Mineralia slov.
20 *(1988), 5, 387—415*

The Triassic foraminifera microbiostratigraphy of the Carpathian — Balkan and Hellenic realm

JOZEF SALAJ*, EKATERINA TRIFONOVA**, DOINA GHEORGHIAN***, VANA CORONEOU****

* Dionýz Štúr Institute of Geology, Mlynská dolina 1, 817 04 Bratislava, Czechoslovakia
** Geological Institute, Bulgarian Academy of Science, Georgi Bončev 24, 1113 Sofia, Bulgaria
*** Institute of Geology, Str. Caransebes 1, 78344 Bucuresti, Romania
**** Institute of Geology and Mineral Exploration, 70, Messoghion St., 11527 Athéns, Greece

Received 19. 8. 1987

Триасовая фораминиферовая микробиостратиграфия карпато-балканского и геленидного поясов

Авторы обсуждают триасовые фораминиферовые ассоциации карпато-балканской и геленидной зон, в основном на территориях Чехословакии, Румынии, Болгарии (обр. I) и Греции (обр. 3) с откликом и на некоторые места в Польше и Венгрии. Фораминиферы характеризуются по отношению к различными типам фаций, которых возраст установлен в основном на основании макрофауны, водорослей и конодонтов. Микробиостратиграфические проблемы отдельных территорий изучаются по их отношению к зональному разчленению выработанному на основании фораминифер. Зональное разчленение форминифер для триаса в карпато-балканской зоне печатал Салай эт.ал. (1986) на третьем симпозиюме о бентицких фораминиферах в Женеве „Бентгос 86" где тоже была апликация и на геленидны.

The Triassic foraminifera microbiostratigraphy of the Carpathian — Balkan and Hellenic realm

The authors discuss types of Triassic foraminiferal assemblages from the Carpathian — Balkan and Hellenic zones, namely Czechoslovakia, Romania, Bulgaria and Greece with reference to some localities in Hungary and Poland, too. The assemblages are described in relation to various types of facies whose ages are mostly indicated by macrofauna, Algae and Conodonts. Microbiostratigraphic problems of individual regions are treated in connection with a brief zonation of the Triassic based on foraminifers. The Foraminifera Zonal Standard for the Triassic System of the Carpathian — Balkan belt was presented by Salaj et al. (1986) at the 3rd Symposium on benthic foraminifers in Geneva "Benthos 86" and is applicated now on the Hellenic zone, too.

West Carpathians
(Pls. 1, 2)

In the West Carpathians of Slovakia the Triassic sediments are largely widespread. Their extension as well as the stratigraphic subdivision of the Triassic is mentioned in the work by Salaj et al. (1983) to which we also refer.

Lower Triassic

The oldest Triassic foraminifer association with *Meandrospira cheni* (Ho) but without *M. pusilla* (Ho) is found in the Slovak karst in the beds with *Neoschyrodus costatus* (Muenst.) and *N. laevigatus* (Alb.); further in the Nízke Tatry Mts. (Fig. 1), in the beds with *Costatoria costata* Zenk. or at several localities in the Nízke Tatry Mts. in the beds overlaying those with *Claraia clarae* (Emmr.) (Kullmanová et al., 1984). The underlying Dienerian is nowhere identified more exactly. In the beds with *Pseudomonotis* sp. and *Claraia clarae* (Emmr.) corresponding to the Lower Dienerian in the West Carpathians so far, similarly as in the basal Triassic detrital beds or lagoonar Permian-Triassic sediments of the South Slovakian karst no foraminifer has been found. For these reasons the question of first actual appearance of the species *M. cheni* (Ho) and *Arenovidalina chialingchiangensis* Ho still remains open, equally as also linking of foraminifer associations in Triassic carbonate sediments with Permian microfauna.

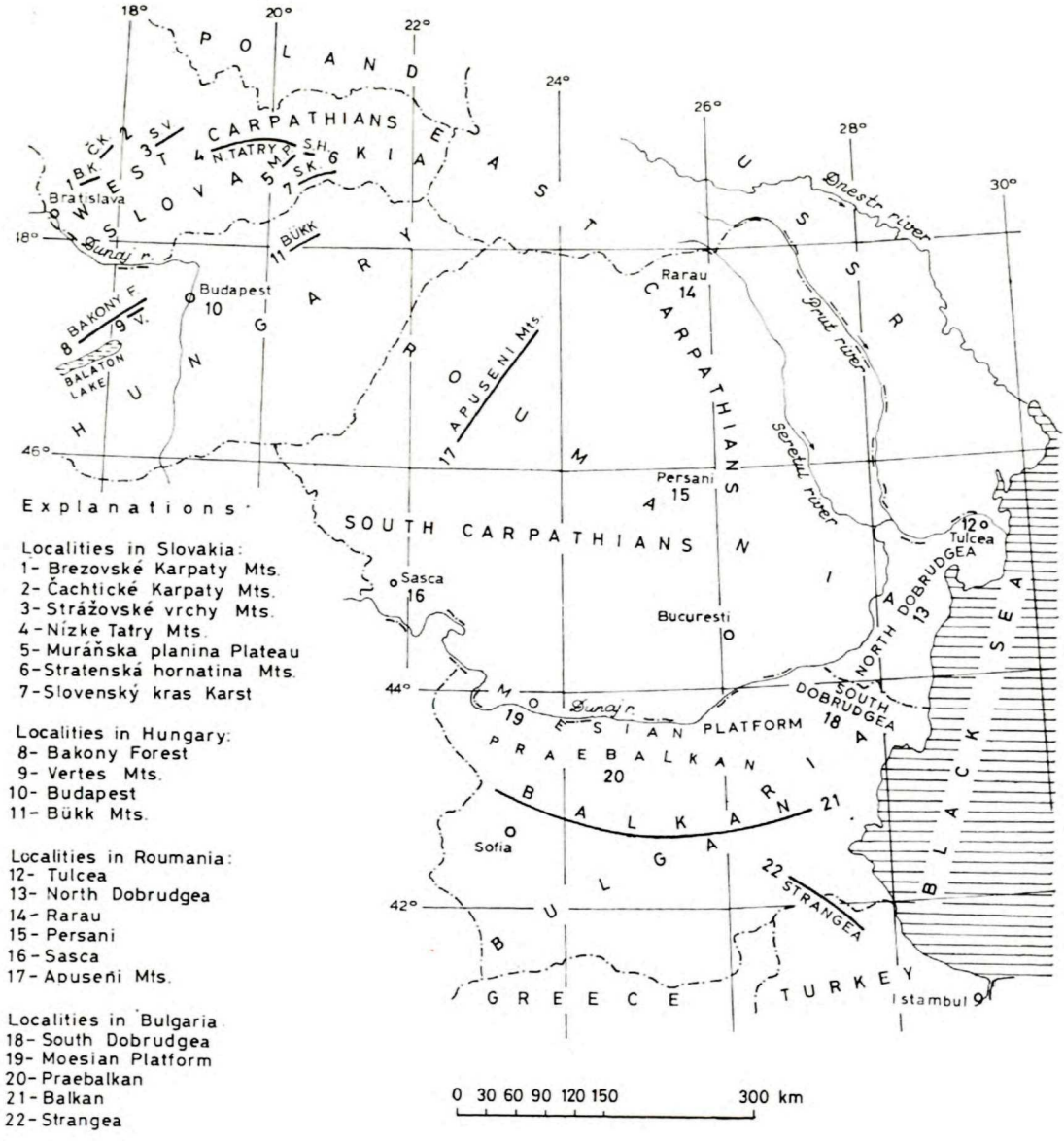
The species *Meandrospira pusilla* (Ho) is present in the beds with a representative of the genus *Tirolites* sp. div., i. e. of the *Tirolites cassianus* Zone. Here it is found together with *Meandrospira cheni* (Ho), but *M. insolita* (Ho) is missing. The upper boundary of the *M. pusilla* Zone is placed more or less arbitrarily to the Lower — Middle Triassic boundary. So if we take into consideration the quotations in literature that *M. pusilla* is also found in the lowermost Anisian, we should place the upper boundary of this zone in the lowermost part of the Aegean.

Middle Triassic

The question of the age of the lower boundary of the Gutenstein limestone, as results from the above mentioned, remains always open. It is not excluded that its sedimentation could have started in the time of the Aegean only, or from base of the Bithynian. This possibility is not excluded for the reason that in the Rumanian Carpathian (Monti Apuşeni) the Lower Anisian is in continental development and proved by sporomorphs. At the base of the Gutenstein limestone *Meandrospira insolita* or — in the more hypersaline facies of the Gutenstein limestone *Meandrospira deformata* has been proved at several places in the West Carpathians.

Regarding the fact that the lower boundary of the Gutenstein limestone is generally placed to the Lower — Middle Triassic in the West Carpathians, the *Meandrospira deformata* Interval Zone defined by Głazek, Trammer and Zawidzka (1973) is related to the Aegean and Bithynian by Salaj et al. (1983). *M. deformata* Salaj is also proved in the Annaberg dolomitic limestones of the Krížna nappe in the Malé Karpaty Mts.

Nodosaroid foraminifers are very scarce or missing completely in the facies of the Gutenstein limestone, similarly as in the underlying Smithian-Spathian beds. The types known in Bulgaria from the *Nodosaria shablensis* Range Zone (Trifonova, 1978a) appear essentially later in the Pelsonian and Illyrian, i. e. in the zones with *Meandrospira dinarica* I. Sbz. with *Pilammina densa* RZ and with *Aulo-*



Explanations:

Localities in Slovakia:
1- Brezovské Karpaty Mts.
2- Čachtické Karpaty Mts.
3- Strážovské vrchy Mts.
4- Nízke Tatry Mts.
5- Muránska planina Plateau
6- Stratenská hornatina Mts.
7- Slovenský kras Karst

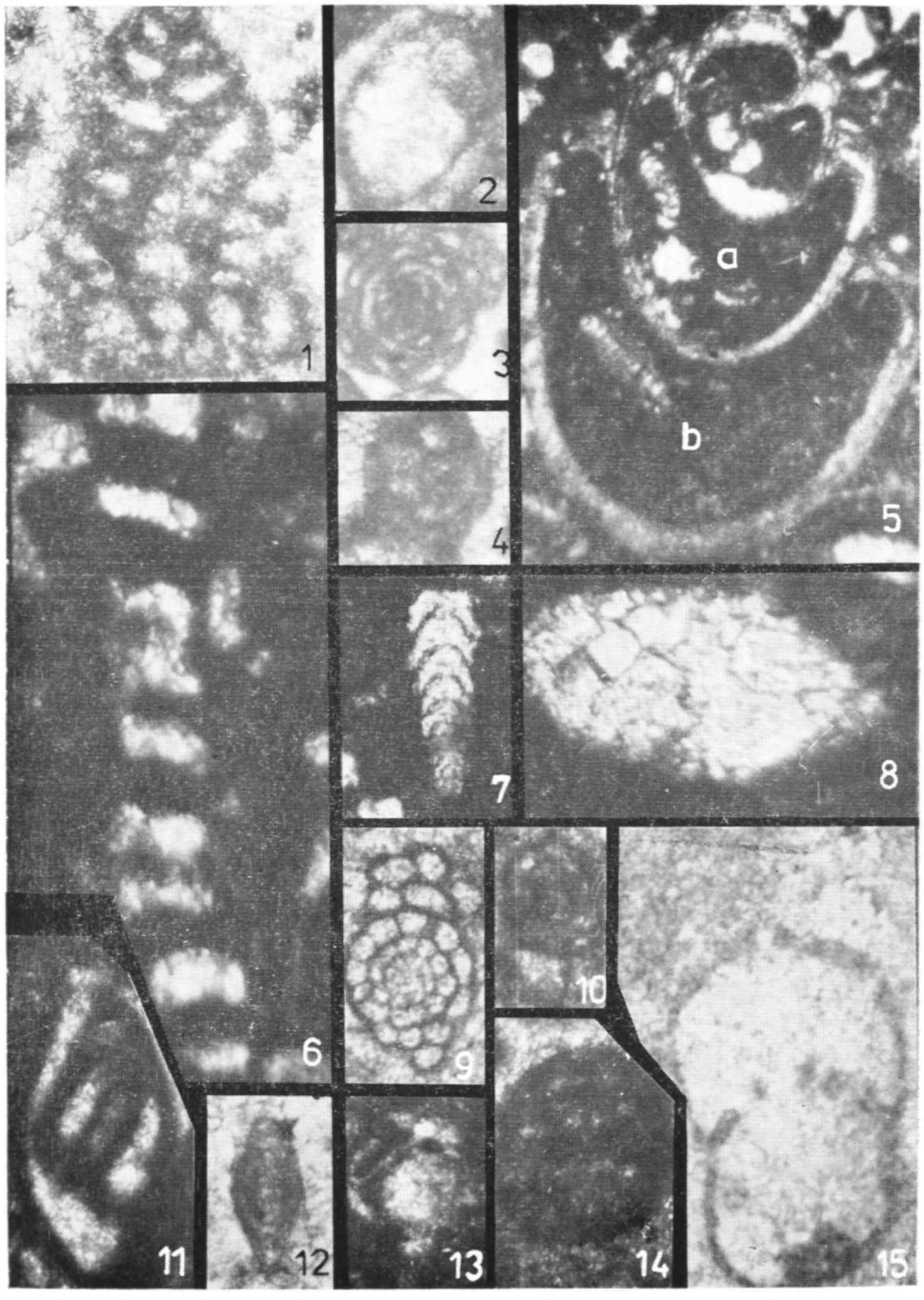
Localities in Hungary:
8- Bakony Forest
9- Vertes Mts.
10- Budapest
11- Bükk Mts.

Localities in Roumania:
12- Tulcea
13- North Dobrudgea
14- Rarau
15- Persani
16- Sasca
17- Apuseni Mts.

Localities in Bulgaria:
18- South Dobrudgea
19- Moesian Platform
20- Praebalkan
21- Balkan
22- Strangea

Fig. 1. Sketch map of localities with Triassic Foraminifera from Carpatho-Balkan Realm.

tortus pragsoides I. Sbz. in the West Carpathians; corresponding to the facies of platform algal *(Dasycladacea)* limestones. They are abundantly represented in deeper facies with the Reifling limestone (Pelsonian to Cordevolian) rich in conodonts and ammonites and the base of which is situated in the *Balatonites balatonicus* Zone (Rakus, 1986; Kovácz, Papšová, 1986). The *Nodosarididae* are, howe-


1
2
3
4
a
b
5
6
7
8
9
10
11
12
13
14
15

ver, abundant only in some and variously situated intervals of the Reifling limestone of one or another tectonic unit. In agreement with Patrulius and Bordea (1970) we may say that nodosaroid foraminifers represent a well defined transitional interval of depth between zone with radiolarians and shallower-water zone with platform dasycladaceans. Their mutual relation changed from place to place, depending on the change of depth conditions.

The sedimentation of shallow-water platform dasycladacean limestones began probably in the uppermost Bithynian. For this reason appearance of the species *M. dinarica* Kochansky — Devidé et Pantić and *P. densa* Pantić are interpreted from the uppermost Bithynian.

Deepening, taking place in the zone of sedimentation of platform limestones caused a decrease to complete disappearance of species of the genera *Pilammina* and *Pilamminella* in the Lower, but mainly in the Upper Illyrian. We find them only in turbidite intercalations of allodapic limestones of the Reifling limestones with the detritus of the crinoids and Nodosaroid foraminifers. Together with *Aulotortus pragsoides* (Oberhauser) they represent thanatocenoses, redeposited from the original shallower to deeperwater sedimentary environment of the Strážov area, as well as in the other sedimentation areas.

In the Pelsonian part of the *Pilammina densa* RZ *Paleomiliolina judicariensis* (Premoli Silva) reaches considerable extension, which, however, is also found in the lower part of the Reifling limestones together with *Turriglommina mesotriassica* (Koehn — Zaninetti), but without representatives of *Pilammina densa* Pantić.

In the Illyrian part of the *Pilammina densa* RZ *Pilamminella grandis* (Salaj) reaches considerable extension, as it was pointed out by Baud, Zaninetti and Broennimann (1971), in the Alps and Budurov, Trifonova (1984) in the Balkans. In the Upper Illyrian of Slovak Karst together with *Pilammina densa* Pantić, *Turriglommina mesotriassica* (Koehn — Zaninetti) and *Meandrospira* aff. *pusilla* (Ho) the species *Aulotortus pragsoides* (Oberhauser) (Pl. 2, fig. 2, 3, 4) occurs relativelly rarely. The species *Opthalmidium* aff. carinatum (Leischner) and *Sigmoilina*

◀ Plate 1. 1 — *Pragsoconulus robustus* Oberhauser ×50, sample no MK 104 A (24—33) — from J. Mello's material, Wetterstein limestone of the Lower Carnian, loc.: Kršlenica — Polámané, Malé Karpaty Mts.; 2 — *Aulotortus pragsoides* (Oberhauser) ×50, sample no LB-1 (thin section no 1865/80), Schreyeralm limestone of the Illyrian, loc.: Gemerská Hôrka — Skalica, Slovenský kras Mts.; 3 — *Pilammina densa* Pantić ×20, sample no LB-1 (thin section no 1865/80); 4 — *Meandrospira pusilla* (Ho) ×50, sample no LB-1; 5 — Section of the juvenile stade of the Gastropode ×20, a — *Angulodiscus pokornyi* Salaj, b — *Aulotortus eomesozoicus* (Oberhauser), sample no 29 (61—29), Upper Carnian — Norian, biomicritic part of the non recrystalised Hauptdolomit, loc.: Hybe, Nízke Tatry Mts.; 6 — *Gyroporella vesiculifera* Guembel ×50, sample no 26b, Hauptdolomit, loc. Hybe; 7 — *Frondicularia woodwardsi* (Howchin) ×50, sample no 24a, Hauptdolomit (intrabiopelmicrite), loc.: Hybe; 8 — *Semiinvoluta* aff. *clari* Kristan ×50, sample no 24a; 9 — *Meandrospiranella samueli* Salaj ×40, sample no 47 B (P15/82), Steinalm limestones, Pelsonian, loc.: Zakázané, Slovenský kras Mts.; 10 — *Angulodiscus friedli* (Kristan — Tollmann) ×50, sample no 24a; 11 — *Agathammina austroalpina* (Kristan — Tollmann et Tollmann) ×50, sample no 24a; 12 — *Arenovidalina amylovoluta* Ho ×50, sample no MK 104 A (24—33); 13 — *Rakusia oberhauseri* Salaj ×50, sample no 24a; 14 — *Parafavreina thoronetensis* Broennimann, Caron et Zaninetti ×50, sample no 24b; 15 — *Haplophragmella inflata* Zaninetti et Broennimann ×40, sample 47 B (P15/82).

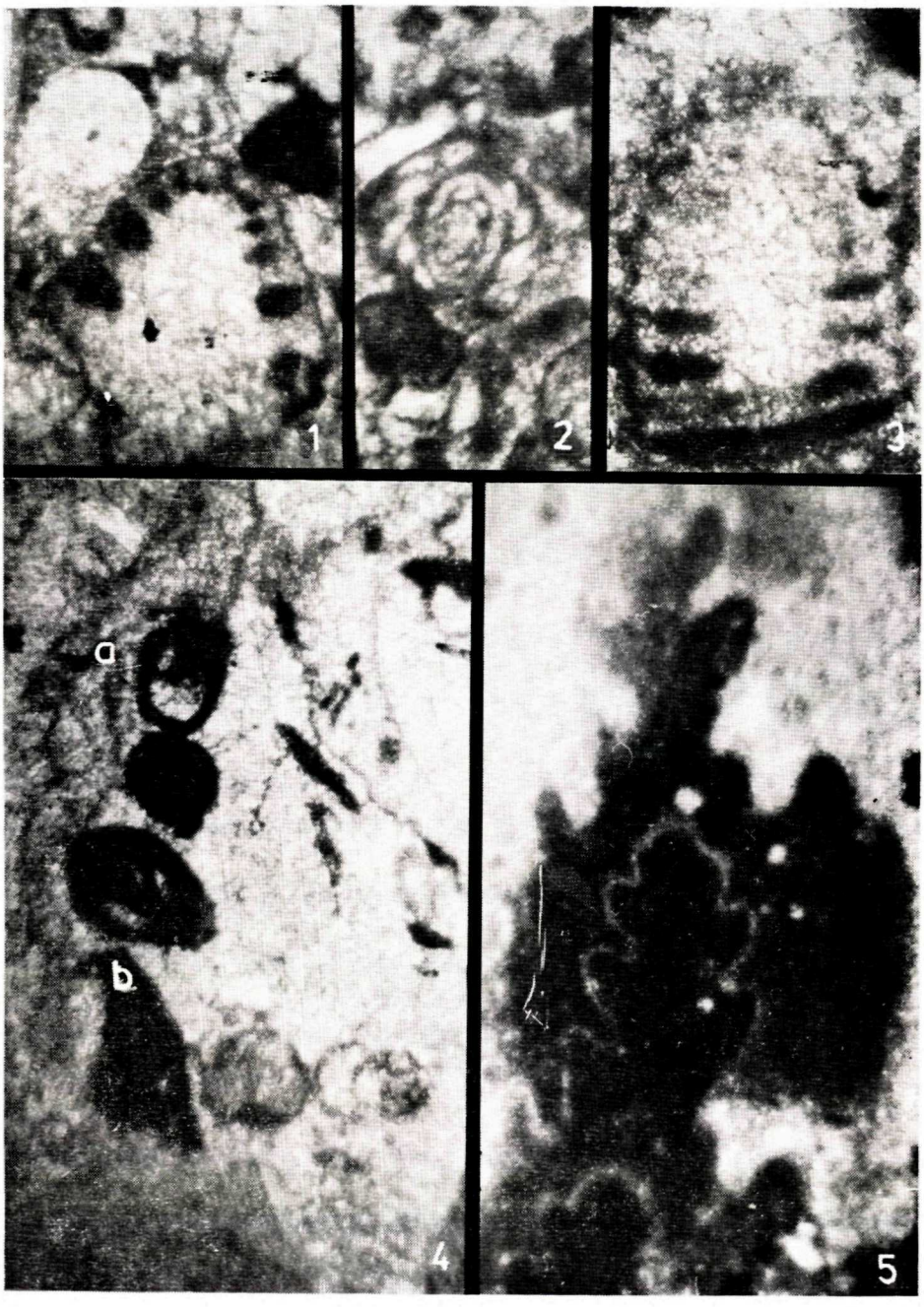


Plate 2. 1 — Intrabiosparit with *Trochonella acuta* (Oberhauser) and Crinoids ×50, sample no BP-1, uppermost part of the Bleskový prameň Limestone, Rhaetian, loc.: Bleskový prameň Slovenský kras Mts.; 2 — *Gandinella falsofriedli* (Salaj, Borza et Samuel) ×20, sample no 621, from J. Hanáček's material, Lower Rhaetian, Dachstein

triadica (Langer) are here present (Pl. 8, fig. 3, 5) abudantly forming so the typical level in the uppermost Illyrian.

The Wetterstein limestones and dolomites contain from their base (Upper Fassanian) *Pilamminella gemerica* (Salaj), to which *Angulodiscus praegaschei* Koehn-Zaninetti is added in the Longobardian and *Pilamminella kuthani* (Salaj), *Lameliconus procerus* (Liebus) or *Pragsoconulus robustus* Oberhauser (Pl. 1, fig. 1) are added from the Lower Carnian (Cordevolian). An important species of the family *Fischerinidae* Millet, 1898, *Paratriasina jaingyouensis* He, described from the Ladinian of China (He, 1979) in this facies and in the Ladinian of the West Carpathians generally has not been proved. Finding of representatives of the genus *Paratriasina* He in the West Carpathians, South Carpathians and Balkans would contribute to clearing up the phylogeny of Carnian representatives of the family *Fischerinidae,* which so far have no phylogenetic linking with their older predecessors.

The reef non detrital and different detrital forereef facies of Wetterstein limestones and dolomites are relatively poor in foraminifers and these, when also present, have a considerable vertical range. Foraminifers from the deeper-water facies of the Reifling limestones, in which also the distinctly different shallower-water dark organodetrital microsparite limestones ("Black Formation" of Jendrejáková et al., 1981) of the Choč nappe of the Nízke Tatry Mts. belonging to the Pelsonian (Papšová, Gaál, 1984) with *Neospathodus kockeli* Tatge and *Gondonella bulgarica* (Budurov et Stefanov) in rich association with *Pilammina densa* Pantić, are included, show similar character. The Pelsonian to Cordevolian age of the Reifling limestones of the Choč nappe of the Biely Váh Group in the Nízke Tatry Mts. is dated by macrofauna and corresponds to the Pelsonian zone with *Balatonites* ex. gr. *balatonicus,* Illyrian zone with *Piarorhynchella trinodosi* and Cordevolian *Monophyllites aonis* (Rakus in Papšová, Pevný, 1982, p. 80). From foraminifers *Turriglommina mesotriassica* Koehn-Zaninetti, *Nodobacularia vujisici* Urošević et Gaździcki and *Ophthalmidium tricki* Lange are found most often in some levels of the Reifling limestones represented by the intrabiopelmicrites.

The range of age of the Reifling or Pseudoreifling limestones in relation to various types of the underlying and overlying beds of the individual tectonic units, in which these beds are present, is various. Heterogeneous arrangement of the succession of the individual microfacial types indicates that deepening or shallowing in the individual original partial basins was changing from south to north.

Upper Triassic

The Carnian in the facies of the Lunz beds is documented by free foraminifers from washings. They are mainly representatives of the genera *Duostomina* and *Lamelliconus.*

In the Cordevolian, in the facies of the Wetterstein and Korytnica limestones and similarly in the Tisovec limestones the index species *Pilamminella kuthani* (Salaj),

◀ Limestone, loc.: Hájnica, Čachtické Karpaty Mts.; 3 — *Lamelliconus turris* (Frentzen) ×50, sample no BP-1; 4 — *Endothyra* sp. (a) ×50, *Quinqueloculina nucleiformis* Kristan-Tollman (b) ×50, sample no BP-1; 5 — Sutures of the *Choristoceras* cf. *marschi* Haug ×15, sample no BP-1.

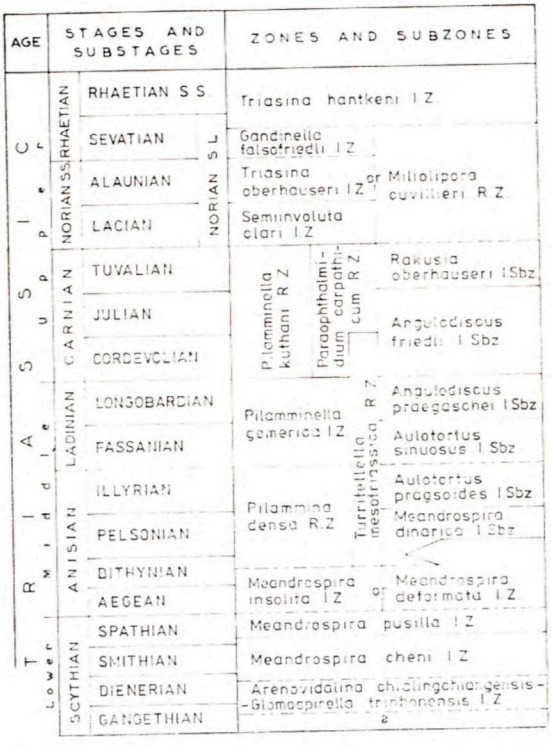


Fig. 2. Standard Foraminifera Zones and Subzones of the Triassic in the Carpathian-Balkan and Hellenic Realm.

Angulodiscus friedli (Kristan-Tollmann), *Lamelliconus procerus* (Liebus) and *Lamelliconus biconvexus* (Oberhauser) are present. To these species *Rakusia oberhauseri* Salaj is added in the Tuvalian of the Tisovec limestones. In the Julian and Tuvalian of the Tisovec limestones, similarly as also in the lower part of the Norian (Lacian) Furmanec limestones representatives of genera from the group *Incertae sedis* are extraordinarily important, with the genera: *Urnulinella* Borza et Samuel, *Amphorella* Borza et Samuel, *Spiriamphorella* Borza et Samuel and *Cucurbita* Jablonský.

As to the microfauna from the Hauptdolomit, we have proved it at the locality Kráľova Lehota in close overlier of the Lunz beds (marls with the dominating species *Duostomina alta* Kristan-Tollmann is association with *Lamelliconus procerus* (Liebus) and *Lamelliconus biconvexus* (Oberhauser) from the base of the Hauptdolomit formed by intrabiopeldolosparite with *Pilamminella kuthani* (Salaj), *Agathammina austroalpina* Kristan-Tollmann and *Opthalmidium* sp. From other remnants *Earlandia gracilis* (Pantić) and echinoid spines are abundant. From a similar facies, also from the lower part of the Hauptdolomit (in the facial contact with the reef Wetterstein limestone of the Ladinian — Carnian which are in the reverse position) at the locality Krasno (Quarry) are present: *Tolypammina gregaria* Wendt, *Meandrospira* cf. *carnica* Oraveczné-Schaffer, *Earlandinita ladinica* Salaj, *Endothyra keupperi* Oberhauser, *Nodosaria* sp., *Ophthalmidium* sp., abundant minute smooth-walled ostracods and sporadically found recrystallized algae. In both cases there is no doubt about the Carnian age of the lower part of the Hauptdolomit. In the middle part of the Hauptdolomit microfauna has been found nowhere in the West Carpathians so far (Bystrický, 1986).

The upper part of the Hauptdolomit of the Choč nappe was documented by microfauna (Pl. 1, fig. 5, 6, 7, 10, 11, 13, 14) at one place in the Nízke Tatry Mts. only (locality Hybe) where rarely the Dasycladacea and its detritus are present too.

If representatives of the genus *Lamelliconus* are present among involute foraminifers in the Lunz beds, so thin-walled representatives of the species *Semiinvoluta clari* Kristan (Pl. 1, fig. 8) and *Rakusia oberhauseri* Salaj are found in the Hauptdolomit, in its upper part. To these higher up together with fragments of the *Gyroporella vesiculifera* (Pl. 1, fig. 6) and *Heteroporella* sp. in the Alaunian *Triasina oberhauseri* Koehn-Zaninetti, *Aulotortus*

eomesozoicus (Oberhauser), *Angulodiscus pokornyi* Salaj and *Auloconus permodiscoides* (Oberhauser) are joined.

The deeper type of the facies of Upper Carnian to Lower Rhaetian Hallstatt limestones, rich in Nodosaroid foraminifers which have not been studied nearer so far.

For the platform limestones of the Upper Triassic involute foraminifers of the family *Involutinidae* Buetschli, 1880, are extremely important. These are known (Bystrický et al., 1973; Michalík et al., 1979; Salaj et al., 1983 and Gaździcki, 1983) from the Carnian Tisovec, Norian Furmanec and Došťanky (= Aflenz Limestone) limestones, from the Rhaetian fossiliferous limestones of Bleskový prameň, Skalky, Hybe and Dachstein (Pl. 2, figs. 1, 4, 5) limestones as well as from the Rhaetian Norovica Formation at Rohatá skala and the Rhaetian Fatra Formation of the Krížna nappe. In the Rhaetian limestones the most important are *Triasina oberhauseri* (Koehn-Zaninetti et Broennimann) and *Triasina hantkeni* Majzon known from the Dachstein limestones of Hungary too (Oravecz-Scheffer, 1987).

Romanian Carpathians and Northern Dobrodgea

(Pls. 3—6)

In Romania the Triassic sediments occur in the Carpathians (Rarău, Perşani, Sasca and Apuşeni) and in North Dobrodgea. They participate in the structure of various units (Baltres, 1975; Bordea et al., 1978; Gheorghian, 1975, 1976, 1980; Mirăută, 1974, 1982; Mirăută and Gheorghian, 1975, 1978; Mirăută et al., 1984; Patrulius and Bordea, 1970; Patrulius et al., 1977, 1987; Popa and Dragastan, 1973) and served as basis for our biostratigraphic study.

Triassic formanifers were studied in thin-sections and from limestones after separation by means of acetic acid.

Former study of foraminifers from Triassic limestones whose age determination was based on conodonts enabled determination of more types of assemblages. They may partly be related to zones known from the West Carpathians and Balkan.

Lower Triassic

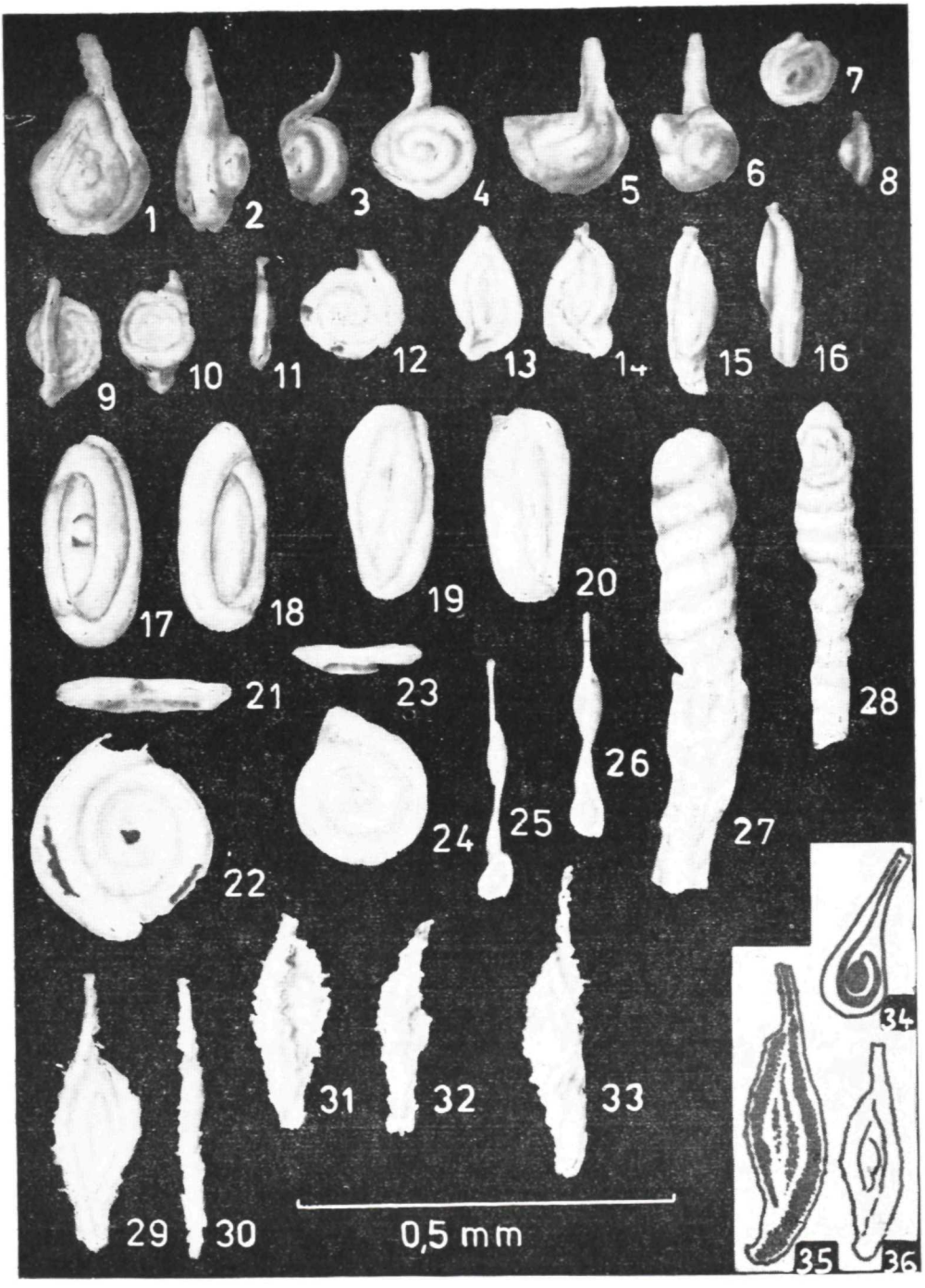
Two assemblages were found in Spathian limestones of North Dobrodgea and from Perşani. One assemblage, represented by ostracods (area of Somov) comprises *Acratina transita* (Kozur), the species described by Kozur (1971) from the Lower Triassic of Greece.

The second assemblage contains plentiful specimens of corroded and fragile foraminifers which may be related to the *Glomospirella* (Plate 5, fig. 6—10), *Meandrospira cheni* (Ho) (Pl. 5, fig. 1—5), *Gaudryina triassica* Trifonova, *Tolypammina discoidea* Trifonova and *Ammodiscus* sp.

Free microfauna was found in Spathian shales of the Rarău syncline represented only by species of the genus *Bigererina* sp. and *Reophax* sp.1.

Middle Triassic

Lower- and Middle Anisian limestones defined by conodonts are characterized by the species *Pilammina densa* Pantić and *Meandrospira dinarica* Kochansky-Devidé et Pantić. Besides these the following species appear in Dobrodgea, in Transylvanian nappes of the East Carpathians and in South Carpathians: *Gaudryina triassica* Trifonova, *Tolypammina discoidea* Trifonova, *Earlandinita libera* (Trifonova), *Gaudryinella* sp., *Ammosphaeroidina* sp., *Trochammina* sp. together with holoturian sclerites.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
23
22
24
25
26
27
28
29
30
31
32
33
34
35
36
0,5 mm

The above mentioned foraminiferal assemblage, associated with holothurian sclerites, also occurs in North Dobrodgea (Agighiol zone) in the same stratigraphic level in pink limestones resemblant to the Hallstatt facies with ammonites and conodonts (equivalent to the Marmarotrapeza of Chios).

The Upper Anisian near Christiana (= bituminous limestones of the Gutenstein type — the Braşov Group) is characterized by a rich foraminiferal assemblage without *Pilammina densa* Pantić but with *Ammobaculites paralellus* Ireland and *Trochammina almtalensis* Koehn-Zaninetti, locally associated with *Gaudryina triassica* Trifonova, *Gaudryinella* sp.$_3$, *Tolypammina discoidea* Trifonova and *Ammosphaeroidina* sp.. *Ammobaculites paralellus* Ireland is present in black limestones with Ceratites de Sasca either alone or with *Glomospirella spirillinoides* Grozd. et Gleb., *Bathysiphon* sp., *Ammodiscus* sp., *Lenticulina* and *Frondicularia*.

Thin-sections contained fragments of *Turriglommina mesotriassica* (Koehn-Zaninetti) known from the Upper Anisian to the Lower Carnian (Zaninetti, 1976). In Dobrodgea the species was also found in the Middle Carnian.

Illyrian limestones near Vida of the Bihor autochton (Apuşeni Mts.) also contain plentiful agglutinated foraminifers with the species *Ammobaculites paralellus* Ireland dominant. Young specimens represented by unfolded part of test (Pl. 4, fig. 6—9), lighted immersion oil (Pl. 4, fig. 10—11) and showing a structure identic with adult specimen structure, and specimens with broken uniserial part of test (Pl. 4 ,fig. 12—13). The foraminiferal assemblage also comprises *Gaudryinella* sp.$_3$, *Erlandinita libera* (Trifonova), *Gaudryina triassica* Trifonova, *Placopsilina* aff. *lacera* Trifonova.

The above mentioned ostracod assemblage (Somova region, Northern Dobrodgea) occurs not only in the Spathian but also in the Lower and Middle Anisian. Beginning with the Upper Anisian the assemblage of Ostracods and *Nodosariidae* gets richer, except the Agighiol zone where the red limestones of the Hallstatt type contain agglutinated foraminifers and holothurian sclerites, similar to Carpathian assemblages.

Assemblages of ostracods and *Nodosariidae,* associated or not with scarce agglutinate foraminifers, characterize cherty limestones of the Upper Anisian Reifling type, of the Lower Ladinian of N Dobrodgea and in the Apuşeni Mts. (Mona nappe).

The plentiful *Nodosariidae* comprise: *Pseudonodosaria major* (Bornemann), *P. ploechingeri* (Oberhauser), *P. simpsonensis* (Tappan), *Lingulina borealis* Tappan, *L. tenera* Bornemann, *L. esseyana* Deecke, *Dentalina* div. sp., *Nodosaria* div. sp. and scarce *Ammodiscus* sp., *Earlandinita libera* (Trifonova), *Tolypammina discoidea* Trifonova, associated with ostracods, viz. *Acanthoscapha veghae* Kozur, *A. goemoeyeri* Kozur, *Policope* sp. a. o. and species described by Kozur (1970) from Hungarian Middle Triassic.

The foraminiferal assemblage has a similar composition in beds of the Cataloi

---

Plate 3. 1—6, 9—10 — *?Orthovertella* sp.; 7—8, 11—16 — *Ophthalmidium* sp.; 17—20 — *?Agathammina* sp.; 21—24 — *Ophthalmidium* sp.$_2$; 25, 26, 34 — *Nodophthalmidium vujisici* Urošević et Gaździcki; 27—28 — *Trepeilopsis spiralis* Guts. et Treck; 29—33, 35—36 — *Ophthalmidium* sp.$_6$;
1—20, 27—28 — sample no H 9, Ladinian, loc.: Hidişel — M. Apuseni 21—26, 29—36 — sample no FF 37, Rhaetian, loc.: Frunzei, Bihor, M. Apuseni.

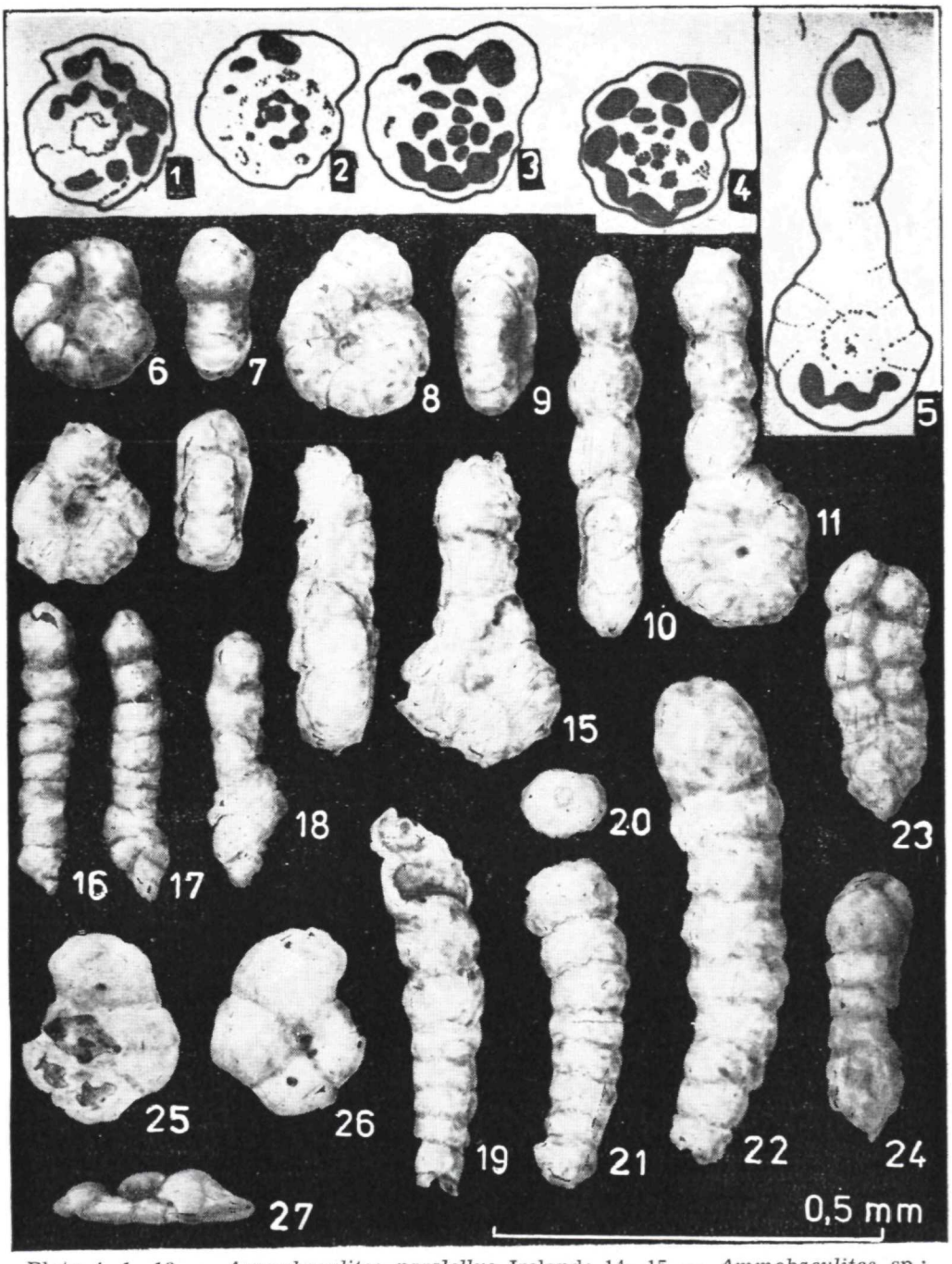
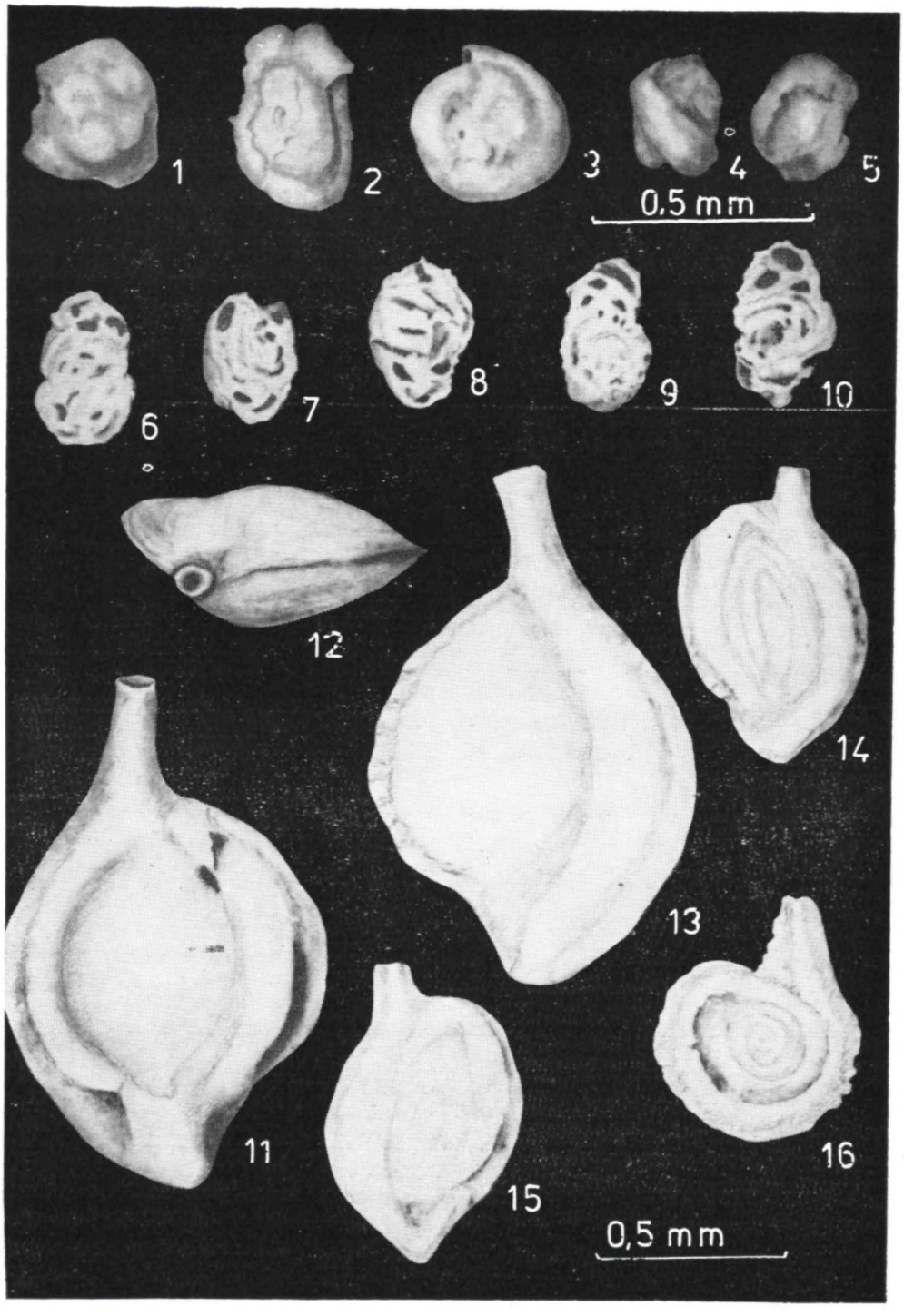


Plate 4. 1—13 — *Ammobaculites paralellus* Ireland; 14—15 — *Ammobaculites* sp.; 16—17 — *Gaudryinella* sp.$_3$; 18 — *Gaudryinella* sp.$_4$; 19—22 — *Earlandinita libera* (Trifonova); 23—24 — *Gaudryina triassica* Trifonova; 25—27 — *Placopsilina* aff. *P. lacera* Trifonova; 1—5 — lighted immersion oil; 1—27 — sample no BP 17, Illyrian; loc.: Bihor, M. Apuseni.


1
2
3
4
5
0,5 mm
6
7
8
9
10
12
13
14
11
15
16
0,5 mm

◀ Plate 5. 1—5 — *Meandrospira pusilla* (Ho); 6—10 — *Glomospirella triphonensis* Baud, Zaninetti et Broennimann; 11—15 — *Ophthalmidium lucidum* (Trifonova); 16 — *Ophthalmidium* sp.$_1$;
1—10 — Spathian, loc.: Dobrodgea; 11—15 — sample no 5748, Upper Norian, loc.: v. Teliţa, Dobrodgea; 16 — sample no 4003, Upper Ladinian, loc.: Parcheş. Dobrodgea.

Formation in N Dobrodgea, whose Upper Anisian — Upper Carnian age was proved by conodonts and bivalves. In the southern part of this area, in Upper Ladinian shales with *Daonella lommeli,* ostracods are represented by *Policope* sp. and instead of *Nodosariidae* there are *Nodophthalmidium annae* Gheorghian, *N. vujisici* Urošević et Gaździcki, *"Vidalina"* sp., *Turriglommina mesotriassica* (Koehn-Zaninetti), *Ammodiscus tzankovi* (Trifonova). This type of assemblages also occurs in Carnian limestone together with *Ophthalmidium lucidum* (Trifonova).

In Romania, *Turriglommina mesotriassica* (Koehn-Zaninetti) mostly occurs in Ladinian formations (Pl. 6, fig. 23—25). In the Apuşeni Mts., the lower part of limestones Roşia de Căbeşti offered more than 300 separated specimens. It is scarcer in the Ladinian of Perşani and Dobrodgea.

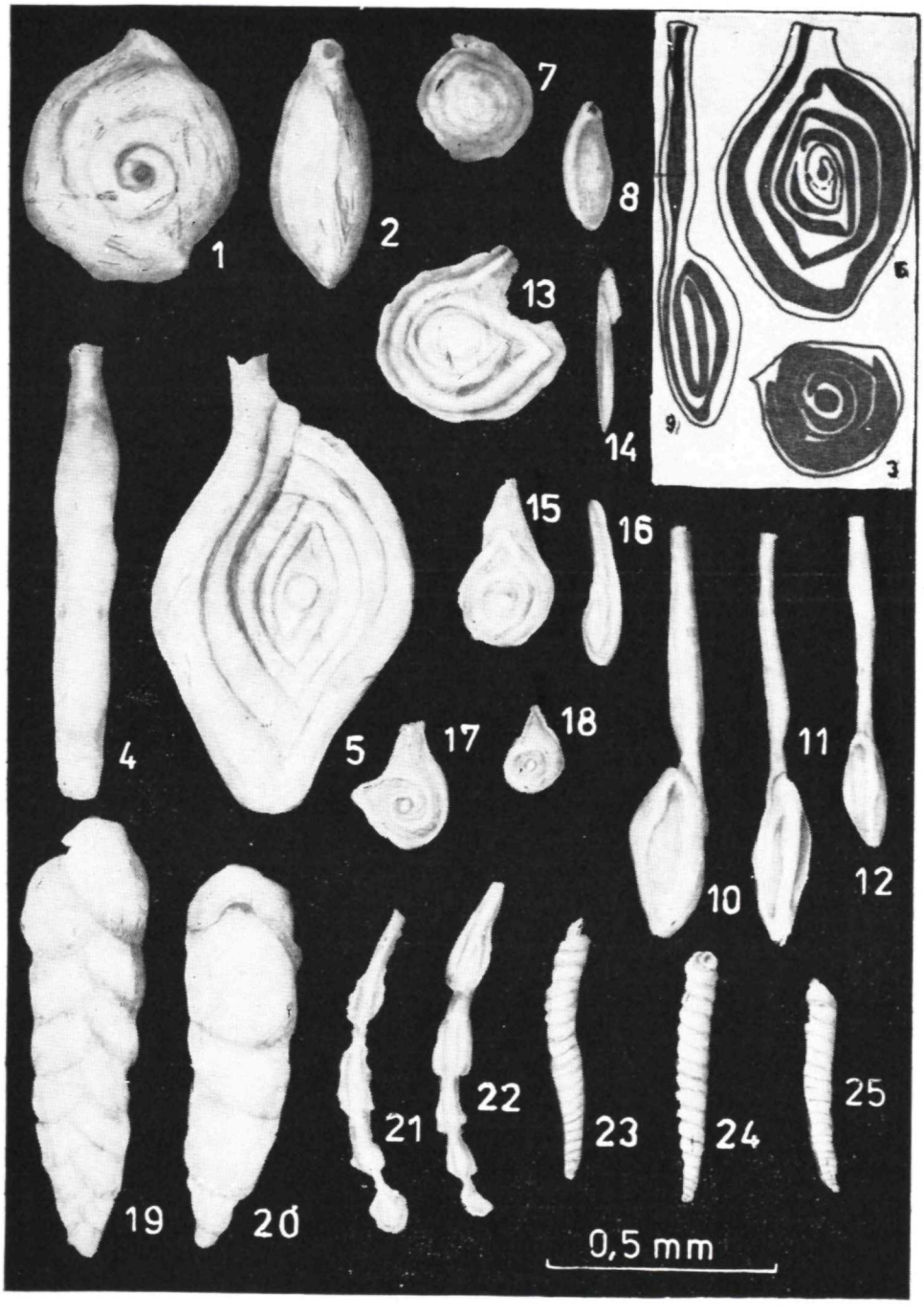
In the upper part of limestone of the Roşia nappe Arieşeni — Apuşeni Mts. (Hidişel profile) corresponding to the Ladinian there was a specific assemblage, mostly consisting of *Fischerinidae* and *Nubeculariidae (Agathammina* sp., *Orthoverthella* sp., *Ophthalmidium* sp.$_2$). There also is *Trepeilopsis spiralis* Guts. et Treck.

Ladinian assemblages in a facies similar to the Hallstatt facies in N Dobrodgea (Agighiol) consist of *Ammobaculites tzankovi* (Trifonova), *Verneuilinoides mauritii* (Terquem), *Ammodiscus* sp. and holothurian sclerites. The Upper Triassic of N Dobrodgea is characterized by agglutinated foraminifers with occasionally plentiful holothurian sclerites and assemblage with *Nubeculariidae* and *Miliolidae.*

The first assemblage seems characteristic of the Hallstatt type limestones with filaments, known in Dobrodgea and in the Carpathians. The foraminiferal assemblage, generally very rich consists of *Ammobaculites tzankovi* (Trifonova), *Plagioraphe tornata* (Kristan-Tollmann), *Pseudobolivina tornata* Kristan-Tollmann, *Triadosphaera radiata* (Kristan-Tollmann), *Endothyranella* sp., *Glomospira gordialis* (Jones et Parker), *Hyperammina casteri* Conkin, *Gaudryina adoxa* Tappan, *Endothyra keupperi* Oberhauser and the following species, generally known in the Triassic: *Tolypammina discoidea* Trifonova, *Gaudryina triassica* Trifonova, *Ear-*

▶

Plate 6. 1—3 — *Ophthalmidium* sp.$_3$, sample no 2, Upper Carnian, loc.: Taušan Bair, Dobrodgea; 4—6 — *Ophthalmidium* sp.$_4$, sample no 2080, Upper Carnian, loc.: Dl. Lung, Dobrodgea; 7—8 — „Vidalina" sp., sample no 3161, Lower Ladinian, loc.: Cairacele, Dobrodgea; 9—12 — *Opthhalmidium fusiformis* (Trifonova), sample no R 106, Upper Carnian, loc.: Curmătura Rarăului, Rarău; 13—14 — *Ophthalmidium* sp.$_1$, sample no 2929, Ladinian, loc.: Cairacele, Dobrodgea; 15—18 — *Ophthalmidium* sp.$_5$, sample no 6327, Norian, loc.: Coasta, Dobrodgea; 19—20 — *?Textularia jurassica* (Guembel), sample no 6413, Norian, loc.: Muchea Verde, Dobrodgea; 21—22 — *Nodophthalmidium annae* Gheorghian, sample no 3/7, Ladinian, loc.: Căbeşti, M. Apuseni; 23—25 — *Turriglommina mesotriassica* (Koehn-Zaninetti), sample no 3/1-3/7, Ladinian, loc.: Căbeşti, M. Apuseni; 3, 6, 9 — lighted immersion oil.


1
2
7
8
13
14
6
9
3
4
5
15
16
17
18
10
11
12
19
20
21
22
23
24
25
0,5 mm

landinita libera (Trifonova), *Gaudryinella kotelensis* Trifonova, *Verneuilinoides mauritii* (Terquem). There also were scarce *Nodosariidae* and holothurian sclerites locally prevalent. A foraminiferal assemblage, common to the Carnian — Norian, mostly consists of species of the family *Variostomatidae*, usually poorly preserved among which *Variostoma crassum* Kristan-Tollmann in regarded as significant for the Upper Triassic by Zaninetti (1976). *Spiroplectammina dobrudziana* Trifonova is also frequent. In Norian limestones of the Rarău syncline are scarce representatives of the genus *Tetrataxis* and *Lamelliconus* and involutines which are most frequent in the Rhaetian of the Dachstein limestone facies. In these limestones (Bordea personal information) *Triasina oberhauseri* Koehn-Zaninetti et Broennimann was found in lower parts (together with juvenile forms of the genus *Rhaetina;* profile of the area of Ferice) and *Triasina hantkeni* Majzon in upper parts.

The second type of Upper Triassic foraminiferal assemblage is characterized by representatives of *Nubeculariidae* and *Miliolidae* in N Dobrodgea and in the Apuşeni Mts. Black Carnian limestones in Dobrodgea contain an assemblage with dominant species *Quinqueloculina nucleiformis* Kristan-Tollmann and *Ophthalmidium* div. sp.. *Ophthalmidium* sp.$_1$ occurs from the Ladinian to the Norian, whereas others like *Ophthalmidium* sp.$_3$ and *Ophthalmidium* sp.$_4$ are only associated with the Upper Carnian. There also are small (0.14—0.22 mm) representatives of two species of *Nodophthalmidium* and small *Miliolidae*, preliminarily range to the genus "*Vidalina*". The species appear from the Anisian to the Upper Norian. Agglutinated foraminifers are also present.

A specific Upper Carnian facies was determined on the island Popina (N Dobrodgea). Neptunian dykes of Wetterstein limestones are filled with micrite containing a rich foraminiferal assemblage of the families *Ophthalmididae* and *Nodosariidae*, scarce *Variostomatidae*, fragments of *Tetrataxis* and *Palmula popinae* Gheorghian. This occurred rarely in the Upper Ladinian to the Upper Carnian of Dobrodgea.

The Norian contains sometimes extremely plentiful species of *Ophthalmidium lucidum* (Trifonova), *O. fusiformis* (Trifonova) and *Ophthalmidium* sp.$_6$. The above mentioned agglutinated foraminifers are scarce. The Upper Norian contains *Textularia jurassica* (Guembel) (Pl. 6, fig. 19, 20). In Dobrodgea the representatives of the family *Ophthalmididae* mostly characterize the Upper Carnian and Middle — Upper Norian. *Ophthalmidium fusiformis* (Trifonova) occurs in the Carpathian (Rarău) Carnian and Norian. *Ophthalmidium lucidum* (Trifonova) in N Dobrodgea (v. Telița) characterizes the Middle — ?Upper Norian. The Rhaetian has not been paleontolocally evidenced in Dobrodgea. In the Kössen Formation (Bihor — Finis nappe, Apuşeni Mts.) there is a foraminiferal assemblage of the family *Ophthalmididae*, particularly *Ophthalmidium* sp.$_2$, appearing in Dobrodgea from the Ladinian, and small *Ophthalmidium* sp.$_6$ (Pl. 3, fig. 29—33, 35—36). There also are plentiful representatives of the species *Nodophthalmidium vujisici* Urošević et Gaździcki. To prove its presence in the Rhaetian but it is necessary to pay more attention to this species which vertical distribution is mostly known in the Upper Anisian and Ladinian.

Balkan, South Dobrodgea and Moesian platform of Bulgaria
(Pls. 7, 8)

The Triassic sediments in the Balkan range and in the Fore — Balkan are

observed in many surface exposures, but to the North in the Moesian platform and South Dobrodgea these sediments are reached only by bore-holes. According to their visible lithological features the Triassic rocks of the area are divided in three units:

The lower unit composed almost exclusively of red-coloured terrigenous rocks: conglomerates, aleurolites and argillites. Some singular thin carbonate rocks appear only in the uppermost part of the complex. The age of the complex is assumed to be Early Triassic.

The middle unit is represented chiefly by carbonate rocks — limestones and dolomites. The terrigenous-argillaceous rocks are with subordinate significance and are presented in the upper part of this unit. As a whole the age of this carbonate part of the Triassic system is from Spathian to Lower — Middle Carnian.

The upper unit is built of variegated carbonate rocks: marly limestones, marls, carbonate sandstones and aleurolites. The specific conglomerates and red sandstones are very characteristic of this unit. The age of the rocks is Late Carnian, Norian, Rhaetian?.

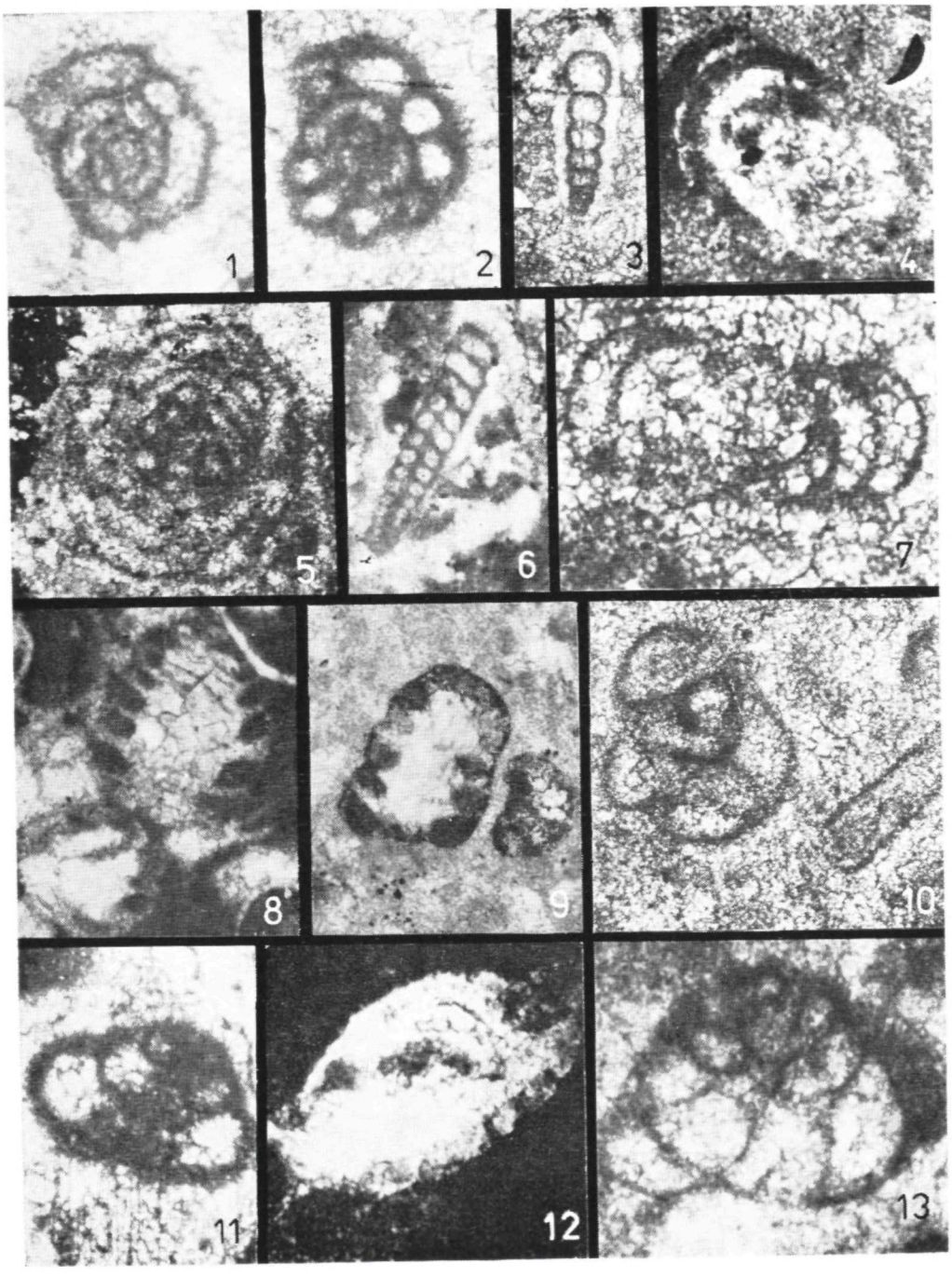
Lower Triassic

During the Early Triassic epoch in the territory of the Balkan range area and the whole North Bulgaria the thick terrigenous red coloured rocks were deposited. Only to the end of the same epoch (Smithian-Spathian age), the terrigenous beds were covered gradually with the transgression from the East Mediterranean sea waters. The sea spread slowly in time, so that while in the North-East Bulgaria marine sediments were deposited in the central and western parts of the North Bulgaria terrigenous rocks were still forming. Gradually at the beginning of the Early Anisian time in the whole North Bulgaria were established more stable sedimentation conditions and typically marine carbonate sediments formed.

Because of the unfavourable living conditions during the Early Triassic epoch, foraminifers contain only in the transitional and typically marine sediments deposited in the Smithian — Spathian time. The foraminifers are represented by benthic, eurifacial, shallow-water species from g. g. *Ammodiscus, Glomospira, Earlandia, Cyclogyra, Meandrospira* etc. (Trifonova, 1984). On the basis of predominante *Meandrospira pusilla* (Ho), the *M. pusilla* Akme-zone has been determined (Trifonova, 1978a). By comparison with macrofossils and conodonts it is assumed, that the stratigraphic range of this zone corresponds to the undivided lower-middle part of the Spathian age in North-East Bulgaria (Budurov and Trifonova, 1984), and to the upper part of the Spathian — in the central and western parts of North Bulgaria. The species of *Meandrospira cheni* (Ho) in the Smithian to the Spathian or *Meandrospira insolita* (Ho) in the Anisian are relatively rare and sometime it is very difficult to distinguish these species from *Meandrospira pusilla* (Ho).

Middle Triassic

The carbonate Anisian rocks of the area studied contain comparatively rich and various foraminifers. The latter are restricted chiefly to limestones but also occur in the dolomites, though not so well preserved. On the basis of appearance and distribution of foraminifers two zones have been subdivided: *Nodosaria shablensis* Range-zone and *Pilammina densa* Range-zone. The stratigraphic range of *Nodosaria shablensis* Range-zone is approximately Uppermost Spathian — Lowermost Bithynian (Budurov, Trifonova, 1984).


1
2
3
4
5
6
7
8
9
10
11
12
13

The zone was subdivided in two subzones: *Hemigordius (= Arenovidalina) chialingchiangensis — Nodosinella rostrata* Interval-subzone and *Nodosinella rostrata* Range-zone with local significance.

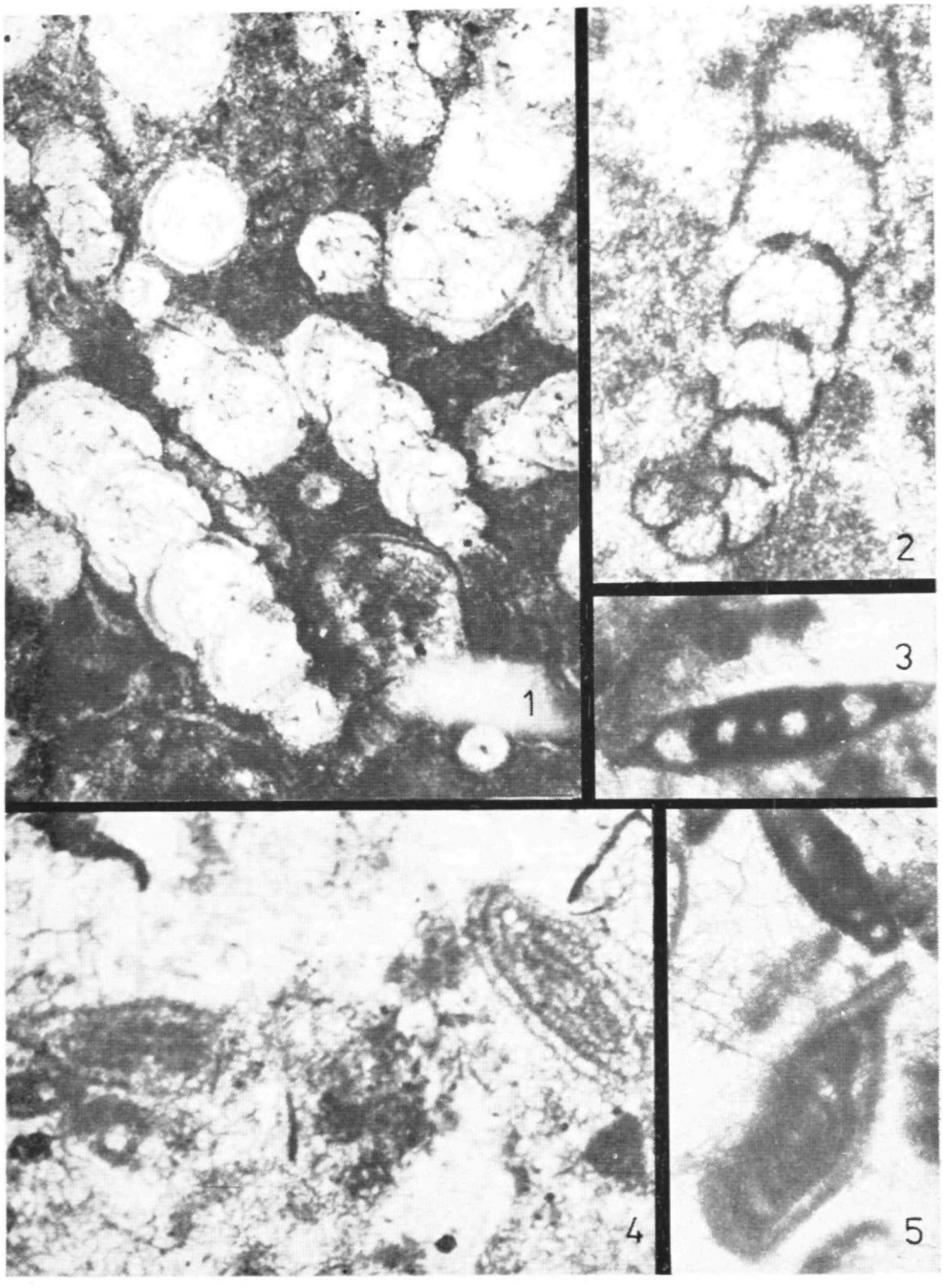
The main problem in using the *Nodosaria shablensis* Range-zone is that the index species is comparatively rare in the zonal assemblages and in such a case it is necessary to have in mind the composition of the zonal assemblage which include: *Ammodiscus parapriscus* Ho, different species of g. g. *Glomospira, Glomospirella, Nodosinella, Nodosaria* etc., and the species *Arenovidalina chialingchiangensis* Ho and *Meandrospira insolita* (Ho) as well.

The stratigraphic range of the *Pilammina densa* Pantić is approximately a part of the Bithynian substage to the Illyrian substage. Except the index species some other typical Anisian species as *Meandrospira dinarica* Kochansky-Devidé et Pantić and *Palaeomiliolina judicariensis* (Premoli Silva) occur. It is important to note, that the first representatives of g. g. *Aulotortus, Duostomina, Diplotremina, Endothyranella, Ophthalmidium* etc., begun their existence during the Late Anisian (Illyrian) age.

The *Palaeomiliolina judicariensis* could have wider regional importance since it is well known and characteristic from the Pelsonian substage in Italy, Bulgaria, Hungary, Jugoslavia and in the last time in Czechoslovakia and Greece too.

The most diverse foraminifers were found (Trifonova, 1978b) in the Ladinian limestones, while the terrigenous-argillaceous layers contain more uniform assemblages. Despite of that it is difficult to define this stage on the basis of foraminifers, because there is no species which can be pointed as an index for the Ladinian stage only. In the region studied the *Pilammina densa — Turritellella mesotriassica* Interval-zone was described earlier. The problem is that in some cases, because of uniform sedimentation and living condition the foraminifers from the Late Anisian time and these from the Early Ladinian — are very similar in composition and it is very difficult to distinguish one from another. But despite of variability or uniformity of the zonal association in general, the species *Pilamminella gemerica* (Salaj) and specially *Turriglomina mesotriassica* (Koehn-Zaninetti) are very often presented. Because of the fact that the last species is characteristic for more deeps facies, the

◀ Plate 7. 1 — *Meandrospira insolita* (Ho) ×130, bore-hole R 8-Boukhovtzi, 1225 m, Early Anisian, loc.: North East Bulgaria; 2 — *Meandrospira pusilla* (Ho) ×130, bore-hole R-118, 3498,80 m, Spathian, loc.: N. E. Bulgaria; 3 — *Nodosaria shablensis* Trifonova ×70; bore-hole R-118, 3418,30 m, Early Anisian, loc.: N. E. Bulgaria; 4 — *Angulodiscus praegaschei* (Koehn-Zaninetti) ×70, bore-hole R-1, 1448,20 m, Carnian, loc.: Blagovo, N. W. Bulgaria; 5 — *Pilammina densa* (Pantić) ×70, bore-hole R-8 Devetani, 2999,80 m, loc.: Central North Bulgaria; 6 — *Turriglommina mesotriassica* (Koehn-Zaninetti) ×70, bore-hole R-121, 3164,60 m, Ladinian, loc.: Gorum. N. E. Bulgaria; 7 — *Angulodiscus friedli* (Kristan — Tollmann) ×70, sample 94-51, Carnian, loc.: Central North Bulgaria, Trojan area, section 18; 8 — *Lamelliconus multispirus* (Oberhauser) ×70, bore-hole R-115, 2943 m, Carnian, loc.: Kneža, Central N. Bulgaria; 9 — *Lamelliconus multispirus* (Oberhauser) ×70, bore-hole R-115, 2943 m, Carnian, N. E. Bulgaria; 10 — *Meandrospira deformata* Salaj ×70, bore-hole R-118, 3170,70 m, Anisian, loc.: N. E. Bulgaria; 11 — *Trochammina almtalensis* Koehn-Zaninetti ×130, bore-hole R-54, 2523,80 m, Anisian, N. W. Bulgaria; 12 — *Miliolipora cuvillieri* Broennimann et Zaninetti ×140, Trojan area, section 21, sample 39a-42, Norian, loc.: Central Bulgaria; 13 — *Duostomina alta* Kristan-Tollmann ×130, bore-hole R-1, 3999,10 m, Uppermost Illyrian, loc.: Pelovo, Central North Bulgaria.


1
2
3
4
5

two species never come together.

An especially characteristic element for the zonal association of the Upper Ladinian is the appearance and presence in it of the first representatives of *Angulodiscus praegaschei* (Koehn-Zaninetti). This is one of the main criteria for determination of the lower boundary of the subzone. The plentiful assemblages with a lot of specimens of different species of g. *Lamelliconus, Austrocolomia, Variostoma* and from the fam. *Oberhauserellidae* are known from the late Ladinian and Early Carnian time not only in Balkan range and in the entire N. Bulgaria but in some localities abroad — Dinarides, W. Carpathians, Tunisia and Turkey as well.

Upper Triassic

In the region studied the Carnian sediments are represented mainly by carbonate rocks — limestones and dolomites as well as by clayey-limestones and clayey rocks. Locally in the Moesian platform thick evaporitic complexes were formed. Towards the end of the Carnian age mixed carbonate-terrigenous multicoloured rocks began to form.

The foraminifers are restricted chiefly to the carbonate rocks, but under the influence of the facies the foraminiferal assemblages often change their composition. Because of this fact the representatives of g. g. *Aulotortus, Rakusia, Angulodiscus, Lamelliconus* and some *Nodosariidae* foraminifers locally are predominating in some levels. In general, foraminiferal assemblage of *Pilamminella kuthani* or *Paraophthalmidium carpathicum* from Bulgarian occurrences are comparable to those from Carnian sediments of many localities in Europe. The most characteristic species of the zonal assemblages are: *Trochammina alpina* Kristan-Tollmann, *Agathammina austroalpina* Kristan-Tollmann, *Ophthalmidium lucidum* (Trifonova), *Triadosphaera ramosa* (Kristan-Tollmann), *Angulodiscus friedli* (Kristan-Tollmann), *Aulotortus tenuis* (Kristan), *Triadodiscus eomezozoicus* (Oberhauser), *Lamelliconus* gr. *biconvexus* (Oberhauser), *L. multispirus* (Oberhauser), *L. procerus* (Liebus), some species of g. *Austrocolomia, Paraophthalmium carpathicum* Borza et Samuel etc.

Norian stage. Lithologically Norian sediments are represented by carbonate and terrigenous-carbonate rocks. The foraminifers were studied only in several occurrences. Lately from the lagoonal-marine carbonate rocks on the basis of the foraminiferal sequence, the *Miliolipora cuvillieri* Range-zone connected with the Norian stage was described. The Norian sediments from East Balkan rich in different species of *Monotis* and *Halobia* contain more various foraminifers chiefly from g. g. *Variostoma, Ophthalmidium, Gaudryina* etc.

In general the Norian sediments of Bulgaria need a more detail investigation. Typical Rhaetian foraminifers have not been found in Bulgaria.

◀ Plate 8. 1 — *Nodosaria ordinata* Trifonova ×130, bore-hole R-1 Prolaz, 3051-3064 m, Carnian, loc.: N. S. Bulgaria; 2 — *Endothyranella wirtzi* (Koehn-Zaninetti) ×130, bore-hole R-1 Pelovo, 3998,30 m, loc.: Central N. Bulgaria; 3 — *Ophthalmidium* aff. *carinatum* (Leischner) ×40, sample no LB-2, Upper Illyrian, loc.: Ostré vŕšky; 4 — *Palaeomiliolina judiraciensis* (Premoli Silva) ×130, bore-hole R-3 Kneža, 4333,40 m, Pelsonian, loc.: Central N. Bulgaria; 5 — *Sigmoilina triadica* (Langer) ×40, sample no LB-2, Upper Illyrian, loc.: Ostré vŕšky.

Hellenic realm of Greece
(Pl. 9)

In Greece the Triassic formations occur on both sides of the Pelagonian Massif in the internal and external zones of the Hellenids. The main non recrystalized localities studied are presented in Fig. 3.

Until 1896 the Triassic was completely ignored in Greece and its occurrences were regarded as Jurassic or Cretaceous. In 1896 H. Douvillé described the first ammonite in Greece (Mycenes) and since then the Triassic started to be revealed almost everywhere.

Most datings were based on ammonites, lamellibranchiates, conodonts and some were based on dasycladaceans and foraminifers. The bibliography concerning the Triassic was revised by Guernet (1971) and Katsikatsos (1980). Triassic foraminifers were described and also depicted in publications by Christodoulou and Tsaila (1972, 1975), Tsaila and Monopolis (1977), Nicora and Premoli Silva (1976), Courtin et al. (1982), Gerolymatos et al. (1982), Senowbari-Daryan (1983), Pomoni et al. 1986).

Lower Triassic

The uppermost Permian Lower Triassic resting upon the marine Permian — as postulated till now — is represented by a detrital facies with layers of neritic

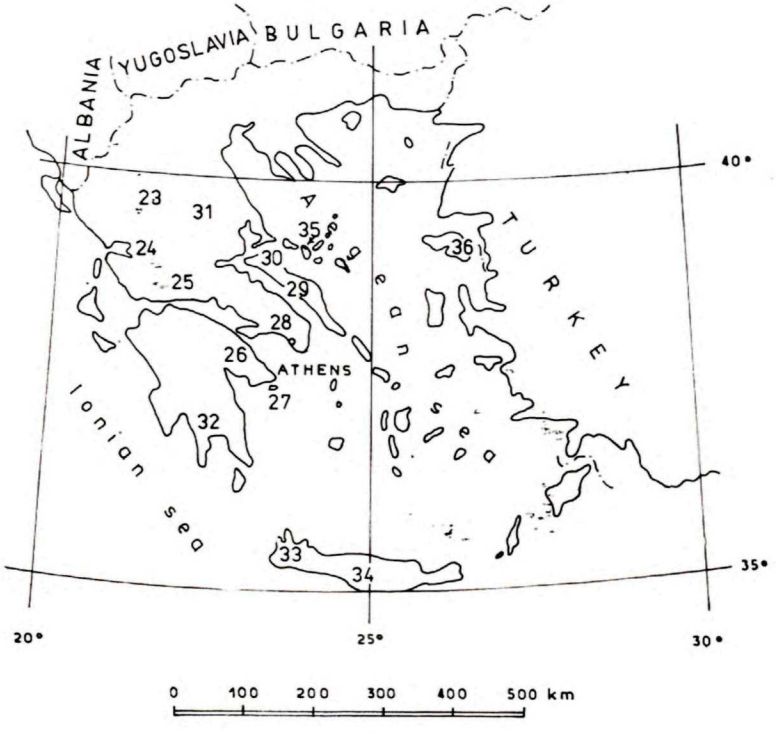


Fig. 3. Sketch map of localities with Triassic Foraminifera from Hellenic Realm. Localities in Greece: 23 — Pindos area, 24 — Akarhania area, 25 — Aetolia area, 26 — Argolis area, 27 — Hydra isl., 28 Attika area, 29 — Central Euboea, 30 — North Euboea, 31 — Thessalia area, 32 — Lakonia area, 33 — Western Creta, 34 — Central Creta, 35 — Skopelos isl., 36 — Lesvos isl.

organodetrital limestones mostly associated with volcanics and tuffites.

The organodetrital limestones and calcareous sandstones (absent in the basal part of the formation) contain *Glomospirella triphonensis* Baud, Zaninetti et Broennimann, *Gl. sigmoidalis* (Rauser), *Gl. irregularis* (Moeller), *Gl. ammodiscoidea* (Rauser), *Ammodiscus parapriscus* (Ho), *Glomospira sinensis* (Ho) and rares *Arenovidalina chialingchiangensis* (Ho). The genus *Meandrospira* is not represented. So we may state that in the area studied its first appearance could not have been in the Lowermost Triassic but only later. We preliminarily relate the newly defined zone *Arenovidalina chialingchiangensis — Glomospirella triphonensis* to the uppermost Gangetian and Dienerian p. p. (Fig. 3). The lower boundary of this zone is defined by F. A. of index species, the upper boundary — by F. A. of *Meandrospira cheni* (Ho).

Since there are no representatives of the genus *Ophthalmidium* in this zone, the species *Arenovidalina chialingchiangensis* Ho is to be regarded as their ancestral form, and in contrast to Zaninetti (1976) we do not regard the genus *Arenovidalina* Ho, 1959 as a synonym probable cf *?Ophthalmidium* Kuebler et Zwingli, 1870.

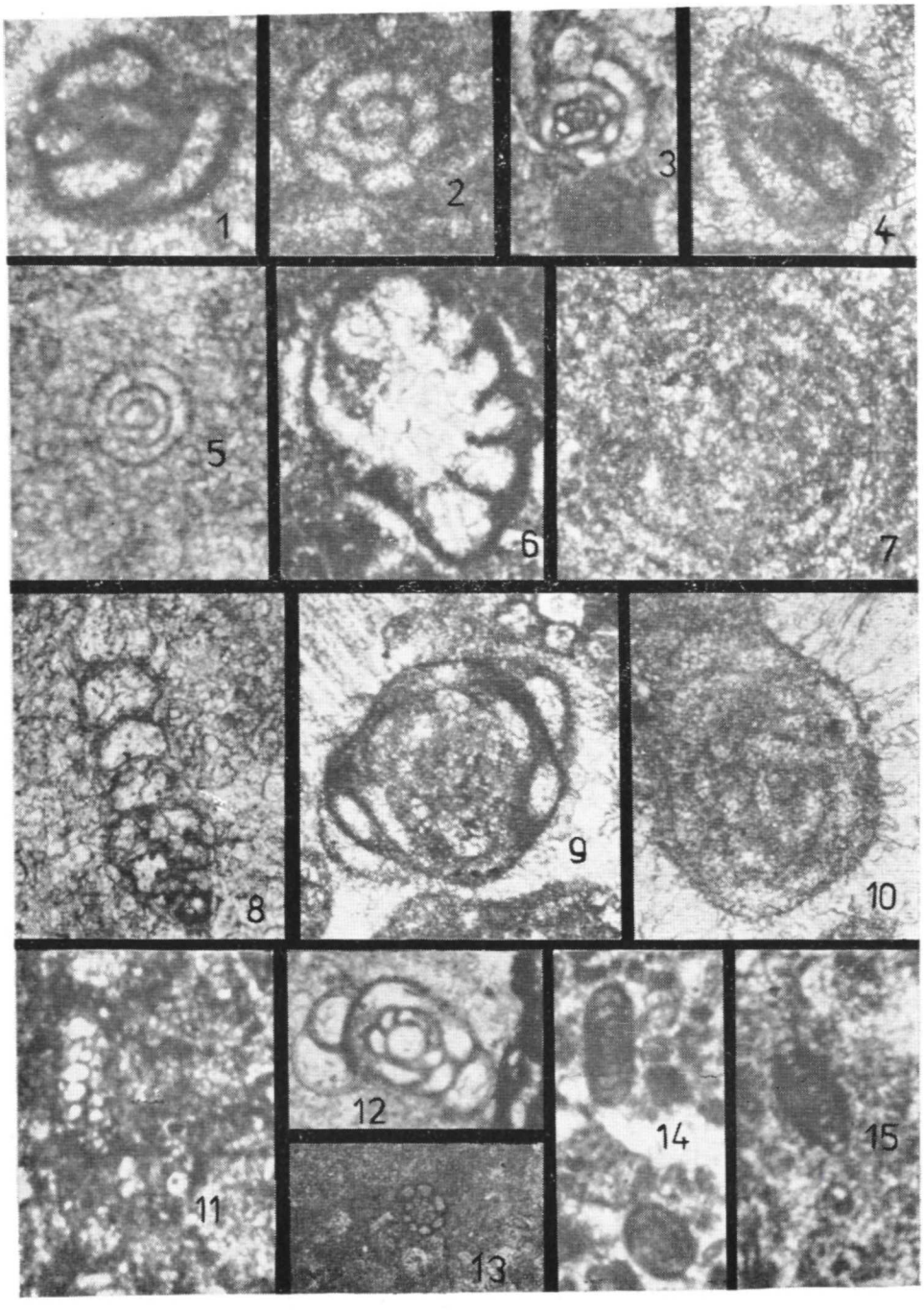
In the course of the Scythian there gradually appeared representatives of the genus *Meandrospira:* at first *Meandrospira cheni* (Ho), then *Meandrospira pusilla* (Ho) in association with *M. cheni* (Ho) or later on not in the association. In the uppermost part of *M. pusilla* Zone (Mont Parnes), where *M. cheni* is absent, the first representatives of the genus *Meandrospiranella* n. sp., have been found (V. C. — J. S.). They constitute evolutionary forms of the species *M. pusilla* (Ho) fact that confirms the polyphylogenetic origion of the genus *Meandrospiranella* Salaj, 1969 whose first representatives appear already in the uppermost Scythian. Then *M. pusilla* (Ho) passes to the Lowermost Anisian whose lower boundary is defined by F. A. of *Meandrospira insolita* (Ho).

Middle Triassic

In the Middle Triassic the sedimentation is carbonatic (with local presence of detrital material) passing up to the Upper Triassic. The detrital material is also present between the Upper Carnian — Norian Hallstatt limestones and the Rhaetian Pantocrator limestones of the Dachstein facies according to bibliographic data.

During the Anisian the neritic limestones of the Carbonatic platform formed in almost all tectonic zones. They are dated upwards by the presence of *Meandrospira insolita* (Ho), *Meandrospira dinarica* Kochansky- Devidé et Pantić, *Pilammina densa* Pantić sometimes associated with *Glomospirella triphonesis* Baud, Zaninetti et Broennimann, *Pilamminella grandis* (Salaj), *Austrocolomia marschalli* Oberhauser, *Diplotremina* div. sp., ostracods, dasycladaceans and the F. A. of *Involutinidae,* represented by *Aulotortus pragsoides* (Oberhauser). Dasycladacean algae are locally predominating forming special levels in the Anisian limestones corresponding to the Steinalm facies known from the Alpin and Carpathians regions. A special facies of Pelsonian age containing only Diplotremmina astrofibriata Kristan-Tollmann has been located, too.

In some places *Meandrospira insolita* (Ho) is associated with numerous *Nodosariidae.* The fact is indicative of certain deepening of the environment. Higher up and in the zone *Meandrospira dinarica* with brachiopods also *Turriglommina mesotriassica* (Koehn-Zaninetti) and *Palaeomiliolina judicariensis* (Premoli Silva) appear.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

These forms are also indicative of lower parts of Anisian so we may place the base of the zone *Turriglommina mesotriassica* earlier. In a more hypersaline environment *Meandrospira deformata* Salaj appeared.

In the Middle — Upper Anisian the basin with purely pelagic sedimentation started to form particularly in the zone of Pindos. On the other hand, the presence of pelagic facies in zones characterized by platform carbonate sedimentation under the neritic conditions is indicative of the existence of small basins resulting from subsequent tectonic movements. The facies are represented by micritic limestones with filaments, frequently associated with Radiolarians. The filaments form sometimes lumachelles and their formation continues up to the Jurassic.

In the platform carbonate facies, *Pilammina densa* Pantić and *Pilamminella gradis* (Salaj) do not surpass the lower boundary of the Ladinian.

The Ladinian of platform carbonate facies comparable to limestones of the Wetterstein facies, is characterized by plentiful dasycladaceans *[Diplopora annulata* (Schaehault), *Diplopora annulatissima* Pia a. o.] and contains frequent *Pilamminella gemerica* (Salaj), and in top parts also plentiful *Aulotortus sinuosus* Weynschenk, *Aulotortus pragsoides* (Oberhauser), *Angulodiscus praegaschei* (Koehn-Zaninetti) and sometimes also *Agathammina iranica* Zaninetti, Broennimann, Bozorgnia et Huber which also ranges to the Carnian.

In some places the Middle Triassic is also characterized by the Hallstatt facies of the pelagic environment, whose deposition commenced in Argolide during the Lower Anisian determined on the basis of ammonites (personal information by Tselepidis) or in the Uppermost Scythian (Chios island) and lasted up to the Norian. The facies consits of biomicrite limestones with filaments, rich in ammonites and containing various species of *Nodosaridae* and *Duostominidae* and other genera which are most frequent in Argolide, and are going to be presented in detail in a future note (V. C.).

Upper Triassic

The Carnian of the less deep facies is

◀ Plate 9. 1 — *Meandrospira deformata* Salaj ×75, Pelagonian Zone, Anisian, loc.: Central Euboea; 2 — *Meandrospira cheni* (Ho) ×75, Pelagonian Zone, Smithian, loc.: Central Euboea; 3 — *Meandrospiranella* sp.1 ×180, Hallstatt facies, Upper Anisian, loc.: Argolis; 4 — *Agathammina austroalpina* Kristan-Tollmann et Tollmann ×180, Pindos Zone, Middle Triassic, loc.: Aetolia; 5 — *Ammodiscus parapriscus* Ho ×75, Hallstatt facies, probably Ladinian, loc.: Argolis; 6 — *Variostoma crassum* Kristan-Tollmann ×75, Pindos Zone, Anisian, loc.: Aetolia; 7 — *Pilammina densa* Pantić ×75, Pelagonian Zone, Middle Anisian, loc.: Central Euboea; 8 — *Gaudryinella elegantissima* Kristan-Tollmann ×180, Hallstatt facies, probably Carnian, loc.: Argolis, 9 — *Pilamminella kuthani* (Salaj) ×110, Pelagonian Zone. Carnian, loc.: North Euboea; 10 — *Pilamminella gemerica* (Salaj) ×110, Pelagonian Zone, Ladinian, loc.: North Euboea; 11 — *Gaudryinella* cf. *clavuliformis* Trifonova ×75, Pindos Zone, Middle Triassic, loc.: Aetolia; 12 — *Glomospira inflata* Michalík, Jendrejáková et Borza ×180. Hallstatt facies, probably Ladinian, loc.: Argolis; 13 — *Meandrospira pusilla* (Ho) ×45, Pelagonian Zone, Spathian, loc.: Attika; 14 — *Glomospirella triphonensis* Baud, Zaninetti et Broennimann ×75, Ionian Zone, Lower Triassic, loc.: Akarnania; 15 — *Arenovidalina chialingchiangensis* Ho ×75, Hallstatt facies. Upper Anisian — Ladinian, loc.: Argolis.

represented by platform limestones (with dasycladaceans, containing plentiful forms of the family Involutinidae among which most important *Angulodiscus friedli* (Kristan), towards the top associated with *Rakusia oberhauseri* Salaj. In places, in the foraminiferal assemblage dominant are representatives of the family *Ophthalmididae*, particularly of the genus *Agathammina* (*A. iranica* Zaninetti, Broennimann, Bozorgnia et Huber, *A. austroalpina* Kristan-Tollmann et Tollmann) and *Paraophthalmidium*, among which *Paraophthalmidium carpathicum* Samuel et Borza is most significant. There are also *Ophthalmidium exiguum* Koehn-Zaninetti, *Ophth. fusiformis* (Trifonova), *Endothyra keupperi* Oberhauser.

In the Norian besides the above mentioned *Involutinidae* there are also significant species of *Galeanella* like G. *tollmanni* (Kristan) and towards the top, approximately at the contact with the Rhaetian also *Gandinella falsofriedli* (Salaj, Borza et Samuel) appears.

In the Rhaetian the presence of *Angulodiscus friedli* is more frequently associated with various species of the family *Involutinidae* among which also Trocholines are aboundant. The upper part of the Rhaetian is characterized by the appearance of *Triasina hantkeni* Majzon but it does not surpass the Upper Rhaetian range.

So we may say that as regards the Triassic carbonate platform formations, in some places deepened, the zonation of the Triassic established by Salaj, Trifonova et Gheorghian (1986) for the Carpathian-Balcan region can — after a slight modification — be also applied on Greece (Fig. 2).

At present it is not possible to establish biozonation of deeper facies because the group of plentiful *Nodosariidae* and *Duostominidae* needs a more detailed study.

Conclusion

The future investigation on the Triassic foraminifera microbiostratigraphy of the Carpathian-Balkan and Hellenic Realm will be connected with the more detailed determination of the stratigraphic range of the biostratigraphic units, comparation with other fossils with presentation of parallel biozonal schemes and specially with the problems of ecostratigraphy.

References

Amieux, P. 1982: La cathodoluminiscence: méthode d'étude sédimentologique des carbonates. *Bull. Centr. Rech. Explor. Prod. Elf-Aquitaine, 6, 2, 437—483.*

Baltres, A. 1975: Der Obere Anis von Lacul Roşu (Ostkarpaten): Algen, Foraminiferen, Sedimentologie und Diagenese. In: *14th European Micropaleontological Colloquium, Romania, 115—121.*

Baud, A., Zaninetti, L., Broennimann, P. 1971: Les Foraminifères de l'Anisien (Trias moyen) des Préalpes Médianes Rigides (Préalpes romandes, Suisse et Préalpes du Chablais, France). *Arch. Sci. Genève, 24, 1, 73—95.*

Bordea, J., Iordan, M., Tomescu, C., Bordea, S. 1978: Biostratigraphic Contribution to the Upper Triassic from the Ferice Unit (Bihor Mountans). *D. S. Şedinţ., LXIV, 63—78.*

Budurov, K. M., Trifonova, E. T. 1984: Correlation of Triassic conodont and foraminiferal zonal standards in Bulgaria. *Dokl. Bolg. Akad. Nauk, 37, 5, 625—627.*

Bystrický, J. 1986: Stratigraphic Ranging and Zonation of Dasycladal Algae in the West Carpathians Mts., Triassic. *Miner. slov., 18, 289—321.*

Bystrický, J. et al. 1973: Triassic of the West Carpathians Mts. *In: Guide to Excurs. D, Xth Congr. Carp.-Balk. geol. Ass. Bratislava, GÚDŠ, 1—37.*

Courtin, B., Zaninetti, L., Altiner, D., Décrouez, D. 1982: Sur l'existence de calcaire de plateforme à foraminifères triasiques en Othrys occidentale (Grèce continentale): importances paléogéographiques. *Rev. Paléobiol., 1, 1, 13—27.*

Gerolmatos, E. Dornsiepen, U., Trifonova, E. 1982: Vorkommen von höheren Zentralhellenischen Deckeneinheiten in Lakonien (Peloponnes, Griecheland). *Praktica Akad. Athenes, 57, 247—261.*

Gheorghian, D. 1975: Date biostratigrafice privind Triasicul de la Sasca (zona Reşita — Moldovo Nouă, Banat). *D. S. Şedinţ., LXI, 4, 51—64.*

Gheorghian, D. 1976: Contributii la cunoasterea unor microfaune triasice din Muntii Apuşeni (Pădurea Craiului). *D. S. Şedinţ., LXII, 3, 25—38.*

Gheorghian, D. 1980: Note concernant quelques espèces de Nodophthalmidium dans le Trias moyen-supérieur de Roumanie. *D. S. Şedinţ., LXV, 3, 37—41.*

Gaździcki, A. 1983: Foraminifers and biostratigraphy of Upper Triassic and Lower Jurassic of the Slovakian and Polish Carpathians. *Paleont. pol., 44, 109—169.*

Głazek, J., Trammer, J., Zawidzka, K. 1973: The Alpine microfacies with Glomospira densa (Pantić) in the Muschelkalk of Poland and some paleogeographical and geotectonic problems. *Acta geol. pol., 23, 3, 463—482.*

Guernet, C. 1971: Etudes géologiques en Eubés et dans le régions voisines (Grèce). *Thèse de doctorat, Univ. de Paris, VI.*

Ho, Y. 1979: Sketch of the Triassic foraminiferal biostratigraphy of Northwestern Sichuan (Szechuan), China. *Riv. Ital. Paleont., 85, 3—4, 1167—1174.*

Christodoulou, G., Tsaila-Monopolis, St. 1975: Eastern Hellenic zone knowledge of the stratigraphy of Triassic in the Eastern Hellenic zone. *Bull. of the Geol. Soc. of Greece, IX, 101—118.*

Christodoulou, G., Tsaila-Monopolis, St. 1975: Eastern hellenic zone microfacies. *National Institute of Geol. et min. Res., V, XVII, 1, 63.*

Jendrejáková, O., Michalík, J., Papšová, J. 1981: Príspevok ku stratigrafii strednotriasových karbonátov hronika (chočský príkrov Horehronia, Západné Karpaty). *Zem. Plyn Nafta, XXVI, 4, 611—624.*

Katsikatsos, G. 1980: Etude geologique de la région Vassiliko-Ithomi, Messinias. *Thèse de doctorat, Univ. de Paris.*

Kovácz, S., Papšová, J. 1986: Conodonts from the Paraceratites binodusus zone (Middle Triassic) from the Mecsek Mts., southern Hungary and from the Choč nappe of the Low Tatra Mts. *Geol. Zbor. Geol. carpath., 37, 1, 59—74.*

Kozur, H. 1971: Die Bairdiaceae der Trias. Teil III: Einige neuer Arten triassischen Bairdiacea und Bemerkungen zur Herkunft der Macrocyprididae (Cypridacea). *Geol. Pal. Mitt. Innsbruck, 1/6, 1—18.*

Kullmanová, A., Rakus, M., Biely, A., Pevný, J., Havrila, M. 1984: Charakteristické litostratigrafické profily mezozoika Nízkych Tatier. Časť II. (mezozoikum chočského príkrovu). *Manuskript — GÚDŠ Bratislava.*

Limongi, P., Panzaneli-Fratoni, R., Ciarapica, G., Cirilli, S., Martini, R., Savini-Bonnard, G., Zaninetti, L. 1987: Turriglommina Zaninetti, n. g., un nouveau nom pour „Turritellella" mesotriassica Koehn-Zaninetti, 1968 (Foraminifère, Trias moyen) avec remarque sur la présence de l'éspèce dans le Ladinien de l'Apennin méridional. Arch. Sci. Genève, vol. 40, 1, 13—22.

Majzon, L. 1954: Contribution to the Stratigraphy of the Dachstein Limestone. *Acta geol. Sci. Hung., 2, 243—249.*

Mirăută, E. 1974: Über die Conodontenfaunen des oberen Werfens und des tieferen Anis der nördlichen Dobrudscha/Rumänien. *Geol. Pal., (Marburg)., 8, 149—158.*

Martini, R., Amieux, P., Gandin, A., Zaninetti, L. 1987: Triassic foraminifers from Punta Tonnara (SW Sardinia) observed in cathodoluminiscence. Rev. Paléobiologie, 6 ,1, 23—27.

Mirăută, E. 1982: Biostratigraphy of the Triassic Deposits in the Somova — Sarica Hill Zone (North Dobrodgea) with Special Regard on the Eruption Age. *D. S. Şedinţ., LXVII, 4, 63—78.*

Mirăută, E., Gheorghian, D. 1978: Etude microfaunique des formation triasiques (transylvaines, bucoviniennes et gétiques) des Carpates Orientales. *D. S. Şedinţ., LXIV, 3, 109—162.*

Mirăută, E., Gheorghian, D. 1975: Norian Conodonts and Foraminifers from North Dobrodgea. *D. S. Şedint., LXI, 3, p. 47—76.*

Mirăută, E., Iordan, M., Gheorghian, D. 1984: New Biostratigraphic Data on the Triassic from the Somova-Sarica Hill Area (Tulcea zone, North Dobrodgea). *D. S. Şedint., LXVIII, 4, 35—48.*

Michalík, J., Jendrejáková, O., Borza, K. 1979: Some new Foraminifera-species of the Tatra-Formation (Uppermost Triassic) in the West Carpathians. *Geol. Zbor. Geol. carpath., 30, 1, 61—91.*

Papšová, J., Gáal, L. 1984: Conodonts from Pelsonian — Cordevolian basinal limestones of Choč and Silica nappes. *Západ. Karpaty, Sér. Paleont., 9, 155—164.*

Nicora, A., Premoli Silva, I. 1976: Bentonic foraminifera from Early — Middle Triassic pelitic sequences from Chios (Greece) and Bithynia (Turkey) and correlation with conodont and ammonoid assemblages: preliminary note. *Maritine Sediments, sp. publ. no. 1, 1st. Int. Symp. Benth. Foram. Continent. Margins, Part B, Halifax, 487—499.*

Oravecz-Scheffer, A. 1987: Triassic foraminifers of the Transdanubian central range. *Geol. hungar. Ser. Palaeont. 50, 1—134.*

Papšová, J., Pevný, J. 1982: Finds of conodonts in Reifling limestones of the West Carpathians (the Choč and Strážov nappe). *Západ. Karpaty, Sér. Paleont., 8, 77—90.*

Patrulius, D., Bordea, S. 1970: Microfacies with Nodosarids in the Triassic of the Apuseni Mountains and East Carpathians. *D. S. Şedimenţ., LV, 3, 201—206.*

Patrulius, D., Gheorghian, D., Mirăută, E. 1977: Corrélation biochronologique du Calcaire de Roşia, formation trasique su système des Nappes de Codru (Monts Apuseni). *D. S. Şedint., LXII, 4, 121—133.*

Patrulius, D., Popescu, I., Mirăută, E., Gheorghian, D. 1987: The Klippen of the Persani Mountains (East Carpathians). (in press).

Poisson, A., Ciarapica, G., Cirilli, S., Zaninetti, L. 1985: Gandinella falsofriedli (Salaj, Borza et Samuel, 1983) (Foraminifère, Trias supérieur), étude de l'espèce sur la base du material-type du Domuz Dag (Taurus Lycien, Turquie). *Rev. Paléobiol., 4, 1, 133—136.*

Pomoni-Papaioannou, F., Trifonova, E., Tsaila-Monopolis, S., Katsavrias, N. 1986: Lofer type cyclotherms in a late triassic dolomitic sequence on the eastern part of Olympus. *IGME, Geol. et Geoph. Res., Spéc. Issue, Athens, 403—417.*

Popa, E., Dragastan, O. 1973: Algae şi foraminifere triasice (Anisian-Ladinian) din estul Pădurii Craiului (Munti Apuşeni). *Stud. Cerc. Geol. Geof. Geogr., Ser. Geol., 18, 2, 425—442.*

Rakus, M. 1986: Ammonites in basal parts of Reifling limestones in Choč nappe on southern slopes of Nízke Tatry Mts. *Geol. Zbor. Geol. carpath., 37, 1, 75—89.*

Salaj, J. — Borza, K. — Samuel, O. 1983: Triassic Foraminifers of the West Carpathians. *Bratislava, GÚDŠ, 1—213.*

Salaj, J., Trifonova, E., Gheorghian, D. 1986: Triassic Foraminifera zonation and its problems in the Carpatho-Balkan Realm. *In: 3rd Symposium on the Benthonic Foraminifera "Benthos 86". Genève (in press).*

Senowbari-Daryan, B. 1983: Zur Gattung Pseudocucurbita Borza et Samuel, 1978 (pro Cucurbita Jablonsky, 1973) und Beschreibung vergleichbarer problematischer Organismen aus der Obertrias des Alpin — mediterranen Raumes. *Riv. Ital. Paleont., 88, 181—250.*

Végh-Neubrandt, E. 1972: Fauna und Faziesverbreitung der Obertrias des Transdanubischen Mittelgebirges. *Ann. Univ. Sci. Budapest, Roland Eötvös Sect. geol., 15, 115—116.*

Trifonova, E. T. 1978a: The Foraminifera Zones and Subzones of the Triassic in Bulgaria. I. Scythian and Anisian. *Geol. Balcan. 8, 3, 85—104.*

Trifonova, E .T. 1978b: Foraminifera Zones and Subzones of the Triassic in Bulgaria. II. Ladinian and Carnian. *Geol. Balcan., 8, 49—64.*

Tsaila-Monopolis, St. 1977: Micropaleontological and stratigraphical study of the Tripolitza (Gavrovo) zone in the Peloponnesus. *Geol. Geophysical Res., XX, 1, 1—106.*

Zaninetti, L. 1976: Foraminifères du Trias. Essai de synthèse et corrélation entre des domaines mésogéens européen et asiatique. *Rev. Ital. Paleont., 82, 1, 1—258.*

Triasová foraminiferová mikrobiostratigrafia karpatsko-balkánskeho a helenidného pásma

Autori pojednávajú o triasových foraminiferových asociáciách karpatsko-balkánskej a helenidnej zóny, menovite Československa, Rumunska, Bulharska (obr. 1) a Grécka (obr. 3) s odkazom aj na niektoré lokality v Maďarsku a Poľsku. Foraminifery sú opísané vo vzťahu k rôznym typom fácií, ktorých vek je určený hlavne makrofaunou, riasami a konodontmi. Mikrobiostratigrafické problémy jednotlivých oblastí sa riešia vo vzťahu k zonálnemu členeniu vypracovanému na základe foraminifer. Členenie bolo vypracované najprv pre Západné Karpaty Slovenska (Salaj, 1969; Salaj et al., 1983) a neskoršie aj pre karpatsko-balkánsku zónu (Salaj et al., 1986) a pre helenidy (obr. 2).

Treba zdôrazniť, že predbežné výsledky o mikrobiostratigrafii triasu sú dosiahnuté v rámci vzájomnej spolupráce GÚDŠ s jednotlivými geologickými ústavmi Rumunska, Grécka a s Geologickým ústavom Bulharskej akadémie vied, z ktorých zainteresovaní pracovníci budú v ďalšej, prípadne rozšírenej spolupráci pokračovať.

Stratigrafia

Najstaršia asociácia foraminifer triasu vô-

bec, reprezentovaná novodefinovanou intervalovou zónou *Arenovidalina chialingchiangensis — Glomospirella triphonensis* (? vrchný gangét — spodný diener), vystupuje v Grécku. Od najvrchnejšieho, na fosílie bohatého morského permu je oddelená málodetritickými, zrejme prevažne lagunárnymi a kontinentálnymi sedimentmi. V tejto zóne nie sú prítomní zástupcovia rodu *Meandrospira*, čo by potvrdzovalo, že sa nezačali vyvíjať v perme, ale neskoršie, až v nadloží spodnodienerských sedimentov s *Claraia clarai* (Emmr.) tak, ako je to preukázané v Nízkych Tatrách (Kullmanová et al., 1982). Ide o druh *Meandrospira cheni* (Ho), reprezentanta rovnomennej zóny, ktorú dávame do vzťahu vrchný diener — smit. Ďalšie indexové druhy jednotlivých zón, ako *Meandrospira pusilla* (Ho), *M. insolita* (Ho) a *M. dinarica* Kochansky-Devidé et Pantić, sú preukázané v celej študovanej zóne (obr. 2).

Druh *Turriglommina mesotriassica* (Koehn-Zaninetti) sa v študovanej oblasti prvý raz zistil v Grécku, a to pred pelsónom, spolu s Pilammina densa Pantić.

Táto skutočnosť dovoľuje potvrdiť názor Salaja et al. (1983) o migrácii významných tetýdnych foraminiferových druhov z juhu a východu na sever a západ.

Tak napr. významný druh *Aulotortus pragsoides* (Oberhauser), preukázaný v dinaridách v priebehu celého ilýru, je v Západných Karpatoch preukázaný až v najvrchnejšej časti spodného ilýru, a to s *Pilammina densa* Pantić a *Meandrospira insolita* (Ho) (Tab. 1, obr. 2, 3, 4). O tomto fakte sa v poslednom čase v Západných Karpatoch pochybovalo (Bystrický, 1986, s. 321). Chýbanie druhu *Pilammina densa* Pantić v prevažnej časti vrchného ilýru v Západných Karpatoch je spôsobené výraznejším prehĺbením sedimentačných podmienok, rovnako aj časté chýbanie druhu *Aulotortus pragsoides* (Oberhauser) v spodnom ladine, či už vo fácii reiflinských alebo wettersteinských biotermných vápencov, je prejavom výrazných batymetrických zmien.

Pre platformné, čiastočne hlbšie fácie až panvové fácie anisu — spodného karnu sú okrem *Turiglommina mesotriassica* (Koehn-Zaninetti) významní zástupcovia rodov *Ophthalmidium* a *Paraopthalmidium*, pričom *Paraophtalmidium carpathicum* Samuel et Borza je indexovým druhom pre karn. Bohatým asociáciám foraminifer čeľade *Nodosariidae*, ktoré sú zastúpené vo fácii schreyeralmských, hallstattských a kössenských vrstiev, sa žiada v budúcnosti venovať zvýšenú pozornosť.

Pre stratigrafické členenie platformných, na riasy bohatých vápencov stredného a vrchného triasu sú významné involutné foraminifery, na ktorých stratigrafický význam upozornili už viacerí autori (Salaj, 1969; Zaninetti, 1976; Trifonova, 1978; Salaj et al., 1983; Gaździcki, 1983; Salaj et al., 1986). Involutné foraminifery, ako aj riasy boli v poslednej dobe preukázané aj v hlavnom dolomite Západných Karpát (Salaj et al., 1983). Vzhľadom na výslovnú pochybnosť o možnosti ich výskytu (Bystrický, 1986) viaceré z nich sú v tejto práci vyobrazené (Tab. 1, obr. 5, 6, 7, 8, 10, 11, 13, 14). Je zrejmé, že štúdiu hlavného dolomitu, ako aj iných dolomitických horizontov triasu bude treba v budúcnosti venovať zvýšenú pozornosť, a to hlavne použitím metodiky katodoluminiscencie (Amieux, 1982; Martini et al., 1987).