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AGE OF ARCHAEOCYATHID ASSEMBLAGES

A. Yu. ROZANOV* and F. DEBRENNE**

ABSTRACT. The Cambrian system itself, and consequently its lowest part, is the only one in the Phanerozoic in which no international stages have yet been accepted. The authors see a way to establish a durable scheme of subdivision using orthostratigraphic groups according to their distribution in the stratotype. Of course, for distant correlations, any other groups could be used. The existant data on archaeocyathids assemblages lead the authors to suggest that this group could be used to divide the Lower Cambrian into stages (corresponding to the steps of their morphological evolution). Siberian archaeocyathids assemblages are proposed for a basic scale. Assemblages of equivalent age are recognized in numerous sections of different continents.

The Cambrian system (especially, its lowest part) is the only one of the Phanerozoic systems for which no international scheme of subdivisions has yet been accepted. Several authors have previously attempted to subdivide the Lower Cambrian (Pokrovskaya, 1954; Suvorova, 1954; Hupé, 1960; Öpik, 1967; Repina and others, 1964; Zhuravleva and others, 1969; Missarzhevsky and Rozanov, 1968; Rozanov, 1972a, b; Konjushkov, 1972; and some others). These schemes were usually based upon trilobites, but more recently, archaeocyathids have been taken into consideration, for the Archaeocyatha have a wide geographical distribution, from the very beginning of Cambrian times to the Middle Cambrian (fig. 1). They have been studied intensively during the last 10 years, principally by I. T. Zhuravleva, F. Debrenne, D. Hill, A. Yu. Rozanov, Yu. I. Voronin, K. N. Konjushkov, V. I. Korshunov, and others. As a first result, it becomes evident that most of the genera of Archaeocyatha known in other parts of the world are also found in the Siberian sections.

Numerous and precise data have been established, and evolutionary stages of the group have been recognized. Studies of the evolution of outer wall porosity, for instance, have established the processes of oligomerization of pores and their subsequent secondary infilling (compensation). Recognition of the successive appearance of these phenomena, in different groups of regular archaeocyathids, and detailed investigations on morphological features have allowed the full range of potential morphological combinations to be realized (fig. 2). Here we give only a general picture of these results, which were detailed in previous publications (Rozanov, 1963; Rozanov and Missarzhevsky, 1966; Rozanov, 1972a,b, in press).

Readers of this article are now asked to examine the actual data on archaeocyathid assemblages and decide if this group could be used

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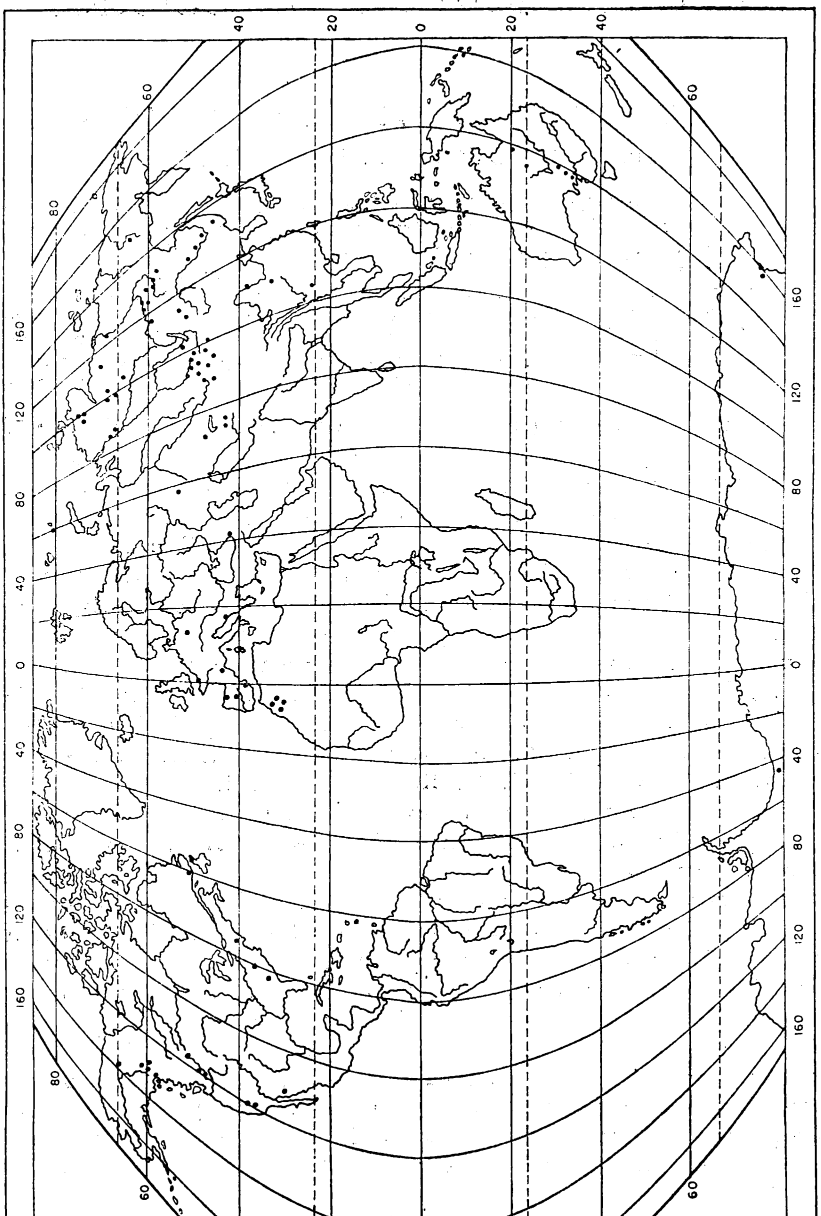
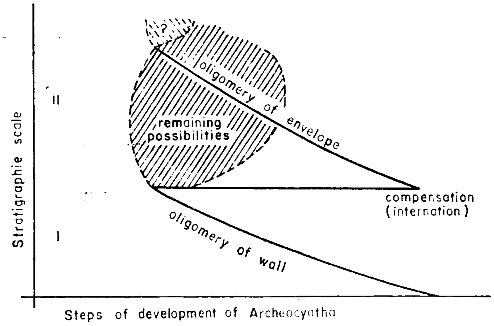
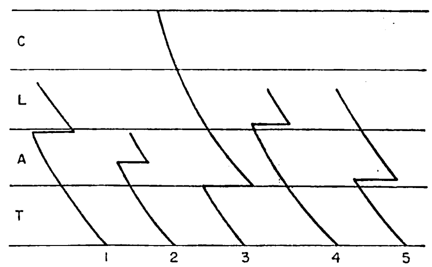


Fig. 1. Occurrences of Archaeocyatha during Lower Cambrian (after Rozanov, in press).



A.



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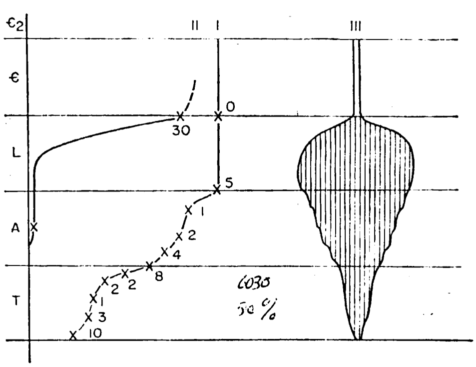

C.

Fig. 2A. Relation between steps of development in archaeocyathids (after Rozanov, 1972b, p. 76).

B. Steps of development into some regular archaeocyathids: 1. Monocyathidae–Rhabdocyathellidae; 2. Dokidocyathidae–Kidrjassocyathidae; 3. Ajacicyathidae–Robertocyathidae; 4. Nochoroicyathidae–Kordecyathidae; 5. Coscinocyathidae–Polycoscinocyathidae.

C. Relations in time between the number of new signs (I), the number of lost signs (II), and the number of genera of Regular Archaeocyatha (III).

PC = Yudomian (Vendian)									
	Aldanian					Lenian			1
PC = Yudomian (Vendian)	Aldanian					Lenian			2
PC = Yudomian (Vendian)	Aldanian					Botamian	Lenian		3
PC = Yudomian (Vendian)	Tommotian			Atdabanian		Botomian	Lenian		4
PC = Yudomian (Vendian)	Tommotian			Atdabanian		Lenian	Elankian		5
PC = Yudomian (Vendian)	Ust-Kundat	Bazhaikcha			Kameshki	Sanashtikgol	Solontzy	Obrutchev	6
PC = Yudomian (Vendian)	Kundat		Bazhaikcha	Kameshki		Sanashtikgol	Solontzy	Obrutchev	7

Aldamian								Botomian		Lenian	
Sunnagin horizon	Kenjada horizon: Profallotaspis			Atdaban horizon: Pagetiellus anabarus		Yudomia		Taryn h.: Bergeroniellus mic- macciformis – Erbiella, Botomocyathus zelenovi	Sinsko-Kutorgina: Bergeroniellus asiaticus; Bergeroniaspis ornata	Edelsteinaspis, Kooteniella, Erbocyathus heterovallum, Bergeroniellus ketemensis, Claruscyathus	8
Aldanocyathus sunnaginicus	D. regularis: Lapworthella tortuosa	D. regularis: Lapworthella bella	Dokidocyathus lenaicus	Leptosocyathus polyseptus, Retecoscinus zegebarti	Porocyathus pinus	Nochoroicyathus kokoulini	Fansycyathus lermontovae	Porocyathus squamosus, Botomocyathus zelenovi			9
Tommotian				Atdabanian				Lenian		Elankian	

for the establishment of a unified scale, divided into four stages corresponding to the steps of their evolution. Such an attempt has already been made in the American Treatise of Palaeontology, by D. Hill, and the possibility of using archaeocyathids is clearly shown there.

Before discussing the material from different regions, it is necessary to show that the authors are able to establish a single scheme using only orthogroups in stratotypes for subdivisions. For distant correlations, any other groups (taxa) could be used. Thus Schindewolf's orthostratigraphic method seems most accurate to us.

SIBERIAN PLATFORM—ALTAI-SAJAN FOLDED REGION

The best sections, well characterized by archaeocyathids and other fossil groups, are exposed on the Siberian Platform and in the Altai-Sajan Folded Region.

On the Siberian Platform, the oldest Cambrian rocks first occur in the carbonate series in different facies zones in which the proportion dolomite-limestone is variable. In the following discussion of the Siberian Platform, we consider the sections of the so-called "eastern" and "transitional" type (Khomentovsky and Repina, 1965), where we have localities with less dolomite and more characteristic fauna than in other sections (fig. 4).

The middle course of the Lena River is, beyond doubt, the best known and studied section of the Siberian Platform (Bodrov, Kolosov, and Val'Kov, 1968; Zhuravleva, 1960; Suvorova, 1960; Khomentovsky and Repina, 1965; Rozanov and Missarzhevsky, 1966; Zhuravleva, Korshunov, Rozanov, Lutchinina, Meshkova, *in* Zhuravleva, 1969; Missarzhevsky and Rozanov, 1968; Zhuravleva, 1972; Rozanov, in press). Numerous authors have described specific sections and their faunas in several monographical studies. Our purpose here is not to repeat all—or even a part—of the exhaustive list of recognized forms. For that reason, we mention only regular archaeocyatha in figure 5 (p. 848 and opposite). The upper part of the section consists of three formations; Kutorgina, Ketema, and Elanka. Here, the Kutorgina Formation contains only *Claruscyathus* in its highest beds. The Elanka Formation has a characteristic complex of Archaeocyatha with *Tegerocyathus edelsteini, T. abakanensis, Erbocyathus heterovallum, "Ethmophyllum" grandiperforatum,* and *Archaeocyathus kuzmini.* Thus, a part of this section corresponding to the Kutorgina and Ketema Formations is poorly characterized by Archaeocyatha, but this lack can be filled by the notably rich archaeocyathid complexes of the Altai-Sajan Folded Region (Repina and others, 1964; Rozanov and Missarzhevsky, 1966; Pospelov and others, 1972; Konjushkov, 1972).

Fig. 3. Comparison between the different diagrams of Lower Cambrian subdivisions in USSR. 1. Official diagrams U.S.K. USSR, 1956. 2. Official diagrams U.S.K. USSR, 1962. 3. Repina and others, 1964. 4. Missarzhevsky and Rozanov, 1968; Zhuravleva, Korshunov, and Rozanov, 1969; Rozanov and others, 1969. 5. Rozanov, in press. 6. Repina and others, 1964. 7. Rozanov and Missarzhevsky, 1966; Rozanov and others, 1969. 8. Khomentovsky and Repina, 1965. 9. Zhuravleva, Korshunov, and Rozanov, 1969; Rozanov, in press.

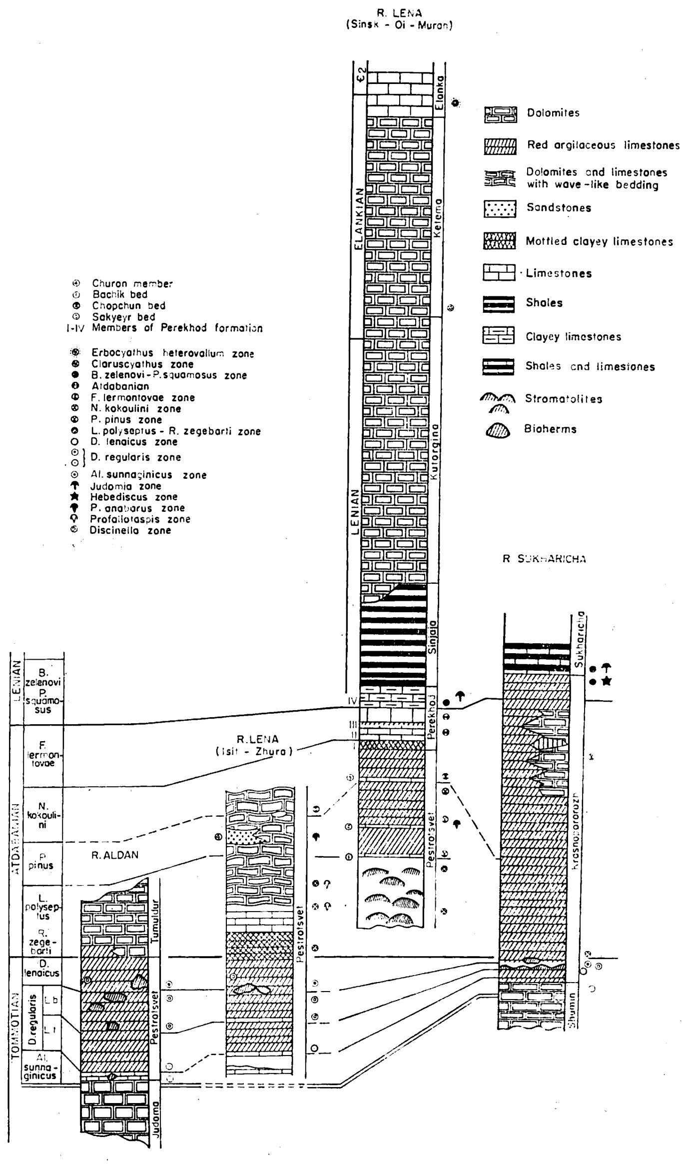

Fig. 4. Correlations of some Lower Cambrian sections of Siberian Platform.
1. Yudoma Formation, Pestrotsvet Formation, Tumuldur Formation.
2. Pestrotsvet Formation, Nochoroi member; 3. Pestrotsvet Formation, Perekhod Formation, Sinjaja Formation; 4. Sukharikha Formation, Krasnoporog Formation, Shumnaja Formation.

In figure 5B, we mention only the distribution of families; in the Siberian Platform as well as in the Altai-Sajan Folded Region, the number of genera of recognized archaeocyathids is at least 200. As stated above, the regional development of archaeocyathids was originally established on the Siberian material; these results are now confirmed by studies of other regions. Examination of collections from the Siberian Platform and the complementary Altai-Sajan region demonstrates clearly that a fourth important developmental stage[1] is recognizable in archaeocyathids, which could be used to divide the Lower Cambrian into stages.

A more extensive correlation chart could be proposed if we also considered the associated fauna of trilobites, hyolithids, hyolithelloides, and gastropods.

The lowest stage (Tommotian) corresponds to the first step in archaeocyathid evolution and is noteworthy for a series of special characteristics. This was the time of simple Archaeocyatha, with simple porosity of the skeleton, also the time during which no trilobites with a carapace are known and when numerous phosphatic fossils made a first, massive, world-wide appearance. Moreover, in the last part of this stage (*Dokidocyathus lenaicus* zone) the well-known fossil, *Mobergella*, appears for the first time with a large areal extent.

The second stage (Atdabanian) corresponds to the second step in the development of the Archaeocyatha, which are characterized by a number of special morphological features; trilobites with a carapace, among which the olenellids are particularly well known, make a massive appearance at the same time. For broad correlations, the complexes described by Repina with *Fallotaspis*, *Profallotaspis*, and *Bigotina*, at the base of this stage, appear to be of special interest. The following stage (Lenian or Botomiam after some authors) is linked with the next step in the evolution of archaeocyathids, the step in which we observe new combinations between the former characteristic features of the skeleton. At the same time, protolenids and other groups of trilobites show an intense development.

The last stage (Elankian and/or Lenian of some authors) is the time when few archaeocyathids genera survived after their strong extension at the end of the previous stage. The first appearance of new groups among trilobites leads some authors to place the beginning of the Middle Cambrian here. Some authors, considering the assemblages of the last two stages, think that the boundary between them is a very important one (Repina, Khomentovsky, Zhuravleva, and Rozanov, 1964) and corresponds to the limit between two subseries.

Thus, stages of archaeocyathid evolution fit the first three stages in the Lower Cambrian, but, above the boundary between the third and fourth stages, as in the Middle Cambrian, it may be better to use trilobites to establish stages and their limits.

[1] Figure 2 (A, B): scheme of evolution on representation of subdivision into stages of Lower Cambrian.

OTHER REGIONS

Archaeocyathids are also developed in well-exposed sections in Morocco, Australia, and probably North America. In other places, (especially western Europe, Antarctica) only fragmentary data are available; they are known from less well known stratigraphical successions (Sardinia, Spain), from inverted sections (Carteret, Yugoslavia), from borings (Doberlung region), or from dredging or boulders (Antarctica, South Africa). These assemblages are poor (Carteret, Montagne Noire, Doberlung region, Yugoslavia). In such cases, all information from other groups and especially from the trilobites are used for correlation, in order to give an accurate scheme of the Lower Cambrian of the world.

Morocco

Archaeocyatha are known mainly from the "schisto-calcaire" succession, well exposed and studied on the northern slope of Anti-Atlas (Choubert, 1953; Hupé, 1953; Debrenne, 1964). Some isolated sections, at the present time of uncertain stratigraphic position, have also given very interesting assemblages of archaeocyathids (Sidi Moussa d'Aglou, southern slope of Anti-Atlas, High Atlas, and particularly Jbel-Irhoud in Jebilets).

The oldest archaeocyathids presently known were found in black limestone beds between the "calcaires supérieurs" and the "série schisto-calcaire" (fig. 6) (Choubert and Debrenne, 1964).

These first archaeocyathids, in which we can recognize *Alataucyathus, Rossocyathella, Coscinocyathus rojkovi,* and other forms closely similar to *Mucchatocyathus* (*"Afiacyathus" compositus*) and *Coscinocyathus marocanoides* (*Erismacoscinus marocanus*) can be compared with the assemblages of the middle part of the Atdabanian stage of the Siberian Platform. The assemblages coeval with the trilobites of zone II and III (Hupé, 1953, 1960) and described previously (Debrenne, 1958, 1964) have clear affinities with the faunas of the lower part of the upper Atdabanian substage. Two conclusions become evident: (A) the "calcaires supérieurs" could be part of the Atdabanian and Tommotian, and (B) the age of the *Fallotaspis* of Morocco appears to be contemporaneous with the upper part of the *Fallotaspis* range-zone.

In other parts of Morocco, some higher archaeocyathids have been found since 1964. The presence of *Anthomorpha* on the southern slope of the Anti-Atlas (Debrenne and Debrenne, 1965) indicates a lower Lenian age. In the Jebilet (Jbel Irhoud, unpub. work), three faunal assemblages have been recognized. Numerous new genera of Alataucyathacea, Cyclocyathellidae, Porocoscinidae, Gloriosocyathidae, Tegerocyathidae, Rozanovicyathidae, et cetera, are characterized by new associations of complex porosities of the walls. This evolutionary step in the aforesaid families is typical of Lenian stage. Until now, these assemblages were the youngest known in Morocco.

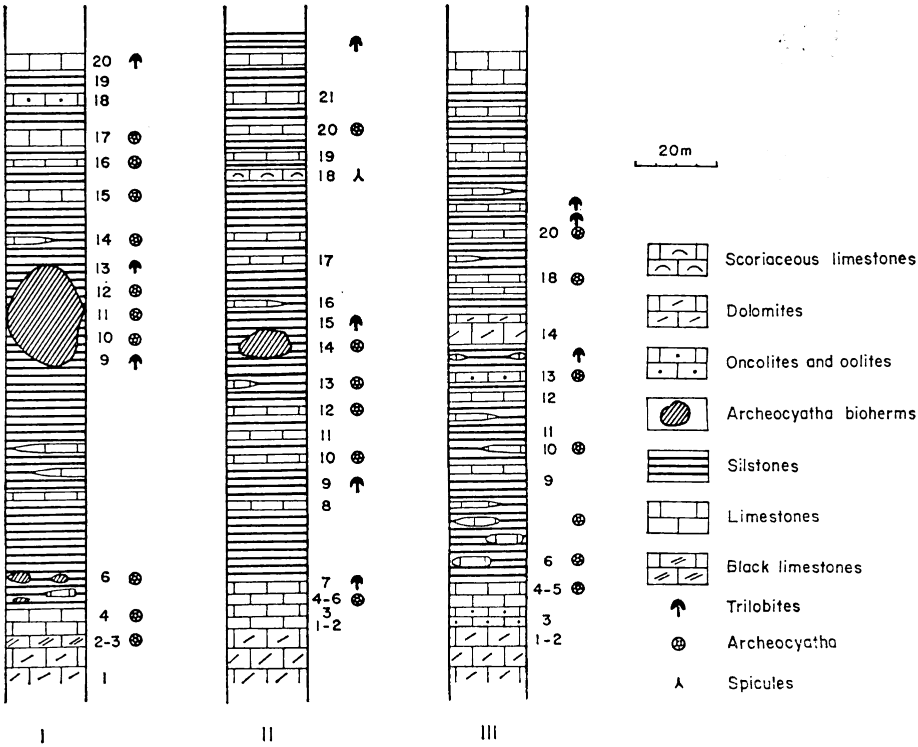

Fig. 6. *Morocco.*—3 sections of the lower part of the Lower Cambrian sequence in Anti-Atlas.

I. *Jbel Taissa.*—1. "calcaires supérieurs"; 2. Afiacyathus compositus, Afiacyathus sp., Erismacoscinus, Hyolithes, Chancelloriidae; 3. Erismacoscinus, Aldanocyathus, Hyolithes, Epiphyton; 4. Protopharetra, Agastrocyathus, E. cf. rojkovi, Hyolithes, Chancelloriidae, Botomaella, Proaulopora; 5. ? Tumulifungia, Afiacyathus compositus, Chancelloriidae; 6. Protopharetra, Erismacoscinus, Epiphyton; 7. and 8. Afiacyathus compositus, Erismacoscinus marocanus, Volvacyathus proteus, Agastrocyathus gregarius, Geniculicyathus varius, Coscinocyathidae, Rossocyathella, Alataucyathus echinus, Hyolithes; 9. Choubertella lata, Fallotaspis cf. acuta, F. longa, F. longispina, ? Tazemmourtia recta; 15. Porocyathidae (gen. and sp. nov.), Protopharetra; 16. Pycnoidocyathus, Baikalocyathus, Retecoscinus.

II. *Amouslek.*—1. "calcaires supérieurs"; 2. and 3. oncolithes; 5. Allothecidae; 6. Protopharetra, Robustocyathus, Agastrocyathus, Epiphyton, Renalcis; 7. ? Fallotaspis; 8. Retecoscinus zhuravlevae, E. rojkovi, Agastrocyathus gregarius, Afiacyathus compositus, Epiphyton, Renalcis; 10. Erismacoscinus marocanus, Agastrocyathus chouberti, Afiacyathus simplex, Afiacyathus tabulatus, Alataucyathus, Aldanocyathus, Loculicyathus; 11. "calcaire scoriacé"; 12. Protopharetra cf. grandicaveata, Loculicyathus, Epiphyton, Renalcis; 13. Loculicyathus abadiei, Protopharetra; 14. Robustocyathus crassus, Loculicyathus abadiei, Afiacyathus compositus, Agastrocyathus chouberti, Aldanocyathus sp.; 20. Alataucyathus n. sp.

III. *Tazemmourt.*—3. Catagraphia; 4. and 5. Aldanocyathus, Protopharetra, Agastrocyathus, Retecoscinus minutus; 6. and above, Aldanocyathus, Erismacoscinus marocanus, Robustocyathus crassus, Loculicyathus, Afiacyathus tabulatus, Agastrocyathus chouberti, Tomocyathus echinatus, Alataucyathus equiporus, Afiacyathus pruvosti, Protopharetra aff. grandicaveata, Renalcis.

Australia

Older authors (Taylor, Bedford, and Bedford) studied collections mainly from the western Flinders Ranges. Recently revised (Debrenne, 1969, 1970), this complex corresponds clearly to the Sanashtykgol association (Lenian stage). (The generic composition of the fauna is given in Debrenne, 1970.) But the relation of most of these faunas to the local stratigraphical units are unknown.

Good sequences of Archaeocyatha were pointed out by M. R. Walter (1967). The fauna, determined only at generic level, suggested two distinct units: the Wilkawillina limestone and the Wirrealpa limestone, the former correlated with pre-Lenian deposits and possibly the Upper Tommotian (*Dokidocyathus, Ajacicyathus, Robustocyathus, Nochoroicyathus, Coscinocyathus, Spirocyathella*), the latter with the Sanashtykgol horizon (*Pycnoidocyathus, Flindersicyathus, Syringocnema*). The Upper Tommotian interpretation cannot now be accepted, and we can say that the first unit has typical Atdabanian affinities, the second Lenian.

Öpik (1957) recorded archaeocyathids from the Northern Territory of Australia. The fauna, with *Archaeocyathus*, is of the Elanka horizon; according to Öpik, the associated trilobites are of Middle Cambrian age. Here is one of the places where the problem of the upper limit of the Lower Cambrian must be studied.

North America

Western North America.—The sequence of the Lower Cambrian of this region is well known from the studies of Nelson (1962) and Nelson and Hupé (1966). The assemblages of Archaeocyatha previously quoted by Okulitch (1954) are being reinvestigated (McKee and Gangloff, 1969), and results are expected soon. Nevertheless, the first publications and examination by the present authors and I. T. Zhuravleva of the material coming from this area allow us to correlate the assemblage of this formation with the Sanashtykgol horizon (*Pycnoidocyathus, Syringocnema, Ajacicyathus, Ethmophyllum*). Just below, a part of the uppermost Montenegro formation with trilobites could be correlated with the Upper Atdabanian stage, and, consequently, the lower Montenegro, with the last *Fallotaspis*, could be Upper Atdabanian. In this case, we have the same results as in Morocco, concerning the actual place of *Fallotaspis* in the Lower Cambrian sequence.

The interpretation of the lowest part of the sequence is more difficult. We might think that the levels corresponding to the Tommotian are below the beds with *Rusophycus-Cruziana*, if these are really traces of trilobites.

Yukon.—The number of taxa described from the Yukon is only the result of more recent and detailed studies and does not indicate a richer fauna. The presence of *Coscinocyathus, Ajacicyathus, Archaeocyathellus, Ladaecyathus, Zonacyathus, Kaltatocyathus,* and some others, as well as the observations of evolutionary features of the new genera, indicates a Lenian age for the series. It is more difficult to include

Fritz's results (1972) on trilobites into this general scheme; he correlates his *Nevadella* zone with the Atdabanian. It may be that all the new forms and genera described, being endemic, give no possibility for a good correlation with Siberia. But the presence of *Kootenia,* as well as the data on archaeocyathids, suggests a younger age, correlated with the Lenian. Things are probably not as clear as Fritz suggested; the part with *Bradifallotaspis* may not be within the *Fallotaspis* range-zone.

Mexico.—Archaeocyathids were not collected in connection with sequences of trilobites (Okulitch, *in* Cooper and others, 1954). Few samples have been described, but these can be compared easily with the fauna of the California-Nevada region (*Ethmophyllum, Ajacicyathus, Syringocnema, Coscinocyathus,* et cetera). A new fossiliferous locality has recently been discovered in the trilobite sequence (point 801b-c in the Puerto Blanco member); first examination of the poorly preserved fossils gives some indication of the presence of the Obrutchev horizon (Elankian stage), but this matter must be further investigated.

Eastern North America.—Labrador-Newfoundland: at present, archaeocyathids have not been collected in sequence in this region and have not been revised since Okulitch (1941, 1955). But numerous samples were examined by the authors; being mainly *Archaeocyathus, Cambrocyathus,* they belong without doubt to the Obrutchev horizon (Elankian stage).

Spain

General features of the Cambrian were studied previously by Lotze. Lower Cambrian archaeocyathids have been described from small collections (Simon, 1939; Debrenne and Lotze, 1963) and scattered outcrops (Debrenne and Lotze, 1963); they are only poor assemblages, often badly preserved. At the present time new investigations (Zamarreño, Debrenne, Perejon) are producing very interesting results: the Elankian fauna with *Archaeocyathus* cf. *laqueus, Pycnoidocyathus* cf. *erbiensis* was discovered just below the *Dolerolenus* fauna in Valdore, while in Las Ermitas, an important assemblage of Archaeocyatha, principally *Aldanocyathus anabarensis, Dokidocyathus* cf. *lenaicus, Sibiricyathus, Dictyocyathus, Protopharetra* is of typical early Atdabanian age.

Sardinia

Archaeocyatha are known from numerous limestone beds of the "Arenarie" series, while trilobites are found mainly in detrital layers, unhappily not in the same sections (Rasetti, 1972). The relative positions of the archaeocyathid limestones in the local stratigraphy is not yet clearly established; the faunal assemblages (Debrenne, 1964, 1972) show affinities with the Sanashtykgol horizon (Lenian stage); *Taylorcyathus rectus, Annulofungia, Coscinocyathus dianthus, Porocoscinus, Anthomorpha* and probably also with the Upper Atdabanian. The trilobite *Hebediscoa,* comparable with *Hebediscus* from SSSR, also indicates the same age.

France

Montagne Noire.—Here there are two poor assemblages of archaeocyathids (Debrenne, 1964); the second with *Anthomorpha* is typical Lenian. The first has not enough characteristic archaeocyathids, but protolenids recently found by Courtessoles strengthened the indication of a Lenian age for the "alternances" and "masse".

The lower part (grès de Marcory) could be Atdabanian or even Tommotian, as some beds with spicules and Hyolitha were noticed (F. Boyer, personal commun.).

In the upper part, a poor trilobite fauna, just below definite Middle Cambrian strata, contains *Ferralsia* and *Paramicmacca*. This last fossil allows comparison with the Elankian stage of the Siberian Platform.

Carteret (Normandy).—With Spain, Carteret is probably the locality with the oldest Archaeocyatha in Western Europe. The simple Archaeocyatha (*Aldanocyathus, Retecoscinus, Sibiricyathus, Protopharetra bigoti*) accompanied by *Bigotina* and unnamed Hyolitha appear Atdabanian, while underlying beds with *Allonia* (? Chancelloriidae) could be terrigeneous facies of the Upper Tommotian.

Democratic Republic of Germany

The actual geological situation is not well known, because the carbonate rocks of Lower Cambrian appear only in wells beneath Mesozoic rocks. The base is unknown. The fauna (*Protopharetra stipata, Afiacyathus compositus*) could be Atdabanian. In the Lausitz (Gerlitz) sections, Schwarzbach (1934, 1939) cited archaeocyathids in strata older than *Lusiatops serrodiscus*, but the collection disappeared during the Second World War, and new collections have not yet been made. We cannot say now if this assemblage is of the same age or not.

Yugoslavia

Only two fragments of one cup have been found in metamorphic rocks, but we can recognize a form like *Aldanocyathus anabarensis*. If so, these probably are Upper Tommotian or Lower Atdabanian.

Southern Caucasia

The discoveries in the Dzirul Massive have not been confirmed, but the region is strongly metamorphic, and fossiliferous localities are hard to find. In collections, oncoliths indicate the presence of Vendhian or Yudomian. A form with simple structures like *Coscinocyathus caucasicus* Vologd., found at an unknown locality in the region, indicates that beds of the Tommotian and Atdabanian stages could be present.

Antarctica

A rich fauna is known, but it comes from dredgings (Weddel Sea, Gordon, 1920) or moraines. Gordon's and Hill's work suggest to us that these assemblages are Atdabanian and Lenian, but no subdivisions could be made. For the list of fossils, the recent work by D. Hill (1965) may be consulted.

South Africa

Recently Dr. M. Cooper (South African Museum) has collected archaeocyathids in glacial erratics embedded in Dwyka tillite of South Africa. The samples were sent to one of the authors (F. Debrenne) for studies. Preliminary observations of the surfaces (without help of thin sections until now) give us first results, the evidence of forms closed to *Thalamocyathus, Zonacyathus, Syringocnema,* and *Pycnoidocyathus.* If clear affinities are established with the faunas of Antarctica and possibly Australia the Archaeocyatha would be used not only for distant correlations but also as a clue for continental drift and recognition of Gondwana in Cambrian time.

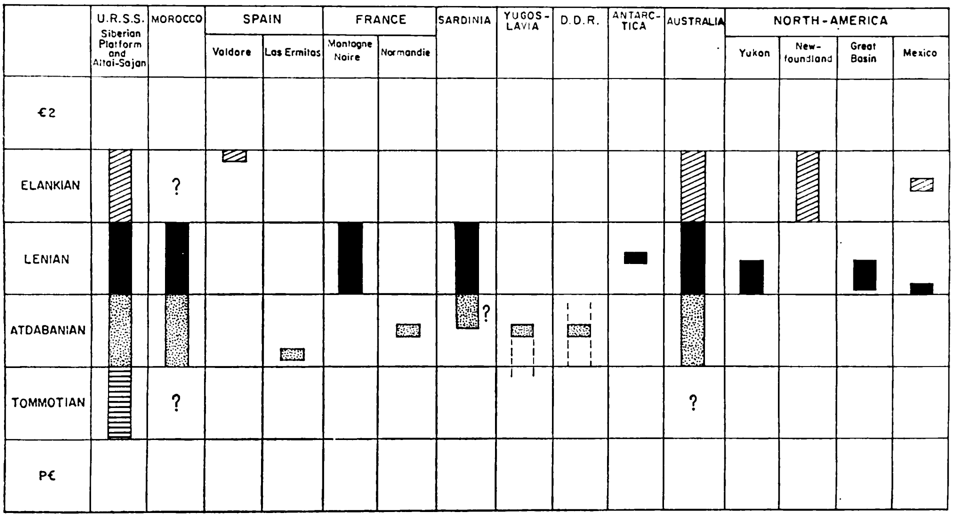

Fig. 7. Tentative correlation chart.

CONCLUSION

In this article, the authors hope to have demonstrated the importance and universal value of Archaeocyatha and that their exposition, despite some incompleteness—which we may expect to be cleared up soon—may convince Cambrian specialists that, if the Lower Cambrian is to be subdivided into stages, the archaeocyathids assemblages would provide the best way to do it.

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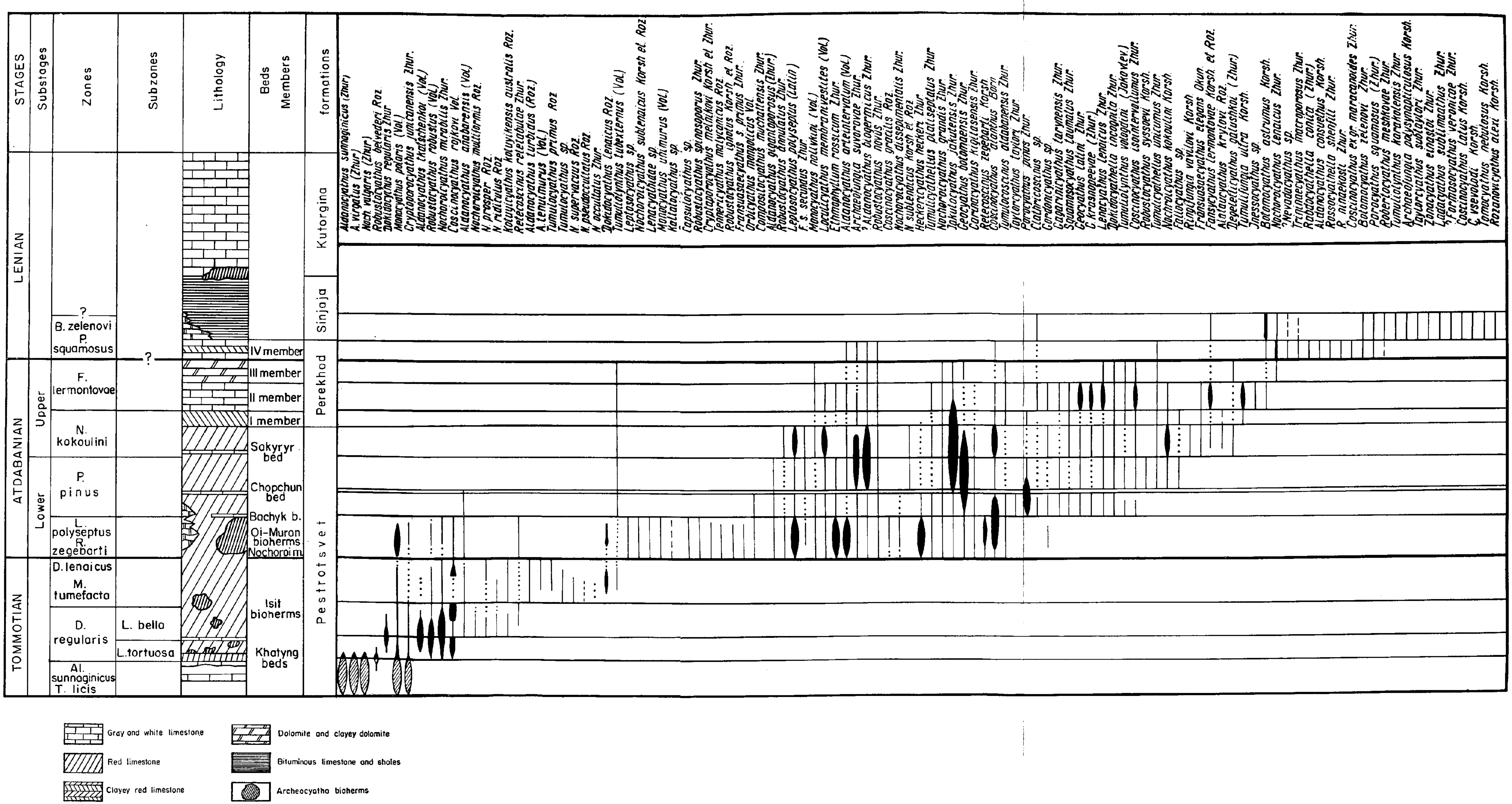

Fig. 5A. Repartition of Regular Archaeocyatha on the Middle course of Lena River.

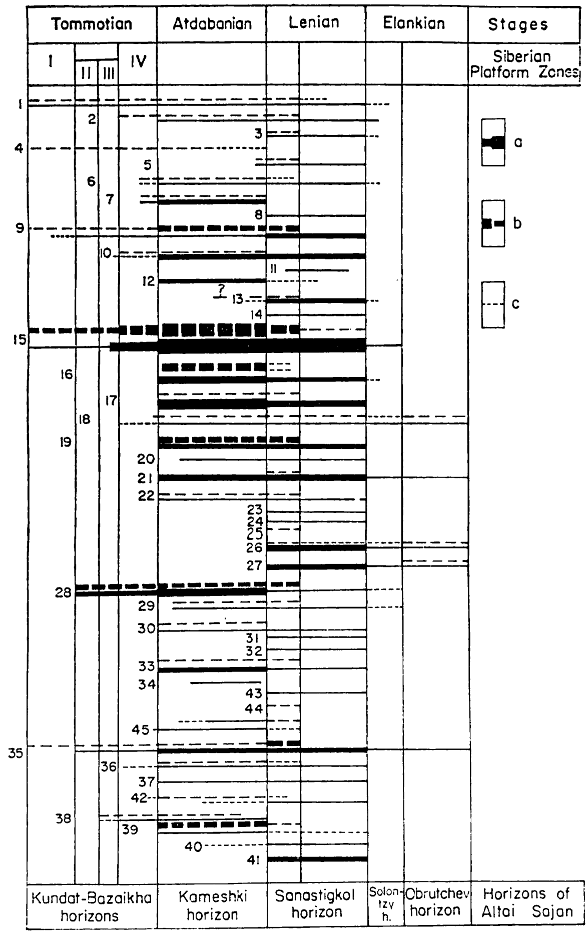

Fig. 5B. Repartition of families of Regular Archaeocyatha during the Lower Cambrian (after Rozanov and others, 1969, p. 270, modified).

1. Monocyathidae; 2. Tumuliolynthidae; 3. Rhabdocyathellidae; 4. Cryptaporocyathidae; 5. Propriolynthidae; 6. Capsulocyathidae; 7. Fransuasaecyathidae; 8. Uralocyathidae; 9. Dokidocyathidae; 10. Kaltatocyathidae; 11. Soanicyathidae; 12. Kidrjassocyathidae; 13. Aptocyathidae; 14. Chabakovicyathidae; 15. Ajacicyathidae; 16. Tennericyathidae; 17. Cyclocyathellidae; 18. Ethmophyllidae; 19. Tumulocyathidae; 20. Kijacyathidae; 21. Vologdinocyathidae; 22. Porocyathidae; 23. Annulocyathidae; 24. Tercyathidae; 25. Botomocyathidae; 26. Erbocyathidae; 27. Tegerocyathidae; 28. Coscinocyathidae; 29. Clathricoscinidae; 30. Alataucyathidae; 31. Peregrinicyathidae; 32. Salairocyathidae; 33. Kazyricyathidae; 34. Mrassucyathidae; 35. Nochoroicyathidae; 36. Bronchocyathidae; 37. Stillicidocyathidae; 38. Kotuyicyathidae; 39. Lenacyathidae; 40. Kordecyathidae; 41. Piamaecyathidae; 42. Carinocyathidae; 43. Coscinocyathellidae; 44. Hupecyathellidae; 45. Pretiosocyathidae.

I. Aj. sunnaginicus—T. licis zone; II-III. D. regularis zone (II. L. tortuosa subzone; III. L. bella subzone); IV. D. lenaicus, M. tumefacta zone.

(A) Stratigraphical distribution in Altaï-Sajan folded region; (B) stratigraphical distribution in Siberian Platform; (C) distribution presumed.