones are easily discernible, and more data are needed to refine them.

Procerites progracilis Zone

This zone has been overlooked within the scarce *Procerites* gr. *progracilis* specimens that were used as the basis for its introduction in Bulgaria (Sapunov and Stephanov, 1964). In the following works of Stephanov (1966, 1972), this situation persisted, as these were Stephanov's last publications, which appeared after his death. It has recently been confirmed that the beds from this level often yield *Procerites* faunas, but they display such an irregular occurrence and incomplete preservation that no certain identification is possible. It has also been found that this level contains *Cadomites* gr. *orbignyi* (de Grossouvre) and *Polyplectites* spp., which are better preserved than *Procerites*. However, both *Cadomites* and *Polyplectites* are not good guide fossils due to the considerable homeomorphism between different species (see Page, 1996). Scarce *Oecotraustes* occur in this level, but they are not good guide fossils, either. Yet with no comparable faunas, the upper parts of the beds attributable to the *P. progracilis* Zone provided common specimens of *Siemiradzkia*. A careful study of descriptions given by J. Stephanov led us to conclude that these ammonites match the description of *Siemiradzkia strungensis*

(Stephanov, 1972, pp. 55–56), although he suggested a higher stratigraphical distribution of this species. We believe that its original position is within this zone, and this taxon likely has older range than reported in the original publication. It is probable that the top of the *P. progracilis* Zone equates to the first appearance of large *Procerites* faunas, namely *Procerites mirabilis* (Arkell). Although the association of this zone in Bulgaria is quite poor in composition, we suggest it as approximate equivalent of the *P. progracilis* Zone in the scheme of Mangold and Rioult (1997).

Tulites subcontractus and *Morrisiceras morrisi* zones

These zones were both introduced without adequate record and clear definitions. Stephanov (1963) and Sapunov and Stephanov (1964) concisely applied the *Subcontractus* Zone. Likewise, Stephanov (1966, 1972) used it later, but he inserted the *Morrisi* Zone at the top of the middle Bathonian, probably on account of the upper wider part of the *Subcontractus* Zone. Therefore, we face the problem of what to do with these zones. We are confident that no authentic *Morrisiceras* record exists in Bulgaria. The *Tulites* faunas, whose distribution is supposed to be present in these zones, occur inconsistently. Hence, the need for new indices is essential. It is the genus *Siemiradzkia* that presents the only valuable element of these ammonite associations. We are presently unable to provide a solution, and therefore the *T. subcontractus* and the *M. morrisi* zones remain in use.

The *Tulites subcontractus* Zone, as now recognized, includes several *Tulites* spp., single *Rugiferites polypleurus* (Buckman) and *R. rugifer* (Buckman), a few *Bullatimorphites* spp., as well as possibly the latest representatives of *Oecotraustes nodifer* Buckman. Also, it comprises *Paroecotraustes* gr. *splendens* Arkell, some poorly preserved *Oxycerites* gr. *oxus* (Buckman), as well as *Siemiradzkia*, in which we recognized common specimens of *S. davitashvilii* Stephanov. This reduced faunal list reflects some elements listed from the *T. subcontractus* Zone by Mangold and Rioult (1997, pp. 58, 59).

The ammonites attributed to the *Morrisiceras morrisi* Zone have not been confirmed by the occurrence of true *Morrisiceras* in Bulgaria to date. It appears that the *Morrisi* Zone *sensu* Stephanov (1966, 1972) is quite capacious and probably corresponds to the combined extent of the *Morrisiceras morrisi* and the *Cadomites bremeri* zones, which are in the Submediterranean scheme (Mangold and Rioult, 1997). The *M. morrisi* Zone, as now used, has a narrower extent than previously thought and, on account of the upper part of the earlier *Morrisi* Zone and the older *Retrocostatum* Zone *sensu* Stephanov (1966, 1972), we propose the *Procerites hodsoni* Zone (see below). Our data have not yet been recorded widely in a normal sequence, but progress is being made. The main components of the present *M. morrisi* Zone are two groups of ammonites of the genera *Siemiradzkia* and *Paroecotraustes*: *Siemiradzkia matisconensis* (Lissajous) (including *S. triballa* and *S. galla* taken from Stephanov, 1972, that do not appear to be a distinct species, but merely morphological variants), *S. pseudorjazanensis* (Lissajous), *Paroecotraustes ziegleri* (Stephanov), *P. splendens* (Arkell), *P. formosus* (Arkell) and *P. glojanensis* (Stephanov). Together, these faunas are the only evidence based on which an approximate correlation between the Bulgarian *M. morrisi* Zone and the coeval Submediterranean ammonite zone in the scheme of Mangold and Rioult (1997) can be drawn.

UPPER BATHONIAN AMMONITE ZONES

Following the scarcely fossiliferous middle Bathonian strata, the rocks of the upper Bathonian yielded numerous and diverse ammonites from both older Bulgarian collections and the newly obtained specimens. However, the middle/upper Bathonian boundary remains arbitrary, and it is impossible to be more precisely drawn for the time being. The upper Bathonian corresponds to the occurrence of the genera *Procerites*, *Siemiradzkia*, *Prevalia, Wagnericeras, Oxycerites* and *Clydoniceras*, although the latter genus occurs rarely. *Paroecotraustes* persisted to and became extinct at the top of the substage. The genus *Thraxites* emerged near the base. The first pseudoperisphictids appeared and diversified throughout the substage, and common *Homoeoplanulites* and less frequent *Choffatia* are also recorded. They range upwards into the lower Callovian but occur as different species. Rare *Bullatimorphites* and *Hemigarantia* were also evidenced. The upper Bathonian is subdivided into the *Procerites hodsoni*, *Oxycerites oppeli* and *Clydoniceras discus* zones (Table 1). The former two zones correspond to the older *Aspidoides* Zone (Sapunov and Stephanov, 1964) and its later divisions, the "*Retrocostatum*" Zone and the "*Aspidoides* Zone" (Stephanov, 1966), whereas the topmost zone conforms to the *Discus* Zone of Sapunov and Stephanov (1964) and Stephanov (1972). With respect to the older *Discus* Zone, the occurrence of the zonal index was virtually the only criterion to identify the zone in previous times. The only known record of *Clydoniceras discus* (Sowerby) is based on a few ammonites from two localities in Bulgaria.

Procerites hodsoni Zone

The older name, *Prohecticoceras retrocostatum* (de Grossouvre), has always been tentatively used as an index (see Stephanov, 1966), since the true *Prohecticoceras* are rare in Bulgaria. The name "*Aspidoides*" is also inappropriate. As stated by Dietl (1982), the type locality of *Oxycerites aspidoides* (Oppel) lies stratigraphically in much lower horizon than previously thought (*i.e.*, the upper Bajocian/lower Batho-

nian boundary interval), and hence this species cannot any longer be used as index for the upper Bathonian. In support of this view, Mangold and Rioult (1997) stated that *O. aspidoides* is present in the lower Bathonian, regardless of whether it would be considered a separate species or interpreted as a morphological variant of another species of the genus *Oxycerites*. Accordingly, the upper Bathonian *Oxycerites* faunas that are similar, but clearly stratigraphically separated from *O. aspidoides*, must be distinguished and placed in another species. Elmi (1967) erected *Oxycerites oppeli* to address this issue. In agreement with that view, the "*Aspidoides* Zone" has recently been disused in Bulgaria (Metodiev *et al.*, 2013).

The main elements of the *Procerites hodsoni* Zone are the abundant *Procerites* species [*e.g.*, *Procerites* gr. *quercinus* (Terquem & Jourdy), *P.* gr. *wattonensis* Arkell, *P. hodsoni* Arkell and *P. magnificus* Arkell]. Significant components of this association are the species of the genus *Prevalia*: *P. pseudoperspicua* (Stephanov), *P. subfluctucosa* (Lissajous), *P. bassae* (Stephanov), *P. subcongener* (Lissajous), *P. prevalensis* (Stephanov) and *P. thressa* (Stephanov). Some of these species may range higher but do not reach the *C. discus* Zone. The *P. hodsoni* Zone also yielded common *Siemiradzkia berthae* (Lissajous), *Paroecotraustes maubeugei* (Stephanov), *P. splendens* (Arkell) and *P. ziegleri* (Stephanov). Some of them came from below and continued ranging up-section. The zonal association also includes common *Wagnericeras* species (see Metodiev, 2015). The pseudoperisphinctids recorded from this zone are similar to those from the French Jura Mts (Mangold, 1970 Mangold et al., 2012). We obtained some *Homoeoplanulites mouterdei* Mangold, Martin & Prieur, *H. bugesiacus* (Dominjon) and *Choffatia vicenti* Mangold. The association also includes scarce *Bullatimorphites stephanovi* Galácz, *Traxites haemussensis* (Stephanov) and a single *Hemigarantia julii* (d'Orbigny). The recorded species have significance for improving the definition of the Bulgarian *P. hodsoni* Zone, but not enough specimens have yet become available to characterize its range and variability. The extent of this zone in Bulgaria, even as it stands, coincides with the full extent of the Submediterranean *Cadomites bremeri* Zone plus the base of the *Hecticoceras* (*Prohecticoceras*) *retrocostatum* Zone. It is at the same time a local equivalent of the NW European *P. hodsoni* Zone (Mangold and Rioult, 1997). Thus, the middle/upper Bathonian boundary is moved lower than it was previously drawn in Bulgaria, so that it matches the one defined in Northwest Europe.

Oxycerites oppeli Zone

This zone has only recently been introduced in Bulgaria (Metodiev *et al.*, 2013). It contains good examples of the index-species, as well as of *Oxycerites subinflexus* (de Grossouvre) and *Paroecotraustes waageni* (Stephanov). We supplement the zonal association with examples of *Homoeoplanulites couxi* (Dominjon), *H. mangoldi* (Dominjon), *Choffatia praecursor* Mangold and *Choffatia richei* Mangold. It appears that the faunal content of the *O. oppeli* Zone is sufficiently comparable to that from the NW European *Oxycerites oppeli*/(*orbis*) Zone and resembles to a lesser extent the Submediterranean *H.* (*P.*) *retrocostatum* Zone (Mangold and Rioult, 1997). So far, the known Bulgarian ammonite fields do not indicate the existence of characteristic faunas of Submediterranean dispersal, such as *Bomburites–Kheraiceras*, *Epistrenoceras* and *Parapatoceras*.

Clydoniceras discus Zone

The *Clydoniceras discus* Zone, used in earlier works of Stephanov, relies only on the occurrence of the index. Two subzones, "*Hollandi*" and "*Discus*", were used in his last work (Stephanov, 1972). However, we did not find any original supporting evidence. Recent efforts to advance our understanding of this zone have made little improvement in the identification of two commonly encountered upper Bathonian groups of ammonites assigned to *Choffatia*: *C. arisphinctoides* (Arkell) and *C. arkelli* Mangold. Some *Homoeoplanulites* also occur but have not been studied yet. Attempts must be made to gather more material in order to conclude if this zone really is an equivalent of the *C. discus* Zone as used in Europe (Mangold and Rioult, 1997).

CONCLUSIONS

As demonstrated in this account, a composite Submediterranean–Northwest European zonation seems to be applicable to the successions of Bathonian ammonite faunas in Bulgaria. And here arises the question whether it is appropriate to restrict one or another group of Bathonian ammonites to NW European or Submediterranean preference. It is apparent that the roles of the genera and species typifying the zonal associations are inconsistent. Also, it is clear that certain genera, especially *Lobosphinctes*, *Planisphinctes*, *Siemiradzkia*, *Prevalia*, *Choffatia* and *Homoeoplanulites*, are the taxa that have the greatest potential for building more correlative ammonite zonal set for the Bathonian in Bulgaria.

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