IUGS · SUBCOMMISSION ON CRETACEOUS STRATIGRAPHY
IUGS · SUBCOMMISSION ON JURASSIC STRATIGRAPHY

WORKING GROUP ON THE JURASSIC-CRETACEOUS BOUNDARY

Chairman J. Remane
Université de Neuchâtel, Institut de Géologie, 11, rue Emile-Argand, CH-2000 Neuchâtel 7, Switzerland

Secretary V. A. Zakharov
Siberian Branch of the USSR Academy of Sciences, Institute of Geology and Geophysics, Novosibirsk, USSR 630090

Neuchâtel, 27th Mai 1987

NEWSLETTER 8

Dear Colleagues,

The main objetive of this newsletter is to distribute the text on boreal ammonite zones written by R. CASEY, M. MESEZHNIKOV and N. SHULGINA. Some minor changes concerning the presentation might perhaps have been desirable from a perfectionist point of view but, as the whole is an excellent piece of work, I did not want to delay its distribution any longer. Many thanks to the authors for this compilation which will certainly prove to be very useful for all of us !

I hope that this will reanimate discussion within on a Working Group which has not been very vivid during the last months. May I also reiterate my proposal that each of us distributes copies of his papers relevant to the problem of the Jurassic-Cretaceous boundary to other members of the Working Group ? To a certain extent, the chairman could distribute photocopies - in any case of titles with abstracts.

I take this opportunity to recall the International Symposium on Jurassic Stratigraphy, to be held from Sept. 12-21 (excursions included) at Lisbon.

The day of 18.09.87 is reserved for meetings of working groups and I plan to gather the members of our Working Group who participate in the Symposium. More detailed information will be given as soon as possible, but please look also for our meeting in the programme of the Symposium.

Yours sincerely

Prof. J. Remane

AMMONITE ZONES OF THE JURASSIC/CRETACEOUS BOUNDARY DEPOSITS IN THE BOREAL REALM

R. Casey, M.S. Mesezhnikov and N.I. Shulgina

1. INTRODUCTION

The establishment of a system boundary such as the Jurassic/Cretaceous boundary is essentially a problem of defining a stratigraphic level traceable for very long distances - ideally across the face of the globe. Assuming that such a stratigraphic level is the plane of contact between two successive zones, then international zonal correlation becomes a prerequisite for the establishment of a system boundary. Aside from historical problems, it is well known that an obstacle to the recognition of an agreed boundary between the Jurassic and Cretaceous systems is the sharp differentiation of the Boreal and Tethyan faunas. This has always ruled out direct correlation of sections in northern and southern Eurasia and has necessitad the use of parallel stage names (Tithonian and Berriasian in the south, Volgian and Ryazanian in the north). Furthermore, within the vast areas occupied by the Boreal and Tethyan realms respectively there are many distinctive ammonite assemblages, which has led to the need for parallel provincial zonations. During recent years such zonations have been proposed and specified for England (Casey, 1973; Wimbledon and Cope 1978), for the Volga and Oka river basins (Mikhailov, 1966; Gerasimov and Mikhailov, 1984a), for the eastern slope of the Polar Urals (Golbert et al.,1972; Mesezhnikov et al., 1983; Mesezhnikov, 1984b), for northern Siberia (Saks et al.,1969, 1972; Shulgina, 1967, 1984; Alekseev, 1984). Similar schemes have been proposed for the separate basins of Southern Europe. Correlation must therefore proceed step by step, from province to province, from realm to realm.

This paper gives a review and correlation of zonal units in the various provinces of the Boreal realm.

2. Oka and Volga River basins (Fig. 1)

2.1. Epivirgatites nikitini zone (Lahusen, 1888)
Index species : Epivirgatites nikitini (Michalsky, 1890)
Type section : right bank of the Volga River near Kashpir village (southern outskirts of the town of Syzran').
Typical ammonites : Epivirgatites, Lomonosovella, Paracraspedites, Laugeites.
Boundaries : the lower boundary is drawn on the appearance of Epivirgatites and Paracraspedites. The upper boundary is established on the appearance of Paracraspedites.
Stratigraphy : ammonite distribution suggests a division into tow subzones.

2.1.1. Lomonosovella Blakei subzone (Pavlov, 1898) is characterized by rare E. nikitini (Mich.) and relatively abundant Lomonosovella, Paracraspedites, Epivirgatites lahuseni (Nik.), E. (?) bicpliciformis (Nik.) Laugeites stschurovski (Nik.).

2.1.2. Epivirgatites nikitini subzone (Lahusen, 1888) yields abundant E. nikitini (Mich.) and fairly rare Lomonosovella.

Geographic distribution: environs of Moscow, the Oka River basin, middle reach of the Volga, the Pechora Riber basin.

2.2. Paracraspedites oppressus Zone (see 5.1)

2.3. Kachpurites fulgens Zone (Nikitin, 1888)

Index-species: Kachpurites fulgens (Trautschold, 1860).

Lectostratotype: Lopatin phosphorite pits (Gerasimov, Mikhailov, 1966).

Hypostratotype: right side of the Volga River near the village of Kashpir village.

Typical ammonites: Craspedites fragilis (Trd.), C. okensis (d'Orb.), Garniericeras catenulatum (Fisch.), Kachpurites fulgens (Trd.), K. subfulgens (Nik.).

Boundaries: the zone embraces is equal to full range of Kachpurites.

Distribution: environs of Moscow, the Oka River basin, the upper and middle Volga, Pechora Rivers, Novaya Zemlya, the eastern slope of the Polar Urals, south-western West Siberia.

2.4. Craspedites subditus Zone (Nikitin, 1888)

Index-species: Craspedites subditus (Trautschold, 1877).

Lectostratotype: Lopatin phosphorite quarries (Gerasimov, Mikhailov, 1966).

Hypostratotype: right bank of the Volga near the village of Keshpir village.

Typical ammonites: Craspedites subditus (Trd.), C. okensis (d'Orb.), Garniericeras catenulatum (Fisch.).

Boundaries: the zone corresponds to a full range of index-species.

Distribution: environs of Moscow, the Oka River basin, the upper and middle the Volga, the Pechora Rivers, Novaya Zemlya, the eastern slope of the Polar Urals.

2.5. Craspedites nodiger Zone (Pavlov, 1887)

Index species: Craspedites nodiger (Eichwald, 1865).

Lectostratotype: Lopatin phosphorite quarries (Gerasimov, Mikhailov, 1966).

Hypostratotype: right bank of the Volga River near the village of Kashpir village.

Typical ammonites: Craspedites nodiger (Eichw.), C. kaschpuricus (Trd.), C. parakaschpuricus Geras., C. mosquensis Geras., C. milkovensis (Strem.), Garniericeras subclypeiforme (Milasch.)

Boundaries: the zone corresponds to a full range of C. nodiger and similar species.

Stratigraphy: P.A. Gerasimov (1969) has subdivided the zone into two subzones.

2.5.1. Craspedites mosquensis subzone.

2.5.2. Craspedites nodiger subzone. Subzones are distinguished by occurrence of C. mosquensis (Gerasimov, 1960) in the lower one.

Distribution: environs of Moscow, the Oka River basin, the upper and middle reaches of the Volga River, ? the Pechora River basin.

2.6. Riasanites rjasanensis and Garniericeras subclypeiforme (Mesezhnikov, 1984)

Index species: Riasanites rjasanensis (Nikitin, 1888), Garniericeras subclypeiforme (Milaschevic, 1881).

Type section: right bank of the Oka River; exposure at the village of Kuzminskoye.

Typical ammonites: Riasanites spp., Garniericeras subclypeiforme (Milasch.), Craspedites ex gr. kaschpuricus (Trd.).

Boundaries: the lower boundary is established by the appearance of Riasanites and Euthymiceras and the upper boundary is drawn by the disappearance of Garniericeras.

Distribution: environs of Ryazan'.

2.7. Riasanites rjasanensis and Hectoroceras kochi Zone (Casey, Mesezhnikov, Shulgina 1977, the name was specified by Mesezhnikov, 1984)

Index-species: Riasanites rjasanensis (Nikitin, 1888), Hectoroceras kochi Spath, 1947.

Type section: right bank of the Oka River: exposure at the village of Kostino.

Typical ammonites: Riasanites, Euthymiceras, Hectoroceras kochi Spath, Shulginites, Craspedites ex gr. kaschpuricus (Trd.).

Boundaries: the lower and upper boundaries are established on the appearance and disappearance of Hectoroceras.

Distribution: environs of Ryazan'.

2.8. Riasanites rjasanensis and Surites spasskensis Zone (Gerasimov, 1971)

Index-species: Riasanites rjasanensis (Nikitin, 1888), Surites spasskensis. (Nikitin, 1888)

Type section: right bank of the Oka River; exposure at the village of Chevkino.

Typical ammonites: Riasanites, Euthymiceras, Externiceras, Borealites, Surites, Peregrinoceras.

Boundaries: the lower boundary is established on the disappearance of Hectoroceras and Craspedites and the upper boundary is defined by the disappearance of Riasanites, Euthymiceras.

Stratigraphy: as mentioned above, (Casey et al., 1977, Mesezhnikov et al., 1979) the zone includes three horizons, viz., the lower horizon with Riasanites, Euthymiceras and Externiceras; the middle horizon, apart from the mentioned above, contains Surites and the upper horizon Peregrinoceras yields.

Distribution: the Oka River basin, the middle reaches of the Volga River, ? the Kaspian Sea area, ? Mangyshlak.

2.9. Surites tzikwinianus Zone (Gerasimov, 1971)

Index-species: Surites tzikwinianus (Bogoslowsky, 1897).

Type section: right bank of the Oka River, exposure at the village of Chevkino.

Typical ammonites: Surites tzikwinianus (Bog.), S. kozakowianus (Bog.), Peregrinoceras.

Boundaries: the lower boundary is established on the appearance of Surites tzikwinianus, and the upper boundary is established on the disappearance of Surites and Peregrinoceras.

Stratigraphy: the S. tzikwinianus Zone is subdivided into two horizons, viz., the lower horizon is known near the town of Ryazan' and from Kashpir and yields Surites tzikwinianus (Bog.), S. subtzikwinianus (Bog.), S. kosakowianus (Bog.) and Peregrinoceras of the pressulum (Bog.) group; the upper horizon was recognized in Kashpir and contains diverse species of Peregrinoceras, including P. albidum Casey.

Distribution: the Oka River basin, middle reaches of the Volga River.

2.10. Pseudogarnieria undulato-plicatilis Zone (Sazonov, 1953)

Index-species: Pseudogarnieria undulato-plicatilis Stchirowsky, 1894.

Type section: The Middle Volga area the Sura River basin, exposure on the right bank of the Meni River (north of the village of Pekhorki).

Typical ammonites: Pseudogarnieria, Proleopolidia, Stchirowskiceras, Menjaites.

Boundaries: the lower boundary is established on the disappearance of Surites and Peregrinoceras; the upper boundary is established on the appearance of polyptychitids.

Distribution: the Sura River basin, the Oka River basin below Old Ryazan'.

3. Eastern slope of the Polar Urals

3.1. Laugeites groenlandicus Zone (Mesezhnikov, 1963)

Index-species: Laugeites groenlandicus (Spath, 1936).

Type section: exposures and bore pits on the right bank of the Yatria River, 1500 m below the mouth of the Lyulia River.

Typical ammonites: Laugeites, rare Taimyrosphinctes.

Boundaries: the lower boundary is established on the appearance of Laugeites groenlandicus (Spath), L. borealis Mesezhn., L. biplicatus Mesezhn.; the upper boundary is marked by the disapperance of Laugeites groenlandicus (Spath) and the appearance of Epilaugeites.

Distribution: East Greenland, Franz Joseph Land, the eastern slope of the Polar Urals, West Siberia, northern and northeastern Taimyr and the lower Lena River.

3.2. Epilaugeites vogulicus (Ilovaisky, 1917)

Index-species: Epilaugeites vogulicus (Ilovaisky, 1917).

Type section: exposures and bore pits on the right bank of the Yatria River, 1500 m below the mouth of the Lyulia River.

Typical ammonites: Epilaugeites, Laugeites, Taimyrosphinctes.

Boundaries: the zone corresponds of a full range of the index species.

Distribution: East Greenland, the eastern slope of the Polar Urals, West Siberia, ? Central Taimyr.

3.3. Kachpurites fulgens ZOne (see 2.3)

3.4. Craspedites subditus Zone (see 2.4)

3.5. Craspedites taimyrensis Zone (see 4.3)

3.6. Subcraspedites maurynjensis and Volgidiscus pulcher beds (Mesezhnikov, Braduchan, 1982)

Typical ammonites: Shulginites, Subcraspedites s.s., Volgidiscus.

Boundaries: the lower boundary has been established. The upper boundary is established on the appearance of Praetollia and Praesurites.

Distribution: eastern slope of the Polar Urals.

3.7. Chetaites sibiricus Zone (see 4.5)

Remarks: Like the Khatanga River basin (Alekseev, 1984), beds with Chetaites, Praetollia, Praesurites and Shulginites (the Praetollia maynci subzone) and beds dominated by Chetaites sibiricus (the Chetaites sibiricus subzone) were recognized in the Polar Urals.

3.8. Hectoroceras kochi Zone (see 4.6)

Remarks: In the Polar Urals the Hectoroceras kochi Zone is subdivided into two parts, viz., Hectoroceras and Shulginites are abundant in the lower part while Hectoroceras and Borealites are known from the upper part (Mesezhnikov, Braduchan, 1982).

3.9. Surites analogus Zone (see 4.8)

3.10. Bojarkia mesezhnikovi Zone (see 4.8)

3.11. Neotollia klimovskiensis Zone (see 4.9)

4. North Siberia (Fig. 3)

4.1. Epivirgatites variabilis Zone (Shulgina, 1967)

Index-species: Epivirgatites variabilis Shulgina, 1969.

Type section: exposure at the Pravaya Boyarka River (the Khatanga River basin).

Typical ammonites: Epivirgatites variabilis Shulg., Virgatosphinctes, Laugeites.

Boundaries: the zone corresponds to the full range of index-species.

Distribution: the Khatanga River basin, coast off the Anaber Bay (Paksa peninsula).

4.2. Craspedites okensis Zone (Saks, Shulgina et al.,1963)

Index-species: Craspedites okensis (d'Orbigny, 1845).

Type section: exposure on the left bank of the Kheta River, 4 km below from the Gavrilin Ulov (the Khatanga River basin).

Typical ammonites: Craspedites okensis (d'Orb.), C. originalis (Shulg.), Subcraspedites arcticus (Shulg.), Virgatosphinctes.

Boundaries: the lower boundary is established on the mass occurrence of Virgatosphinctes and the upper boundary is established by the disappearance of Craspedites okensis and C. originalis.

Stratigraphy: the zone subdivided into three subzones (Shulgina, 1967).

4.2.1. The recognition of the Virgatosphinctes exoticus subzone is based on the absolute predominance of representatives of the genus Virgatosphinctes.

4.2.2. Craspedites okensis subzone which is recognized on occurrence of Virgatosphinctes in association with abundant

Craspedites spp.

4.2.3. The Craspedites originalis subzone is recognized on the occurrence of C. originalis and Subcraspedites arcticus.

Distribution: ? East Greenland, Spitzbergen, West Siberia, the Yenisei-Anabar interfluve.

4.3. Craspedites taimyrensis Zone (Bodylevsky 1956, zonal boundaries were specified by Saks V.N. and Shulgina N.I 1963)

Index-species: Craspedites taimyrensis (Bodylevsky, 1956).

Type section: the left bank of the Kheta River above the mouth of Bukatyi Creek (the Khatanga River basin).

Typical ammonites: Craspedites taimyrensis (Bodyl.), C. laevigatus (Bodyl.), C. ex gr. nodiger (Eichw.), Garniericeras margaritae Schulg., Virgatosphinctes.

Boundaries: the lower boundary is established on apperance of Craspedites taimyrensis. The upper boundary is established on the appearance of Chetaites chetae and disappearance of Craspedites taimyrensis.

Distribution: the eastern slope of the Polar Urals, West Siberia, Yenisei-Anabar interfluve.

4.4. Chetaites chetae Zone (Saks, Shulgina, 1963)

Index-species: Chetaites chetae Shulgina, 1962.

Type section: left bank of the Kheta River above the mouth of the Bukatyi Creek (the Kahatnga River basin).

Typical ammonites: Chetaites chetae Schulg., Craspedites, Garniericeras margaritae Schulg., Virgatosphinctes.

Boundaries: the zone corresponds to a full range of index-species.

Distribution: ? Eastern Greenland, the Khatanga River basin

4.5. Chetaites sibiricus Zone (Saks, Shulgina, 1962)

Index-species: Chetaites sibiricus Schulgina, 1962.

Type section: left bank of the Kheta River, below the mouth of the Bukatyi Creek (the Khatanga River basin).

Typical ammonites: Chetaites sibiricus Schulg., Praetollia.

Boundaries: the lower boundary is established on the appearance of Chetaites sibiricus and Praetollia. The upper boundary is based on the appearance of Hectoroceras kochi.

Stratigraphy: the zone is subdivided into two subzones (Alekseev, 1984).

4.5.1. Praetollia maynci subzone contains Chetaites sibiricus and abundant Praetollia.

4.5.2. The Chetaites sibiricus subzone yields rare Praetollia and an index-species.

Distribution: East Greenland, Spitzbergen, the Pechora River basin, the eastern slope of the Polar Urals, West Siberia, the Khatanga River basin.

4.6. Hectoroceras kochi Zone (Saks, Shulgina, 1962)

Index species: Hectoroceras kochi Spath, 1947.

Type section: the left bank of the Levaya Boyarka River, 0.5 km above the mouth.

Hypostratotype: the Kheta River, above the mouth of the Bukatyi Creek (the Khatanga River basin).

Typical ammonites: Hectoroceras, Ronkinites, Pseudocraspedites, Borealites, Surites spasskensis (Nik.).

Boundaries: the zone corresponds to a full range of Hectoroceras kochi.

Stratigraphy: The zone is subdivided into subzones (Alekseev, 1984).

4.6.1. The Hectoroceras kochi subzone is contains Hectoroceras and Chetaites sibiricus.

4.6.2. The Borealites constans subzone is characterized by the appearance of Borealites, Surites, Pseudocraspedites and occurrences of Surites furcatus Aleks., Borealites constans Aleks. only within this subzone.

4.6.3. The Surites praeanalogus subzone yields Hectoroceras, Pseudocraspedites, Borealites.

Distribution: East England, East Greenland, the Oka River basin, the Pechora River basin, the eastern slope of the Polar Polar Urals, West Siberia, the Khatanga River basin, the lower Anabar River, the lower Lena River.

4.7. Surites analogus Zone (Saks and Shulgina, 1962)

Index-species: Surites analogus (Bogoslowsky, 1897).

Type section: the right bank of the Boyarka River, just below the confluence of the Right and Left Boyarka Rivers.

Typical ammonites: Surites analogus (Bogosl.), S. subanalogus Schulg., Ronkinites, Pseudocraspedites.

Boundaries: the lower boundary is established on the disappearance of Hectoroceras and Borealites. The upper boundary is drawn by the disappearance of Surites.

Stratigraphy: the zone is subdivided into two subzones (Alekseev, 1984).

4.7.1. The Surites subqudratus subzone contains Surites praeanalogus Aleks., S. subquadratus Aleks., S. subanalogus Schulg., Ronkinites, Pseudocraspedites.

4.7.2. The Surites analogus subzone contains S. analogus (Bogosl.), S. subanalogus Schulg.

Distribution: the Khatanga River basin, the lower Lena River, West Siberia, the eastern slope of the Polar Urals, the Pechora River basin.

4.8. Bojarkia mesezhnikovi Zone (Saks, Shulgina, 1969)

Index-species: Bojarkia mesezhnikovi Schulgina, 1969.

Type section: right bank of the Boyarka River, 1 km below the confluence of the Left and Right Boyarka Rivers.

Typical ammonites: Bojarkia, Tollia, Virgatoptychites.

Boundaries: the lower boundary is established on the disappearance of Surites and the upper boundary is drawn by the appearance of Neotollia.

Stratigraphy: according to data of S.N. Alekseev (1984) the mesezhnikovi Zone can be subdivided into the Bojarkia (lower part) and the Tollia (upper part) beds.

Distribution: the Khatanga River basin, West Siberia, the eastern slope of the Polar Urals, North Norway.

4.9. Neotollia klimovskiensis (Saks and Shulgina,1969)

Index species: Neotollia klimovskiensis (Krimholz).

Type section: the Khatanga River basin, the left bank of the Boyarka River, 2 km 300m below the confluence of the Left and Right Boyarka Rivers.

Typical ammonites: Neotollia, Tollia, Virgatoptychites, rare Temnoptychites.

Boundaries: the lower boundary is established on the disappearance of Bojarkia and the upper boundary is drawn by the appearance of polyptychitides.

Distribution: the Yenisei-Lena interfluve, the Pechora River basin, the eastern slope of the Polar Urals, Western states of the USA, ? East Greenland, ? Norway.

5. Eastern England

5.1. Paracraspedites oppressus Zone (Casey,1973)

Type section: East England, Lincolnshire (the Spilsby sandstone).

Typical ammonites: Paracraspedites oppressus Casey, P. stemomphaloides Swinn., P. bifurcatus Swinn., Epilaugeites, Crendonites (Neopavlovia).

Distribution: eastern England - Lincolnshire, Norfolk USSR - Volga River basin.

5.2. Subcraspedites primitivus Zone (Casey, 1973)

Index-species: Subcraspedites primitivus Swinnerton, 1935.

Type section: eastern England, Lincolnshire (the Spilsby Sandstone).

Typical ammonites: Subcraspedites (Swinnertonia) primitivus Swinn., S. (S.) subundulatus Swinn., S. (S.) parundulatus Swinn.

Distribution: eastern England, Lincolnshire.

5.3. Subcraspedites preplicomphalus (Casey, 1973)

Index-species: Subcraspedites (Subcraspedites) preplicomphalus Swinnerton, 1935.

Type section: eastern England, Lincolnshire (the Spilsby Sandstone).

Typical ammonites: Subcraspedites preplicomphalus Swinn., S. sowerbyi (Spath), S. cf. claxbiensis Spath, Craspedites plicomphalus (Sow.), C. thurelli Casey.

Distribution: eastern England-Lincolnshire, Norfolk, East Greenland (James Land).

5.4. Volgidiscus lamplughi (Casey, 1973)

Index-species: Subcraspedites (Volgidiscus) lamplughi Casey, 1973.

Type section: eastern England, Lincolnshire (the Spilsby Sandstone).

Typical ammonites: Volgidiscus lamplughi Casey, V. aff. lamplughi Casey.

Distribution: eastern England - Lincolnshire, Norfolk.

5.5. Praetollia runctoni Zone (Casey, 1973)

Index-species: Runctonia runctoni Casey, 1973.

Type section: eastern England. Norfolk.

Typical ammonites: Praetollia (Runctonia) runctoni Casey.

Distribution: eastern England, Norfolk. It seems to be equivalent to the Praetollia maynci subzone of the Chetaites sibiricus Zone from North Siberia and the Praetollia maynci Zone from East Greenland (Wollaston Foreland).

5.6. Hectoroceras kochi Zone (see 4.6)

5.7. Lynnia icenii Zone (Casey, 1973)

Index-species: Surites (Lynnia) icenii Casey, 1973.

Type section: eastern England, Norfolk.

Typical ammonites: Lynnia icenii Casey, Surites (Surites) ex gr. spasskensis (Nik.), Bojarkia.

Distribution: Eastern England - Norfolk, Lincolnshire.

5.8. Surites stenomphalus Zone (Casey, 1973)

Index-species: Olcostephanus stenomphalus Pavlow, 1889.

Type section: eastern England, Lincolnshire.

Typical ammonites: Bojarkia stenomphala (Pavl.), Borealites suprasubditus Bogoslov. pavlovi Casey.

Distribution: eastern England, Lincolnshire, Norfolk. It seems to correspond to the part of the Bojarkia mesezhnikovi Zone from North Siberia and B. payeri from the Polar Urals as well as the Surites tzikwinianus Zone from the Russian Plain.

5.9. Peregrinoceras albidum Zone (Casey, 1973)

Index-species: Peregrinoceras albidum Casey, 1973.

Type section: eastern England, Norfolk.

Typical species: Peregrinoceras albidum Casey, P. rosei Casey, P. subpressulum (Bogosl.), P. wrighti (Neal), P. pseudotolli (Neal), Bojarkia sp.

Distribution: eastern England - Norfolk, Lincolnshire, Yorkshire. It seems to correspond to the Peregrinoceras aff. albidum beds from the Russian Plain (Kashpir).

5.10. Paratollia beds (Casey,1973)

Index-species: Paratollia Casey = Paratollia kemperi Casey = Tollia tolmatschowi Kemper non Pavlow.

Type section: eastern England, Norfolk.

Typical ammonites: Paratollia, Propolyptychites, Pseudogarnieria, Platylenticeras, Menjaites.

Distribution: eastern England - Norfolk, Lincolnshire, Yorkshire.

6. Correlation

As mentioned above, the successions of ammonite assemblages from North Siberia, the eastern slope of the Polar Urals, central European part of the USSR, and eastern England are the most complete and well known as concerns the Boreal Realm. The data available for other basins of the Boreal Realm and primarily for East Greenland (Surlyk et al., 1973; Callomon, Birkelund, 1982), the Pechora River basin (Mesezhnikov et al., 1976b), western and eastern Canada (Jeletzky, 1966, 1967, 1984) though not so complete can be in general compared with data obtained for these regions.

Despite a great number of zonal indices the presence of some widely distributed genera and individual ammonite species makes easier rather reliable correlation of most zonal units (Table I). The uppermost Middle Volgian of the Russian platform is characterised by Epivirgatites, Laugeites, Paracraspedites, Lomonossovella, Crendonites (Neopavlovia).

The occurrences of Epilaugeites in the Oppressus Zone of England allows its correlation with Epilaugeites vogulicus Zone

of Polar Urals, moreover, the occurrences of Paracraspedites and Crendonites (Neopavlovia) in the Gorodishche section open opportunity of correlation of this level to the Middle Volga area and, possibly, to Yaroslavl area. The Nikitini and Oppressus zones of the Volga region (and consequently Groenlandicus and Vogulicus Zones of the Urals) correspond to the Epivirgatites variabilis Zone of North Siberia, marked by the occurrence of Laugeites (Pakhsa Peninsula section) (Zakharov et al., 1983). In the central and eastern Taimyr occurrences of Laugeites and Epilaugeites are reported (Mesezhnikov, 1984; Saks, Shulgina, 1969).

The lower zone of the Upper Volgian, i.e. the Kachpurites fulgens Zone, apart from the central Russian platform was reported from the Pechora basin (Mesezhnikov et al., 1975b), Novaya Zemlya (Bodylevsky, 1967), and the eastern slope of the Polar Urals (Bodylevsky, 1944; Mesezhnikov, 1984). A wide distribution of Craspedites okensis (d'Orb.) - a typical form of the fulgens and subditus zones of the Russian platform has supplied a possible explanation for the correlation of the base of the fulgens Zone and that of the okensis Zone. Even more tentative seems the correlation of the base of the fulgens Zone and that of the primitivus Zone.

More conclusive is the establishment of the base of the nodiger Zone within the Boreal realm. The appearance of Craspedites with robust rounded umbilical tubercles, namely, C. pseudonodiger Schulg., C. taimyrensis (Bodyl.), C. ex gr. nodiger (Eichw.) and others, are assigned to this stratigraphic level in Siberia. Similar forms were reported by Casey (1973) from the preplicomphalus Zone of eastern England. This permits

the correlation of the bases of the nodiger, taimyrensis, and preplicomphalus zones. An assumption about a lower level for the base of the preplicomphalus Zone (Casey et al., 1977) owing to the occurrence of Subcraspedites (S.) arcticus (Schulg.) in the okensis Zone in the Khatanga River basin though cannot be disproofed seems quite unlikely because we know about the erosion at the preplicomphalus and primitivus zone boundary in the most complete fossiliferous sections of eastern England and hence the lower limit of the appearance of Subcraspedites s.s. in these sections might not have been established precisely.

To establish the upper boundary of the nodiger Zone is even more difficult. Casey (1973) believed that the nodiger Zone in general corresponds to the preplicomphalus Zone while he placed the lamplughi Zone above the nodiger Zone and correlated it with the chetae Zone of Siberia. However, Craspedites singularis (Schulg.) and Garniericeras margaritae Schulg. were reported from the latter (Shulgina, 1967). Hence in Siberia, Craspedites occur to the top of the Upper Volgian. Apparently there are no grounds to suggest a different stratigraphic range of Craspedites for the Middle Russian basin. This genus ingressed into the eastern England basin only in the Late Volgian (the absence of Craspedites from the primitivus Zone) and lived there for a very short time. The beds overlying the Upper Volgian deposits yield ubiquitously (except for the Russian platform basins) ammonites of the genus Praetollia (Praetollia s.s., P. Runctonia, P. (Pachypraetollia), Chetaites sibiricus Schulg. known from a higher horizon being found together with Praetollia in northern Siberia and the Urals. Both horizons form the Chetaites sibiricus Zone which is subdivided into the Praetollia

and Chetaites sibiricus s.s. subzones in the Urals and Siberia (Alekseev, 1984). In eastern England only Praetollia (Runctonia) was found in the runctoni Zone. Therefore, the runctoni Zone probably to be correlated with the maynci subzone. On the Russian platform at the base of the Ryazanian horizon there is the Riasanites rjasanensis and Garniericeras subclypeiforme Zone which cannot be compared in ammonite composition with the Chetaites sibiricus Zone and its equivalents directly.

The above lying Hectoroceras kochi Zone is the most widespread horizon of the Boreal Berriasian. This zone is subdivided into three subzones (Alekseev, 1984) in the most complete sections within the Khatanga River basin, the lower subzone is marked by the presence of Hectoroceras, and the two upper subzones contain Hectoroceras and Borealites. This holds true for the Polar Urals (Mesezhnikov, Braduchan, 1982) amd apparently for eastern England (Casey, 1973). Borealites were not found from the Riasanites rjasanensis and Hectoroceras kochi Zone in the Oka River basin this makes more probable the suggestion about the correlation of this zone with the Hectoroceras kochi s.s. subzone of the Boreal realm. However, considering the break in the section between the Riasanites rjasanensis and Hectoroceras kochi Zone and the Riasanites rjasanensis and Surites spasskensis Zone one cannot completely exclude a possibility that higher beds of the former zone have not been established as yet.

Higher horizons contain mainly ammonites of the genera Surites and Bojarkia. As mentioned, stratigraphic ranges of the genera apparently have not been identical in separate basins therefore zonal units are not easily tracable. The succession of the Surites analogus - Bojarkia mesezhnikovi zones (including the Tollia beds) holds good within eastern and western Sibe-

ria, Polar Urals and possibly in the Pechora River basin. A different succession of zonal units was found in eastern England and on the Russian platform. However, the presence of the index-species of the Peregrinoceras albidum Zone of England in the upper tzikwinianus Zone allows for a reliable correlation of the upper boundary of the tzikwinianus and albidum zones (see Table).

References

Alekseev S.N. Novye dannye o zonalnom raschlenenii berriaskogo yarusa na severe Sibiri (New data on zonal subdivision of the Berriassian in northern Siberia). In : Pogranichnye yarusy yurskoi i melovoi system. Moscow: Nauka, 1984, p. 81-106.

Bodylevsky V.I. Morskoi mel Urala (Marine Cretaceous of the Urals). - Geologia SSSR, 1944, t. 12, pt. I, p. 140-148.

Bodylevsky V.I. Yurskie i melovye fauny Novoi Zemli (Jurassic and Cretaceous faunas from Novaya Zemlya). Zap. LGI, t. III, vyp. 2, 1967, p. 99-122.

Casey R., Mesezhnikov M.S., Shulgina N.I. Sopostavlenie Pogranichnykh otlozhenii yuri i mela Anglii, Russkoi platformy, Pripolyarnogo Urala i Sibiri (Comparison of the Jurassic-Cretaceous boundary beds of England, the Russian Platform, Urals, and Siberia). Izv. AN SSR, ser. geol 1977, N 7, p.14-33.

Casey, R. and Mesezhnikov, M.S. Verkhnie gorizonty srednebolzhskogo pdyarusa i ikh Angliiskie ekvivalenty (The upper levels of the Middle Volgian substage and its English equivalents). Izv. AN SSSR ser. geol. 1986, N 10, p. 69-81).

Gerasimov P.A. Verkhnii podyarus volzhskogo yarusa tsentralnoi chasti Russkoi platformy (The Upper Volgian of the cetral Russian platform). Moscow; 1969, p. 1-143.

Gerasimov P.A. O berriase i nizhnem valanzhine Russkoi platformy (On the Berriasian and Lower Valanginian of the Russian platform). Dokl. AN SSSR, 1971, t. 198, N 5, p. 1156-1157.

Gerasimov P.A. Mikhailov N.P. Volzhskii yarus i edinaya stratigraficheskaya shkala verkhnego otdela yurskoi sistemy (The Volgian and the standard for the Upper Jurassic). Izv. AN SSSR, ser. geol., 1966, N 2, p. 118-138.

Golbert A.V., Klimova I.G., Saks V.N. Opornyi razrez neokoma zapadnoi Sibiri v Pripolyarnom Zauralie (Key sections for the Neocomia of West Siberia, the Polar Urals). Novosibirsk: Nauka, 1972, p. 1-184.

Mesezhnikov M.S., Golbert A.V. et al. Novoe v stratigrafii pogranichnykh mezdu yuroi i melom sloev basseina r. Pechory (New data aboub the stratigraphy of the Jurassic/Cretaceous boundary beds in the Pechora basin). In: Verkhyaya yura i granitsa eye s melovoi sistemoi. Novosibirsk: Nauka, 1979a, p. 66-71.

Mesezhnikov M.S., Zakharov V.A., Shulgina N.I., Alekseev S.N. Stratigrafia ryazanskogo gorizonta na r. Oke (Stratigraphy of the Ryazanian horizon on the Oka River). In: Verkhnyaya yura i granitsa eye s melovoi sistemoi. Novosibirsk: Nauka, 1976b, p. 71-80.

Mesezhnikov M.S., Braduchan Yu.V. Detalnaya stratigrafia pogranichnykh sloev yury i mela na vostochnom sklone Pripolyarnom Urale (Detailed stratigraphy of the Jurassic/Cretaceous boundary beds on the eastern slope of the Polar Urals). In: Stratigrafia triasovykh i yurskikh otlozhenii neftegasonosnykh basseinov SSSR. L., 1982, p. 83-94.

Mesezhnikov M.S., Alekseev S.N. et al. O razvitii nekotorykh Craspeditidae na rubezhe yury i mela (On the evolution of some Craspeditidae at the Jurassic/Cretaceous boundary). In: Mezozoi Sovetskoi Arktiki. Novosibirsk: Nauka, 1983, p. 103-125.

Mesezhnikov M.S. Kimeridzhskii i volzhskii yarusy severa SSSR (Kimmeridgian and Volgian of the northern USSR). L.: Nedra, 1984, 166 p.

Mesezhnikov M.S. Zonalnoe raschlenenie ryazanskogo gorizonta (Zonation of the Ryazanian horizon). In: Pogranichnye yarusy morskoi i melovoi sistem. Moscow: Nauka, 1984, p. 54-65.

Mikhailov N.P. Borealnye yurskie ammonity (Dorsoplanitinae) i zonalnoe raschlenenie volzhskogo yarusa (Boreal Jurassic ammonites (Dorsoplanitinae) and zonation for the Volgian). Tr. GIN AN SSSR, vyp. 151, M., 1966, 151 p.

Saks V.N., Shulgina N.I. Melovaya systema v Sibiri i Predlozhenia o yarusnom i zonalnom raschlenenii (The Cretaceous of Siberia. Proposed stage subdivision and zonation). Geol. i Geophys., 1962, N 10, p. 23-40.

Saks V.N., Shulgina N.I. O vydelenii berriasskogo yarusa v melovoi systeme (On the recognition of the Berrisian in the Cretaceous). Geol. i geofiz., 1964, N 8, p. 3-13.

Saks V.N. et al. Opornii razrez verkhneyurskikh otlozenii basseina r. Khety (Khatangskaya vpadina) (Key section of the Upper Jurassic of the Kheta Basin (Khatanga Depression). L.: Nauka, 1969, p. 1-200.

Saks V.N., Shulgina N.I. Novye zony neokoma i granitsy beriasskogo i valanzhingskogo yarusov v Sibiri (New Neocomian zones and the Berriasian/Valanginian in Siberia). Geol. i Geofiz., 1969, N 12, p. 42-52.

Saks N.V. (ed.). Granitsa yury i mela i Berriasskii yarus v horealnom poyase (Jurassic/Cretaceous boundary and the Berriasian of the Boreal realm). Novosibirsk: Nauka, 1972, p. 1-371.

Saks V.N. (ed.). Stratigrafia yurskoi sistemy severa SSSR (Jurassic stratigraphy of the northern USSR). Moscow: Nauka, 1976, 436 p.

Shulgina N.I. Titonskie ammonity Severnoi Sibiri (Tithonian ammonites of Severnaya Siberia). In: Problemy paleontologicheskogo obosnovania detalnoi stratigrafii mezozoya Sibiri i Dalnego Vostoka. L.: Nauka, 1967, p. 131-177.

Shulgina N.I. Sapostavlenie pogranichnykh yarusov yury i mela v Borwalnom poyase i za ego predelami (Correlation of the Jurassic/Cretaceous boundary beds in the Boreal realm and outside). In: Pogranichnye yarusy yurskoi i melovoi sistem. M.:

Nauka, 1984, p. 67-81.

Zakharov V.A., Nalnyaeva T.I., Shulgina N.I. Novye dannye po biostratigrafii verkhneyurskikh i nizhnemelovykh otlozhenii na poluostrove Paskha, Anabarskii zaliv (sever Srednei Sibiri) (New data on the Upper Jurassic and Lower Cretaceous biostratigraphy on Paskha Island, the Anabar Bay (northern Central Siberia). In: Paleogiogeografia i biostratigrafia yury i mela Sibiri. M.: Nauka, 1983, p. 56-113.

Figure Captions .

Fig. 1. Distribution of ammonites across the Jurassic/Cretaceous boundary beds of the Russian platform

Fig. 2. Distribution of ammonites across the Jurassic/Cretaceous boundary beds on the eastern slope of the Polar Urals

Fig. 3. Distribution of ammonites across the Jurassic/Cretaceous boundary beds in northern Siberia

Fig. 4. Distribution of ammonites across the Jurassic/Cretaceous boundary beds in England.

Fig. 1

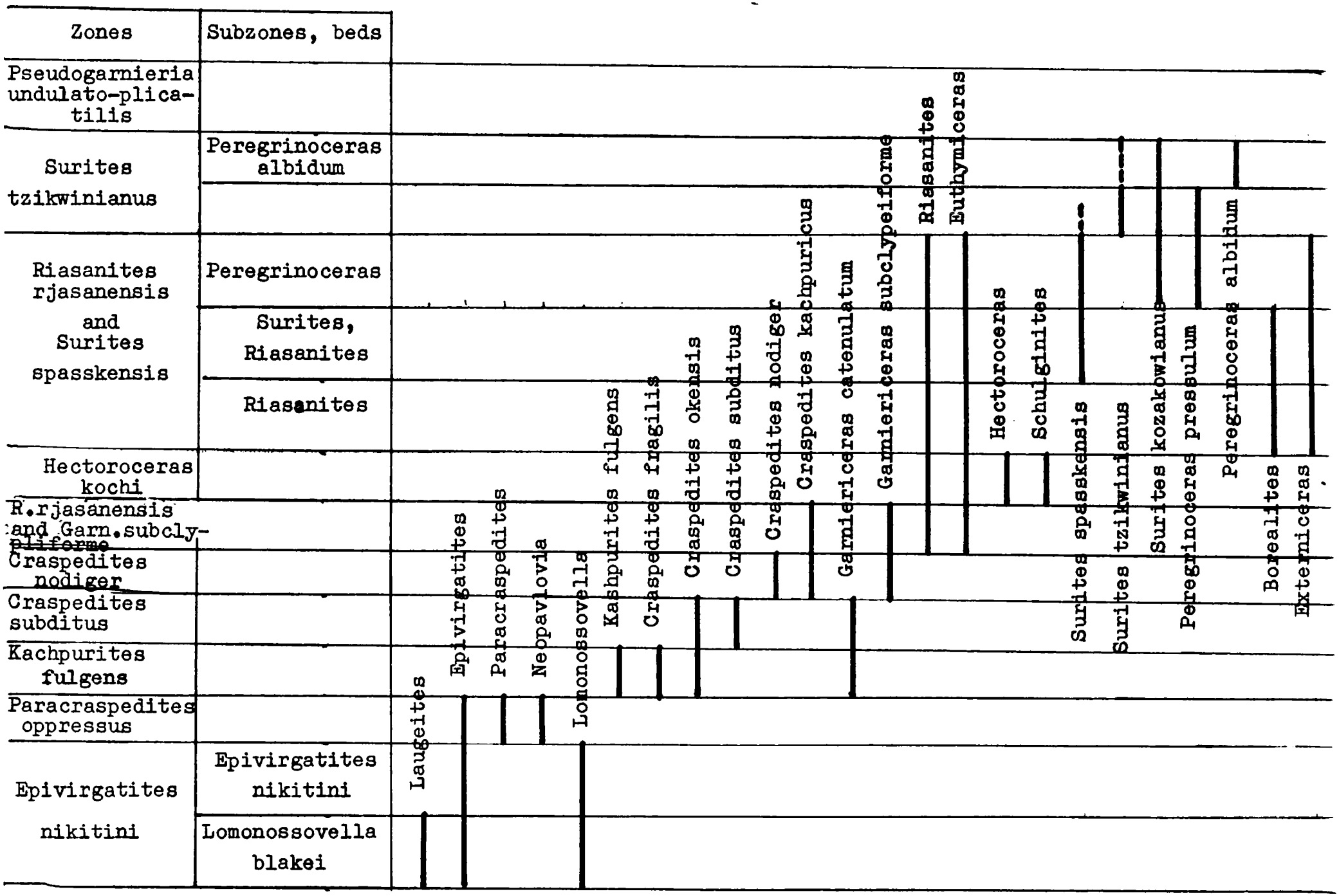

Zones
Subzones, beds
Pseudogarnieria undulato-plicatilis
Surites tzikwinianus
Peregrinoceras albidum
Riasanites rjasanensis and Surites spasskensis
Peregrinoceras
Surites, Riasanites
Riasanites
Hectoroceras kochi
R.rjasanensis and Garn.subclypliforme
Craspedites nodiger
Craspedites subditus
Kachpurites fulgens
Paracraspedites oppressus
Epivirgatites nikitini
Lomonossovella blakei
Laugeites
Epivirgatites
Paracraspedites
Neppavlovia
Lomonossovella
Kachpurites fulgens
Craspedites fragilis
Craspedites okensis
Craspedites subditus
Craspedites nodiger
Craspedites kachpuricus
Garniericeras catenulatum
Garniericeras subclypeiforme
Riasanites
Euthymiceras
Hectoroceras
Schulginites
Surites spasskensis
Surites tzikwinianus
Surites kozakowianus
Peregrinoceras pressulum
Peregrinoceras albidum
Borealites
Externiceras

Fig. 2

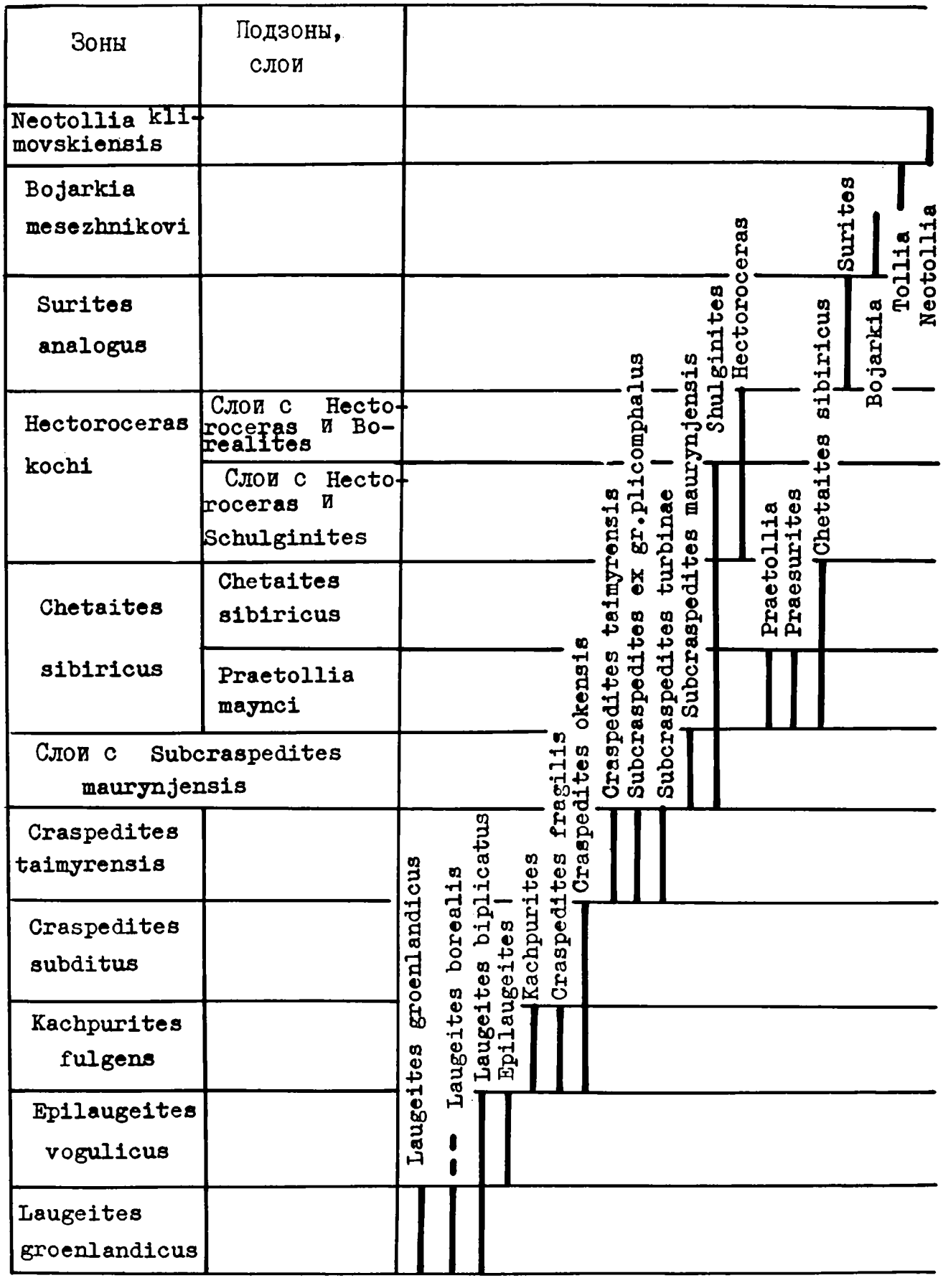
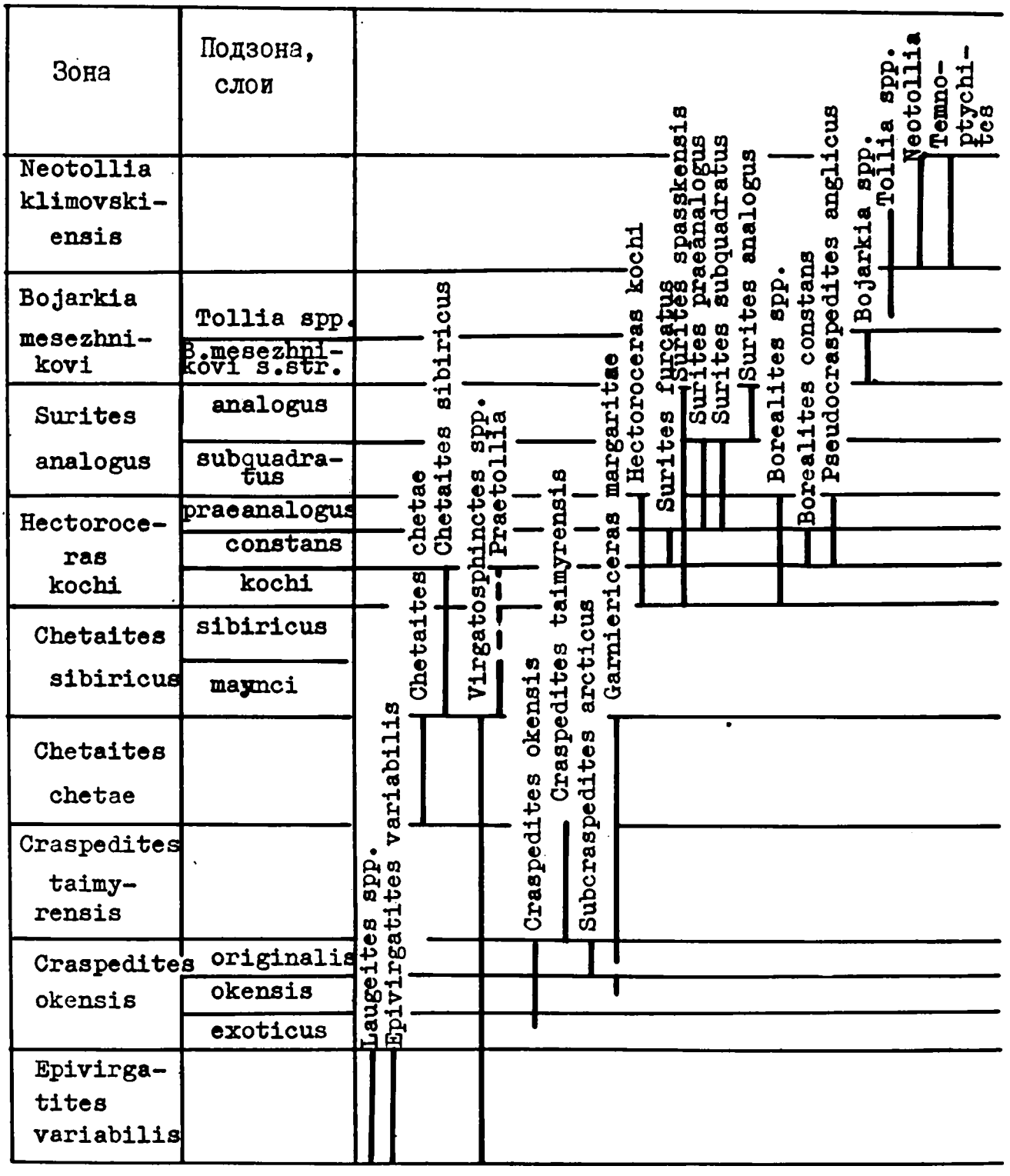

Зоны
Подзоны, слои
Neotollia klimovskiensis
Bojarkia mesezhnikovi
Surites analogus
Hectoroceras kochi
Слои с Hectoroceras и Borealites
Слои с Hectoroceras и Schulginites
Chetaites sibiricus
Chetaites sibiricus
Praetollia maynci
Слои с Subcraspedites maurynjensis
Craspedites taimyrensis
Craspedites subditus
Kachpurites fulgens
Epilaugeites vogulicus
Laugeites groenlandicus
Laugeites groenlandicus
Laugeites borealis
Laugeites biplicatus
Epilaugeites
Kachpurites
Craspedites fragilis
Craspedites okensis
Craspedites taimyrensis
Subcraspedites ex gr.plicomphalus
Subcraspedites turbinae
Subcraspedites maurynjensis
Shulginites
Hectoroceras
Praetollia
Praesurites
Chetaites sibiricus
Surites
Bojarkia
Tollia
Neotollia

Fig. 3


Зона
Подзона, слои
Neotollia klimovskiensis
Bojarkia mesezhnikovi
Surites analogus
Hectoroceras kochi
Chetaites sibiricus
Chetaites chetae
Craspedites taimyrensis
Craspedites okensis
Epivirgatites variabilis
Tollia spp.
B. mesezhnikovi s.str.
analogus
subquadratus
praeanalogus
constans
kochi
sibiricus
maymci
originalis
okensis
exoticus
Laugeites spp.
Epivirgatites variabilis
Chetaites chetae
Chetaites sibiricus
Virgatosphinctes spp.
Praetollia
Craspedites okensis
Craspedites taimyrensis
Subcraspedites arcticus
Garniericeras margaritae
Hectoroceras kochi
Surites furcatus
Surites spasskensis
Surites praeanalogus
Surites subquadratus
Surites analogus
Borealites spp.
Borealites constans
Pseudocraspedites anglicus
Bojarkia spp.
Tollia spp.
Neotollia
Temnoptychites

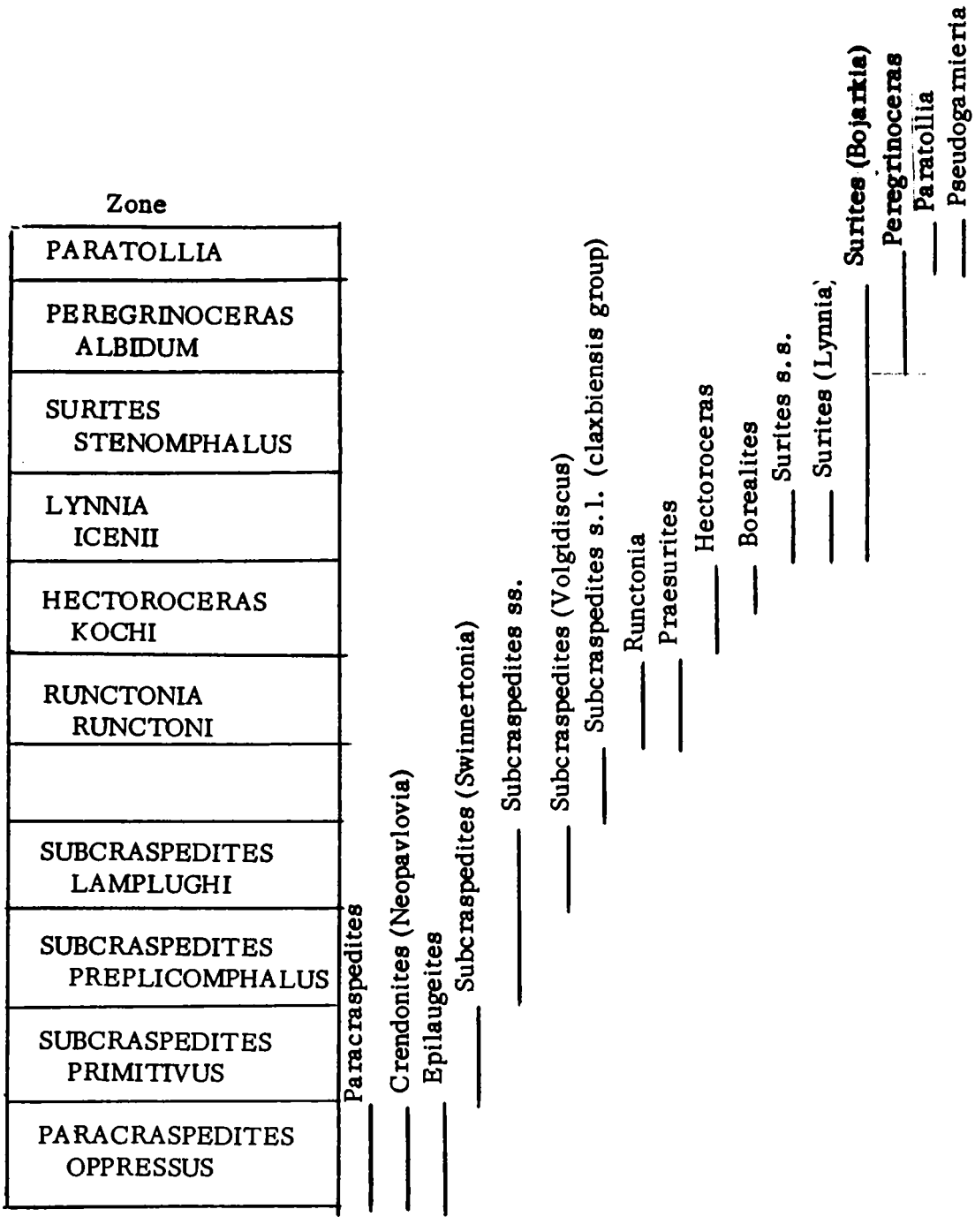

Zone
PARATOLLIA
PEREGRINOCERAS ALBIDUM
SURITES STENOMPHALUS
LYNNIA ICENII
HECTOROCERAS KOCHI
RUNCTONIA RUNCTONI
SUBCRASPEDITES LAMPLUGHI
SUBCRASPEDITES PREPLICOMPHALUS
SUBCRASPEDITES PRIMITIVUS
PARACRASPEDITES OPPRESSUS
Paracraspedites
Crendonites (Neopavlovia)
Epilaugeites
Subcraspedites (Swinnertonia)
Subcraspedites ss.
Subcraspedites (Volgidiscus)
Subcraspedites s.l. (claxbiensis group)
Runctonia
Praesurites
Hectoroceras
Borealites
Surites s.s.
Surites (Lynnia)
Surites (Bojarkia)
Peregrinoceras
Paratollia
Pseudogamieria

Fig. 4.

Correlation of the uppermost Jurassic and lowermost Cretaceous of England, the Russian Platform, Urals, and Siberia