THE SEQUENCE AND DISTRIBUTION OF LUDLOVIAN, LOWER DEVONIAN, AND COUVINIAN CORAL FAUNAS IN THE UNION OF SOVIET SOCIALIST REPUBLICS

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ABSTRACT. The records of coral faunas in the U.S.S.R. are summarized and some suggested synonyms mentioned. The distribution of the faunas is discussed and characteristic faunal elements for the different horizons are given. In particular, first and last occurrences of genera are noted as these may be of stratigraphical value.

This review has been facilitated by several recent Russian reviews (Dubatolov 1964, Spasskiy 1964, Kaf'o 1965, Nikiforova and Obut 1965, and Ivanovskiy 1965(b)), but is based in the main on the very numerous papers descriptive of the Ludlovian, Lower Devonian, and Couvinian corals of the U.S.S.R.

Russian coral taxonomy has a somewhat different tradition from that of Europe and America, but I have attempted some reconciliation by suggesting changes in published taxonomy. Russian evaluation of the genera of tabulate corals seems to me to be superior to that of western usage and I have in general adopted it herein. I apologize to my Russian colleagues for any misrepresentations of their views; any such are due to my poor knowledge of Russian. I thank them for their generosity in supplying reprints.

LUDLOVIAN, SKALIAN, AND TIVERIAN

Ludlovian, when not qualified, is taken in this review to mean the time of development of the faunas in the post-Wenlockian strata of England deposited before the Ludlow Bone Bed. In Hony's view (1962) this corresponds approximately with the Kopanina Beds of Czechoslovakia. Skalian implies the time of development of the faunas of the Skala beds of Podolia which may or may not be equivalent in age to the Ludlow Bone Bed and perhaps to part of the Downtonian, and may correspond approximately with the Pridoli Beds of Czechoslovakia containing graptolite zones P. ultimus to M. angustidens. Tiverian implies the time of development of the faunas of the Borszczow and Czortkow beds of Podolia, and by indirect correlation is regarded as approximately equivalent to the Lochkovian of Czechoslovakia. The Lochkovian faunas, by the graptolite correlations of Jaeger (1962, 1963) and the range of Hysterochiton hystericus (Sehlotheim) as established by Solle (1963), are taken to be time equivalents of the Gedinnian and much of the Siegenian of Belgium and Germany. For discussions on the equivalence of the base of the Lochkovian to the base of the Gedinnian see also Alberti (1962, 1963), Boucot (1960), Boucot and Pankiwskyj (1962), Hollard (1963, 1965), and Walliser (1962, 1964). The Pragian of Czechoslovakia is considered roughly equivalent to the remaining Upper Siegenian plus Lower Emsian time as is the Zlichovian of Czechoslovakia to Upper Emsian time. Couvinian and Eifelian stages are regarded as

approximately equivalent, though it is recognized that the Lower Couvinian (Co₄ of Belgium) may have begun slightly earlier than the Lauch Beds of the Eifel. It would appear from the table given by Erben (1962) that the zone of uncertainty may have narrowed to Co₄; Erben suggests that Co₄ may be broadly equivalent to the Heisdorf Beds and a part of the underlying Wetteldorf Beds of the Prum Syncline; the Heisdorf Beds he considers topmost Emsian.

It is believed that justification for these working correlations exists as a result of the Prague (Svoboda, Horný, and Chlupac 1960) and Bonn (Erben 1962) symposia on the boundary between the Silurian and Devonian systems and the colloquium on the Lower Devonian and its limits held in Rennes in 1964 (‘Colloque’, 1965), and of the subsequent literature, including Hollard (1965).

In the U.S.S.R. the common usage of Lower Ludlovian corresponds reasonably with ‘Ludlovian’ as defined above, but possibly includes Skalian in some sequences; while the Russian ‘Upper Ludlovian’ has recently (Nikiforova and Obut 1965) been correlated with the Tiverian of Podolia. In some places it may also include the Skalian.

Podolia

Here the Rugosa of the Malinovetski Formation appear to be Ludlovian as Boucot and Pankiwskyj (1962a) suggested, rather than Wenlockian as previously accepted (Różkowski 1946). They include Weissmerella lindstromi (Smith and Tremberth) which is illustrated elsewhere at present only from the Hemse group of Gotland and the Ludlovian of Tuva (Soshkina, Dobrollyubova, and Kabakovich 1962), but is reported by Bulvanker (1952) also from the Skala of Podolia. The rest of the Rugosa illustrated by Bulvanker (1952) and by Ivanovskiy (1965a) are consistent with a Ludlovian age and the fauna bears a general resemblance to that of the M. leinwardinei zone of England. It consists of Phaulacis, Pilophyllum, Rhabdocyclus minutus (Bulvanker), solitary Trypsiplasma, Aphyllyum (phaceloid Trypsipla), Cystiphyllum including ‘Microplasma’, Holophyllum, and Rhizophyllum. Boucot and Pankiwskyj (1962b) listed Favosities, Alveolithes, Coenites, Thecia, Heliolites, Halyssites, Autopora, and Syringopora. Halyssites is not listed by them from younger formations in Podolia. According to Sokolov (1962d) and Sokolov and Tesakov (1963, p. 124) in the upper Malinovetski horizon there is a distinctive new genus of alveoloid corals without pores, very common in the Kopanina beds of Czechoslovakia and in the ‘Lower Ludlow’ of Central Asia; they also state that the upper beds of the Malinovetski horizon and the Skalian horizon have pre-dominant Favosities with rare Squamalosfavosities, Subulveolithes, Taxopora, and the last Halyssitidae, with Syringopora and small thegnoporoids. Earlier descriptions are in Venyukov (1899) and Semiradski (1906).

The Skalian Rugosa (Bulvanker 1952, Ivanovskiy 1965a) are Dokophyllum, Spongophyllidae, ‘Acanthophyllum nikiforevae’ (Bulv.), solitary Trypsiplasma (as Pholidophyllum and Storitophyllum), fasciculate Trypsiplasma (as Aphyllyum), three species referred by Bulvanker to Holophyllum but which do not appear to me to be congenere to H. holmi, the type species. Bulvanker recorded Phaulacis cyathophylloides Ryder and Weissmerella lindstromi (Smith and Tremberth) but did not figure them. A? nikiforevae would seem to indicate that Devonian solitary pentaphyllids developed from the Silurian Spongophyllidae, for this species seems related to the species group S. perfectus (Wedekind). This rugosan fauna is certainly still closely related to that of the Ludlovian,
Różkowska (1946) described some of the Rugosa of the Tajna beds of Mazurwoka which according to Boucot and Pankiwskyj (1962) include both Skala and Borsczów horizons. Her list is *Spongophyllodes grayi* (E. & H.), *S. perfectus* (Wdck.), *Tryplasma loveni* (E. & H.), *Cystophylum* (as Microplasma), and *Rhizophyllum gotlandicum* (Roemer). Bulvanker (1952) figured *Phaulactis* from the Borsczów horizons.

Skala Tabulata are considered by Klaaman (1965, p. 38) to indicate that the Skala is of the same age as the Estonian ‘Lower’ Ludlow (Kaarma to Ohesaare stages). He does not list the Skala fauna, but states that in the overlying Borsczów only *Pachyfavosites kozloviskii* Sokolov (1955, pl. 4) occurs in abundance and that in Gotland the Burgsvik, Hamra, and Sundre horizons at the top of the Gotlandian form a zone of *Pachyfavosites*. He thus deduces that the Tiverian (Borsczów and Czortków horizons of Podolia) is equivalent to the Burgsvik, Hamra, and Sundre. Supporting evidence is necessary before his correlations can be regarded as established. According to Sokolov and Tesakov (1963, p. 124) the Skalian and upper Malinovetski horizons have *Favosites* predominant, with rare *Squameofavosites* and *Subalveolites*. Dubatolov (1963, p. 139) says that *Multisolenia* makes a late appearance in the Skalian of Podolia with *Squameofavosites* but he does not figure it.

The Skalian coral faunas are too little known at present for precise definitions. Present records suggest that *Squameofavosites* and *Thannopora* entered therein (or in the Lower Ludlow? Upper Malinovetski horizon). Whether the Skalian is Gedinnian or pre-Gedinnian is still for discussion.

We lack definitive studies of the Tiverian (Borsczów and Czortków) corals of the type area in Podolia. The *Phaulactis* figured from the Borsczów by Bulvanker (1952) seems correctly referred to that Silurian genus. Sokolov and Tesakov (1963, p. 128) remark that in Podolia the first representatives of *Pachyfavosites* are characteristic for the Tiverian with extremely rare *Pleurodictyum* and a new genus of alveolitoid corals without pores (Sokolov 1962d).

Sokolov (1965, in the unpublished Bull. Ludlow Research Group, No. 12, p. 16) records a report by Obut of the discovery of a great number of *Monograptus uniformis* Pribil in the upper part of the lower half of the Borsczów horizon, giving direct comparison with the lower Lochkovian of Czechoslovakia.

According to Tarlo (1964) the fishes of the Czortków beds are Lower Gedinnian. If this is so, probably the entire Tiverian of the type area is equivalent to only the early part of the Lochkovian. The ‘Upper Ludlovian’ or ‘Tiverian’ of the rest of the U.S.S.R. must be separately evaluated for each region for correlation with the Lochkovian and the Western European stages Gedinnian and Siegenian.

**Estonia**

To the north-west of the Russian platform, in Estonia, the Kaarma, Paadla, Kaugatama, and Ohesaare horizons forming the zone of *Favosites similis* Sokolov and *F. kogdniensis* Sok. are taken by Klaaman (1965) to correlate with the Lower Ludlovian of England, and with the Klinteberg, Hemse, and Eke groups of Gotland. The characteristic complex of Tabulata in Estonia is *Favosites forbesi* E. & H., *F. eifius* Klaam., *F. pseudoforbesi* Sok., *Thecla svinderviana* (Goldf.), *Laceripora cribrosa* Eichw., *Parastratiopora commutabilis* Klaam., and *Syringopora schmidtii*, but *Palaeofavosites*, *Multisolenia*, *Coenites*, and *Roningeraella* also occur. Klaaman considers this fauna
to be still represented in the Skala of Podolia, but does not list the species of the latter. The Estonian tabulatian fauna has been described by Sokolov (1952a, 1955) and Klaman (1962a, b). Halyisitidae are not known in the Ludlovian of Estonia.

Unfortunately the Rugosa have not been re-studied. The illustrations of Dybowskii (1873) may be doubtfully interpreted as of Entelophyllum, Phanadactis, Mica!a, or Entelophyllum cf. prosperum Barraud, Stauria, Strombodes, Tryplasma, and Cy/stiphylum. Ivanovskii (1965b) listed also Pilophyllum, Acrulatia, Weisserrnelia, Kadonophyllum, and Holmophyllum, but these have not been figured. No younger corals are known in Estonia.

Novaya Zemlya, Vaygach Island, and Pay Khoy

In this mioesysmclinal milieu (Cherkesov in Nikiforova and Obut 1965), the Lower Ludlovian of Novaya Zemlya contains Favorsites and Heliolites and that of Pay Khoy has granitoliths. That of Vaygach Island has Spongophylloides perfectus Wdck. and Pholophyllum vermiculare Wdck. (Strel’nikov 1965a, b). The overlying Grebeni and Vaygach horizons are together correlated with the Trierian but Chekhovich (1965) suggests that the Grebeni horizon, widespread also in the Subpolar and Polar Urals, correlates with the Burgsvik–Hamra–Sundre succession of Gotland, and that only the Vaygach horizon of the Sub-polar Urals would correlate with the Trierian. The Grebeni horizon of Novaya Zemlya contains Parastratiaporpora and Favorsites, while on Vaygach it contains Microplasma, Favorsites, Squamosfavorsites, and Syringopora. The overlying Vaygach horizon on Vaygach contains Favorsites. The corals of this region have been described by Lindström (1882), Tchernyshev and Yakovlev (1898), Cherkesov (1932), and Chernyshev (1937a, 1938a, b).

Urals

Chernova Uplift. In the Chernova structure that reaches the coast at Sin-kin Nos (Barskaya 1965) the late Silurian to Trierian has four coral faunal complexes; the earliest of these is characterized by Parastratiaporpora and the second and third by Thc/ia and Laceripora, though Thecosi.egtes enters in the third, in what may be its earliest appearance anywhere. The fourth has Squamosfavorsites, Favorsites, Rhaboeolites, Thecosi/egtes, and Syringopora. The fourth complex may be Lochkovian; perhaps the third is Skalian; the others seem equivalent to the Ludlovian of Estonia. Strel’nikov (1964) described Stereogyllodes argulus from the ‘Upper Ludlovian’.

Polar and Sub-polar Urals. In the Sub-polar Urals that lie subparallel to and a little west of the Polar Urals, Chekhovich (1965) recognized (in the Rivers B. Sunya and Kzhim) a zone of Laceripora cibrosa and Parastratiaporpora arctica (with Favorsites and Conenites) as approximately equivalent to the early Ludlovian Kaarma and Paadla beds of Estonia. From this zone in the Durnayus suite Strel’nikov (1965b) reported that the Rugosa are dominated by Spongophylloides, Zelophyllum, Pholophyllum (= solitary Tryplasma), Stauriophylum, and Holmophyllum; very rare are Mica!a and Tenuiphylum; some Tabularia and Detilasma continue from the Wenlockian and Stereogylides occurs. Illustrations are not yet available.

Above this, in the lower part of the Into-Parm suite is a zone of Favorsites pseudo-forbesi oheesaarensis and Howellella pseudogibbosa, which Chekhovich (1965) equated with the Grebeni horizon of Vaygach Island. Favorsites, Parastratiaporpora, Striatoporoplastidae,
Table 1. Main stratigraphic or biostratigraphic units mentioned in the text.

<table>
<thead>
<tr>
<th>Country or Region</th>
<th>Suggested approximately equivalent to:</th>
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<tr>
<td>Czechoslovakia</td>
<td>Kopnina</td>
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| Podolia          | Malinovetski | Skala    | 1: Dorscino
2: Cairnbrook | Tiverian                              |
| Estonia          | 1: Karsma
2: Paadla
3: Krupekev
4: Obisare   | Vaygich | Mesnovs Inlet | Eifelian                  |
| Novaya Zemlya    | “Lower Ludlovian” Greben   | Vaygich | Mesnovs Inlet | Eifelian                  |
| Chernova Uplift  | Foss. Comp. 142 | F. C. 3 | F. C. 4  |                                     |
| Polar and Subpolar Ural | 1: Durnaya
2: L. Ito-Parma | U. Ito-Parma | Western Slopes |
|                  | see Nikolova & Obot (1946) | “Upper Ludlovian” | see Spankly (1930) |
|                  | see Nikolova & Obot (1946) | “Lower Ludlovian” |                                     |
| Taimyr            | “Lower Ludlovian” | “Upper Ludlovian” | Lower Devonian | Eifelian                  |
| Armenia           | Eifelian            |                                     |
| Tom-Sian         | Dalvan = Mustavas and Karsagol | 1: Ibarria
2: Kazakau      | Akkai
Behdani
Monk and “Coblenzian” | Katran and Eifelian |
| Kazakhstan        | Akkan f. c.       | 1: Ayunay f. c.
2: Barum f. c.
“Upper Ludlovian” | Bugimbar f. c.
1: “Coblenzian”
2: “Coblenzian” | Eifelian                  |
| Altai-Sayan      | Potpens = Chalgar | Sakhaya
“Upper Ludlovian”
Tum-chumynak = Tomsusmosvod = Lochtev | 1: Krenov
2: Maliahehek
“Lower Devonian” |
| Amur Geosyncline | 1: Bolsheverev
2: Imanurin
Sakhalin and Bilingov | 1: Sakahir
2: Shandos
3: Monamond | Lesabir, Tankuy, Kryukov, Sokolin, Sakhalin & Ust-Kamen |
| Verkhoyan - Chukotka Gras. | 1: Bolsennuyer
2: Inakayn
Sakhalin and Bilingov | Nelyas decorative “Lower Devonian” | Eifelian                  |

Numerical sequence gives ascending stratigraphic position in the stage. F. C. = fossil complex.
and Syringopora occur in the lower part of the zone which he correlated with the Ohesare and Kaugatoma beds of the Estonian Ludlovian. In the upper part of the zone the above four genera are joined by the first Squameofavositess and Thecostegites; possibly this upper part may correlate with the Skalian of Podolia. The rugosan Styphophyllum Strel’nikov (1964) occurs in this zone.

In the upper part of the Into-Parm suite of the Sub-polar and Polar Urals which Chekhovich (1965) correlated with the Vaygach horizon of Vaygach, and with the Teverian of Podolia, Tabulata are rare but a zone of Favosites socialis uralicus and Herebertella hebe is recognized; Strel’nikov (1965b) reported the occurrence herein of Orthopateryphyllum (= Palaeoanthus Focke from the highest Silurian of Yass, N.S.W.), a disphylid [?] ‘Disphylum’, Spongophyllotides, and the spinose Thecaspinellum (a cystophylid with scaly? epithea and very simple tabulae), Pholidophytum, Stortophytum, Cystophytum (including Microptasma), Diplochone, and Heidstromophytum. Chekhovich (1965, Table) listed Monographus formosus from beds on the R. Limba considered equivalent to the base of the upper Into-Parm suite.

Northern, Central, and Southern Urals. Sytova (1952) described Kyphophyllum elkinense and Entelpatyphyllum uralicum from the top of the Wenlockian or base of the Ludlovian of the eastern slopes of the Northern Urals. Soshkina (1937) described fasciculate Trypsasma and ceriod ‘Trypsasma (as Zelophyllum) from ‘Lower Ludlovian’ strata of the micaceous zones of the western slopes; and from the eastern slopes Entelpatyphyllum (as Temophyllum flexuosum Soshk., and Kyzodes uralicus Soshk.), solitary Kodanophyllum, Stortophyllum, fasciculate Trypsasma (as Zelophyllum), and Rhizopatyphyllum. This list may well indicate a Ludlovian age. From the ‘Middle Ludlow’ of the western slopes ceriod ‘Acervaria’ [? = Zeloplasma], ‘Pseudomphyma elongata Wedekind’, solitary Trypsasma, and Stortophyllum were described from scattered outcrops; the age is doubtful; it may be Devonian. ‘Acervaria luxurians var. brevisepata Weiss.’ of Soshkina (1937, pl. 17) seems almost identical with Zeloplasma genniforme (Etheridge) from the late Emnian or early Couvinian of eastern Australia. See Pedder (1964) for figures. From the ‘Upper Ludlow’ (Tiverian) of the western slopes, possibly a new genus of solitary ptemophyllids was figured as Onophyma; and from the eastern slopes Neomphyma ortigata Soshkina and ‘Neocystophyllum’ [? = Acantophyllum] keyserlingi (Dybowski). Nikolaeva (1949) described Thecaspinellum from the upper Silurian (Ludlovian sensu lato) of the Urals (R. Taliya). I have found no recent discussion of the stratigraphy of these coraline beds, but I have deleted from Soshkina’s list those species whose holotypes were stated by Spasskii (1960a) to be from D11 Eifelian and not from the Silurian, and other species listed as occurring only with these holotypes.

Taimyr

In the ‘Lower Ludlow’ of central Taimyr, Favosites and Syringopora occur (Zhizhina in Nikiforova and Oub 1965) and Squameofavositess was described by Barskaya (1962) from undifferentiated Ludlovian. Sokolov (1962d) reported that the ‘Upper Ludlow’ (Tiverian) of the Urals and adjoining islands of the Arctic and the Pechora Basin is characterized by very numerous Squameofavositess, Pachyfavositess, Favosites (peculiar small forms of the type of F. socialis), and Syringopora; and the first Tetraporininae appears.
Central Asia

*Tien Shan.* In this geosynclinal region in the Soviet Republics of south-east Uzbek, Tadjikistan (including Pamir and Darwaz), and Kirghiz, Ludovician and Tiverian coral faunas occur in the Turkestan, Zeravshan, Gissar, Alai, Fergana, and Kirghiz ranges (Nikiforova and Obut 1956; Rukhin 1937; 1958a; Orlov 1930; Obut 1939; Chekhovich 1955a, b, c; 1956, 1961, 1964; Chekhovich et al. 1960; Dubatolov and Chekhovich 1964; Leleshus 1964a, 1965).

The Dal’yan horizon and the Mustavass (Yassu-Atbashin belt), Karasay (Aksan Belt) suites correlated with it are considered Ludovician, having Conchilium knighthi and Favorites, Squameofavosites tchernychevi Chekhovich, Daljanolites Leleshus, Heilolites, Helioplasmolites Chekhovich (1955a, 1956), Propora, Halystites, and Syringopora. This is possibly the earliest occurrence of Squameofavosites. Daljanolites is of creeping habit, with cylindrical branches having corallites with walls thickened so that no tabulae are observed.

The Isfarin horizon with Pholidophyllum limestones is considered Lower Tiverian. The only rugosan I have found described is Charsitakia Labrusevich (1959), a large solitary cystiphylloid with scaly epitheca and coarse disepiments and tabulae, recalling Thecaspinellum from the upper part of the Into-Parin suite of the Polar and Sub-polar Urals; but Sokolov (in Nikiforova and Obut 1965) determined Cohnnaria, Thecaspinellum, Cystiphyllum, and Holmophyllum. These occur with Favorites, Squameofavosites, Pachyfavosites, Cladopora, Heliolites, Propora, Syringopora, and Thecostegites. In the Dzhangdzei Belt Helioplasmolites is recorded from the Isfarin horizon.

The Kunzhakh horizon has Favorites, Squameofavosites, Pachyfavosites, and Alveolites and is regarded as Upper Tiverian (Dubatolov and Chekhovich 1964). In the Kunzhakh beds in the Zeravshan Range occur Monograptus hercynicus and M. angustidens and in the Turkestan Range *M. ex gr. hercynicus* (fide Dubatolov and Chekhovich 1964, p. 8). Nikiforova and Obut (1965, p. 489) refer to a recent find of Monograptus hercynicus with Pararhovikia geintiziana Bouček and *P. obutii* Bouček in the western parts of the southern Tien Shan beds, and note that this gives correlation with the Upper Loehkovan of Bohemia (i.e. probably Lower and Middle Siegenhin). Pavlov (1962, 1965) has described Fasciphyllum kokshullicum herefrom; it has two regular series of large subglobose disepiments in its very slender corallites. Its walls are much thinner than those of *F. conglomeratum* Schule.

From the Chinese Tien Shan Regnella (1941, 1961) has described a fauna that could well be Tiverian from the Arpishmelaq series of Chol-tag: Cystiphyllum, Teratophyllum, Favorites, Angopora, Thamnopora, Striatopora, Alveolites, Heliolites, Plasmodpora, and Aulopora.

Kazakhstan

In the geosynclinal regions of Central and South-east Kazakhstan in the Karaganda basin, the Dzungarian Alatau and the Balkhash region, the Akkan fauna complex is considered Ludovician; Nikolaeva (in Bulvanker et al., 1960) has described Kretophyllum (very like forms from the Eke marls of Gotland considered to be Pilophyllum sp.) solitary Tryplasma and Holmophyllum; Nikiforova and Obut (1965) list also Calostylus. The Tabulata are listed by Keller (1962) and Bondarenko (1962) as Favorites,
Mesofavonites, Heliolites, and Propora. Kovalevskiy et al. (1960) and Kovalevskiy (1965) described species of Favosites, Multisolenta, Parastriatopora, and Halysites.

From the probably Tiverian Aynnasy faunal complex, Nikolaeva (in Bulvanker et al. 1960) has described the new genera Neobrachyelasma and Orthopatryphyllum (to which she refers Streptelasma australis) from the Ludlovian of the Yass District, N.S.W., and colonial Tryplasma (as Zelophyllum). Nikiforova and Obut (1965) list also Alleynia, Petraia, Chonophyllum, Oligophyllum, Kypnophyllum, Kodanophyllum, Neoxyphyllum, and Rhadophyllum, but of these I have found no descriptions. Keller (1962) listed Favosites and Squameofavosites herefrom and Bondarenko (1962) Pseudoplasmodopora and Heliolites.

From the Burnak faunal complex above the Aynnasy complex, Keller (1962) listed Plicatomus Chan (like Pachyfavites but lacking fibrolamellar wall-structure); Bondarenko (1962) listed Heliolites, Squameofavites, Pseudoplasmodopora, and Propora. These two authors referred this complex to the middle and upper parts of the 'Upper Ludlow' (i.e. Tiverian). Descriptions of Pseudoplasmodopora and Squameofavites are given by Bondarenko (1963). Pseudoplasmodopora differs from Plasmodopora in having tubular, not dissepimental, coenenchyme. Squameofavites has mixed tubular-dissepimental coenenchyme, and squamulate rather than septal spines. Bondarenko noted that Plasmodopora gippalderica Chapman from the Lower Devonian of Victoria differed from the type species of Pseudoplasmodopora only in having thickened walls to the coenenchymal tubules, this being regarded as a Devonian character.

From the Bogimbat complex, regarded as either uppermost Tiverian or basal Devonian, Keller listed Favosites, Pachyfavites, Squameofavites, Ausiolites (Shar- kova 1963a, a coenid? genus), and Calliopora. Barskaya and Sharova (1963) have discussed the Tabulata of the Ludlovian of the Tarbagatay Range, and Smelovskaya (1963) the Rugosans but I have not seen their works. Also Rukhin (1939) described Upper Silurian Tabulata from near Lake Balkhash, and Chan (1959) has founded Plicatomus for favositids from the Upper Silurian (Tiverian) of Central Kazakhstan. Sharova (1964) has described Sceliofora from the 'Ludlovian' of the Tarbagatay Range.

Altai-Sayan Geosynclinal Region

This region which includes the Rudny Altai, Southern Altai, Mountainous Altai, Salair, the flanks of the Kuznetsk and Minusinsk Basins, the Sayan and Tuva, was mobile during the Siluro–Devonian, for Upper Silurian and Lower Devonian beds are missing in many places. The best-known sequences are probably those of the Altai and the Salair.

In the Salair the Baskuskian suite (including the Mt. Gilyadin beds with Mesosolentia) is probably Wenlockian but may include basal Ludlovian. The overlying Potapov suite, with Cantrillia [* = Rhabdocycla] extima Zhdantsev (1961) common, is considered Ludlovian. Nikiforova and Obut (1965). In the Altai the Chagyr suite is probably Ludlovian, and a rich fauna of Rugosa has been described by Zhdantsev (1961, 1965) and Cherepina (1965). Tabulata (including Heliolitida and Chaetellida) have been described by Chernyshev (1951), Krasnovskaya (1955a), Mironova (1961a, b, 1965), Dzyubko and Mironova (1961) and Dzyubko (1961). The Chagyr coral fauna is Entelophyllum [as Stereocyclus and Petrozium], Phialactis microcystis (Zhdantsev), Ryderophyllum Cherepina (1965), solitary ‘Neobrachyelasma balchaschia Nik’,
‘Dokophyllum’, Circophyllum and ‘Neobrachynasma’ variable Zhelt. [these last two are fasciculate columnarids without disseminations and with narrow peripheral stereotype], Tabularia oblonga (? = Dedrostella), Sosudkineolites (a homeomorph of the L. Carb. Carenophyllum), Tryplasma, species both solitary and fasciculate [as Zelophyllum and possibly as Pyenostythus?] and Cystiphylum [including ‘Holmophyllum’]; Favorites, Mesofavorites, Mesosolenia, Stratitopora, Parastratitopora, Laceritopora cribrosa Eichwald, Taxopora altaicica Mironova, Hillaeopora, Heliolites tchouangensis Mironova, Scheldohylistes pseudoorthopteroides (Chern.), and Halyrites hamadae Mironova. This fauna has endemic elements.

From the Gorny Altai Barskaya (1963) has described Squameofavorites, Pachycalculites, Heliolites pachycamalculicoides, and Favorites in association with the halytid Hexismia. She refers the deposits to the Upper Ludlovian, which, it seems, means Tiverian as now defined; so possibly Hexismia lasted into the Tiverian here, and may thus be the youngest halytid.

In the Salair the Sukhaya suite lies between the Ludlovian Potapov suite and the Tom-Chumysh beds which are regarded by all who have worked on them as Tiverian. The corals of the Sukhaya suite that have been described by Zhelononogova (1961), Chernyshev (1951), Mironova (1960), Dyubo and Mironova (1961) are the cerioid Altajia? indistincta Zhelt. (a homeomorph of Lithostroton with a columnella formed from a thin extension of the cardinal septum), Dubrovia (a solitary ptenophyllid? possibly of the Spongophylloidea perfectus Wedekind group), Storophyllum, Squameofavorites including S. fungites (Sok.), Thaumopora khalimni Dubatolov, Stratitopora parietica Mironova, Cialopora bella Mironova, Hillaeopora spica Mironova, Heliolites, and Syringopora selmundii var. This suite is commonly referred to the Tiverian; perhaps it is Skalian.

The Tom-Chumysh (ostracod) beds (= Tomskozovod suite) have a brachiopod fauna regarded as equivalent to that of the Lochkov of Czechoslovakia and the Tiverian of Podolia. Its Rugosa have been described by Bulvanker (1958), Zhelononogova (1961) and its Tabulata by many; Peetz (1901); Chernyshev (1951); Mironova (1960, 1961a), Dyubo and Mironova (1961); Dubatolov (1959, 1963); Dubatolov and Chekhovich (1964), and Chudnova (1959, 1964).

Its rugosan fauna comprises Phaulacis cyathophylloides Ryder of Bulvanker, and ‘Pilophyllum’ insolitum Zhelt. (both probably cyathophyllids like Radiophyllum), Pilophyllum angustum Zhelt. (possibly ptenophyllid), and Dubrovia also possibly ptenophyllid, the spongophyllid Spongophyllum shearsbyi? Chapman, cerioid Neopennina rosiformis Zhelt. and tryplasmids, solitary and fasciculate. Of the Tabulata, Squameofavorites has the most numerous species, but species of Dictyofavorites (the first), Favorites, Pachycalculites, Stratitopora, Parastratitopora, Thaumopora, Heliolites, Pachycalamcula, and Syringopora are also characteristic. Dubatolov (1959) listed, as Multi- solenia, Squameofavorites mirabilis var. baskiakamensis Chern. (1951). This may represent the youngest occurrence of Multi-solenia. With these beds are correlated the Lochtei limestones of the Altai (Dubatolov 1962; Dubatolov and Chekhovich 1964) with Favorites kogulaensis (which is Lower Ludlov in Estonia), Squameofavorites, and Parastratitopora.

Siberian Platform

On the Siberian platform upper Silurian deposits are confined to the north-west flank of the Tungus syncline and the south flank of the Anabar antecline. Parastratitopora

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and Favosites ex gr. coreaniformis occur (Sokolov and Tesakov 1963, Nikiforova and Obut 1965) and may be Ludlovian.

North-eastern U.S.S.R.

In the Verkhoyan-Chukotsk geosyncline of north-eastern U.S.S.R. Ivanovskiy (1965b) refers to Ludlovian Lamprophyllum from the R. Kolyma. The Tiverian? Nelyudum suit in the Omulev Mountains in the basins of the R. Kolyma and R. Tirekhty-a has abundant Favosites socialis Sokolov and Tesakov (1963) and new species of Favosites. Nikiforova and Obut (1965) refer to Tiverian beds with Favosites ex gr. coreaniformis Sok. and Squamosfavosites in the basins of the Rivers Omulev and Taskar, and beds with F. aff. coreaniformis, Favosites, and Dictyofavosites in the Sette-Daban Range. F. socialis occurs also in the Tiverian of the R. Pechora and the northern Urals. Earlier descriptions are by Chernysheva (1936, 1941b), Rukhin (1938b), and Nikolaeva (1936).

Faunal Analysis and Palaeozoogeography

Sokolov, Kovalyevskiy, and Chekhovich (in Nikiforova and Obut 1965) state that the Ludlovian and Tiverian tabulatian faunas of the U.S.S.R. might be considered as forming one zoogeographic province and that regional differences are most likely due to facies. A similar opinion regarding the rugosan faunas is held by Kaf’o (1965), who considered that in the pre-Ludlovian Silurian, two provinces were distinguishable, the European–central Asiatic, and the Siberian–American and that the degree of faunistic difference gradually decreased. Kaf’o’s map of the Wenlockian seas of the U.S.S.R. showing his suggested migration routes of the Rugosa is given in text-fig. 1.

Analysing the foregoing, we may say that the Ludlovian is characterized by genera with few exceptions (e.g. Weissmerella) relict from the Wenlockian, and consists nearly everywhere mainly of the Rugosa Phaularcis, Entolophyllum, Weissmerella, Pilophyllum, Spongophylloides of the perfectus (Wdke.) group which are morphologically close to Acanthophyllum, numerous solitary and pachyderm tryplostems, Cryptophyllum, Holmophyllum, and Rhizophyllum, with the Tabulata Favosites, Palaeofavosites, Multisolenia, Parastroiocerata, Alveolites, Coenites, Theca, Laceripora (the last?), Heliolites, Propora, Halyrites (the last), Anulopora, and Syringopora and Romingerella (the first). In the Tien Shan Squamosfavosites is recorded in an early occurrence, and in the Alai-Sayan, Hillaepora. Halyrites are not recorded from younger strata, except for Hexisnita sp. from the ‘Upper Ludlow’ (i.e., presumably Tiverian) of the Mountainous Altai, Sokolov (1962) concluded that for the wider correlation of Ludlovian (s.s.) deposits, of leading significance are Favosites ex gr. forbesi, Theca swinderiana, Mesolena festivus, and Helioplasmolites amongst others.

A small fauna distinguished in some regions and following this one includes, like the Skalian, ‘Dokophyllum’, Spongophylloides, Acanthophyllum, solitary and fasciculate tryplostems, species referred to Holmophyllum but some probably not of that genus, and Cryptophyllum, Phaularcis and Weissmerella are recorded but not illustrated. Favosites is predominant but rare Squamosfavosites occur and Thamnopora with rare Multisolenia (the last?). Thecostegites enters in beds that may be Skalian in the Polar and Sub-polar Urals, with the Rugosan Spongophyllum Strel’nikov. This fauna is not very different from that of the Ludlovian, with the possible exception that Thecostegites and Thamno-pora (s.s.) have entered.
Nikiforova and Obut (1965) consider that in the early Ludlow regression of the seas began, reaching its maximum in Tiverian time; when, however, migration was still possible from Podolia via the Urals and South Caucasus to Central Asia. Their map is redrawn in text-fig. 2.

**TEXT-FIG. 1.** Directions of migration and geographical distribution of Wenlockian Rugosa.


I, Probaltic; II, Podolia; HI, Tadjikistan; IV, Urals; V, Sayano-Altai; VI, Siberian platform; VII, NE. U.S.S.R. After Ka'io, 1965.

Tiverian faunas are sometimes divisible into two, but these taken together comprise *Neobrachyelasma* Nik., *Palaeocystites* Foerste (= *Orthopasirophyllum* Nik.), 'Diplophyllum' (a disphylid?), *Spongopilooides* of the *perfectus* Wdkd, group, 'Faceliphyllum' and numerous solitary tryplasmids and cystiphyllids, with *Favosites*, *Pachyfavosites* (the first?), *Squareofavosites*, *Dictyofavosites* (the first), *Multisolenia* (the last?), *Cladopora*, *Hillaepora*, *Thamnopena*, *Sriatopora*, *Parastrietopora*, *Heliolites*, *Propora*, *Pseudoplasmopora*, *Squareolites*, *Syringopora*, and *Thecostegites*. 
The boundary between the Silurian and Devonian seems to me to be possibly best taken at the base of the Tiverian and the base of the Lochkovian and the base of the Gedinnian, all of which appear in the continuing results of the Prague and Bonn symposia to represent practically the same point in time, which may well be part of Ludlow Bone Bed time, or perhaps the base of the Downtonian.

TEXT-FIG. 2. Tiverian Geography of Eurasia.

A, Palaeo-Baltic Sea; B, South European Sea; D, Ural Sea with volcanoes; E, Tien Shan Sea; F, Tadzhik Sea; G, Balkhash–Karaganda Sea; H, Altai Sea; I, Sayan Gulf; J, Tuva–Mongolian remnant basin; K, Novozemel Sea; L, Tungus Sea; M, Amur remnant basin; N, Verkhoyan Sea. Dotted area unknown or not analysed. Contouring of land is indicated by closeness of lining and mouths of rivers are shown. After Nikiforova and Obut, 1965.

The value of the Tabulata as indicators of the boundary between Silurian and Devonian has been argued by Mironova (1961b) on the one hand and by Dubatolov and Chekhovich (1964) on the other. Thus Dubatolov and Chekhovich consider that a sharper palaeontological boundary may be fixed in the Kuznetsk Basin, in Central Asia, and in Podolia at the top of the Tiverian and the base of the Krekov by the complete disappearance above this boundary of the genera _Palaeofavosites_, _Mesofavosites_, _Syringolites_, and _Propora_ and by the appearance above it of _Pseudoroemertia_, _Roemeripora_, _Dendropora_, _Crasialveolites_, _Placocoenites_, and _Lecempiatia_. Mironova noted that
the extinction of the halyssids and the multisolenids and the incoming force of
Pachyfavosites, Dictyfavosites, Squamefavosites, and Thecostegites gave a sharpness
to the base of the Tiverian; however, rare exceptions occur, as noted above.

Both boundaries appear to have value in correlations within Eurasia, and may well be
applicable elsewhere, regardless of where it is finally decided to draw the Silurian-
Devonian boundary.

It should be noted that the only ptenophyllids figured from Tiverian strata are solitary
corals referable to the Spongophranoides perfectus (Wd.) group of species which was
present in the Ludlovian (and which may be Acanthophyllum s.l.) and the fasciculate
‘Fasciphyllum’ kokshalicum Pavlova. There is a notable absence of Xystrophyllum and
Tatinyrophyllum as also of disphyllids (solitary, fasciculate, ceroidi, and thanaestraeoid)
and of Pseudamplexus altaicus (Dybowskii).

It seems that the ‘Upper Ludlovian’ or ‘Tiverian’ of Asiatic Russia is broadly equi-
ivalent to the Lochkovian but the base and top of the faunal interval have still to be deter-
mined in the different regions. The equivalence of the Asiatic Tiverian with the stratotype
Tiverian in Podolia is not yet certain either. If the Czortkow fishes are lower Gedinnian,
as Tarlo thinks, the type Tiverian may be older than much of the Asiatic ‘Tiverian’.

POST-TIVERIAN AND PRE-COUVINIAN

These are the faunas thought by this reviewer to be equivalent to the Pragian and
Zhlovian of Czechoslovakia and to the upper Siegenian and Emsian of western Europe.
None are described from Podolia.

Novaya Zemlya

A Lower Devonian assemblage from the horizon of the Morzhov Inlet has recently
been described, the Rugsosa by Kravtsov (1965) and the Tabulata by Smirnova (1965b).
It consists of Pseudamplexus altaicus (Dyb.), Acanthophyllum, Spongophyllum [?]
(solitary? or phaceloid), Tryphinema, Storrophyllum [?] and Plasmodophyllum (Plasmo-
phyllum) (as Cylisiphyllodes, Nardopothyllum, and Pseudomicroplasma); and of Favosites,
Squamefavosites, Dictyfavosites, Syringolites (?), Pachyfavosites, Striatopora, Than-
opora, Caliopora, Alveolites, Ateoliapora, and Syringopora.

Ural

Soshkina (1937, 1941, 1949 a, b, 1951, 1952), Spasskiy (1959), and Pavlova (1956)
have described Lower Devonian Rugsosa from the eastern and western slopes of the
Ural and Porfir’ev (1937), Sokolov (1952b), and Yanet (1956, 1965) have described Tabu-
lata. Chernyshev (1885, 1887, 1893) included descriptions of corals in his faunal papers.
Some of the ages assigned in the early works have been modified in the later papers.

Correlation of the widely spread strata is still in progress and at present it does not
seem that they can be precisely apportioned to the west European stages. The faunal
lists of Spasskiy (1964) and Dubatolov (1966) have presumably taken account of in-
creasing stratigraphic knowledge along the Urals, but unfortunately they do not enable
me to refer precisely to the relevant illustrations of species. Spasskiy (1959) states that the
following species have maximum distribution in the lower part of his post-Tiverian
Lower Devonian of the eastern slopes (upper part of the Petropavlovka formation):
Pseudamplexus quadripartiutus (Soshk.), ‘Acanthophyllum heterophyllum E. & H.’ and Fasciphyllum petschorense Soshk. These he called Gedinnian. The ‘Coblenzian’ beds with Karpinskyia conjugula contain Pseudamplexus (solitary and weakly colonial species), Chlanydophyllum tabulatum (Soshk.), cerioid Favisella minor (Soshk.) and F. massivum, Lyrielasma petschorense (Soshk.) (these last two species at the top), Neophyta origiellata and N. striata S., Acanthophyllum, Australophyllum? (as F. petschorense pars.), Xystrophyllum medium (S.), Talmynophyllum, Spongophyllum halystoides, Tryplasma, Plasmo-
phylum (Plasmocephalum) as Pseudomicroplasma and large Rhizophyllum occur; also Favosites, Squamosefavosites, Parastriatopora, the Cleistopora-like Rhipaeolites Yanet 1956, and Syringopora.

Central Asia

In the ranges of Turkestian, Gissar, Fergana, Alay, Nuratau, Kokschaaltau, and in the Pamir and Darwas, the post-Tierian Lower Devonian Akkul suite contains numerous Pseudamplexus including P. altaicu"S Dyb.) and Acanthophyllum, together with Chlanyd-
ophyllum tabulatum (Soshk.), Neophyta striata Soshk., Loylophylum, Spongophyllum halystoides Eth., fasciculate Tryplasma (as Aphyllum), Rhizophyllum enorne, and Plasmo-
phylum (Plasmocephalum) (as Pseudomicroplasma). See Goryanov et al. (1961) and Spassky (1964). From the Dzhidalin suite of the Lower Devonian of S. Fergana Pavlova (1963, 1965) included in Fasciphyllum two cerioid species that could be Xystrophyllum and from the Akkul suite Xystrophyllum prismaticum (Soshk.) (see also Goryanov, 1962, 1963).

Dubatolov (1964) and Dubatolov and Chekhovich (1964) listed tabulatan species determined by Chekhovich but not yet illustrated from the Manak suite of Central Asia as of the genera Favosites, Oculipora, Dictyofavosites, Squamosefavosites, Pachy-
avosites, Parasatriatopora, Striatapora, Cladopora, Pseudoremeria Chekhovich (1900), Heliplasma, and Heliolites.

Leleshus (1964b) has described from Lower Devonian ‘Coblenzian’ beds with Karpinskyia conjugula from the northern slopes of the Zaravshan Range, the new tabulatan genus Rudakites, like Thamnopora but with intermural increase. Listed with it are Favosites, Squamosefavosites, Dictyofavosites, Emmonia, Pleurodictyum, Striatapora, and Crassidavolites and the Rugosa Pseudamplexus, Lyrielasma petschorense (Soshk.), Spongophyllum halystoides Eth., Tryplasma, and Rhizophyllum enorne Eth.

Goryanov (1963) considers that in the Southern Tien Shan the Lower Devonian fauna is not divisible into zones but is analogous to the Pragian of Czechoslovakia. He lists Chlanydophyllum tabulatum (Soshk.), Luidstromia spp., Petraia spp., Syringaxion spp., Barrandophyllum, Oligophyllum, Orthoperaophyllum [= Palaeoophyllum], Pseudamplexus [as Mucoophyllum] and P. altaicus, Kionelsasma spp., Kodonophyllum spp. Desmophyllum, ‘Entiophyllum’, Pilophyllum, Acanthophyllum spp., Ptenophyllum spp., Spongophyllum halystoides Etheridge, Loylophylum cresswelli Chapman, Fasciphyllum halliforme, Lyrielasma [petschorense (Soshk.), Xystrophyllum prismaticum (Soshk.), Apiphynum, Tabularia, Tryplasma, cystiphylloids (under the names Pseudomicroplasma, Wedekin-
dophyllum, and Pseudogoniophyllum), and Rhizophyllum enorne Eth.

Kazakhstan

Spassky (1965) described from rocks of the Dzgharian Alatau which he ascribed to the Gedinnian but which may be Pragian, the new genus Neokypophyllum [resembling
Pilophyllum] and listed Orthopaterophyllum [= Palaeeocycathus], Trystplasma devonianum (Soshk.), Tabularia, Favosites, and Helicosites. As Coblenzian he listed Barrandeophyllum, Orthopaterophyllum, Chlamydophyllum, Pseudamplexus, and Acanthophyllum. From the northern sub-Baikal he listed (1964) *Xystriphyllum devonianum* (Bulv.), Sokolov (1962b) reported that Tabulata here and in some districts of Central Asia and parts of the Mongolo-Oktotsk geosyncline are rare and usually represented by *Pleurodictyum* and rare *Thamnospora* and *Trachypora*.

**Altai-Sayan Geosynclinal Region**

For this coral-rich region, the coral faunal sequences of the south-western margins of the Kuz Basin and the northern Salair may be taken herein as the standard of reference; the stratigraphic sequences in other parts of the region differ, but some suggested correlations are mentioned.

As seen above, the Tom-Chumysh beds are, by correlation with the *Monograptus hercynicus*-bearing marginalis beds of the Kunzhak suite of the Zeravshan Range, to be regarded as Lochkovian (i.e. within the range Gediminian to base of early Upper Siegenian). Above them lie the Krekov beds.

The rugosan fauna of the Krekov beds has been described by Kraevskaya (1955a), Bulvankov (1958), Ivanaya (1957a, b; 1958a, b, c, d; 1960, 1961), and Zheltonogova and Ivanaya (1961) and consists of *Syringaxon, Petrozium?*, *Pseudamplexus alticus* (Dyb.) *Pseudotryphyma Ivanaya* (like *P. alticus* but with sporadic large dissepsiens), *Dendrosteilla columnaris* Zhelt. (as Soshkinev), *Tryplasma sociale* (Soshk.), *Plasmodophyllum* (*Plasmodophyllum*) [as *Pseudopilinosus* and *Diplolchone*], *Rhizophyllum gyrile* Bayle, and R. *enorme* Eth. See also Ivanaya (1965).

Tabulata of the Krekov beds have been described by Peetz (1901), Cherskhech (1951), Iraevskaya (1955a), Chudinova (1959, 1964), Dubatolov (1956, 1959, 1963, 1964), Dubatolov and Mironova (1961a, b, c), Dubatolov and Chekhovich (1964), Dubatolov and Smirnova (1964), and Mironova (1957, 1961a, b, c), and discussed by Khalifina (1956). *Favosites, Dictyofavosites, Squameofavosites, rare Pachyfavosites, Syringolites?* (last appearance?), *Parastratiopora, Thamnospora, Striatopora, Gacilopora* (first appearance), *Cladopora, Dendropora, Crassialveolites* (first appearance), *Coenites, Placocoeites, Lecanoplia, Stelliporella, Heliolites, Pachybiaculida* (first appearance), *Syringopora, and Roeneripora* (first appearance) all occur. The first three genera named above are dominant.

The Malobachat beds with *Karpinskia congugula* Tschernychev overlying the Krekov beds have Rugosa described mainly by Kraevskaya (1955a) and by Zheltonogova and Ivanaya (1961): *Syringaxon, Pseudamplexus alticus* (Dyb.), the solitary disphyllid *Gurievskia Zhelt., Neephyma, Acanthophyllum* (as *Pseudochonophyllum*), *Lyricelasma, Xystriphyllum gorskit* (Bulv.), *Taimyrphyma*, and *Tryplasma*. Tabulata, described in the same works as those of the Krekov beds are *Favosites, Pachyfavosites, Striatopora, Cladopora, Acevolites, Helicosites, and Syringopora* and for the most part the species are different from those of the Krekov beds. Bulvankov (1958) referred to the rugosan genus *Loyolophyllum*, a species (*brissietapata*) of the tabulata *Roeneripora*. The transverse section she figured shows mural pores. Kraevskaya (1955a) referred to the undifferentiated Lower Devonian two ceroiid small-celled *Spongophyllum* spp. See Ivanaya (1965).

Similar tabulata faunas to those of the Krekov and Malobachat beds have been
described from the Mountainous Altai (Cherepnina and Dzyubo 1962, Dubatolov 1964).

Taimyr

Lower Devonian Rugosa and Tabulata of the Taimyr have been described by Chernyshev (1944a), Lower Devonian Rugosa by Kravtsov (1963) and Lower Devonian Tabulata by Dubatolov and Smirnova (1964) and Smirnova (1965a). Lists of species have been given by Spasskiy (1964), Dubatolov (1964), Smirnova (1965a, c), and Kravtsov and Smirnova (1965).

The lowest of three post-Tiverian Lower Devonian coral faunas contains Squameofavosites, Parastratiopora, and Striatopora. The second has Pseudamplexus alatius (Dyb.), Tryplasma devonianum (Soshk.), Plasmophyllum (Plasmyllum) [as Pseudomicroplasma and Zonophyllum spp.], Tabularia [?], Zmeinogorska [= Heteroplentis?], Audacephylhum [?], Taimyrpophylhum speciosum Chernyshev and presumably also Disophyllum? planivisculus (Chern.) together with Favositas kolymensis Chern. and F. spp., Squameofavosites, Parastratiopora, Striatopora, Caliopora, Pleurodictyum?, and Syringopora. The highest has Tryplasma devonianum (Soshk.), Plasmophyllum (Plasmyllum) [as Pseudozonophyllum] and Xystrophyllum taimyricum (Kravtsov), with Squameofavosites, Thamnophora taimyrica (Chern.), and Atveolitella (first appearance).

Transbaikalia and the Mongolo–Okhotsk (Amur) Geosyncline

In the Upper Amur, the Bolshenever suite is considered Lower Devonian, possibly later Lower Devonian. Spasskiy (1960b) described Barrandeeophyllum perplexum Pokta and Lindstroemia minima; Dubatolov (1964) listed Favositas and Pleurodictyum. The younger Imachin suite, possibly ranging from the late Lower into the Middle Devonian (Dubatolov 1964) or possibly entirely Eifelian (Spasskiy 1960b, 1964), contains ‘Zaphenritis’, Plasmophyllum (Plasmyllum) [as Pseudomicroplasma and Lythophyllum] and Cyathophyllum (Peripædium) spinulosum (Soshk.). This latter species seems from Spasskiy’s figures to differ from Soshkina’s type and to be a cyathophyllid quite close to Radiophyllum arborescens Hill from the Emsian? Mt. Etna limestone of Queensland. Tabulata are Favositas, Squameofavosites, Crenulipora, Thamnophora, and Tyrgonolites —this last genus normally being an indicator of Middle Devonian.


North-eastern U.S.S.R.

From the upper part of the Upper Silurian of the R. Kolyma, Rukhin (1938b) has established Kozłowiophyllum which Ivanovskiy (1965b) has considered a synonym of Tenuiphyllum Soshkina and regarded as Wenlockian. From the Lower Devonian, Rukhin described Entrophyllolites inequalis (Hall) which is possibly the same genus as Xystrophyllum. Bulvanker (1965) figured from the undivided Lower Devonian of the
Ormulev region *Acanthophyllum mansfieldense* (Dun), *Taimyrophyllum colymense* Bulv., *Pseudalpamplexus altaicus* (Dyb.), and *Plasmodiphyllum* (*Plasmodiphyllum*) aff. *nesteroewskii* (Pez). From beds regarded as transitional from Lower Devonian to Eifelian she figured *Acanthophyllum* spp., *Taimyrophyllum carinatum* Bulv., and *P. altaicus*. Other descriptions are by Bulvanker (1948). Spasskiy (1964) listed *Tryplasma maximum* (Chern.) additionally in a similar fauna from the Yerkhoyan.

Tabulata have been described by Chernysheva (1935), Rukhin (1939), and Dubatolov and Spasskiy (1964) and Dubatolov (1964) has supplied lists of Lower Devonian forms. The distinctive feature of the north-east Siberian fauna is the presence of *Favosites socialis* Sok, and Tes. and of great numbers of local species of *Parastriatopora*, *Striatopora*, *Cladopora*, *Aлеволиела* and *Caliopora*, the endemic *Yecutipora* (like *Parastriatopora* but with trabecular wall thickening in the peripheral part of the branch, and long narrow pore canals with diaphragms), and the absence of heliolitids. *Dictyofavosites* and *Squameofavosites* occur also in the Sette-Daban and Yakhkhet regions.

Faunal Analysis and Palaeozoogeography

Reviewing the above, we see that the Altai-Sayan faunas are the best illustrated and further that in the Salair there is a proved sequence of faunas from that of the Tom-Chumysh beds, through the Krekov beds and into the Malobachat beds. If we accept the correlation of the Tom-Chumysh beds with the Kunzhak beds of the Zeravshan Range in the Tien Shan, as indeed seems completely reasonable, we then have the probability that the Tom-Chumysh beds are Upper Lochkovian, since *Monograptus hercynicus*, Paramoicinia geinitziana Bouček and *P. obtus* Bouček are reported from the Kunzhak beds, though I have found no illustrations to substantiate the identifications. The Krekov beds may then well be Pragian, within the range Upper Siegenian-Lower Emsian and the Malobachat beds may possibly be either Lower Emsian or Zichovian. Such correlations can be only very tentative at present.

The Krekov fauna as listed above, is very similar to the Pragian upper Konieprus fauna of Czechoslovakia, differing mainly in the absence of ptenophyllids, but ptenophyllids are found in force accompanying *Pseidualpamplexus altaicus* and tryplasmids, *Rhiziphyllum enormes* and *Roemeripora* in the overlying Malobachat beds, where *Pseidualpamplexus*, phaeoloid *Neophyllum*, ceroid *Xystrophyllum*, and thamnastreacoid *Taimyrophyllum* occur (Zheltonogova and Ivaniya 1961), together with *Spongiphyllum balyhostoïdes* Eth., and the solitary disphylid *Gariolovskii* Zhelt. We are left wondering whether the absence of ptenophyllids and disphylids in the Krekov beds and their presence in the overlying Malobachat beds is due solely to the difference in age.

The Krekov plus Malobachat beds and their correlatives in Asia are clearly distinguished from the underlying Tiverian by an assemblage of the Rugosa *Pseudalpamplexus* (especially *altaicus*), *Gariolovskii*, *Lyofoiphyllum*, *Neophyllum*, *Acanthophyllum* (s.l.), *Lyrielasma*, *Xystrophyllum*, *Taimyrophyllum*, *Spongiphyllum*, *Tryplasma*, *Plasmodiphyllum* (*Plasmodiphyllum*) and *Rhiziphyllum*, together with the Tabulata *Favosites*, *Dictyofavosites*, *Squameofavosites*, *Pachyfavosites*, *Thamnopora*, *Gareclipora*, and *Roemeripora*. The genera marked † are not known in older beds in Asia.

The chief character of the tabulatan fauna is the exceptionally wide and rich development of the squamate favositids *Squameofavosites* and *Dictyofavosites*, many of the species having profuse mural pores; also notable is the wall thickening of the branching
favositids *Parastriatopora* and *Striatopora*; the *Thamnpora* and *Cladopora* species have relatively thin walls, and the heliolitids show some thickening of the walls of their interstitial tubuli; at the same time the alveolitids differ from Silurian representatives in the thickening of their walls.

Dubatolov’s (1964) and Spasskiy’s (1964) maps, here reproduced as text-figs. 3 and 4, show their views on the zoogeographic provinces of the Lower and Middle Devonian. Spasskiy’s map showing also the reefs and his deduction on the position of the equator.

**Text-fig. 3.** Palaeozoogeographic provinces in the Early and Middle Devonian, based mainly on the Tabulata.


In my view, however, the distribution of the reefs can be equally well explained by climatic and temperature difference induced by the Devonian relation of continents and oceans, with the continental nuclei in their present position relative to the poles and to the present direction of the axis of rotation of the earth.

The Uralo-Tien Shan Province including Novaya Zemlya and the Taimyr with *Pseudamplexus, Chlamydophyllum, Tryplasma, Acanthophyllum*, and *Favositites* dominant, and with *Striatopora* and *Cladopora* present is considered continuous with that of Western Europe via Asia Minor and the Mediterranean region. The Altai-Sayan Province is characterized by *Tryplasma, Acanthophyllum*, and in the younger beds by ptenophyllids, and by the dominance of *Squameofavositites, Dictyofavositites*, and *Plicatomurites*, and the presence of *Cladopora, Placocoenites*, and *Lecomptia*. The Dzhungarian-Balkash province has, as known at present, only small solitary non-
disseminated Rugosa (due to facies?); the Tabulata, though also poorly known, suggest to Dubatolov (1964) sharp regional differentiation. The Mongolo–Okhotsk province appears characterized by the absence of Tryptasma, Acanthophyllum, Stratopora, Thamnopora, Cladopora, Alveolites, and Heliolites, and the presence of distinctive species of Pleurodictyum, Favositites, and Squameofavositites. The Indigiro–Kolyma Province shares a rugosan complex with the Taimyr region—Taimyrophyllum speciosum and Tryptasma maximum being characteristic; its tabulatan fauna is distinct, characterized by an abundance of branching Favositites ex gr. socialis and the endemic Yacutipora.

COUVINIAN

Russian formations and faunal horizons referred to the 'Eifelian' have been so referred by general faunal correlation. According to Sokolov (1962d) the common usage of 'Eifelian' in the U.S.S.R. includes the Eifelian proper and the cultijugatus beds, and is thus presumably equivalent to the Couvinian of Belgian geologists. They lie below Stringocephalus-bearing beds referred to the Givetian, contain Conichedella in the greater, upper part and, in some regions, Pararapitifer in the lower part and lie above beds
bearing Karpinskia conjuga which have been generally referred to the Coblenzian, but which in her review of Devonian correlations Rzhonsnitskaya (1962) has called Lower Emsian and Upper Pragian.

In the same review Rzhonsnitskaya has referred the Paraspirifer beds (= zone of Favorites regularissimus of the eastern slopes of the Urals and the Salaîkin beds of the Kuznetsk sequence) to the Zechovian which she accepted as Upper Emsian but regarded as equal to the Assise de Bure of Belgium and considered Middle Devonian pre-Eifelian. However, in most current Russian work the east Uralian zone of F. regularissimus and the Salaîkin beds are called Lower Eifelian.

Unfortunately the Russian zonal brachiopods do not occur in Western Europe, but detailed work on brachiopod groups such as the Atrypida, as well as on the goniatites, conodonts, tentaculites, and corals now in progress must eventually give precise correlations both within the U.S.S.R. and with the standard sequences of Western Europe. In the meantime we must regard the Salaîkin beds and their correlates as possibly Upper Emsian or possibly Lower Couvinian.

Novaya Zemlya, Vaygach Island, and Pay-Khoy

Spasskiy (1964) and Dubatolov (1964) listed from the 'early Eifelian' of this northern region Barrandeophyllum, Pseudamplexus, Chlamydropyllum (as Zelophyllia), Loyophyllum, Neocolumnaria vavranica Soshk., Spongophyllum kalyzoides Eth., Acanthophyllum, Neomphyma striata Soshk., Fasciphylum morientale Soshk., Xystrophyllumuralicum (Soshk.), Tryplasma and Plasmodocyllum (Plasmodocyllum) [as Pseudocrocopla], and the Tabulata Favorites regularissimus and Pachyfavorites.

From the later Eifelian Spasskiy (1964) listed Zelophyllia, Cyathophyllum (Peripaeulum) spirosum (Soshk.), 'Campophyllum' soporenum Schlüter, 'Charactophyllum' antiquum Soshkina, Faviocella floriformis (Soshk.), Neomphyma striata, Tryplasma, Plasmodocyllum (Plasmodocyllum) [as Lythophyllum, Zonophyllum, Pseudozonophyllum], P. (Mesophyllum) [as Diagonophyllum] and Calcisula. Dubatolov (1964) listed Favorites ex gr. goldfussi d'Orb. and Syringopora eifelienst Schlüter. Descriptive papers are scanty (Chernyshev 1937a, 1938a, b).

Urals

The 'Eifelian' of the western slopes of the Urals, earlier taken to comprise the Takatin, Vanyashkin, and Vyazov beds and their correlates has been augmented by the overlying Calcisula and Biya beds which were removed from the Givetian by resolution of a conference held in Sverdlovsk in 1957 (Spasskiy 1960a). Similarly the 'Eifelian' of the eastern slopes has been augmented (Spasskiy 1959; Khodalevich et al. 1959) by the highest of the beds with Conchidiella bashkirica (D. 2a and D. 2b of Andronov) previously considered Givetian; Stringocoelphalus curtii had been reported from them but this record was doubted by Khodalevich et al. (1959). Also some of the sequences considered Lower Devonian or older by Soshkina are considered Eifelian by Spasskiy (1960b).

The correlation of the eastern sections one with another and of the western sections one with another and of the eastern with the western (including the type localities of Soshkina's species Zelophyllia tabulata, Tryplasma magnum, Astrophyllum turgidens, Neomphyma striata, and Fasciphylum petchoirensis) is still under discussion, the main
point at issue being how much of the sequence on either side should be regarded as lower and how much upper ‘Eifelian’. Spasskiy (1955, 1959, 1960a, 1964) treated as lower Eifelian on the western slopes, the Takatín, Vanyashkin, and Vyzov beds and on the eastern slopes, the horizons D1 a–e of Andronov; he considered the Yaiva Band, the *Calcicola* Beds, and the Biya beds of the western slopes as Upper Eifelian as also the Bogoslovsky bauxite horizon and overlying conchiferous limestone of the eastern slopes. Yanet (in Khodalevich et al. 1959) zoned the Eifelian of the eastern slopes into a lower zone of *F. regularissimus* and an upper *Conchidiella* zone; but this division does not necessarily coincide with Spasskiy’s.

Khodalevich et al. (1959) considered the *F. regularissimus* zone to correlate with the Salairkin beds of the Kuznetsk sequences and the *Conchidiella* zone with the Shandin beds of that sequence.

Using Spasskiy’s early and late Eifelian for the Rugosa, and for the Tabulata of the western slopes, and Dubatolov’s (1964) division (following Yanet in Khodalevich 1959) for the eastern slopes, it is possible to distinguish an early Couvinian from a late Couvinian fauna. Both are clearly distinct from the ‘Coblenzian’ fauna and both contain many species in common, but there are a few generic and more specific differences. Taking the Rugosa first:

Continuing into the early Middle Devonian (*sensu* Spasskiy) from the ‘Coblenzian’ are *Pseudamplexus, Chlamydophyllum tabulatum* (Sosik.), *Favistella, Dentrostella, Lioyolophyllum, Fasciphyllum, Acanthophyllum, Neophyina striata* Sosik., *Lyrilasma petchoresene* (Sosik.), *Xystrophyllum, Spongophyllum halysitoides* Eich., *Tryplasma* and *Plasrnophyllum* (*Plasmophyllum*). Newly appearing in the early Middle Devonian (*sensu* Spasskiy) are *Pseudopetraea, Barradophyllum, Nalikzwella, Keriphyllum astrei-ifornis* (Sosik.), *Peneckitella poroflovi* Spasskiy, *Trapezophyllum brevisepatum* (Yoh), *Megaphyllum jurenanum* (Sosik.), *Charactophyllum antiguum* Sosikina, *Neoconularia, Stringophyllum, Plasmophyllum (Mesophyllum)*, and *Calcicola* (with thickened tabellae). This represents a very considerable enrichment of the late Lower Devonian fauna from which *Rhzophyllum* has nearly everywhere disappeared. In the late Eifelian occur the following genera not listed earlier from the Urals: *Cystophyllum* (*Peripodium* *spinulosum* (Sosik.), *Thaunophyllum, Plasmophyllum* (*Plasmophyllum*) [as *Pseudopetraea, Pseudomicroptasma*, and *Lihyphyllum*], *P. (Mesophyllum)* [as *Arcephyllum, Uralophyllum*, and *Glosophonium*], *’Cystophyllum’ soeteicum* Schützer and *Calcicola* (without tabellae). A large number of species is common to both lower and upper parts of the Eifelian; however, *Pseudamplexus* is not reported from the Upper Eifelian of the Urals. From the undifferentiated Eifelian of the eastern slopes, Vaganova (in Khodalevich et al. 1959) figured solitary disphyllids (as *Tabulophyllum* and *Tortophyllum*), the phaceloid disphyllids *Paradisophyllum zingipek* (Vaganova), *P. caespitosum* (Vag.), and the ceroid ‘*Hexagonaria’ massiva* (Vag.). The Rugosa have been described by Bulvanker (1934), Sosikina (1936, 1937, 1941, 1949a, b, 1951, 1952), Markov (1941), Spasskiy (1955, 1959), and Pavlova (1965). Earlier papers on Devonian corals from the Urals are by Bogatyrev (1899), Chernyshev (1885, 1887, 1893), and Lebedev (1902).

The tabulata fauna described by Yanet in Khodalevich (1959) from the Lower Eifelian *Favartites regularissimus* zone of the eastern slopes comprised *Favartites*, *Facil-favartites, Squameoflavartites, Thamnopora, Cladopora, Alveolites, Caliapora, Heliolites*, and *Syringopora*. Their stratigraphic significance was discussed by Yanet (1960). Tabulata
described by Sokolov (1952b) from the Vyazov beds of the western slopes are species of Pachyfavositess, Crassialveolites, and Caliapora. For the Calceola and Biya beds of the western slopes Sokolov has described (1952b) or recorded (1962f) species of Favositess including F. goldfussii, Pachyfavositess, Emmonsia, Oculipora, Thammopora, Stratopora, Cladopora, Coralites, Alveolites, Crassialveolites, Caliapora, Coenites, Natalophyllum, and Syringopora (usually large). Yanet described from the Upper Eifelian Conchidiella zone of the eastern slopes species of the genera Calceolites, Favositess, Pachyfavositess, Emmonsia, Thammopora, Cladopora, Alveolites, Alveolitiella, Crassialveolites, Caliapora, Heliolites, and Syringopora.

Russian Platform

Ermakova (1960, 1964, 1965) described from bore-cores from the south-eastern part of the platform species of several of the rugosan and tabulatian genera listed for the Calceola and Biya beds above and in addition the new phaeole-ceroid rugosan genus Brevisceptophyllum.

Armenia

Soshkin (1952) figured Macgeea machsoni (Penecke), Cyathophyllum (Pteropodium) spinulosum (Soshk.), Fasciphylloids orientale Soshk., Acanthophyllum (as Pseudochonophyllum), Plasmophyllum (as Lythophyllum) from Armenian beds that she referred to the Eifelian. Ultinina (1963) has described Plasmophyllum species (as Nardophyllum) from the Rivers Arpa and Araks. In his Eifelian list Spasskiy (1964) included Peneckiella bashkirtica (Spasskiy). Chudinova is working on the Tabulata of the Eifelian Volchevorot beds, including Favositess goldfussii, Thammopora, Alveolitiella, and Heliolites. Frech (in Frech and Arthaber 1900) described other corals some of which may have been Eifelian.

Central Asia

From the Eifelian mainly reef limestones of this region in Fergana, Tadzhikistan, the Pamir, and Darwas, Spasskiy (1964) listed †Lindstroemia, Pseudepetraia, Barrandeophyllum, *Oligophyllum, *Tabulophyllum rotundum Spasskiy, *Calceola, †Pseudamplexus, Chlamydophyllum [as Zelophyllum] *Zoeinogorskia sagasaki Spasskiy, Tryplasma devonianum, Plasmophyllum (Plasmophyllum), Acanthophyllum, *Campophyllum sotenicum Schluter, *Helophyllum bali, *Favistella symbiotica, *F. vulgaris (Soshk.), Spongophyllum halystoides, *Xystrichophyllum altum (Soshk.), X. *devonianum (Bulv.), Grypoophyllum striatum (Soshk.), †Loyolophyllum, ceroid and phaeolecoid Fasciphylloids, and Neocolliumaria. Of these the ones marked * are from the upper parts only and those marked † from the lower parts only. Dubatolov (1964) listed from the Eifelian tabulatian fauna, which like the rugosan fauna is largely undescribed, Favositess, †Pachyfavositess, Oculipora, †Scasanefavositess, *Caliapora and Heliolites.

Goryanov (1963), working in S. Fergana, distinguished three rugosan assemblage zones; from the first two, the Acanthophyllum–Plasmophyllum zone and the Cohunaria–Fasciphylloids zone of the lower and middle parts of the Katan suite and which he regarded as correlative with the Takatin Vanyashkan and Vyazov beds of the Urals and the Salairin beds of the margin of the Kuzbas, he listed but has not figured Chlamydophyllum tabulatum (Soshk.), Petraia, Syringaxon, Barrandeophyllum, Helophyllum.
spongiosum Schlüter, ‘H’, cf. antiquum (Soshk.), Loyalophyllum cresswelli, Neocolonaria vagranensis (Soshk.), Acanthophyllum, Neomphya striata (Soshk.), Fasciphyllum halliforme, F. orientale, and F. conglomeratum Schlüter, Xystrophyllum spp. (as Stenophyllum), and no Plasmophyllum.

From the Stenophyllum–Zonephyllum zone which he correlated with the Calceola and Biya beds of the western Urals, and the Shandin beds of the Salair, he listed Nativkinella, Barrandeophyllum, Macophyllum biseptatum (Soshk.), Gryposphyllum, Xystrophyllum, Fasciphyllum, Colanaria, ‘Campophyllum’ societens, ‘Helophyllum spongiosum (Schlüter)’, ‘H’ antiquum (Soshk.) and Plasmophyllum (Plasmophyllum) [as Zonephyllum], and P. (Mesophyllum) [as Digonophyllum].

Kazakhstan

Spasskii (1965) described from rocks considered Eifelian in the Dzhunganian Altai, the new genus Multicarinophyllum, ‘Bethaniphyllum’ maximum Spasskii, and Spongophyllum genunatum Spasskii and listed Barrandeophyllum, Orthopaturityphyllum, Ridderea, Acanthophyllum, Stringophyllum and Plasmophyllum (Mesophyllum) [as Digonophyllum], and Favosites, Thamnophora, and Tyrganolites. His 1964 list included Edelastrea grandis (Dun) (= Taimorphyllum). From the northern sub-Balkash Dubatolov (1964) listed the undescribed late Eifelian tabulatan fauna as species of Squameofavosites, Thamnophora, Cladophora, Coenites, Placocoeoites, Tyrganolites, Steilliporella, and Syringographea and Spasskii (1964) listed Thamnophyllum, Campophyllum maximum Spasskii, Helophyllum halli E. & H., and Cyathophyllum (Peripædium) spinulosus (Soshk.). I have seen no figures of this interesting fauna, which presumably is late Eifelian. Shkarov (1963b) has described the middle Devonian Tabulata of the Tarbagatay Range.

Altai–Sayan Geosynclinal Region

The Salairiski beds with Paraspirifer guberskensis were considered Zicjovian by Rzhonsnitskaya (1962) and Upper Emsian; but she included these occurrences in the Middle Devonian with the Assis de Bure of the Ardennes, which she regarded as older than the Eifelian. Dubatolov (1964) lists the Salairiski beds as early Eifelian.

Rugosa of the standard sections have been described by Peetz (1901), Bulvanker (1908), Kraevskaya (1955), and Zheleznogova and Ivaniya (1961) and comprise Thamnophyllum, Dishyllum, Loyolophyllum, Acanthophyllum, Xystrophyllum maximum (Bulv.), X. submassivum (Bulv., with culmella), X. devonicum (Bulv.) and X. gorskii (Bulv.), ‘Gryposphyllum’ gracile (Soshk.), Spongophyllum [or? Australophyllum], Plasmophyllum (Plasmophyllum) (as Pseudomicroplasma). The species referred to lowaphyllum in Zheleznogova and Ivaniya (1961) seems rather to be Endophyllum—possibly the earliest of that genus. See also Ivaniya (1965).

Spasskii (1960 c, d) described some Rugosa from the southern Altai and neighbouring regions, including a small fauna from the lower part of the Lower Kultabari suite which may be Lower Devonian, but possibly is as young as the Salairiski faunas of the Salair. Tabulata from the Salairiski beds have been described by Peetz (1901), Chernyshov (1951), Chudinova (1959, 1964), Dubatolov (1956 a, b, c, 1959, 1962, 1963, 1964), Dubatolov and Mironova (1961 a, b, c), Dubatolov and Chekhovich (1964), and Dubatolov and Smirnova (1964). They comprise Favosites regularissimus Yanet and other species of Favosites, rare Squameofavosites, Pachyfavosites polymorphus (Goldfuss),
Gephyropora, Striatopora, Gracilopora, Thamnopora, Cladopora, Placeococcites, Egosciella, Lecomptia, Alveolites, Coeolites, Calliapora, Grabaudites, Armalites, Syringopora, Roomerolites (also named as Lovolophyllum breviseptatum Bulv.), and Roomerolites. Many of the favositid species are unknown earlier. Khafzin (1961) considered it possible that the lower part of the Salairkin beds may represent the upper Emsian.

The Shandin beds of the South-west Kuz basin and North Salair standard sections are generally accepted as Eifelian, and most Russian authors consider them equivalent to part of the Upper Couviñian (Co). The Rugosa of the standard Salair sections have been described by Peetz (1901), Chernyshev (1930), Bulvanker (1958, 1963), Ivanina (1957a, 1958b, 1960, 1961), Zheltovogova and Ivanina (1961), and those of neighboring regions by Spasskiy (1960c, d), Bulvanker in Rzonsonitskaya et al. (1952), Bulvanker in Rzonsonitskaya and Meleschenko 1955. They comprise species of Barrandeophyllum, Thamnopophyllum, Eríophyllum [? astiatum Ivan.], Dendrostella, Lobolophyllum, Sinospargophyllum major (Bulv.), Aemaphyllum, Xystriphyllum spp. [as Stenophyllum], fasciculate Fasciphyllum hollifornc Sosh., Tainymophyllum carinatum Bulv. [? = Aphroditophyllum Lenz, 1961], Calceola, Plasmophyllum (Plasmoophyllum) and P. (Mesophyllum). Lists are given by Spasskiy (1964). See Ivanina (1965).

The Tabulata of the standard South-west Kuz Basin margin and Salair sections of the Shandin beds have been described by Chernyshev (1951), Dubatolov (1959, 1963, 1964), Chudinova (1959, 1964) and Dubatolov and Mironova (1961a, b, c) and comprise Favosites gollflussi d’Orb., Pachyfavosites polymorphus (Goldfuss), and species of Squamoceratites, Enunseria, Fonticchvia, Pleurodictyum, Striatopora, Thamnopora, Cladopora, Alveolites, Crassialveolites, Calliapora, Placeoccites, Egosciella, Tyrogonites, Armalites, Notalophyllum, Syringopora, Helolites, Pachycanalicula, Chaetetes, and Cyclobothaeites.

In addition, Kraevskaya (1955a) described from the undivided Eifelian (i.e. Salairkin plus Shandin beds), Pseudospargophyllum massivum Kraevskaya [? = Xystriphyllum], and ‘Pseudochonophyllum’.

Eifelian Tabulata of neighbouring regions have been described from the Mountainous, Southern, and Rudny Altai by Dubatolov and Mironova (1961a, b, c), Dubatolov (1952, 1953, 1955, 1962), and Chudinova (1955, 1959) and from Mongolia and Tuva by Chernyshev (1937b). Chudinova (1965) has discussed their palaeoecology. Tyrogonioites and Thecostegites are included in the descriptions from the Leshkin beds of the Rudny Altai and Adetopora is found in the Tashtyp beds of the Minusinsk trough. Eifelian Rugosa of neighboring regions have been described from the Mountainous, Southern, Rudny, and Mongolian Altai by Spasskiy (1960c, d, 1965), Bulvanker et al. (1960), Besprozvannykh (1964), Bulvanker in Rzonsonitskaya et al. (1952), and Bulvanker in Rzonsonitskaya and Meleschenko (1955). The faunas are in general similar to those of the Shandin or Mamontov beds or both, but Minusiella occurs in the Tashtyp Formation of the Minusinsk trough (considered equivalent to the Shandin beds); Sinospargophyllum (as Tabulophyllum rotundum) and Tainymophyllum occur in the Leshkin beds, Riederia in the Kryukov and Sokolin beds, Austropleophyllum (as Spongophyllum kurgaeense) in the Rakitin beds, all three formations being regarded as Lower Eifelian. Stringophyllum is recorded by Besprozvannykh (1964) from the Eifelian Ust’-Kamen beds. Rhizophyllum mongolicum Spasskiy with ‘Heliophyllum antiquum’ (Sosh.) occurs in the Mountainous Altai in beds considered equivalent in age to the Shandin
beds and *Zmeinogorskia* makes an early appearance at the same horizon but not in the same locality (Spasski, 1960c).

The Mamontov beds of the standard South-west Kuz-North Salair sections have been regarded as late Eifelian by Dubatolov (1959) and Zheltonogova and Ivanova (1961), and by Bulvanker (1958) as *Dendrostella, Fasciphyllum* [*?] kaznetskiense Ivanova, *Grypophyllum gracie* (Wdkd.), *Xystrophyllum* spp., *Stringophyllum* (Sociophyllum) *sp.*, *Plasmophyllum* (Plasmophyllum). See also Ivanova (1965).

The Tabulata of the Mamontov beds are Favosites, *Squareofovasites, Pachyfavosites, Thannopora, Chadopora, Alveolites, Alveolitella, Crassialveolites, Placooenites, Tyrgano- lites, Heliolites, Thecostegites, and Chaetetes* (Cherenshevy 1951; Dubatolov 1959, 1963; Dubatolov and Mironova 1961a; and Chudinova 1959, 1964). Dubatolov considered that *Squareofovasites*, not known elsewhere above Eifelian equivalents, indicates that the Mamontov beds are Eifelian.

**Taimyr**

From the Middle Devonian of the Taimyr Spasskiy (1964) listed *Campophyllum* *soetienum* Schluter, *Favistella quadrisepata* Soshk., *Acanthophyllum, Neophy- ma striata* (Soshk.), *Xystrophyllum* [as Stenophyllum], *Fasciphyllum* cl. orientale (Soshk.), *Diplochone, Plasmophyllum* [as *Pseudozonophyllum*], and *Plasmophyllum* (Mesophyllum) [as *Digonophyllum*]. Those marked *are* considered late Eifelian. Dubatolov and Smirnova (1964) listed *Favosites regularissimus* Yanet, *Pachyfavosites, Squareofo- vosites, Pleuridictyum*, *Alveolites, Crassialveolites*, and *Syringopora*. Smirnova (1965b) described new species.

**North-eastern U.S.S.R.**

Bulvanker (1965) figured from strata in the Ormulev regions referred to the Eifelian.

*Campophyllum* *soetienum* Schluter, *Aulacocephillum* [*?] Minusiliella solida Bulv. [Hexagonaria quadrigemina group], *Grypophyllum, Plasmophyllum versiforme* (Markov), and *P. latum* (Soshk.); Spasskiy (1964) added *Taimyrophyllum* and *Pseudoalcius alcius* to the list.

The Eifelian Tabulata of the Tas-Khayakhtakh, Sette-Daban, and Ormulev Mt. regions (Dubatolov 1964) form a unit, though different families predominate in the Ormulev Mts. The genera are: *Favosites, Pachyfavosites, Squareofovasites, Thannopora, Chadopora, Alveolites, Crassialveolites, Alveolitella, Calaipora, Coenites, Placo- coenites, Heliolites, and Syringopora.*

**Faunal Analysis and Palaeozoogeography**

The early Couvinian fauna (of the Salairkin beds and their equivalents) is less sharply distinguished from that of the late Lower Devonian than the latter was from the Tivervian; its most important rugosoan genera are *Barrandophyllum, Pseudomalvis, Chlamydo- phyllum, Loyolophyllum, Favistella, Acanthophyllum, Neophyllum, Fasciphyllum,.*
Xystrophyllum, and Spongyphyllum, all these being known in the late Lower Devonian. But rare Neocolonaria, Keriophyllites, Trapezophyllum, 'Charactrophyllum' antiquum, Stringophyllum, and Calciphyllum appear. The tabulatana fauna is characterized by the rapid development and dominance of thick-walled Thanophyllum and Cladopora which begin to displace the favositids, by the wide distribution of thick-walled favositids (Pachyfavositites, Ocelipora, Gephyropora) that were still sparse earlier (Yanet 1965), by the reduction in importance of Squamoserifavositites and Favositites, by the wider distribution of thick-walled alveolitids, and by the occurrence in many regions of Favositites regularis-sinus.

Zoogeographical provinces of the early Covinian are the same as those of the later Lower Devonian, but the Uralo–Tien Shan province shows great uniformity and the Altai–Sayan province is rather distinct, differing in the large number of Xystrophyllum spp. and the absence of Pseudamplexus.

The late Covinian faunas (Shandin and Mamontov) began to luxuriate with wide transgressions of the sea, and in Asia both Rugosa and Tabulata reached their Devonian acme with a remarkable number of genera, species, and individuals. The most characteristic rugosas genera are Ridderia, Ophiophyllum, 'Camphophyllum' soetenticum, Heltophyllum including 'H'. antiquum (Soshkina), Cyathophyllum (Peripadiwm), Thanophyllum, Macgeea, Neocolonaria, Favistella, 'Grypophyllum', Fasciphyllum, Xystrophyllum, 'Tabulophyllum', Plasophyllum (Plasophyllum) [as Pseudomicroplasma, Lythophyllum, Nardophyllum, Zonophyllum, Pseudonemophyllum], and Plasophyllum (Mesoophyllum) [as Arthyllum, Digonophyllum], and Calcita.

Of the Tabulata, thanmporids, alveolitids, and coenites showed remarkable development; Thanophyllum and Cladopora dominate and with them may occur Siriatopora and Fonticharia; strong development of wall thickening, of septal elements, and of mural pores characterize the first two. Alveolitids continued to develop thickening of their skeletal elements. Coenites and Coenites reached their acme and the appearance of Placocentrites, Tyrocanites, and Natalyphyllum is typical for this time. The favositids have waned, Pachyfavositites is less numerous, Squamoserifavositites, Gephyropora, and Placocentrites have become extinct before the Givetian.

The earlier zoogeographic provinces became less distinct; by the late Covinian the Uralo–Tien Shan and the Altai–Sayan provinces had become one, to which also the Caucasus and Western Europe belonged, or at least were in communication. The Mongolo–Okhotsk and Indigo–Kolyma provinces and the Taimyr region also showed immense similarity to the Altai–Sayan region of this common province, with easier diffusion of species. Nevertheless, there were still some provincial differences, such as the occurrence of Minussiella in the Minussinsk–Tuva region.

Within the limits of the U.S.S.R., the Givetian faunas are found in smaller areas than the late Eifelian fauna, and are less rich in genera and species.

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Addendum


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