ISSN 0869-5938, Stratigraphy and Geological Correlation, 2006, Vol. 14, No. 6, pp. 642–654. © MAIK "Nauka/Interperiodica" (Russia), 2006.
Original Russian Text © S.V. Lobatscheva, T.N. Smirnova, 2006, published in Stratigrafiya. Geologicheskaya Korrelyatsiya, 2006, Vol. 14, No. 6, pp. 68–80.

Berriasian (Lower Cretaceous) Brachiopods from the Crimea

S. V. Lobatscheva[a] and T. N. Smirnova[b]

[a] *A.P. Karpinsky All-Russia Research Institute of Geology, St. Petersburg, Russia*
[b] *Moscow State University, Moscow, Russia*

Received June 1, 2005; in final form, December 18, 2005

Abstract—Four successive assemblages of Berriasian brachiopods distinguished for the first time in the Crimea are correlated with concurrent subdivisions of the ammonoid scale. Berriasian brachiopods are represented by 44 species of 27 genera and 14 families, which are most complete in terms of taxonomic composition as compared to other concurrent brachiopod faunas known elsewhere. The assemblages are dominated by local species. As is proved, the Berriasian brachiopods studied are appropriate for age determination, subdivision and correlation of their host deposits. Their geographic distribution that has been analyzed elucidates connections of the Berriasian sea basins within the Mediterranean paleozoogeographic region.

DOI: 10.1134/S0869593806060049

Key words: brachiopods, Lower Cretaceous, Berriasian, stratigraphy, correlation, Mediterranean paleozoogeographic region.

INTRODUCTION

A.S. Moiseev was first researcher who described Berriasian brachiopods from the Crimea. He studied a great collection of Tithonian, Berriasian and Valanginian brachiopods and identified among them the European species and subspecies *Lacunosella hoheneggeri* (Suess, 1858), *L. malbosi* (Pictet, 1867), *Rhynchonella corallina neocomiensis* (Jacob et Fallot, 1913), *Ismenia pectunculoides* (Schlotheim, 1820) and other taxa known from the Tithonian of Western Europe. Moiseev noted a considerable number of endemic forms in the collection, discriminated the new genus *Belbekella* (1939) of rhynchonellids, and described four new species: *B. airgulensis, Terebratula kuckensis* (= *Weberithyris moisseevi*) Weber, *Terebratulina arguinensis, Zeilleria airgulensis*, and one new subspecies *T. yailensis kojnautensis* (collection nos. 4802 and 6137 TSNIGR Museum, St. Petersburg). Investigation of Berriasian brachiopods from the Crimea was continued by T.N. Smirnova who studied their taxonomy, phylogeny, microstructure of shell substance, stratigraphic and paleozoogeographic significance (Smirnova, 1962, 1968, 1972, 1990, 1997; Smirnova and MacKinnon, 1995; Yanin and Smirnova, 1981). As she concluded, Berriasian brachiopods of the Crimea are very similar to brachiopod species from the Berriasian stratotype section of southeastern France, which have been described by d'Orbigny (1847), Loriol (1868), Pictet (1867, 1872), Jacob and Fallot (1913). S.V. Lobatscheva and her colleagues (Lobatscheva, 1977, 1983, 1993; Lobatscheva et al., 1994) analyzed stratigraphic distribution of brachiopods in Berriasian sections of the Crimea and distinguished assemblages of their species characteristic of particular stratigraphic intervals, which were correlated with subdivisions of the ammonoid scale. As a result, sections of southwestern, central and eastern Crimea, which are of different facies types, have been correlated.

Brachiopods represent one of the fossils groups frequently occurring in shallow-sea deposits of the Crimea. Their species are usually very abundant, often concentrated in coquina lenses and interlayers. This group of fossils from Berriasian deposits of the Crimea is very diverse in taxonomic aspect, classed with 44 species of 27 genera and 14 families of inarticulate (order Craniida) and articulate (orders Rhynchonellida and Terebratulida) brachiopods. Terebratulids are most diverse, represented primarily by megathyridids, cancellothyridids and thecideid brachiopods frequent in reefs and confined in sections to biohermal and clayey facies. Being well preserved and frequently occurring in sediments, the studied brachiopods are suitable for stratigraphic subdivision of Berriasian deposits in the Crimea. They are divided into four stratigraphic assemblages.

The Berriasian ammonoid zonation was elaborated first by Druschits (1975). Later on, it was verified and changed in accord with new data on Berriasian ammonites of the Crimea obtained by Bogdanova and Kvantaliani (1983), Bogdanova et al. (1988, 1999b), Baraboshkin (1997), Bogdanova and Arkad'ev (1999), Glushkov (1997), Arkad'ev (2003) and other researchers.

The Lower Cretaceous Field Team organized by the Chair of Paleontology of the Moscow State University (MSU) under guidance of Druschits collected Berria-

sian brachiopods studied in this work. The collection includes paleontological materials sampled by B.T. Yanin, T.N. Smirnova, T.N. Gorbachik, M.A. Golovinova and E.I. Kuzmicheva in 1954–1965, by T.N. Bogdanova, S.V. Lobatscheva, T.A. Favorskaya (All-Russia Research Institute of Geology) and V.A. Prozorovskii (Leningrad State University) in 1977–1978, and by V.M. Nerodenko (Kiev University) in 1976–1978. Over 1000 specimens of brachiopod shells, which have been sampled, are stored at the F.N. Chernyshev TSNIGR Museum in St. Petersburg (collection nos. 12075, 12770, and 12810) and at the Chair of Paleontology MSU (collection nos. 109, 136, 327, 26-539, 12-2830). The studied brachiopods have been collected from Berriasian sections of eastern, central and southwestern Crimea (Fig. 1). The sections are described by Bogdanova, Lobatscheva and Favorskaya (Fig. 2).

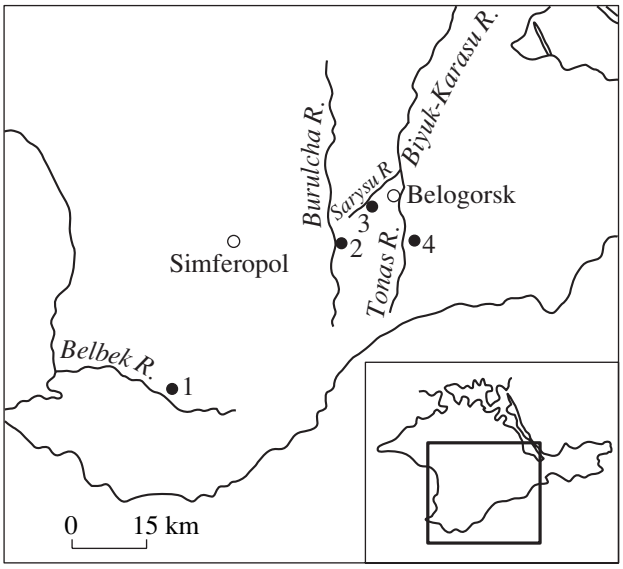


Fig. 1. Main localities of Berriasian brachiopods in the Crimea (geographic scheme, scale 1 : 1500000): (1), Kuibyshevo locality, Belbek River, southwestern Crimea; (2) Mezhgor'e locality, Burulcha River, (3) Balki locality, Sarysu River, and (4) Krasnoselovka locality, Tonas River, of central Crimea.

DESCRIPTION OF SECTIONS

The oldest assemblage of Berriasian brachiopods from the *Tonasirhynchia janini* Beds is confined to clayey limestones of flyschoid sequence in the eastern (sections of the Nanikovo Village, Cape Il'i, Zavodskaya Balka and Sultanovka Village) and central Crimea (sections near the Krasnoselovka Village, Tonas River basin).

The *Berriasella jacobi–Pseudosubplanites grandis* Zone, the lower one in the Berriasian Stage, containing brachiopod shells of this assemblage, is studied near the Krasnoselovka Village along the Kuchuk-Uzen Creek, the right tributary of the Tonas River, where the following succession of members is exposed in the gorge upper part (Fig. 2):

I. Member of rhythmically alternating gray clay, dark gray clayey siltstone and brown limestone; limestone interlayers frequently of breccia-like appearance range in thickness from 5 to 50 cm, being sometimes up to 1.5 m thick. Marl interlayers appear in the upper part of the member. Ammonites of the lower Berriasian zone *Holeophylloceras tauricum* (Ret.), *Pseudosubplanites ponticus* (Ret.), *P.* ex gr. *lorioli* Zitt., *Delphinella* sp. indet. and others (determinations of Bogdanova) are identified in the upper interval 22 m thick; brachiopods are represented by *Lacunosella monsalvensiformis* (Jacob et Fallot, 1913), *L.* ex gr. *malbosi*, and *Symphythyris* sp. Member is 66 m thick.

II. Distinctly flyschoid member of rhythmically alternating dark gray, green and brown, soft to compact laminated clay, marl, compact crystalline and less compact organogenic limestone; many marl and limestone interlayers are lenticular. Limestone interlayers are from 0.05 to 0.5 m thick. In each rhythm of the member, there are intervals of interlayering fine laminae of marl, limestone, soft and more compact clay, the main rock types of each rhythm. In the upper part of the member, organogenic limestones frequently overlie the uneven surface of clay and marl laminae.

Ammonites of the lower Berriasian zone, crinoids, bivalves, corals, bryozoans and rare belemnites have been encountered throughout the member. Brachiopods represented by *Lacunosella corallina neocomiensis* (Jacob et Fallot, 1913), *Tonasirhynchia janini* Lobatscheva et Smirnova, 1994, *Symphythyris* cf. *substriata* (Schlotheim, 1820), and *Ismenia pectunculoides* (Schlotheim, 1820) are characteristic of the member upper part (54 m). Member is 157 m thick.

III. Member of gray clay with rare thin interlayers of compact coquina limestone and organogenic marl; in distinction from older deposits, it is lacking intervals of fine interlamination and has a sharply reduced amount of limestone interlayers. Gray clay prevailing in the member encloses thin interlayers of reddish clay. Abundant diverse fossils of the member are of the same composition as in Member II, being characteristic of the lower Berriasian zone. Brachiopods abundant in coquina interlayers are represented by the following species and subspecies: *Tonasirhynchia janini, Lacunosella corallina neocomiensis, L.* cf. *contracta* (d' Orbigny, 1847), *L.* ex gr. *malbosi* (Pictet, 1863), *Symphythyris latirostris* (Suess, 1858), *S.* cf. *substriata*, and *Ismenia pectunculoides.* Member is 24 m thick.

Based on frequently occurring species *Tonasirhynchia janini*, members II and III of clayey and marly sediments are attributed to synonymous beds. Overlying sediments corresponding to the *Dalmasiceras tauricum* Zone and *Euthymiceras–Neocosmoceras* Beds have been studied in the Tonas River basin near the village of Alekseevka, but brachiopods have not been found there.

Concurrent deposits with abundant brachiopods are observable in the northeast of the southwestern Crimea and in central area of the region. The Assemblage 2 typical of the *Belbekella airgulensis–Sellithyris uniplicata* Beds is well represented in the Belbek River valley (sections near the village of Solnechnosel'e and settlement of Kuibyshevo) and in the clay–siltstone sequence of the central Crimea near the Village Balki. In the

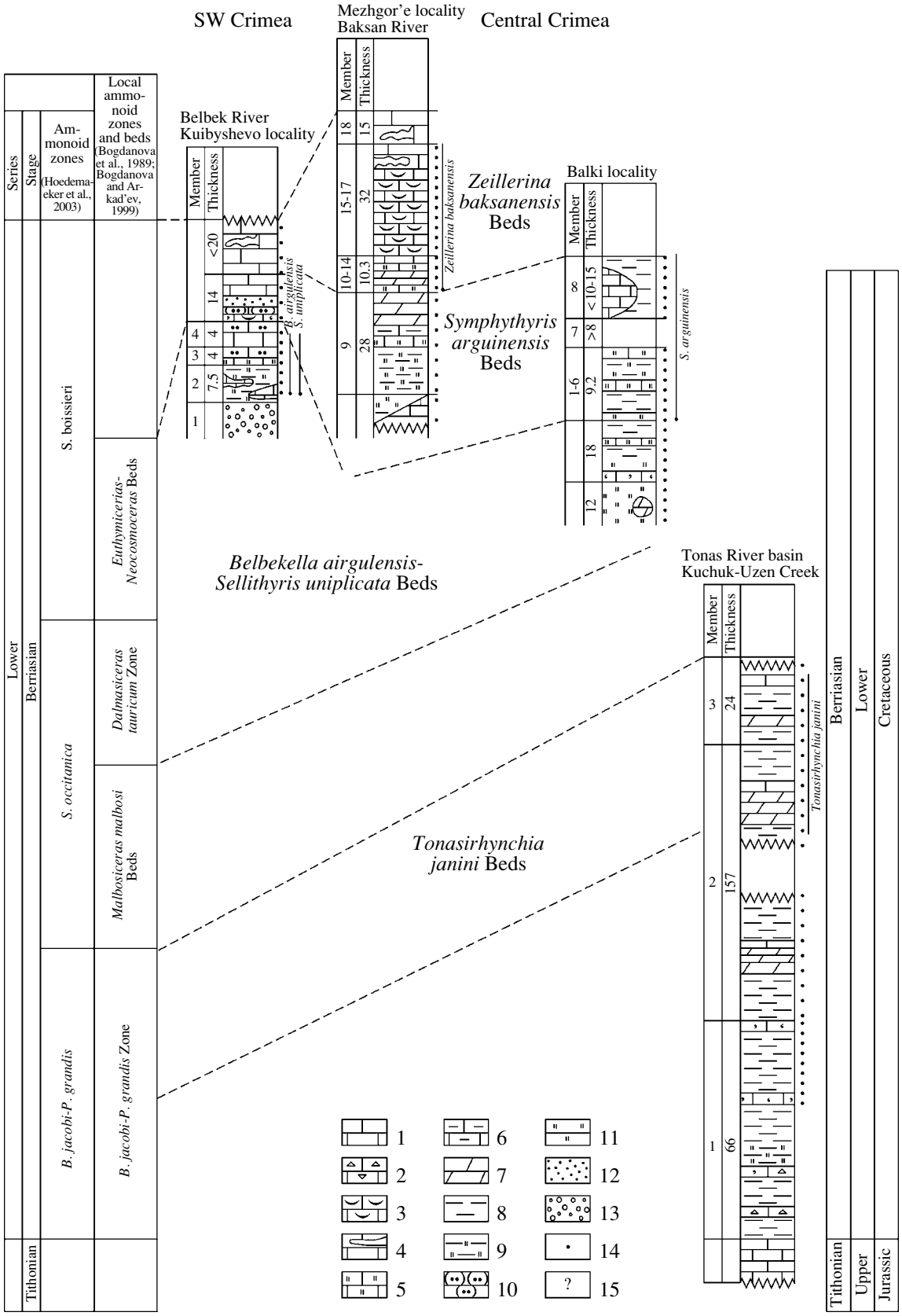


Fig. 2. Subdivision of Berriasian deposits in the Crimea based on brachiopods: (1) limestone; (2) breccia-like limestone; (3) coquina; (4) biostromal limestone; (5) silty and (6) clayey limestones; (7) marl; (8) clay; (9) clayey siltstone; (10) sandstone; (11) siltstone; (12) loose sandstone; (13) conglomerate; (14) section levels with brachiopods; (15) section intervals covered by talus. Thickness, in meters.

ammonoid scale, distribution interval of this assemblage corresponds to the *Dalmasiceras tauricum* and *Euthymiceras–Neocosmoceras* Beds.

This interval of the Berriasian succession is described based on outcrops in the Kabanii Log Gorge near the settlement Kuibyshevo, the Belbek River basin (Fig. 2).

Member I. Polymictic conglomerate that is composed mostly of quartz pebbles and subordinate sandstone and siltstone pebbles ranging in diameter from 1 to 10 cm. Conglomerate is locally cemented by compact or loose calcareous sandy material. Apparent thickness is about 5 m.

Member II. Rusty-brown loose calcareous sandstone with separate lenticular interlayers of more compact varieties and rare redeposited pebbles of sandstone and quartz; member is about 2 m thick.

The overlying rocks are rusty-gray sandy flaggy limestone and layered loose sandstone and siltstone of dark gray coloration. Proportion of loose rocks is higher in the member upper part, the appearance level of clayey siltstone interlayers. Calcareous sandstone interlayers are lenticular here. Numerous bivalves, the most frequent shells *Gervillia anceps* Desh., *Cucullaea gabrielis* Leym., *C. glabra* Park., and *Myophorella loewinsonlessingi* (Renng.) included, and abundant brachiopod shells *Belbekella airgulensis* Moisseev, 1939, and *Sellithyris uniplicata* Smirnova, 1972, are confined to the lower part of the member. Fossils occurring throughout the member are abundant ammonites *Ptychophylloceras ptychoicum* (Quenst.), *Protetragonites tauricum* Kulj-Vor., *Dalmasiceras crassicostatum* Djan., *D.* ex gr. *dalmasi* (Pict.), bivalves *Neithea simplex* Mordv., *Lima dubisiensis* Pict. et Camp., and brachiopods *Belbekella airgulensis, B. mutabilis* Lobatscheva, 1983, *Sellithyris uniplicata* and rarer *Praecyclothyris gracilis* Lobatscheva, 1977, *Sellithyris* cf. *gratianopolitensis* (Pictet, 1972), *Psilothyris airgulensis* (Moisseev, 1939), and *Zeillerina walkeriformis* Smirnova, 1972. Member is 7.5 m thick.

Member III. Alternation of gray compact calcareous sandy siltstone, greenish brown loose sandstone and dark gray clayey siltstone; rocks of the member yield ammonites *Ptychophylloceras* ex gr. *inordinatum* Touc., *P. ptychoicum* (Quenst.), *Protetragonites tauricus* Kulj-Vor., *Dalmasiceras crassicostatum* Djan., bivalves *Gervillia anceps* Desh., *Neithea* ex gr. *simplex* Mordv., *N. valangiensis* Pict. et Camp., *Lima dubisiensis* Pict. et Camp., *Myophoella* cf. *loewinsonlessingi* (Renng.), *Pterotrigonia caudate* (Ag), and brachiopods *Belbekella airgulensis* and *Sellithyris uniplicata.* Member is 4.1 m thick.

Member IV. Loose sandstone with frequent interlayers (5–10 cm thick) of limestone and coquina; in the member upper part 1.5 m below the top, there is an interlayer of greenish brown loose sandstone with abundant shells *Sellithyris uniplicata.* Shells *Belbekella airgulensis, B. minor* Lobatscheva, 1983, *Sellithyris uniplicata, S. gratianopolitensis, Toxaster* cf. *granosus* (d'Orb.), *Neithea simplex* Mordv., *N. valangiensis* Pict. et Camp., *Rhynchostreon subsinuatum* (Leym.), and *Inoperna gillieroni* Pict. et Camp. are dispersed throughout the member that is 4.2 m thick.

According to ammonites occurring in sandy–calcareous members II–IV, their interval corresponds to the *Dalmasiceras tauricum* and *Euthymiceras–Neocosmoceras* Beds (Bogdanova et al., 1999). As one can see from the section description, sediments under consideration contain abundant shells *Belbekella airgulensis* and *Sellithyris uniplicata*, and their interval is discriminated in this work as beds with relevant brachiopod species. The beds are traceable as well in the clay–siltstone sequence of the central Crimea near the village of Balki, where they yield ammonites of genera *Dalmasiceras, Euthymiceras*, and *Neocosmoceras.* In addition to *Belbekella airgulensis* and *Sellithyris uniplicata*, the beds enclose here coquina interlayers with terebratulids *Loriolithyris valdensis* (Loriol, 1868).

Assemblage 3 with *Symphythyris arguinensis* (Moisseev, 1949) corresponding to the *Tauricoceras* sp. Beds of the ammonite scale is characteristic of sponge bioherms. Deposits with this assemblage are well exposed in the Sarysu River basin near the village of Balki. A belt of their outcrops is traceable westward from here to the village of Mezhgor'e in the Burulcha River basin. The corresponding whitish loose sediments are close in composition to clayey limestone.

In separate outcrops, they are composed of abundant sponge skeletons, brachiopod shells, small oysters, corals, and echinoid spines. This is the so-called well-known "Sponge Horizon" of the Kuchki, Rodnoe and Peredovoe localities in the Baidarskaya Valley of the southwestern Crimea.

In the western slope of hills situated 1.5 km southward of the village of Balki, the *Symphythyris arguinensis* Beds are composed of the following sediments (Fig. 2):

1. Gray siltstone with ocherous patches that conformably rests on clay containing *Euthymiceras* ex gr. *euthymi* (Pict.) and *Neocosmoceras* ex gr. *rerollei* Paq. Shells found in siltstone are classed with *Balkites nerodenkoi* Bogdanova et Kvant., *Lima nicoletti* Pict. et Camp., *Picnodonte weberae* Janin, *Rhynchostreon subsinuatum* (Leym), *Loriolithyris valdensis, Symphythyris arguinensis, Dictyothyris spinulosa* Smirnova, 1968, and *Aplocyathus laticonica* Kot.; thickness 0.2–0.5 m.

2. Brown layered clay with small ferruginate casts of ammonites *Euthymiceras* sp. and *Balkites* sp.; thickness 0.1 m.

3. Dark gray layered and brown compact silty calcareous clays; sediments contain ammonites *Tauricoceras* cf. *crassicostatum* Kvant. et Lyss. and *Balkites tauricus* Bogdanova et Kvant. The associated abundant brachiopods are represented by *Echinirhynchia balkinensis* Smirnova, 1972, *Belbekella* sp., *Loriolithyris valdensis, Symphythyris arguinensis, Terebrataliopsis quadrata* Smirnova, 1962, and *Bosquetella robusta* Smirnova, 1972; thickness 5 m.

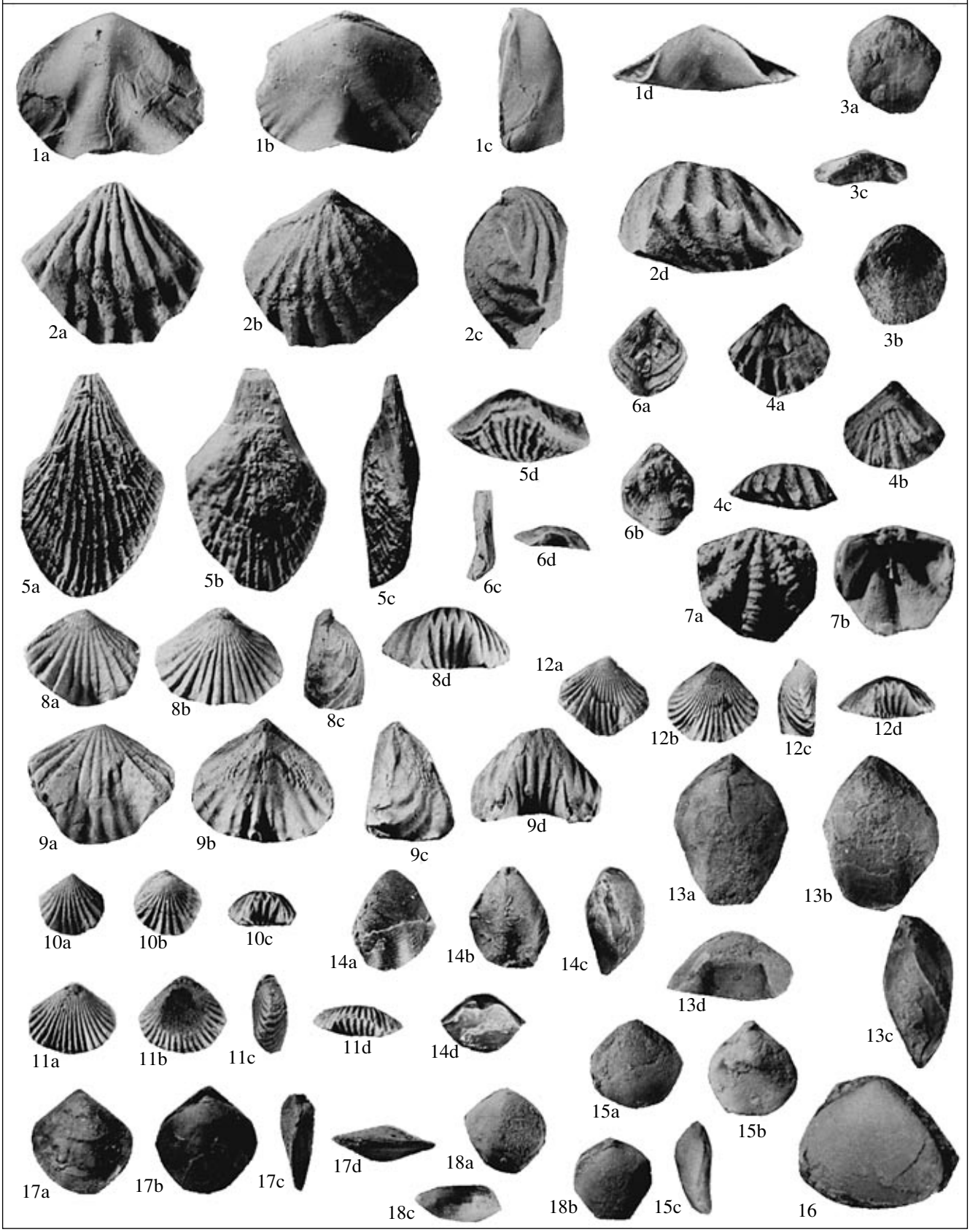
4. Compact calcareous siltstone with abundant shells *Symphythyris arguinensis* and *Loriolithyris valdensis.* Subordinate brachiopod taxa are *Rhynchostreon subsinuatum* (Leym.), *Dictyothyris spinulosa, Terebrataliopsis quadrata*, and *Advenina* ex gr. *villersensis*; thickness 0.2 m.

5. Brown compact viscous clay with silty admixture and rare shells *Loriolithyris valdensis* in the lower part; thickness 2 m.

6. Compact calcareous siltstone containing small gastropods; its outcrops form a ledge on slope surface.

7. Brown siltstone with single ammonites *Riasanites* sp.; apparent thickness 8 m.

Plate I


1a
1b
1c
1d
3a
3c
2a
2b
2c
2d
3b
6a
4a
4b
5a
5b
5c
5d
6b
4c
6c
6d
7a
7b
8a
8b
8c
8d
12a
12b
12c
12d
9a
9b
9c
9d
13a
13b
10a
10b
10c
14a
14b
14c
13d
13c
11a
11b
11c
11d
14d
15a
15b
17a
17b
17c
17d
18a
18c
18b
15c
16

8. Dark gray clayey limestone and calcareous clay; sediments enclose calcareous nodules and bioherms full of sponge remains, small oysters *Ceratostreon minos* Coq., corals, spines of echinoids *Cidaris* affpr. *etiosa* Des., *Rhabdocidaris arginensis* Weber, and *Diplocidaris (?) bicarinata* Weber. Abundant shells *Symphythyris arguinensis* are associated in the rocks with other brachiopod taxa: *Conocrania spinocostata* Smirnova, 1972, *Echinirhynchia balkinensis* Smirnova, 1972, *Monticlarella korlukensis* Lobatscheva, 1983, *Tropeothyris* sp., *Weberithyris moisseevi* (Weber, 1949), *Dictyothyris spinulosa, Ismenia perillustris* Smirnova, 1972, *Praeargyrotheca hexaplicata* Smirnova, 1972, *Evagyrotheca alta* (Smirnova, 1972), and *Krimargyrotheca concinna* (Smirnova, 1972); apparent thickness 10–15 m.

Continuation of the section is observable near the Village Mezhgor'e, where sponge limestone is overlain by the following rocks:

9. Greenish gray silty clay with yellowish siltstone intercalations locally calcareous; proportion of siltstone interlayers increases upward in the section, where they are more calcareous, grading into marl in the upper part. Ammonites found here are represented by *Spiticeras proteus* Ret. and *Subalpinites* sp. Associated brachiopods *Symphythyris arguinensis, Loriolithyris valdensis, Tropeothyris* sp., *Weberithyris moisseevi*, and *Terebrataliopsis quadrata* are rather scarce; thickness 28 m.

Member 9 is conformably overlain by beds with *Zeillerina baksanensis* Smirnova, 1972.

Members 1–7 of clayey–silty sediments with ammonites *Tauricoceras crassicostatum* and *Riasanites* (Bogdanova et al., 1983), limestones of Member 8 ("Sponge Horizon") in the Balki section, and siltstones of Member 9 in the Mezhgor'e section (Fig. 2), all containing numerous species *Symphythyris arguinensis* and associated brachiopod taxa are attributed to the *Symphythyris arguinensis* Beds (Bogdanova et al., 1981). They span the interval corresponding to the *Tauricoceras crassicostatum* Beds with Berriasian ammonites of genera *Riasanites, Spiticeras*, and *Subalpinites*, or to the lower part of the *Fauriella boissieri* Zone of the General Stratigraphic Scale.

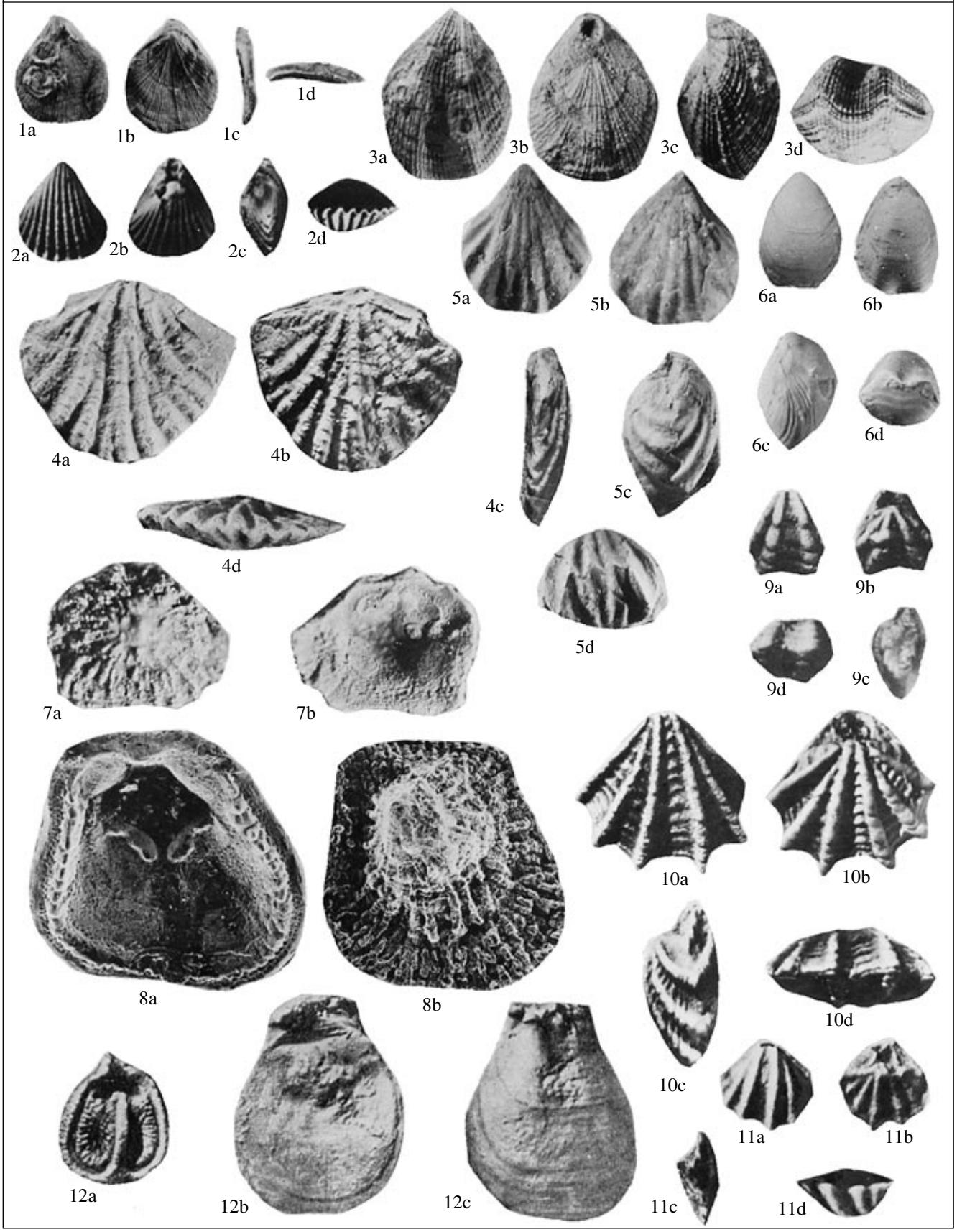
The upper Berriasian is represented in the Crimea by silty marls and biostromal limestones containing the *Zeillerina baksanensis* assemblage. The assemblage is represented completely in the central Crimea (villages of Mezhgor'e and Solov'evka) and less completely in southwestern sections (Belbek River basin). Near the village of Mezhgor'e (Baksan Cliff), the *Zeillerina baksanensis* Beds (Fig. 2) incorporate the following sediments:

10. Bluish gray siltstone grading into yellowish gray calcareous siltstone; these sediments conformably rest on siltstones of Member 9. They contain diverse benthic fauna of crinoids, bivalves, corals, echinoids, and brachiopods. The latter are represented by species *Mesocrania barskovi*

Plate I. Berriasian brachiopods, assemblages 1 and 2.

(1) *Tonasirhynchia janini* Lobatscheva et Smirnova: 12075/1 holotype, St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; eastern Crimea, Cape Il'i, Feodosiya locality; *Berriasella jacobi–Pseudosubplanites grandis* Zone. (2) *Lacunosella malbosi* (Pictet): 13127/1 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Tonas R., Kuchuk-Uzen Creek; Berriasian, *Berriasella jacobi–Pseudosubplanites grandis* Zone. (3) *Lacunosella monsalvensiformis* (Jacob et Fallot): 13127/2 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) frontal view; Tonas R., Kuchuk-Uzen Creek, *Berriasella jacobi–Pseudosubplanites grandis* Zone. (4) *Rhactorhynchia corallina neocomiensis* (Jacob et Fallot): 13127/3 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) frontal view; Tonas R., Kuchuk-Uzen Creek; *Berriasella jacobi–Pseudosubplanites grandis* Zone. (5) *Symphythyris latirostris* (Suess): 12075/2 (×2) St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; Tonas R., Kuchuk-Uzen Creek; *Berriasella jacobi–Pseudosubplanites grandis* Zone. (6) *Symphythyris substriata* (Schlotheim): 12075/3 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; Tonas R., Kuchuk-Uzen Creek; *Berriasella jacobi–Pseudosubplanites grandis* Zone. (7) *Ismenia pectunculoides* (Schlotheim): 12075/4 (×2) St. Petersburg, TSNIGR museum; (a) ventral valve outside, (b) ventral valve inside; Tonas R., Kuchuk-Uzen Creek; *Berriasella jacobi–Pseudosubplanites grandis* Zone. (8) *Belbekella airgulensis* Moisseev: 12770/4 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; southwestern Crimea, Belbek R., Solnechnosel'e locality; *Dalmasiceras tauricum* Zone and *Euthymiceras–Neocosmoceras* Beds. (9) *Belbekella mutabilis* Lobatscheva: 12075/11 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; southwestern Crimea, Belbek R., Solnechnosel'e locality; *Dalmasiceras tauricum* Zone and *Euthymiceras-Neocosmoceras* Beds. (10) *Belbekella minor* Lobatscheva: 12075/13 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; southwestern Crimea, Belbek R., Solnechnosel'e locality; a *Dalmasiceras tauricum* and *Euthymiceras–Neocosmoceras* beds. (11) *Praecyclothyris gracilis* Lobatscheva: 12075/7 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; southwestern Crimea, Belbek R., Solnechnosel'e locality; *Dalmasiceras tauricum* Zone and *Euthymiceras–Neocosmoceras* Beds. (12) *Praecyclothyris berriasensis* Lobatscheva: 12075/6 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Balki locality; *Dalmasiceras tauricum* Zone and *Euthymiceras–Neocosmoceras* Beds. (13) *Sellithyris uniplicata* Smirnova: 12075/17 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; southwestern Crimea, Kuibyshevo locality; Zone *Dalmasiceras tauricum* and *Euthymiceras–Neocosmoceras* Beds. (14) *Loriolithyris valdensis* (Loriol): 12075/21 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Balki locality; *Tauricoceras crassicostatum* Beds. (15, 16) *Sellithyris gratianopolitensis* (Pictet): (15) 12075/14 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Balki locality; *Dalmasiceras tauricum* Zone; (16) 2075/15 St. Petersburg, TSNIGR museum; (a) ventral valve; southwestern Crimea, Belbek R., Kuibyshevo locality; *Dalmasiceras tauricum* Zone. (17, 18) *Psilothyris airgulensis* (Moisseev): (17) 327/9 Moscow State University (MSU), Chair of Paleontology; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; southwestern Crimea, Belbek R., Kuibyshevo locality; *Dalmasiceras tauricum* Zone and *Euthymiceras–Neocosmoceras* Beds; (18) 13127/4 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) frontal view; southwestern Crimea, Solnechnosel'e locality; *Dalmasiceras tauricum* Zone and *Euthymiceras–Neocosmoceras* Beds.

Plate II


1a
1b
1c
1d
3a
3b
3c
3d
2a
2b
2c
2d
5a
5b
6a
6b
4a
4b
6c
6d
4c
5c
4d
9a
9b
5d
7a
7b
9d
9c
10a
10b
8a
8b
10d
10c
11a
11b
12a
12b
12c
11c
11d

Smirnova, 1972, *Echinirhynchia nucleatoformis* Smirnova, 1972, *Cyclothyris (?) rectimarginata* Smirnova, 1972, *Krimargyrotheca concinna* Smirnova, 1972, *Terebrataliopsis quadrata, Thecidiopsis tetragona* (Roemer, 1839), and *Bosquetella campichei* (Loriol, 1872); thickness 2.8 m.

11. Yellowish gray foliated marl that yields rare bivalves; thickness 1.2 m.

12. Light bluish gray siltstone commonly loose and grumous but locally more compact and calcareous; brachiopod species found in sediments are *Cyclothyris (?) rectimarginata, Symphythyris kojnautensis* (Moisseev,1960), *Advenina* ex gr. *villersensis, Terebrataliopsis quadrata*, and *Zeillerina baksanensis*; thickness 2.5 m.

13. Alternation of yellowish calcareous siltstones and light-colored marls; the characteristic succession is (1) marl at the base, 0.4 m; (2) overlying siltstone, 0.4 m; (3) next marl and thin siltstone interlayer, 0.5 m; (4) light-colored organogenic limestone at the top, 0.2 m. All rocks of the member contain abundant organic remains: corals, crinoids, bivalves, gastropods, echinoids, and brachiopods. The identified brachiopod species are *Mesocrania barskovi, Echinirhynchia nucleatoformis, Cyclothyris (?) rectimarginata, Apodosia lorioli* (Smirnova, 1972), *Krimargyrotheca concinna, Agerinella cuneata* Smirnova, 1972, *Bosquetella campichei, Thecidiopsis tetragona, Symphythyris kojnautensis*, and *Zeillerina baksanensis*; thickness 2.1 m.

14. Greenish to yellowish calcareous siltstone layered and loose; the rock is rich in fossils, especially in brachiopods. Species of the latter are *Septaliphoria guerassimovi* Moisseev, 1949, *Cyclothyris (?) rectimarginata, Symphythyris kojnautensis, Weberithyris moisseevi, Zeillerina baksanensis, Terebrataliopsis quadrata, Mesocrania barskovi, Krimargyrotheca concinna, Agerinella cuneata, Apodosia lorioli*, and *Thecidiopsis tetragona*; thickness 1.7 m.

15. Light gray biostromal limestone locally grading into calcareous siltstone; looser areas contain coral colonies and brachiopods. Shells *Symphythyris kojnautensis* are rock-forming. In the upper half of the member, light gray coralline limestone contains abundant shells *Weberithyris moisseevi.* Other brachiopod taxa encountered in the member are *Echinirhynchia nucleatoformis, Cyclothyris (?) rectimarginata, Sellithyris uniplicata, Zeillerina baksanensis, Terebrataliopsis quadrata*, and others; thickness 8 m.

16. Light-colored cavernous limestone with inclusions of silty material; in places, there are coral colonies in the rock. Brachiopods are represented by *Symphythyris kojnautensis, Weberithyris moisseevi, Zeillerina baksanensis*, and *Terebrataliopsis quadrata*; thickness 5.4 m.

17. Light-colored compact recrystallized limestone with slaty jointing; the rock contains brachiopods *Cyclothyris (?) rectimarginata, Weberithyris moisseevi, Symphythyris kojnautensis, Zeillerina baksanensis*, and *Terebrataliopsis quadrata*; thickness 3.5 m.

18. Light-colored compact biostromal limestone; alveolar weathering patterns and ferruginate inclusions more frequent upward in the section are characteristic of this marmoraceous medium- to coarse-bedded rock that is exposed in the steep Baksan (or Koinaut) Cliff. Single brachiopods *Septaliphoria* cf. *guerassimovi, Cyclothyris (?) rectimarginata, Weberithyris moisseevi*, and *Symphythyris kojnautensis* are found in the member that is 15.5 m thick.

19. Member of oolitic limestones with rudists; abundant fucoids are visible on top surface of the member; apparent thickness is about 10 m.

In the Mezhgor'e section, carbonate rocks of members 10–18 contain diverse benthic fauna. Characteristic species of especially diverse brachiopods is *Zeillerina baksanensis* Smirnova, the index taxon of synonymous beds (Bogdanova et al., 1981). In the Belbek River basin of the southwestern Crimea, the beds are correlated with sequence of organogenic and oolitic limestones 10 to 16 m thick, which contain coral colonies. Brachiopods *Zeillerina baksanensis, Z. walkeriformis, Weberithyris moisseevi, Advenina villersensis*, and *Terebrataliopsis quadrata* found in that sequence represent the assemblage characteristic of the *Zeillerina baksanensis* Beds. According to position in the section, the beds presumably correspond to the upper part of the *Fauriella boissieri* Zone.

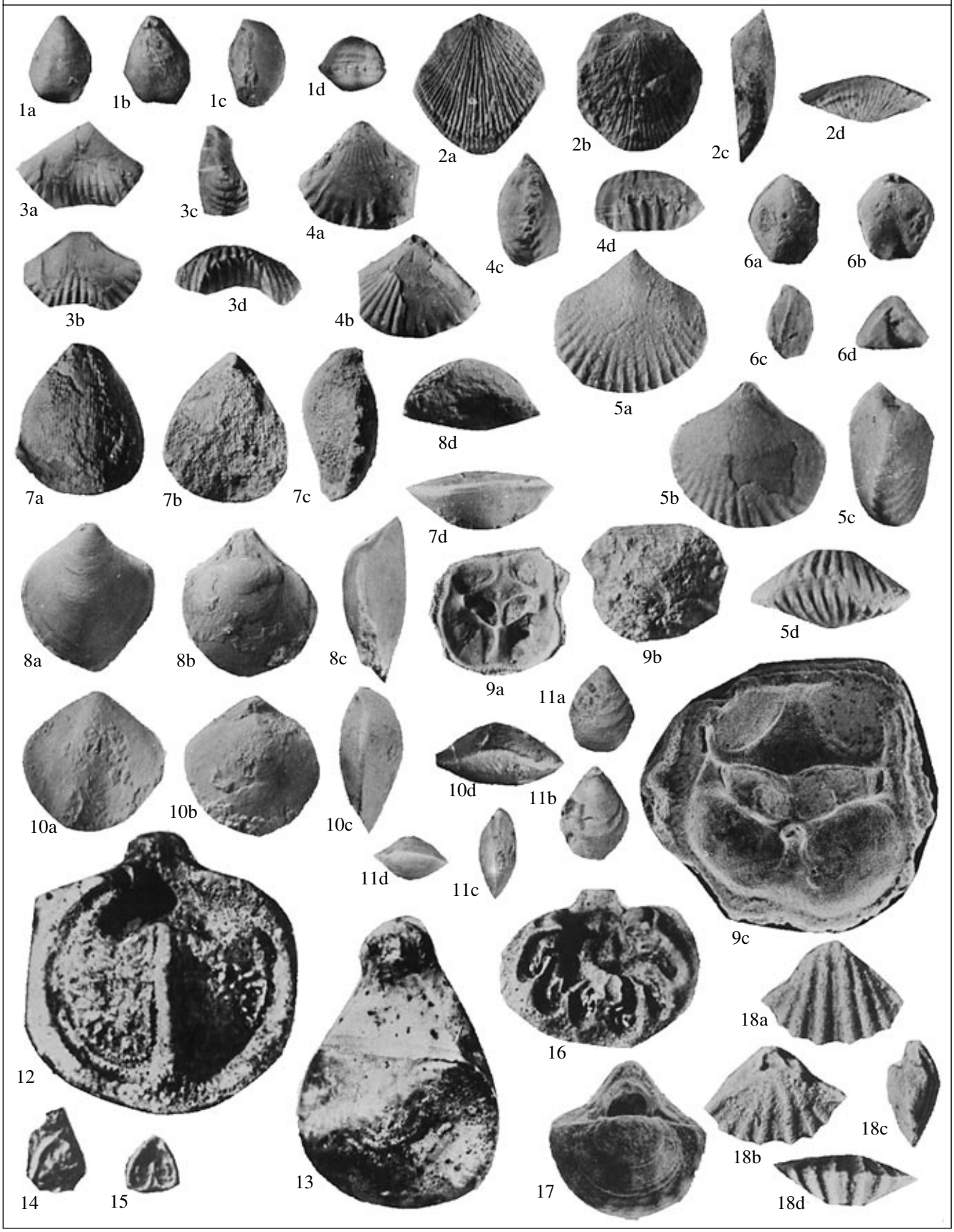
ANALYSIS OF BRACHIOPOD ASSEMBLAGES

Four brachiopod assemblages distinguished in Berriasian deposits of the Crimea characterize different

Plate II. Berriasian brachiopods, assemblage 3.

(1) *Symphythyris arguinensis* (Moisseev): 2075/18 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Balki locality; *S. arguinensis* Beds. (2) *Echinirhynchia balkinensis* Smirnova: 136/405 MSU, Chair of Paleontology; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Balki locality, *Tauricoceras crassicostatum* Beds. (3) *Dictyothyris spinulosa* Smirnova: 26-539/121 MSU, Chair of Paleontology; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Sarysu locality; *Tauricoceras crassicostatum* Beds. (4) *Ismenia perillustris* Smirnova: 13127/5 (×3) St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Balki locality; *Symphythyris arguinensis* Beds. (5) *Monticlarella korlukensis* Lobatscheva: 2075/19 holotype St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; southwestern Crimea, Baidarskaya Valley, ravine Koreu; *S. arguinensis* Beds. (6) *Tropeothyris* sp.: 12075/20 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Balki locality, *S. arguinensis* Beds. (7, 8) *Conocrania spinacostata* (Smirnova): (7) 12844/25 *holotype* (×10) St. Petersburg, TSNIGR museum; (a) dorsal valve outside, (b) dorsal valve inside; (8) 12942/169 (×17) St. Petersburg, TSNIGR museum; (a) dorsal valve inside, (b) dorsal valve outside; central Crimea, Kuchki locality; *Tauricoceras crassicostatum* Beds. (9) *Evargyrotheca alta* (Smirnova): 12844/20 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Balki locality; *Tauricoceras crassicostatum* Beds. (10) *Praeargyrotheca hexaplicata* (Smirnova): 12844/19 St. Petersburg, TSNIGR museum: (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Balki locality; *Tauricoceras crassicostatum* Beds. (11) *Krimargyrotheca picteti* (Loriol): 136/173 MSU, Chair of Paleontology; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Balki locality; *Tauricoceras crassicostatum* Beds. (12) *Bosquetella robusta* Smirnova: (a) 12844/23 (×6), dorsal valve inside; 12844/24 (×10), (b) dorsal valve outside, (c) ventral valve outside; St. Petersburg, TSNIGR museum; dorsal valve inside; central Crimea, Balki locality; *Tauricoceras crassicostatum* Beds.

Plate III


1a
1b
1c
1d
2a
2b
2c
2d
3a
3b
3c
3d
4a
4b
4c
4d
5a
5b
5c
5d
6a
6b
6c
6d
7a
7b
7c
7d
8a
8b
8c
8d
9a
9b
9c
10a
10b
10c
10d
11a
11b
11c
11d
12
13
14
15
16
17
18a
18b
18c
18d

facies and age intervals of the succession. Each assemblage is specific in terms of geographic distribution within the Mediterranean paleozoogeographic region and ecological characteristics. Twelve of 44 species known from Berriasian deposits of the Crimea are widespread in this region, while the other taxa are of local origin.

Assemblage 1 (Plate I) consists of six species. It is the oldest one (*Tonasirhynchia janini* Beds), corresponding in age to the *Berriasella jacobi–Pseudosubplanites grandis* Zone of the Berriasian ammonoid scale. Species of this assemblage are widespread in clayey limestones of flyschoid sequence in the eastern and central Crimea. In the Tonas River basin (section near the village of Krasnoselovka), brachiopods of the assemblage are most diverse (Fig. 2). Local species *Tonasirhynchia janini* characteristic of the assemblage has been found in the Cape Il'i, Zavodskaya Balka and Yakornaya Bay localities and in sections of the Tonas River and Kuchuk-Uzen Creek. Beds with this species can be regarded as a marker suitable for detecting deposits concurrent to the lower zone of the Berriasian Stage. Five other species are known in Western Europe as well. *Lacunosella monsalvensiformis* and *L. malbosi* have been found in the upper Tithonian–Berriasian marls and limestones of southeastern France and Switzerland. *Symphythyris substriata* and *S. latirostris* are described from the Tithonian–lower Berriasian strata of the Slovak Republic and Poland. *Ismenia pectunculoides* is typical of the Tithonian in southeastern France and Switzerland, of the Tithonian–lower Berriasian in Moravia (Stramberg) and Poland (Rogoznik), and of the Tithonian in the northern Caucasus. The assemblage is dominated by Tethyan taxa, being close in composition to brachiopod assemblages from Tithonian–lower Berriasian sediments of southeastern France (flyschoid deposits of the stratotype), Moravia and Poland. According to presented data, sea basin of the Crimea freely communicated with West European basins of the Alpine province.

Assemblage 2 (Plate I) of 12 species is most completely represented in sandy limestones of the Belbek River basin and in clay–siltstone sequence of the Balki locality, the southwestern and central Crimea, respectively. These deposits containing ammonites of genera *Dalmasiceras, Euthymiceras*, and *Neocosmoceras* are attributed to the *Dalmasiceras tauricum* Zone and *Euthymiceras–Neocosmoceras* Beds of the Berriasian in the Crimea (Bogdanova et al., 1981; Bogdanova and Arkad'ev, 1999). Three of 12 brachiopod species present in the assemblage are endemics, and nine are of a broad geographic range. Characteristic of the assemblage is appearance of Cretaceous genera and species represented by abundant rhynchonellids of the genus *Belbekella* (*B. airgulensis, B. mutabilis, B. minor*), terebratulids of genera *Sellithyris* (*S. uniplicata, S. gratianopolitensis*) and *Loriolithyris* (*L. valdensis*), and dallinids of genera *Psilothyris* (*P. airgulensis*), *Terebrataliopsis* (*T. quadrata*), *Zeillerina* (*Z. walkeriformis*) and *Advenina* (*A. villersensis*). In addition, the

Plate III. Berriasian brachiopods, assemblage 4.

(1) *Zeillerina baksanensis* Smirnova: 12075/22 (×2) St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Mezhgor'e locality; *Fauriella boissieri* Zone, *Zeillerina baksanensis* Beds. (2) *Symphythyris kojnautensis* (Moisseev): 12074/26 (×2) St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Mezhgor'e locality; *Zeillerina baksanensis* Beds. (3) *Cyclothyris rectimarginata* Smirnova: 13127/6 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Mezhgor'e locality; *Zeillerina baksanensis* Beds. (4) *Septaliphoria guerassimovi* Moisseev: 12075/23 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Mezhgor'e locality; *Zeillerina baksanensis* Beds. (5) *Cyclothyris desori* (Pictet): 13127/7 (×2) St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Mezhgor'e locality; *Zeillerina baksanensis* Beds. (6) *Zeillerina walkeriformis* Smirnova: 13127/8 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Mezhgor'e locality; *Fauriella boissieri* Zone, *Zeillerina baksanensis* Beds. (7) *Echinirhynchia nucleatoformis* Smirnova: 136/104 (×2) MSU, Chair of Paleontology; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Mezhgor'e locality; *Fauriella boissieri* Zone, *Zeillerina baksanensis* Beds. (8) *Weberithyris moisseevi* (Weber): 13127/9 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Mezhgor'e locality; *Fauriella boissieri* Zone, *Zeillerina baksanensis* Beds. (9) *Mesocrania barskovi* (Smirnova): 12942/1 holotype (×3) St. Petersburg, TSNIGR museum; (a) dorsal valve inside, (b) dorsal valve outside; (c) 12942/27 topotype (×46), dorsal valve inside; central Crimea, Solov'evka locality; *Fauriella boissieri* Zone. (10) *Terebrataliopsis quadrata* Smirnova: 12075/24 (×2) St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Solov'evka locality; *Zeillerina baksanensis* Beds. (11) *Advenina villersensis* (Loriol): 12075/27 St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; southwestern Crimea, Belbek R., Solnechnosel'e locality; *Zeillerina baksanensis* Beds. (12, 13) *Bosquetella campichei* (Pictet): (12) 2830/109 (×20) MSU, Chair of Paleontology; dorsal valve inside; (13) 2830/110 (×15) MSU, Chair of Paleontology; whole shell, dorsal view; central Crimea, Solov'evka locality; *Zeillerina baksanensis* Beds. (14, 15) *Agerinella cuneata* Smirnova: (14) 12844/22 (×6) St. Petersburg, TSNIGR museum; whole shell, dorsal view; (15) 12844/23 (×6) St. Petersburg, TSNIGR museum; dorsal valve inside; central Crimea, Solov'evka locality; *Zeillerina baksanensis* Beds. (16) *Thecidiopsis tetragona* (Roemer): 109/1 (×10), MSU, Chair of Paleontology; dorsal valve; central Crimea, Solov'evka locality; *Zeillerina baksanensis* Beds. (17) *Apodosia lorioli* (Smirnova): 12844/21 (×5) St. Petersburg, TSNIGR museum; ventral valve; central Crimea, Solov'evka locality; *Zeillerina baksanensis* Beds. (18) *Krimargyrotheca concinna* (Smirnova): 12844/18 (×3.5) St. Petersburg, TSNIGR museum; (a) ventral valve, (b) dorsal valve, (c) lateral view, (d) frontal view; central Crimea, Mezhgor'e locality; *Zeillerina baksanensis* Beds.

All the figured specimens are collected by S.V. Lobatscheva, T.N. Smirnova, and B.T. Yanin.

assemblage includes representatives of the Late Jurassic genus *Praecyclothyris* (*P. gracilis* and *P. berriasensis*) characteristic of Boreal sections and known from concurrent strata of the Mangyshlak, northern Caucasus and Kopetdag. Species occurring in the Caucasus and Mangyshlak coexist in the assemblage with European taxa of brachiopods widespread in the Berriasian and Valanginian deposits of France and Switzerland (Plate 1). Coexistence of species known from the northern Caucasus, Mangyshlak and Kopetdag, on the one hand, and from West European countries, on the other, indicates that the Crimean sea basin was connected in the *Dalmasiceas–Euthymiceras* time with concurrent basins of the Alpine and Caucasus–Turkmenistan provinces. In the last province (Mangyshlak, Kopetdag), rhynchonellids of the thermophilic genus *Belbekella* are unknown, and abundant shells of the genus *Praecyclothyris* present here suggest intercommunication of sea basins in the North Caucasus–Turkmenistan and Boreal provinces. Since the assemblage 2 of the Crimea is dominated by species *Belbekella airgulensis* and *Sellithyris uniplicata*, deposits containing these brachiopods are termed as synonymous beds. In their age interval, the beds correspond to the *Dalmasiceras tauricum* Zone and *Euthymiceras–Neocosmoceras* Beds, being traceable over a considerable distance in the southwestern and central Crimea.

Assemblage 3 (Plate II) includes 16 species of 14 specific brachiopod genera frequent in reefs. These brachiopods are mainly widespread in sponge bioherms of the central and southwestern Crimea. They are represented most completely in brown siltstones with intercalations of gray compact siltstones in the lower part and in dark gray calcareous clays with large calcareous nodules or sponge bioherms in the upper part (Balki and Mezhgor'e sections). They occur as well in spongy calcareous clays of the Baidarskaya valley near the villages of Kuchki and Peredovoe. Based on ammonites, respective stratigraphic interval is attributed to the *Tauricoceras crassicostatum* and overlying *Riasanites* sp. beds. The assemblage is of diverse taxonomic composition. The relevant outburst of speciation was probably caused by habitat environments favorable for brachiopods, which are capable to generate diverse morphotypes and thus to react and adapt quickly to changing ecologic settings. The reef-populating, mostly endemic species *Conocrania spinacostatus, Echinirhynchia balkinensis, Monticlarella (?) korlukensis, Symphythyris arguinensis, Dictyothyris spinulosa, Tropeothyris* sp., *Ismenia perillustris, Praeargyrotheca hexaplicata, Evagyrotheca alta, Krimargyrotheca balkii, K. picteti*, and *Bosquetella robusta* are characteristic of this assemblage only. Sporadically occurring among them are *Belbekella airgulensis* and *Loriolithyris valdensis.* The mass abundance of *Symphythyris arguinensis* in association with sponges and echinoid spines is a distinctive feature of the assemblage. The same strata characterize the first occurrence of *Weberithyris moisseevi* typical of overlying sediments.

In the studied Berriasian deposits of the Crimea, stratigraphic range of *Symphythyris arguinensis* and associated sponges is defined as the *S. arguinensis* Beds above the *Tauricoceras crassicostatum* Beds (Bogdanova et al., 1981). Analyzing in details distribution of brachiopods from Assemblage 3 in the Balki section, we established that the former beds are of a wider range spanning the interval of the *Tauricoceras crassicostatum* Beds (Balki section, members 1–4). The spongy, properly biohermal part of the *Symphythyris arguinensis* Beds is dated based on single ammonites of the genus *Riasanites* sp. occurring in Bed 7 of the Balki section (Bogdanova and Kvantiliani, 1983). Consequently, the *Symphythyris arguinensis* Beds of the Crimea can be tentatively correlated with the lower part of *Riasanites rjasanensis* Zone in the northern Caucasus (Sakharov and Shilkin, 1987) and with local *Riasanites–Pygurus rostratus* Zone of the Mangyshlak Mountains (Luppov et al., 1988). The beds correspond to the lower part of *Fauriella occitanica* Zone of the General Stratigraphic Scale.

European species *Loriolithyris valdensis, Advenina villersensis* and *Krimargyrotheca picteti* present in the beds suggest that sea basin of the Crimea communicated somehow at that time with seas of the Alpine province.

Assemblage 4 (Plate III) includes 16 species and differs in taxonomic composition from the underlying assemblage. This upper Berriasian assemblage is well represented in light-colored biostromal limestones of the Crimea, especially in underlying calcareous siltstones and marls of the central Crimea near the villages of Mezhgor'e and Solov'evka. Species of the assemblage occur as well in biostromes near the village of Solnechnosel'e, the Belbek River basin, Kabanii Log gorge, the southwestern Crimea. The relevant part of the Berriasian succession with frequent species *Zeillerina baksanensis* is attributed to the *Zeillerina baksanensis* Beds (Bogdanova et al., 1981) and corresponds to the upper part of *Fauriella boissieri* Zone of the ammonoid scale. The assemblage includes mostly the reefs-populating brachiopods, including eight endemic species: inarticulate *Mesocrania barskovi*, articulate rhynchonellids *Echinirhynchia nucleatoformis, Cyclothyris (?) rectimarginata, Apodosia lorioli*, and terebratulids *Krimargyrotheca concinna, Agerinella cuneata, Zeillerina walkeriformis*, and *Symphythyris kojnautensis.* In places, shells of the last species are rock-forming components of biostromal limestone near the village of Mezhgor'e. Seven other species are widespread in other regions: *Septaliphoria guerassimovi, Weberithyris moisseevi* and *Terebrataliopsis quadrata* occur in the Berriasian of the northern Caucasus; *Thecidiopsis tetragona, Bosquetella campichei, Loriolithyris valdensis* and *Advenina villersensis* are known from the Berriasian–Valanginian deposits of southeastern France and Switzerland. The last two species are also characteristic of the Berriasian in the northern Caucasus, Kopetdag and Mangyshlak.

CONCLUSIONS

The studied Berriasian brachiopods of the Crimea are of a very diverse taxonomic composition. They are divided into four facies assemblages different in age, successively replacing one another in the section, and correlative with subdivisions of the ammonoid scale. Having definite stratigraphic ranges in the Berriasian of the Crimea, brachiopod assemblages can be used for age determination, subdivision, and interregional correlation of their host deposits. Biostratigraphic beds defined based on brachiopod assemblages and correlated with ammonoid zones are traceable in the Crimea and North Caucasus–Turkmenistan province. The *Tonasirhynchia janini* Beds of the eastern and central Crimea are correlative with the *Berriasella jacobi–Pseudosubplanites grandis* Zone of Berriasian ammonoids. The *Belbekella airgulensis–Sellithyris uniplicata* Beds corresponding to the *Dalmasiceras tauricum* and *Euthymiceras–Neocosmoceras* Beds of the ammonoid scale are discriminated in the southwestern and central Crimea. Species *Praecyclothyris gracilis* and *Advenina villersensis* can be regarded as taxa indicative of Berriasian strata in the Crimea, northern Caucasus, Mangyshlak and Kopetdag. The *Symphythyris arguinensis* Beds correlative with the lower part of the *Riasanites rjasanensis* Zone are detected in the Crimea, northern Caucasus and Mangyshlak. The *Zeillerina baksanensis* Beds of the central and southwestern Crimea correspond to the upper part of the *Fauriella boissieri* Zone. Presence of Berriasian deposits in the Crimea and northern Caucasus is proved by the found species *Weberithyris moisseevi* and *Terebrataliopsis quadrata.* Two of four biostratigraphic subdivisions described in this work, i.e., the *Symphythyris arguinensis* and *Zeillerina baksanensis* beds have been included earlier into the regional stratigraphic chart of Berriasian deposits in the Crimea (Bogdanova et al., 1981; *Zones of the Cretaceous*…, 1989, p. 40).

The established taxonomic composition of Berriasian brachiopod assemblages from the Crimea elucidates connections between northern sea basins of the Mediterranean paleozoogeographic region. Broad connections of the Crimean basin with seas of the Alpine province, in particular, of the Berriasian stratotype area in southeastern France, are evident from the species composition of Assemblage 1. Species prevailing in Assemblage 2 are known as well in the northern Caucasus, Mangyshlak and Kopetdag that is indicative of enhanced connections with the North Caucasus–Turkmenistan province. At the same time, the last province communicated with Boreal seas. This is evident from scarce representatives of the Boreal genus *Praecyclothyris* present in the second assemblage. Prevalence of endemics in assemblages 3 and 4 is to some extent a consequence of brachiopods' confinement to biohermal deposits. Characteristic of these assemblages are typical reefal taxa of cementing craniids and thecideid brachiopods megathyridids, the anchored forms with well-developed pedicle that held shells in almost vertical position.

Reviewers B.T. Yanin and G.A. Afanas'eva

REFERENCES

1. V. V. Arkad'ev, "The *Berriasella jacobi–Pseudosubplanites grandis* Zone of the Berriasian in the Crimean Mountains," Byull. Mosk. O-va Ispyt. Prir., Otd. Geol. **78** (6), 29–35 (2003).
2. E. Yu. Baraboshkin, "A New Stratigraphic Scheme of Lower Cretaceous Deposits in the Kacha–Bodrak Interfluve (Southwestern Crimea)," Vestn. Mosk. Univ., Ser. Geol., No. 3, 22–29 (1997).
3. T. N. Bogdanova and V. V. Arkad'ev, "The Genus *Dalmasiceras* (Ammonoidea) from the Berriasian of the Crimean Mountains," Paleontol. Zh., No. 4, 20–26 (1999) [Paleontol. J. **33**, 354–362 (1999)].
4. T. N. Bogdanova and I. V. Kvantaliani, "New Berriasian Ammonites from the Crimea," Byull. Mosk. O–va Ispyt. Prir., Otd. Geol. **58** (3), 70–83 (1983).
5. T. N. Bogdanova and S. V. Lobatscheva, "Correlated Berriasian Zonations of the Eastern Tethys," in *Cretaceous System: Zonal Subdivisions and Interregional Correlation of Paleozoic and Mesozoic Deposits in Russia and Adjacent Regions* (VSEGEI, St. Petersburg, 1994), Vol. 2, pp. 105–126 [in Russian].
6. T. N. Bogdanova, E. D. Kalacheva, and I. I. Sei, "On the *Tirnovella occitanica* Zone (Lower Cretaceous, Berriasian) in the Feodosiya Section of the Eastern Crimea," Reg. Geol. Metallog., No. 9, 27–32 (1999).
7. T. N. Bogdanova, V. L. Egoyan, N. I. Shul'gina, and A. S. Sakharov, "The Berriasian Stage," Tr. Mezhved. Stratigr. Kom. **20**, 15–47 (1989).
8. T. N. Bogdanova, S. V. Lobatscheva, V. A. Prozorovskii, and T. A. Favorskaya, "On Subdivisions of the Berriasian Stage in the Crimean Mountains," Vestn. Leningrad. Univ., Ser. 7., No. 6, 5–14 (1981).
9. V. V. Druschits, "The Berriasian of the Crimea and Its Stratigraphical Relations," Mem. Bur. Rech. Geol. Mineral., Lyon-Neuchatel, No. 86, 337–341 (1975).
10. A. Yu. Glushkov, "Berriasellids of the Crimean Mountains and Substantiation of General Stratigraphic Scale for Berriasian Stage in the Crimea," Vest. St. Peterb. Gos. Univ., Ser. 7 **2** (14), 98–99 (1997).
11. P. J. Hoedemaeker et al., "Report on the 1st International Workshop of the IUGS Lower Cretaceous Ammonite Working Group, the Kilian Group (11 July, Lyon, 2002)," Cretaceous Res. **24**, 89–94 (2003).
12. Ch. Jacob and P. Fallot, "*Etude sur le Rhynchonelles portlandiennes*, neocomiennes et mesocrétacés du sud-est de la France," Mém. Soc. Pal. Suisse **39**, 1–82 (1913).
13. S. V. Lobatscheva, "A New Species of Rhynchonellids from the Berriasian of the Mangyshlak," in *New Species of Plants and Invertebrates of the USSR, Issue 4* (PIN AN SSSR, Moscow, 1977), pp. 130–131 [in Russian].
14. S. V. Lobatscheva, "On Berriasian Brachiopods from the Crimea," Ezheg. VPO **26**, 184–206 (1983).
15. S. V. Lobatscheva, "The Genus *Belbekella* Moisseev, 1939 (Brachiopods), Its Volume and Evolution, in *Proc.*

of the XXXV VPO Session: Phylogenetic Aspects of Paleontology, Moscow, 1993, pp. 83–100.

16. S. V. Lobatscheva and T. N. Smirnova, "A New Brachiopod Genus of the Family Ochotorhunshiidae from Lower Cretaceous Deposits of the Crimea," Paleontol. Zh., No. 3, 131–135 (1994).
17. P. Loriol, "Monographie des couches de l'etage Valangien des carriers d'Arzier (Vaud)," Mater. Paleontol. Suisse. Ser. 4 X (10), 1–110 (1868).
18. N. P. Luppov, T. N. Bogdanova, S. V. Lobatscheva, et al., *The Berriasian of Mangyshlak* (Nauka, Leningrad, 1988) [in Russian].
19. A. S. Moisseev, "Brachiopods from Jurassic Deposits of the Crimea and Caucasus," Tr. Vses. Geol.-Razved. Ob. NKTP SSSR, No. 203, 1–103 (1934).
20. Al. d'Orbigny, "Paleontologie Francaise. Terrain Crétacé" **4**, 1–389 (1847).
21. F. Pictet, "Etudes paleontologique sur la fauna *Terebratula diphyoides* de Berrias (Ardeche)," Mel. Paleontol. No. 2, 158–172 (1867).
22. F. Pictet, "Description des fossils du terrain crétacé des environs de Sainte-Croix," Mater. Paleontol. Suisse (1872).
23. F. A. Roemer, in *Die Versteinerungen des norddeutschen Oolithen Gebirges* (Nachtrag, Hannover, 1839).
24. A. S. Sakharov, V. N. Shilkin, and M. S. Mesezhnikov, *Jurassic–Cretaceous Boundary Beds in the Northeastern Caucasus (Guidebook to Geological Excursion)* (Vses. Nauchno-Issled. Geol. Razved. Inst., Leningrad, 1987) [in Russian].
25. E. Schlotheim, *Die Petrefactenkunde auf ihren jetzigen Standpunkte* (Gotha, 1820).
26. T. N. Smirnova, "New Data on Early Cretaceous Dallinids (Brachiopoda)," Paleontol. Zh., No. 2, 97–105 (1962).
27. T. N. Smirnova, "Shells of the Genus *Dictyothyris* Douvillé Found in Lower Cretaceous Deposits of the Crimea," Vestn. Mosk. Gos. Univ., No. 4, 59–64 (1968).
28. T. N. Smirnova, *Early Cretaceous Brachiopods of the Crimea and Northern Caucasus* (Nauka, Moscow, 1972) [in Russian].
29. T. N. Smirnova, *Systematics of Early Cretaceous Brachiopods* (MOIP AN SSSR, Moscow, 1990) [in Russian].
30. T. N. Smirnova, "Shell Structure of Upper Jurassic and Lower Cretaceous Craniids (Brachiopoda) and Its Systematic Significance," J. Paleontol. **71** (6), 998–1007 (1997).
31. T. N. Smirnova and D. MacKinnon, "*Apodosia*, an Enigmatic New Genus of Micromorphic Brachiopod from the Cretaceous of Crimea, Ukraine, and the Jurassic of England," J. Paleontol. **69** (4), 686–692 (1995).
32. E. Suess, "Die Brachiopoden der Stramberger Schichten," Hauer's Beitr. Paläontogr. Geol. Osterreich-Ungarns Orients. Wien **1**, 15–58 (1858).
33. G. F. Veber, "Brachiopods of the Lower Cretaceous," in *Atlas of Guide Fossils in the USSR* (Gosgeolizdat, Moscow, 1949), vol. X, pp. 107–200 [in Russian].
34. B. T. Yanin and T. N. Smirnova, "Stratigraphic Ranges of Valanginian and Berriasian Bivalve Mollusks and Brachiopods in the Crimea," Byull. Mosk. O–va Ispyt. Prir., Otd. Geol. **56** (1), 82–94 (1981).
35. *Zones of Cretaceous System in the USSR. Lower Cretaceous* (Nauka, Leningrad, 1989) [in Russian].