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The Biostratigraphy of the Ordovician of Bohemia

(7 text-figures, 16 plates, Czech summary)

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Abstract: The full stratigraphy of the Ordovician of Bohemia is given, based partly on the results of detailed geological mapping and prospecting for iron-ore deposits, and partly on sedimentological, palaeogeographical and palaeontological investigations, as well as studies of facies carried out by a number of specialists. Attention has been paid to the relations of the Bohemian area to foreign regions of the Mediterranean Province. The immigration of a warm water fauna from the Baltic and British areas during the Ashgill has been pointed out. The Caradoc Stage has been divided into three Substages.

Introduction

Since the Second World War great attention has been paid to the study of the Ordovician of Bohemia in connection with prospecting for sedimentary iron ores. Several papers dealt in detail with the stratigraphy, facies development and palaeogeographical conditions (V. HAVLÍČEK and M. ŠNAJDR 1955, 1957), iron ores (J. SVOBODA and F. PRANTL 1951, 1955), sedimentology (Z. KUKAL 1957–1963) and tectonics (J. SVOBODA 1960, V. HAVLÍČEK 1963).

The evaluation of the biostratigraphy was last published by J. KOLIHA (1937) and B. BOUČEK (1937). Since then our knowledge of the stratigraphy, facies development and fauna has been substantially extended and it is, therefore, expedient to summarize the results recently obtained.

Our biostratigraphical conclusions are based mainly on the evaluation of earlier palaeontological papers, as well as new material used in the investigation of the graptolites and brachiopods (V. Havlíček – including a summary of all stratigraphic and palaeogeographic results obtained so far) and on a revision of the trilobites (J. Vaněk).

Chronostratigraphic units as Tremadoc, Arenig, Llanvirn etc. have been often considered as series in Great Britain; in conformity with the resolution of the International Subcommission on stratigraphic terminology (Copenhagen 1961, p. 24–26, articles D3, D4 and D5), we indicate them as stages.

Tremadoc

In the area of central Bohemia the Třenice and Mílina Formations correspond to the Tremadoc; in eastern Bohemia (the Železné hory Mts. area) the Lipoltice Beds are of Tremadoc age.

The Třenice Formation and the Lipoltice Beds

The Třenice Formation is built predominantly of quartzose sandstones, greywackes and arkoses. In the lower Tremadoc the sea penetrated from the east (through the Železné hory) into central Bohemia and extended westwards to Volduchy. Sedimentological study (Z. KUKAL 1963) has shown that the sedimentation basin was bordered in the west by mountain ridges made up mostly of Upper Cambrian porphyries and porphyrites. Thus, sedimentation took place in an environment of fanglomerates, alluvial fans or in a fluvio-marine environment. In the central and eastern parts of the basin (E of Točník), sedimentation was no longer affected by morphological differences, and the basin gradually became deeper towards the east.

As may be gathered from the recapitulation of the palaeogeography during the deposition of the Třenice Formation conditions for the development of the marine

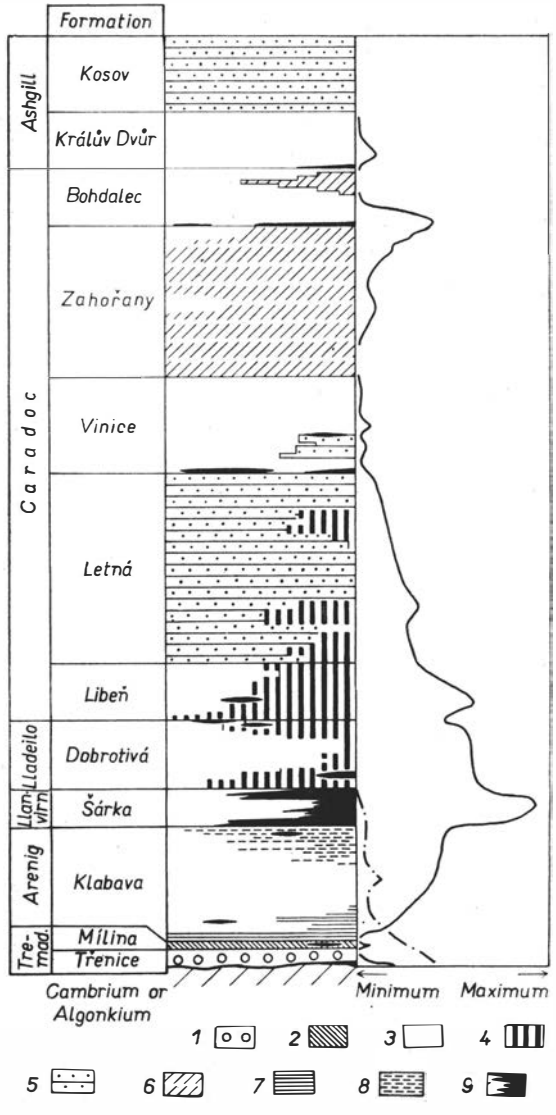
Table 1

Stratigraphic Table of the Ordovician of Bohemia

R. Kettner – F. Prantl 1948				V. Havlíček 1961			
Zdice Beds		Kosov Quarzites	Ashgill	Ashgill		Kosov Formation	
		Králův Dvůr Shales				Králův Dvůr Formation	
Zahořany Beds	Nučice Beds	Bohdalec Shales	Caradoc	Caradoc	Bohdalec Subst.	Bohdalec Formation	
		Chlustina Beds			Lodě-nice Sub-stage	Zahořany Formation	
		Černín Beds				Vinice Formation	
	Chrustenice Beds	Letná Beds	Llandeilo		Chruste-nice Substage	Letná Formation	
		Libeň Shales				Libeň Formation	Libeň Shales / Řevnice Quarzites
Drabov Ouarzites							
Osek-Kváň Beds		Svatá Dobrotivá Shales	Llanvirn	Llan-deilo		Dobrotivá Formation	Dobrotivá Shales / Skalka Quarzites
		Skalka Quarzites					
		Šárka Beds		Llan-virn		Šárka Formation	
Komárov Beds			Skiddaw	Arenig		Klabava Formation	
Krušná Hora Beds		Olešná Beds					
		Mílina Beds	Tre-madoc	Trema-doc.		Mílina Formation	
		Třenice Graywacke				Třenice Formation	

fauna were not very favourable. This is why the dominant part of the fauna consists of inarticulate brachiopods which could most readily adapt themselves to unfavourable conditions. Very typical and widely distributed are the big species *Lingulobolus feistmanteli* and *Thysanotos siluricus*. The largest brachiopod of the Bohemian Tremadoc "*Obolus*" *giganteus* has so far been found only in the porous reddish brown sandstones of Úvaly. Additional fairly abundant species of the Třenice Formation are *Westonia lamellosa*, *Lingulella expusla*, *Acrotreta minima* and others.

Articulate brachiopods occur in the Třenice Formation at only a few localities, especially near Olešná and Jívina, in the quarries near Březany and on the dump of the test pit in Úvaly. The most common are *Tritoechia kodymi*, *T. kolihai*, *Jivinella praecedens* and *Poramborthis kettneri*. The dendroids representing a very important part of the fauna in the lower Tremadoc of other countries are extraordinarily rare in central Bohemia. O. Kodym and A. Matějka found them only in one intercalation of grey shales in the sandstone quarry near Březany. Later, the dendroids of the Třenice formation were studied by F. PRANTL and A. PŘIBYL (1950) who described them as *Dictyonema flabelliforme intermedium* and *Callograptus kodymi*. Trilobites, echinoderms and representatives of other groups of fauna are not to be found in the sandstones and greywackes of the Třenice Formation.



1. Stratigraphic table of the Ordovician of Bohemia

1 – fine-grained and coarse-grained sandstones and arkoses; *2* – cherts; *3* – clayey and silty shales; *4* – quartzites and quartzose sandstones; *5* – greywackes with intercalations of shales and of quartzose sandstones; *6* – siltstones, *7* – red coloured shales and greywackes; *8* – redeposited laminated fine tuffs; *9* – iron ores. Column on the right: solide line — basic volcanism; broken line — acid volcanism

The occurrence of an abundant fauna in haematites at the base of the Třenice Formation near Holoubkov is interesting. Trilobites, numerous brachiopod species and cystoids are not known from the Třenice Formation at any other locality: no doubt, the anomalous environment of the chemical sedimentation in which the ore lens originated was not unfavourable to the marine fauna. Although in the haematites the fauna occurs in fragments only, its farther transport cannot be assumed, as the locality lies in close proximity to the ancient coast. Of the articulate brachiopods *Poramborthis lamellosa*, *P. grimmi*, *Ocnerorthis soror*, *O. filia*, *Apheorthina ferrigena* and others occur here. To the inarticulate brachiopods belong the abundant *Siphonotreta simulans* and *S. krafti*. The trilobites are represented by the species *Holubaspis perneri*, *Eulomina mitratum*, *Hemibarrandia holoubkovensis*, *Platylichas kloučeki* and others. Of the echinoderms *Paleosphaeronites crateriformis* is abundant.

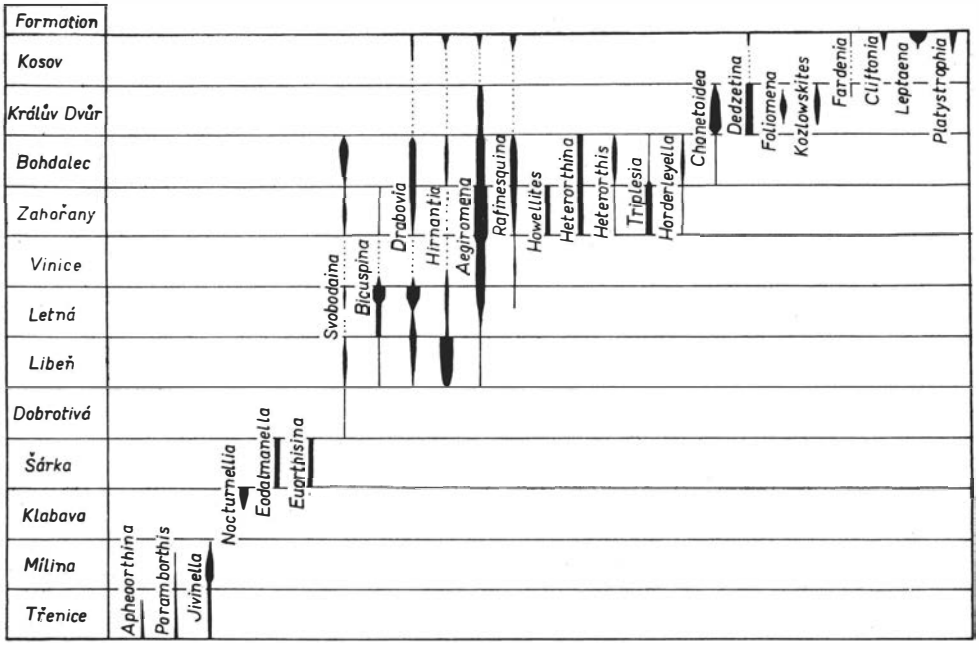
The Tremadoc fauna is also well-known from the Železné hory in the so-called Lipoltice Beds. As is indicated by the fossil content and the lithological development, the Lipoltice Beds of the Železné hory are essentially synchronous with the Třenice Formation of the Barrandian basin. The inarticulate brachiopods of the Železné hory agree with those of the Barrandian area; moreover, in the Lipoltice Beds the species *Lingulella wirthi* and *Acrotreta inchoans* appear. The Lipoltice Beds differ more markedly from the Třenice Formation in the content of articulate brachiopods. The species of the Barrandian area are not known in the Železné hory and in their place are *Angusticardinia zelenkai* and *Nanorthis ? bavarica*. Of the trilobite fauna of the Železné hory *Bavarilla hofensis* and *Geragnostus bavaricus* are to be found.

Notes on the Třenice Formation: the Tremadoc character of the fauna is confirmed by the presence of the index species *Dictyonema flabelliforme* (subspecies *intermedium*) and *Thysanotos siluricus*. The characteristic Tremadoc trilobites from the Třenice Formation and the Lipoltice Beds belong to the genera *Bavarilla* and *Hemibarrandia*. The genera of the articulate brachiopods *Angusticardinia* and *Poramborthis* are confined exclusively to the European Tremadoc. Some brachiopods of the Třenice Beds still have a Cambrian character (*Apheoorthina*, *Jivinella*); they are the last representatives of the family *Billingsellidae* (subfamily *Eoorthinae*) which occurred throughout the Cambrian.

The Mílina Formation

As is generally known, the Mílina Formation is a regression deposit. The basin of deposition became smaller, and the sedimentation was predominantly chemical. In sections through the Mílina Formation beds of cherts represent 50 percent and in places a still greater proportion. The sedimentary environment of the Mílina Formation, as compared with recent basins, has no analogy (Z. KUKAL 1963). The Mílina Formation consisting essentially of beds of cherts was evidently not a convenient environment for the development of a marine fauna. The unfavourable conditions of life are indicated by the clear prevalence of inarticulate brachiopods

(as far as the quantitative representation of individuals is concerned) over other animal groups. By contrast with the earlier Třenice Formation, in the Mílina Formation minute species, such as *Orbiculoidea sodalis*, *O. sodalis undulosa*, *Lingulella insons*, *Acrotreta minima* are present. The large inarticulate brachiopod *Thysanotos siluricus* is rare, known only from the quarries near Olešná and the tuffaceous

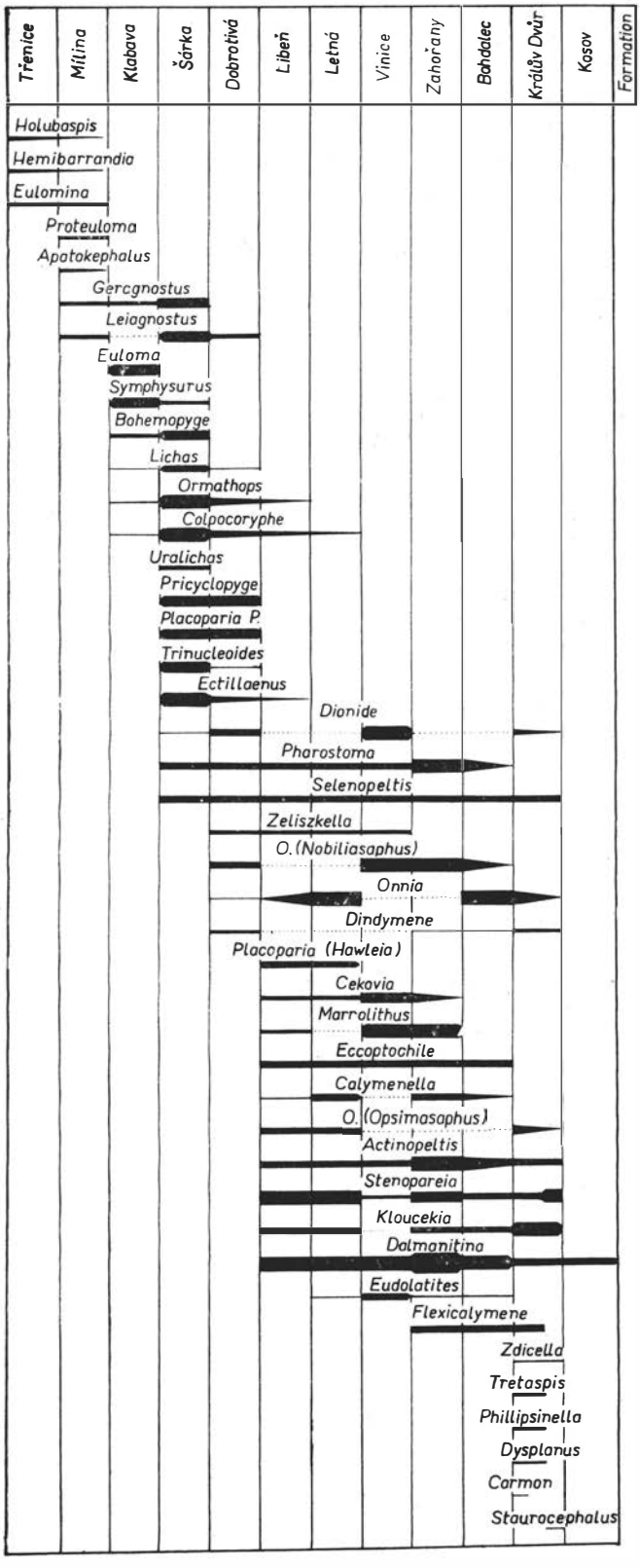


2. Stratigraphic distribution of the most important brachiopod genera in the Ordovician of Bohemia (Instead of *Platystrophia* should be: *Plectothyrella*)

intercalation at Úvaly. Compared with the earlier Třenice Formation, in the Mílina Formation not only the species of inarticulate brachiopods, but also the articulates are numerically less, which indicates a certain deterioration of the conditions of life. *Jivinella incola* and *Poramborthis kloučeki* have been found in the quarries near Olešná and in Úvaly. *Jivinella incola* also occurs, though rarely, near Jívina, Komárov, Svatá Dobrotivá and Těně.

In the uppermost horizons of the Mílina Formation, reddish brown greywackes, another orthid brachiopod, *Jivinella slavíki* occurs.

The trilobite fauna is very rare in the Mílina Formation, known only from a chert bed in the quarry near Olešná and from the tuffaceous intercalations in the close surroundings of Úvaly. The trilobites here belong to the species *Geragnostus bavaricus*, *Proteuloma geinitzi*, *Pilekia olešnaensis*, *Holubaspis perneri*, *Hemibarrandia holoubkovensis*, *Harpides grimmi*, *Curiaspis notabilis*, *Pharostomina ferentaria*, *Eulomina mitratum* and others.



3. Stratigraphic distribution of the most important trilobite genera in the Ordovician of Bohemia

The chemical sedimentaion in the Mílina Formation was responsible for the development of siliceous sponges, as is indicated by very abundant spicules of the species *Pyritonema feistmanteli*.

Notes: The fauna of the Mílina Formation is closely related to that of the Třenice Formation, and the Tremadoc character of the fauna is quite incontestable.

In the earlier Třenice Beds faunal elements of the Baltic Province have been established, primarily the genera *Orthambonites* and *Angusticardinia*. But these genera do not reach as far as into the Mílina Formation, so that no important influence of the Baltic fauna can be observed in them.

The biostratigraphical evaluation of the Tremadoc. A detailed biostratigraphical subdivision of the Bohemian Tremadoc has been dealt with especially by J. Koliha and C. Klouček, who established several various associations of

fauna (see J. KOLIHA 1935, 1937). These authors gave to these assemblages the status of zones and characterized them, from the base upwards, as follows:

Zone 1. *Obolus feistmanteli*, *Lingulella expulsa*, *L. bukovensis*, *Orthis kettneri*, *Orbiculoidea sodalis*,

Zone 2. *Obolus barrandei primus*, *Orthis incola praecedens*,

Zone 3. *Lingulella arachne*, *Obolus lamellosus*,

Zone 4. *Lingulella insons*, *Orbiculoidea sodalis undulosa*, *Obolus barrandei*, *Billingsella incola*, *Orthis grimmi*, *O. soror*,

Zone 5. *Orthis slavíki*,

Zone 6. *Obolus complexus*, *Obolus kloučeki*, *Acrotreta minima*, *Orbiculoidea sodalis undulosa*.

The biostratigraphical division of the Tremadoc proposed by Koliha and Klouček has only in part the character of zones. The assemblages of fauna concerned here are to a great extent bound to facies (especially their zones 1 to 3). In the Barrandian area, unfortunately, there is not even one section in which Klouček and Koliha's zones can be traced in the order as given above. Their zones 1 to 3 belong to the Třenice Formation, zones 4 and 5 to the Mílina Formation. Zone 6 characterizes the Olešná Shales which are now referred to the Arenig.

In the present authors' opinion it is better to divide the Tremadoc of Bohemia on the basis of the phylogenic evolution of the genus *Jivinella* into three horizons as follows:

1. the lower horizon with *Jivinella praecedens*, corresponding to the Třenice Formation;
2. the middle horizon with *Jivinella incola*, which occupies the lower and central portions of the Mílina Formation;
3. the upper horizon with *Jivinella slavíki*, which is bound to the top part of the Mílina Formation.

The proposed subdivision of the Tremadoc of Bohemia is in conformity with the phylogenic evolution of some additional brachiopods or trilobites. In the Třenice Formation (J. praecedens Horizon) the species *Poramborthis kettneri* and *P. grimmi* are present, in the Mílina Formation (J. incola Horizon) *P. kloučeki* occurs. The trilobite *Pilekia olešnaensis* (J. incola Horizon) is undoubtedly a descendent from of the older species *P. bohemica* (J. praecedens Horizon).

The fossil content of the individual horizons of the Bohemian Tremadoc is as follows. All the fauna of the Třenice Formation belongs to the horizon with *J. praecedens*. The J. incola Horizon, forming the lower and middle parts of the Mílina Formation, carries the prevailing part of the Mílina Formation fauna, including trilobites and articulate brachiopods with the exception of the brachiopod *J. slavíki* which is of later date. The uppermost horizon of the Bohemian Tremadoc – that with the species *J. slavíki* – is distinguishable only near Jívina and Olešná, and consists of greywackes with the species *J. slavíki* and minute inarticulate brachiopods (*Acrotreta minima* and others). Trilobites are not known from this horizon.

On the basis of its fauna the Tremadoc of Bohemia incontestably belongs to the Mediterranean Province. It is closely related to the Bavarian area (Leimitz-Schiefer), as was pointed out by F. PRANTL and R. RŮŽIČKA (1941) and K. SDZUY (1955). This close relationship is indicated by the presence of the following brachiopod genera in both areas: *Poramborthis*, *Thysanotos*, *Siphonotreta* and others. Especially remarkable is the trilobite fauna of the Mílina Formation, in which the following species are known also from the Leimitz-Schiefer: *Geragnostus bavaricus*, *Leiagnostus franconicus*, *Parabolina frequens*, *Diceratopyge troedssoni*, *Proteuloma geinitzi*, *Apatokephalus asarkus*, *Niobella innotata*, *Pharostomina ferentaria*, *Leimitzia bavarica*, *Pilekia olešnaensis*, *Curiaspis notabilis.*

The Lipoltice Beds of the Železné hory also have some species in common with the Leimitz-Schiefer, i.e. *Lingulella wirthi*, *Acrotreta inchoans* and *Bavarilla hofensis.*

K. SDZUY (1955) has divided the Leimitz-Schiefer into three zones, in ascending order: the Pharostomina öpiki Zone, the Pharostomina ferentaria Zone and the Macrocystella ? bavarica Zone. The index species *Pharostomina ferentaria* is of great importance for the Tremadoc of Bohemia, as it occurs in the cherts of the Mílina Formation. Also of stratigraphic value is the unique find of *Pharostomina* cf. *öpiki* in the haematites of the Třenice Formation. Other species of trilobites occurring in the Mílina Formation, as well as in the Leimitz-Schiefer, are less important for zonal determination, as they usually occur in all three zones of Leimitz-Schiefer. The correlation of the Bohemian and Bavarian faunas can for the present be carried out approximately only (see table 2).

Table 2

Correlation of horizonts in the Tremadoc of Bohemia and Bavaria

	Bavaria (Leimitz)	Bohemia
Tremadoc	Macrocystella bavarica Zone	Jivinella slavíki Horizon
	Pharostomina ferentaria Zone	Jivinella incola Horizon
	Pharostomina öpiki Zone	Jivinella praecedens Horizon

The relationship of central Bohemia to other areas of the Mediterranean province is less close. The Tremadoc of France (Montagne Noire) has only a few species or genera of trilobites in common with those of the Bohemian area (cp. K. SDZUY 1955). Close relations to the neighbouring Polish area are indicated by the species *Thysanotos siluricus*, *Lingulobolus feistmanteli minor*, *Lingulella insons*, which occur in both areas (W. BEDNARCZYK 1964).

The Tremadoc of Bohemia differs from that of the Baltic region. The genera *Angusticardinia* and *Orthambonites* known from the Třenice Formation or the Lipoltice Beds are elements of the Baltic fauna in our area. A closer comparison of the

Tremadoc of central Bohemia with the Baltic area is impossible at present and the question of the stratigraphic assignment of the Leetse- Sandstone, containing, in addition to other fossils, the species *Thysanotos siluricus*, has not yet been decided. This inarticulate brachiopod is indicative of the Tremadoc in the Mediterranean Province, for instance, in central and eastern Bohemia, Bavaria (Leimitz-Schiefer), Thuringia (upper Frauenbach Quartzite) and in Poland (Holy Cross Mts., Zbilutka Beds). Some authors (T. ALICHOVA 1960) refer the Leetse Sandstone to the Tremadoc, others – on the basis of the conodont fauna – to the Arenig (R. MÄNNIL 1963).

Arenig

The Klabava Formation

In central Bohemia the Arenig is represented by the Klabava Formation and its stratigraphic equivalents. The facies development of the Klabava Formation is very complicated and was studied by V. HAVLÍČEK and M. ŠNAJDR (1957) who examined the areal distribution of the individual facies and their mutual relations. V. HAVLÍČEK (1961) also assigned to the Arenig as a special facies the red shales and greywackes of Olešná, which were earlier regarded as a separate stratigraphic member of the uppermost Tremadoc.

The basic Arenig facies, which differ from each other even in their fossil content, are as follows: greyish green Euloma Shales, dark grey to blakish grey Didymograptus Shales, red shales and greywackes of Olešná, laminated variegated redeposited tuffs and tuffites and finally the volcanic lithofacies composed of pyroclastic sediments covered in places with diabase amygdaloidal rocks. In the Klabava Formation there are lenses of sedimentary iron ores, organogenic limestones, conglomerates (especially at the base of the Klabava Formation) etc.

The Euloma Shales, which were defined and studied palaeontologically for the first time by K. HOLUB (1911), are wide-spread in the western part of the Barrandian basin (the Rokycany area). From the results of borings in the wider vicinity of Třenice, Mýto, Holoubkov, Starý Plzenec (the Stradiště Mt.) and other places the Euloma Shales are poor in organic remains. The same picture results from the study of the outcrops of these shales. Thick portions of the sequence of beds are quite unfossiliferous; in places minute or fairly large lingulellae and dendroids occur. The graptolite and trilobite fauna is known from some localities only and the determination of faunal zones is therefore difficult. The biostratigraphy of the Euloma Shales has been studied recently, especially by B. BOUČEK (1956).

The earliest characteristic fauna of the Euloma Shales was established by J. V. ŽELÍZKO (1909) not far above the base of the Arenig near Starý Plzenec (locality Sv. Blažej), where the species *Hologaptus expansus*, *Didymograptus bohemicus*, *Asaphellus bohemicus* were found.

B. Bouček assigns this assemblage to the Holograptus expansus Zone.

A somewhat younger assemblage has recently been discovered by core drilling while prospecting for iron ores in the close vicinity of Holoubkov and Sirá. The fauna found consists almost exclusively of graptolites and dendroids, especially *Didymograptus volucer volucer*, *D.V-fractus*, *D. simulans*, *Dendrograptus klouček*i, *Callograptus* (*Alternograptus*) *holubi*, *Callograptus* (C). *rokycanensis*, *Dendrograptus horáki*, *Dictyonema krafti*, *Desmograptus callograptoides* etc. Very well-preserved graptolites and dendroids of this assemblage have also been found in a gallery near Sirá.

To the upper half of the Euloma Shales belongs the fauna from the locality Městská stráň in Rokycany, which was studied by R. Horný and I. Chlupáč (1952) and B. Bouček (1956). These authors distinguished two different faunal assemblages belonging, according to B. Bouček, to two separate zones: He assigned the lower assemblage from the Městská stráň locality to the Schizograptus tardifurcatus Zone, the upper one to the Tetragraptus reclinatus abbreviatus Zone. In the Schizograptus tardifurcatus Zone the following species were established: *Ormathops* sp. n., *Dictyonema krafti*, *Callograptus* (C.) cf. *expansus*, *Callograptus* (*C.*) *rokycanensis*, *Callograptus* (*Alternograptus*) sp., *Dendrograptus klouček*i, *Desmograptus callograptoides*, *Thamnograptus rokycanensis*, *Schizograptus tardifurcatus*, *Holograptus* cf. *expansus*, *Tetragraptus* (*Eotetragraptus*) *quadribrachiatus*, *Tetragraptus* (*Eotetragraptus*) *harti*, *Expansograptus* cf. *goldschmidti*, *Didymograptus nicholsoni*, *Lingulella rugosa* and others.

From the Tetragraptus reclinatus abbreviatus Zone in Rokycany R. Horný, I. Chlupáč and B. Bouček have recorded *Euloma bohemicum*, *Symphysurus pater*, *Bohemopyge decorata*, *Caryocaris* cf. *wrighti*, *C.* cf. *marri*, *Lingulella sulcata* etc., together with *Callograptus* (*Alternograptus*) *holubi*, *Dendrograptus horáki*, *D. irregularis*, *Schizograptus* cf. *tardifurcatus*, *Tetragraptus* (*T.*) *reclinatus abbreviatus*, *Didymograptus nicholsoni*, *D. strangulatus*, *Protospongia nováki*.. As was established at the Městská stráň locality in Rokycany, as well as in borehole profiles from the Klabava area, the *Tetragraptus reclinatus abbreviatus* Zone lies in the uppermost part of the Klabava Formation, closely underlying the Šárka Formation, of Llanvirn age.

B. Bouček designated the Tetragraptus bigsbyi Zone as the youngest Arenig zone. According to the present authors' observations this graptolite, which occurs sparsely in Bohemia, appears in the same stratigraphic position as *Tetragraptus reclinatus abbreviatus*, i.e. in the uppermost layers of the Klabava Formation. It appears several metres under the Osek-Kváň ore horizon, as was proved (according to oral communication by L. Marek) by the results obtained in bore KL-77 near Klabava.

The well-known palaeontological locality "pod Starým hradem" near Klabava undoubtedly belongs to the Tetragraptus reclinatus abbreviatus Zone. Here, the following species are known: *Conulariella sulca*, "*Hyolithes*" *klabavensis*,

Tetragraptus reclinatus abbreviatus, *Phyllograptus angustifolius*, *Geragnostus splendens*, *Geragnostella consors*, *Bohemopyge decorata*, *Megistaspis cuspidatus*, *Rokycania primula*, *Aspidaeglina miranda*, *Microparia bröggeri*, *Symphysurus pater*, *Lichas praecursor*, *Euloma inexpectatum*, *E. bohemicum*, *Colpocoryphe* n. sp. and others. The stratigraphic position of the locality "pod Starým hradem" is well-known. The fauna occurs here in the upper layers of the Arenig directly underlying variegated laminated tuffs of the Nocturnellia Horizon.

The facies of the Didymograptus Shales, defined for the first time by V. HAVLÍČEK and M. ŠNAJDR (1957), has been exposed by borings in close proximity to Ejpovice and Klabava; some bedding planes are covered by minute specimens of the graptolites *Didymograptus nicholsoni* and *Azygograptus suecicus*. Petrographically the Didymograptus Shales resemble the Euloma Shales, from which they differ in their greyish colour and the absence of benthic fauna (except for single valves of the genus *Lingulella*). The Didymograptus Shales near Ejpovice and Klabava do not represent the whole Arenig, as the top beds of the Arenig consist of laminated variegated tuffs (Nocturnellia Horizon). The lower layers of the Arenig are more or less absent near Ejpovice and Klabava, due to the gradual transgression of the Arenig sea over the pre-Ordovician basement.

From the palaeogeographical point of view the graptolite facies of the Arenig is confined to a sea bay which was bordered to the north and the west by ridges of Algonkian cherts. Streams transported minute graptolite branches (and to a lesser extent those of dendroids) into this bay where they sank to the bottom, accumulating in places in large quantities.

The red shales and greywackes of Olešná are a facies of the Klabava Formation restricted as a rule to its lower layers as has been proved by borings near Cheznovice, Medový Újezd, Třenice, on the Chrbina Mt. and in other places. The facies of the Olešná red shales and greywackes attains its greatest thickness in the proximity of the ancient coast and towards the centre of the basin it passes into normal, greyish green Euloma Shales. Palaeontologically the red shales and greywackes are very monotonous: at almost all outcrops an assemblage of small inarticulate brachiopods such as *Obolus kloučeki*, *O. complexus*, *Lingulella insons*, *Orbiculoidea sodalis undulosa*, *Acrotreta minima* can be demonstrated. Locally they contain abundant sponge spicules. In the red shales and greywackes trilobites, graptolites, articulate brachiopods and molluscs are completely absent. The unfavourable environment was evidently responsible for the striking lack of fauna. According to Z. Kukal, the facies of red silty shales and greywackes was due to a rapid supply of weathered material from the adjacent continent into the basin.

Of the above-mentioned fauna from the Olešná Shales *Obolus complexus* is the most important; it is also represented in other facies of the Klabava Formation, but is not known from the Tremadoc of Bohemia. (On the other hand, in Poland *O. complexus* has been recorded by W. BEDNARCZYK [1964] from the Tremadoc Zbilutka and Koziel Beds, but it does not appear there in the Arenig.)

The facies of the redeposited variegated laminated tuffs in the western part of the Barrandian basin borders especially its north-western flank. On the south-eastern flank of the basin it is particularly well developed between Těně and Strašice. In the laminated tuffs the fauna is represented by few species which, however, occur in enormous numbers in some places.

The index species of this facies is the brachiopod *Nocturnellia nocturna*; minute, often fragmentary valves of the genera *Lingulella* and *Obolus* represent the inarticulates. Spicules of sponges are locally abundant on the laminated tuffs. Trilobites, graptolites and representatives of other groups have not been found. The fauna of the laminated tuffs facies occupies a constant stratigraphic position in the upper layers of the Arenig, and has been designated by V. HAVLÍČEK and M. ŠNAJDR (1957) as Nocturnellia Horizon.

The main palaeontological localities of the Nocturnellia Horizon are as follows: Klabava – Kristiánka gallery, Osek – the western part of the village, the Sirská hora Mt., Bukov and Velíz Hills and others. Palaeontological material has been obtained from bores in the vicinity of Klabava, Březina, the Rač Mt. and other places. Wherever the Nocturnellia Horizon is represented only by intercalations of tuffs and tuffites in the Euloma Shales, the faunal assemblage is somewhat different. The number of minute inarticulate brachiopods increases, and *Nocturnellia nocturna* becomes rare. Occasionally abundant ostracods appear (collections by M. Šnajdr in the Kristiánka gallery near Klabava), but have not yet been studied in detail.

Of interest are white organogenic limestones forming intercalations several metres thick in the laminated tuffs. These limestones are developed on the Mount Rač and consist almost exclusively of valves of the brachiopod *Nocturnellia nocturna*; rarely *Prantlina bohemica* also occurs.

The last important facies of the Klabava Formation is formed by pyroclastic sediments, restricted mainly to the central parts of the basin in the Komárov, Hořovice and Beroun areas. The Arenig part of the volcanic complex is extremely poor in fossils; in the diabase tuffs near Kleštěnice and Hudlice the species *Archaeorthis přibyli* has been established. Near Neřežín in the tuffs with haematite cement *Ranorthis lipoldi* has been found. Concretions composed of haematite oolites containing *Prantlina desiderata* are enclosed in the diabase tuffs (abandoned quarry Hlava near Komárov). Trilobites are still rarer in the pyroclastic rocks: near Kváň *Pseudopetigurus hofmani* has been found, as has the rare gastropod *Mimospira helmhackeri*. In the diabase tuffs there are rather thick shale intercalations (the mountains Velíz and Krušná Hora) which carry a common fauna of inarticulate brachiopods and dendroids (L. MAREK - J. VACEK 1954).

The biostratigraphical evaluation of the Arenig. Of greatest biostratigraphic importance for the evaluation of the Bohemian Arenig are the graptolites: on the basis of this fauna the Euloma shales have been divided into several zones whose sequence is given in table 3.

Table 3

Graptolite zones in the Arenig of Bohemia

Llanvirn	Didymograptus retroflexus Zone
Arenig	Tetragraptus reclinatus abbreviatus Zone Schizograptus tardifurcatus Zone Didymograptus volucer volucer Zone Hologaptus expansus Zone
Tremadoc or pre-Ordovician basement	

The fossils contained in these zones have been dealt with above.

The relation of the Nocturnellia Horizon to the above-mentioned graptolite zone is, on the whole, well-known. The Nocturnellia Horizon represents, no doubt, most of, or all, the Tetragraptus reclinatus abbreviatus Zone in the facies of variegated laminated tuffs.

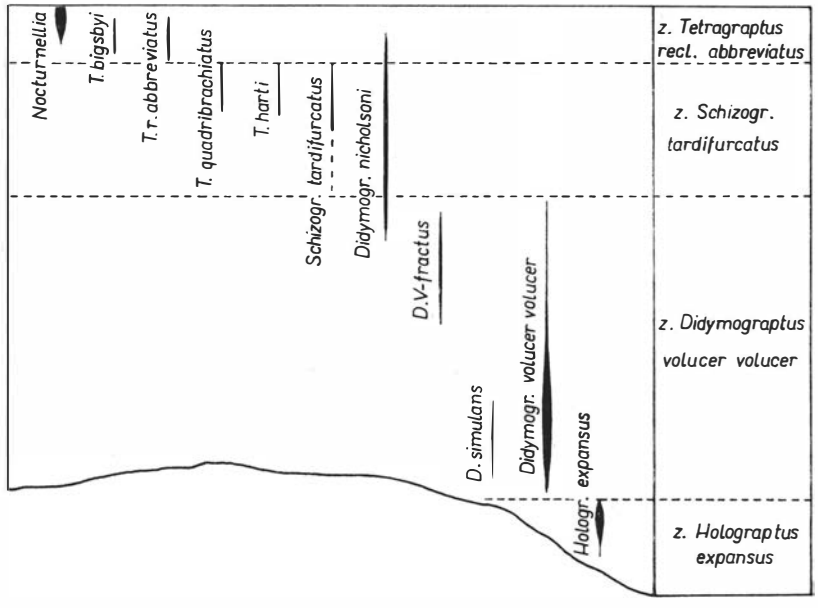
The boundary between the Tremadoc and the Arenig has not been determined with certainty in central Bohemia. At present, it is drawn on the basis of sedimentology, between the cherts of the Mílina Formation and the red shales and greywackes at the base of the Klabava Formation. The fossils in the red shales and greywackes of Olešná do not, however, prove their assignment to the lower Arenig.

The correlation of the Klabava Formation with similar areas abroad has been carried out on the basis of graptolites by B. Bouček (1956), who confirmed that the Klabava Formation corresponds to the Arenig (= Skiddaw according to its original designation) in Great Britain or to the lower Didymograptus Shales in Norway and Sweden. According to B. Bouček (1956), the Klabava Formation can also be equated with the Deep Kill Formation in North America.

B. Bouček (1956) tried to correlate with greater accuracy the Bohemian zones with those of Britain and Norway-Sweden. The Hologaptus expansus Zone from the lower layers of the Euloma Shales corresponds to the lowermost layers of the Didymograptus Shales of Sweden, i.e. most probably to the zones with *Tetragraptus phyllograptoides* and *Didymograptus balticus*. The Schizograptus tardifurcatus Zone corresponds approximately to the British zone of *Didymograptus extensus* in a broader sense or to the zones in Norway-Sweden ranging from *Didymograptus balticus* to *Phyllograptus densus*. According to B. Bouček, the Tetragraptus reclinatus abbreviatus Zone belongs to the time span between the zones with *Phyllograptus densus* and *Phyllograptus angustifolius elongatus*.

Palaeozoogeographical evaluation of the fauna is difficult. The Bohemian area has close relationships with the Montagne Noire area where with the exception of an almost conform graptolite fauna, the species *Symphysurus rouvillei* and *Pliomerops escoti* are encountered. The first of the trilobites mentioned is closely

related to, or identical with the Bohemian *Symphysurus pater*, the second probably agrees with the species *Pliomerops lindaueri* from the Klabava Formation. In addition, according to M. THORAL (1941) in the Arenig of the Montagne Noire the genera *Geragnostus* and *Microparia* (*Microparia*) occur which are also known from



4. Distribution of graptolites in the Euloma Shales The uneven line beneath expresses schematically the transgression boundary of the Euloma Shales of the Algonkian

the Bohemian beds of the same age. Some other important Mediterranean genera, such as *Babinka*, *Redonia*, *Kodymaspis* (here belongs *K. macrophthalmus*), *Bathycheilus* and others are known from the Montagne Noire area from beds as early as of Arenig age (M. THORAL 1935, 1941, T. DEAN 1965), but in the Bohemian area they appear later, i.e. in the Llanvirn.

Certain relations of the Bohemian fauna to the Baltic Province can be seen in the presence of the genus *Ranorthis* in the Arenig rocks of Bohemia: the genus in question was originally reported from Norway. The Bohemian genus *Prantlina* is closely related to the Lower Ordovician genus *Panderina*, widespread in the Estonian S.S.R. and in the Leningrad area, from which it differs only in having parallel vascula media in the ventral valve. The trilobites also indicate certain relations to the Baltic region: the genera *Lichas*, *Megistaspis*, *Symphysurus* and *Euloma* known from the Klabava Formation are also distributed in the Lower Ordovician of the Baltic Province.

In addition to the common elements mentioned there exist essential differences

by which the Arenig of Bohemia is strikingly distinguished from the Anglo-Scandic and Baltic areas. They are: (1) the absence of important brachiopod genera such as *Porambonites*, *Lycophoria*, *Orthis* and others from the Bohemian area, (2) the complete absence from the Bohemian Arenig of the superfamilies *Plectambonitacea* and *Clitambonitacea*, which are well-known from the Baltic Province; (3) the superfamily *Orthacea* is extraordinarily weakly represented in Bohemia; (4) the mollusc fauna is almost totally absent there; (5) bryozoa are not known from the Bohemian Arenig (except for insignificant remnants); (6) the trilobite genera *Plesiomegalaspis*, *Megalaspis*, *Nileus* and others, which are considered to be of importance in the zonal division of the Baltic Arenig, are lacking in Bohemia.

With regard to the general paucity of the fauna in our Arenig, only a few typically "Bohemian" elements can be found which are unknown from areas abroad. They include, for instance, *Nocturnellia* (*Dalmanellacea*) and the trilobite genera *Bohemopyge*, *Aspidaeglina* and *Rokycania*.

Llanvirn

In central Bohemia the Llanvirn is represented by the Šárka Formation which shows a variegated lithological development, similar to the earlier Klabava Formation. The basic lithofacies and their mutual relations have been studied by V. HAVLÍČEK and M. ŠNAJDR (1957). The boundary between the Klabava Formation (Arenig) and the Šárka Formation (Llanvirn) is sharp not only palaeontologically, but also palaeogeographically. At the beginning of the Llanvirn a striking transgression of sea over the pre-Ordovician bedrock took place. At the base of Šárka Formation the Osek-Klabava iron ore horizon is, as a rule, developed. A noteworthy character of the Šárka Formation is the fact that basic volcanic activity attained its maximum there. In the Llanvirn, pyroclastic sediments in the Barrandian basin reach their widest distribution.

The fauna of the Šárka Formation is abundant only in the blackish grey shales. In oolitic iron ores organic remains are rare and consist mainly of fragments of valves of minute inarticulate brachiopods. Pyroclastics of Llanvirn age are unfossiliferous.

The fauna of the Šárka Shales is known primarily from siliceous concretions which were abundant in the localities of Brandýs nad Labem, Úvaly, Žižkov, Šárka, Pětidomky near Zbiroh, in the proximity of Sirá, Těškov, Osek, Rokycany, Lhotka and Libuš. The fauna is also present in shales, but is less well preserved owing to deformation by pressure. A substantial part of the fossils in the Šárka Formation consists of trilobites, of which more than 50 species are known. Especially abundant trilobites are *Megistaspis* (*Nerudaspis*) *aliena*, *Asaphellus desideratus*, *Pricyclopyge binodosa binodosa*, *Ectillaenus katzeri*, *E. šárkaensis*, *Placoparia* (*P.*) *barrandei*, *Colpocoryphe bohemica*, *Ormathops atava*, *Trinucleoides reussi* and others. Compared with the Arenig the number of articulate brachiopods in the

Llanvirn diminished; in particular the representatives of the superfamily *Orthacea* became completely extinct. Only *Eodalmanella socialis* and *Euorthisina moesta* are abundant. Inarticulate brachiopods are represented by several minute species. Contrasting with those of the Arenig, gastropods appear fairly frequently in the Šárka Formation (they have been partly studied by R. Horný). Especially common are: *Gamadiscus nitidus*, *Tropidodiscus* (*Peruniscus*) *pusillus*, *Sinuites sowerbyi*, *Mourlonia desiderata*, *Lesuerella prima.*

In the Šárka Formation primitive lamellibranchs occur, i.e. *Babinka prima*, *Redonia bohemica* and *Monoplacophora* (*Archinacella ovata*). Cephalopods are represented especially by the species *Bathmoceras complexum*, *B. praeposterum*, *Eobactrites sandbergeri*, *Endoceras peregrinum* etc. Very abundant are hyolithids, which are at present being studied by L. Marek.

In contrast to the Lower Ordovician, echinoderms are more abundant in the Šárka Shales. They are represented by the species *Lagynocystites pyramidalis*, *Mitrocystella barrandei*, *Mitrocystites mitra.* Also noteworthy are the abundant ostracods which, however, have not yet been re-studied. Some concretions are crowded with the species *Parapyxion prunella* and *Tallinnella complicata.*

I. Chlupáč has recently described from the Šárka Shales the oldest known representative of the suborder *Limulina*, *Archaeolimulus hanusi.* J. Obrhel reported remains of higher organized plants (*Bojophyton pragense*) from the Šárka Shales.

Graptolites are another important component of the Šárka Shales, and were studied mainly by J. Perner (1895) and B. Bouček (1927, 1932, 1944). They are often associated with animal groups, even in siliceous concretions, for instance, in the Šárka valley and near Rokycany. In addition, graptolites have also been discovered in the iron ore mines in Mníšek, in the Chrbina Mt., in the Krušná hora Mt. and in Kyšice where they often crowd the shale intercalations within the deposit. The graptolites from these shale intercalations are especially important, as they occur either without any associated fauna or in association with minute inarticulate brachiopods or other stratigraphically unimportant organic remains. Different conditions can be observed in the area between Ejpovice and Klabava, where in places the bulk of the Šárka Shales consists of blackish-grey shales in which, apart from the graptolites (especially *Didymograptus*), organic remains are rare; a benthic fauna is almost completely absent. Near Ejpovice and Klabava graptolite shales of Llanvirn age can be found; from the palaeogeographical point of view they were confined to the bay of the sea into which the planktonic fauna was transported by streams. Thus, the sea bay near Ejpovice influenced the faunal association during the Arenig (see the preceding chapter), as well as during the Llanvirn. The sediments of the lower Llandeilo in this area also approach the facies of graptolite shales, though the black shales with graptolites are sandy in places.

The graptolite assemblages change during the Llanvirn and the upper layers of the Šárka Shales differ markedly from the lower ones in graptolitic content. But determination of the graptolite zones in the Llanvirn of Bohemia meets with

the following difficulties: (1) at each locality a somewhat different graptolite assemblage is found; (2) the zones established in one section through the Šárka Shales cannot be applied with confidence to another section.

In the section through the Vokovice brickyard B. BOUČEK (1927, 1944) has established that the lower part of the Šárka Shales belongs to the Didymograptus V-fractus volucer Zone. In addition to abundant trilobites and other groups *Didymograptus bifidus*, *D. denticulatus*, *D. indentus*, *D. artus* and others also occur in this zone. The Didymograptus geminus Zone in the Vokovice brickyard is somewhat younger. The uppermost part is made up of *Didymograptus clavulus* associated with abundant trilobites and other fossils.

A different graptolite assemblage has been established in the iron ore mine on the Krušná hora. In the shale partings of the so-called "small deposit" an interesting graptolite fauna has been found, which is undoubtedly older than the Didymograptus clavulus Zone and was elaborated in detail by B. BOUČEK (1944). The species *Expansograptus lonchotheca*, *E. leptotheca*, *Didymograptus climacograptoides*, *Climacograptus paradoxus* have not yet been found in any other locality. This assemblage has been referred by B. BOUČEK (1944) and A. PŘIBYL (1949) to the Expansograptus lonchotheca Zone, which they consider to be older than the Didymograptus V-fractus volucer Zone.

The graptolite shales of the Šárka Formation have been bored in a close net of bores between Ejpovice and Klabava. In the nothern part of this area graptolite shales are intercalated in the oolitic iron ores; to the south, i.e. towards the axis of the sedimentation basin, the ore facies of the Šárka Formation passes laterally into the shale facies, practically the whole thickness of which consists of graptolite shales devoid of benthic fauna. The following graptolites have been determined here: *Didymograptus retroflexus*[1], *D. bifidus*, *D. perneri*, *D. murchisoni*, *D. denticulatus*, *D. halli*, *D. clavulus*, *Pseudoclimacograptus scharenbergi* and others. The graptolite shales of the Ejpovice area can be divided with certainty into two zones on the basis of two very abundant and easily distinguishable species: below is the Didymograptus *retroflexus* Zone, and above it the D. clavulus Zone. It has been established in one bore (E-40) only that the vertical ranges of these species somewhat overlap: the first (i.e. the youngest) representative of the species *D. retroflexus* was encountered at a depth of 232.0 m; the deepest (= the oldest) occurrence of the species *Didymograptus clavulus* was established in the bore (E-40) at a depth of 238.4 m (the possibility of a slight tectonic disturbance, however, is not excluded).

The iron ore facies in its optimum development, when it represents the whole Llanvirn, is restricted to isolated parts of the basin which were separated in part or

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[1] In our country usually designated as *Didymograptus V-fractus volucer*; at present, the specimens from the Šárka Formation are considered to be a separate subspecies differing from the typical *D. volucer* of the Klabava Formation in having broader stipes. According to B. Bouček they are conspecific with *D. retroflexus* PERNER.

completely by ridges from the rest of the sedimentation area. A lower pH value and a lower salinity (according to an assumption by J. Petránek) rendered the environment of the iron ore facies unsuitable for the development of a marine fauna. In oolitic haematites and in leptochlorites, only fragments of valves of inarticulate brachiopods occur. The fauna is somewhat richer only at the margin of ore lenses, where oolitic haematites and leptochlorites contain a higher proportion of a clayey admixture. From such slightly mineralized layers C. KLOUČEK (1924) reported *Obolus complexus* (Kristiánka gallery near Klabava and the abandoned pit near Osek). In slightly mineralized shales in which leptochlorite and siderite oolites are sparsely disseminated, the fauna, on the whole, conforms with that of the normal Šárka Shales (for instance, in the test pit near Osek).

The biostratigraphical evaluation of the Llanvirn: great palaeogeographical changes between the Arenig and the Llanvirn in central Bohemia (especially a great marine transgression at the beginning of the Llanvirn) were also responsible for striking alterations in the composition of the fauna. Species common to the Klabava and the Šárka Formations rarely occur; an exception is *Obolus complexus*, well-known from the Klabava Formation. C. KLOUČEK (1924) also mentions this species from the base of the Šárka Formation, from the Klabava-Osek ore horizon. A very small number of genera characteristic of the Bohemian Llanvirn appear as early as in the Klabava Formation. Of trilobites there occur *Asaphellus*, *Geragnostella*, *Bohemopyge*, *Microparia*, *Lichas*, *Colpocoryphe* and *Ormathops*. The important genus *Symphysurus*, of Lower Ordovician age, extends from the Klabava Formation into that of Šárka.

B. BOUČEK (1927) was the first to attempt a more detailed biostratigraphical division of the Šárka Formation, using the cross-section of the Vokovice brickyard. Two somewhat differing trilobite assemblages established there by him are of only local importance. More important is the division of the Šárka Formation on the basis of graptolites. In 1927 B. BOUČEK proposed the following zones:

3. Didymograptus clavulus Zone
2. Didymograptus geminus Zone
1. Didymograptus V-fractus volucer Zone

Later, B. BOUČEK (1944) and A. PŘIBYL (1949) distinguished in the Šárka Formation the following zones:

3. Didymograptus clavulus Zone
2. Didymograptus V-fractus volucer Zone
1. Didymograptus lonchotheca Zone

On the basis of borings in the graptolite facies of the Šárka Formation the present authors divide the Šárka Formation into only two zones:

2. Didymograptus clavulus Zone
1. Didymograptus *retroflexus*[2] Zone

[2] According to B. Bouček's recent investigations the large graptolites of the Šárka Formation do not belong to *D. V-fractus volucer*, but they are conspecific with Perner's species *D. retroflexus*.

The interesting graptolite assemblage from the iron ore mine on the Krušná hora Mt., designated by B. Bouček as Didymograptus lonchotheca Zone, is not yet known from any other place. It may locally represent the lower part of the zone with *Didymograptus retroflexus.*

The assignment of the Šárka Formation to the Llanvirn has been made with certainty on the basis of graptolites. *Didymograptus bifidus*, after which the lower Llanvirn zone in Great Britain is named (zone 6 as designated by L. G. Elles and E. M. R. Wood), occurs abundantly in the lower part of the Šárka Formation in the zone with *Didymograptus retroflexus.* The upper boundary of the Llanvirn is defined in the Bohemian as well as the Swedich areas by the occurrence of the species *Didymograptus clavulus. D. murchisoni*, after which the zone of the upper Llanvirn in Great Britain is named (zone 7 of the L. G. Elles and E. Wood scale), also occurs in Bohemia, i.e. in the D. clavulus Zone.

The benthic fauna of the Šárka Formation is of marked Mediterranean character, many "Bohemian" species and "Bohemian" genera are spread over the whole Mediterranean Province from Wales to the Balkans. The striking congruence of fauna in remote regions may be due to some palaeogeographic factors (the transgression at the beginning of the Llanvirn) which made connection between individual basins easier.

In central Bohemia a surprising enrichment of fauna occurred at the beginning of the Llanvirn contrasting with relatively scarce palaeontological finds in the Arenig. Similar conditions may also be observed in other areas of the Mediterranean Province. The improved conditions of life during the Llanvirn of Bohemia made possible the spreading and further evolution of some very rare genera of the Klabava Formation (*Ormathops*, *Colpocoryphe*). Faunas from other areas of the Mediterranean Province also migrated into Bohemia: during the Llanvirn in our country the following genera appeared for the first time: *Babinka*, *Redonia*, *Corrugatagnostus*, *Cyclopyge*, *Pricyclopyge*, *Selenopeltis*, *Bathycheilus*, *Dionide*, *Stapeleyella* and others which are known from the Arenig of Wales, Montagne Noire or other areas. The origin of the Bohemian Llanvirn fauna, however, is not accurately known, as in the vast areas of the Mediterranean geosyncline in the proximity of Bohemia the fossil content became obliterated by the regional metamorphism of sediments.

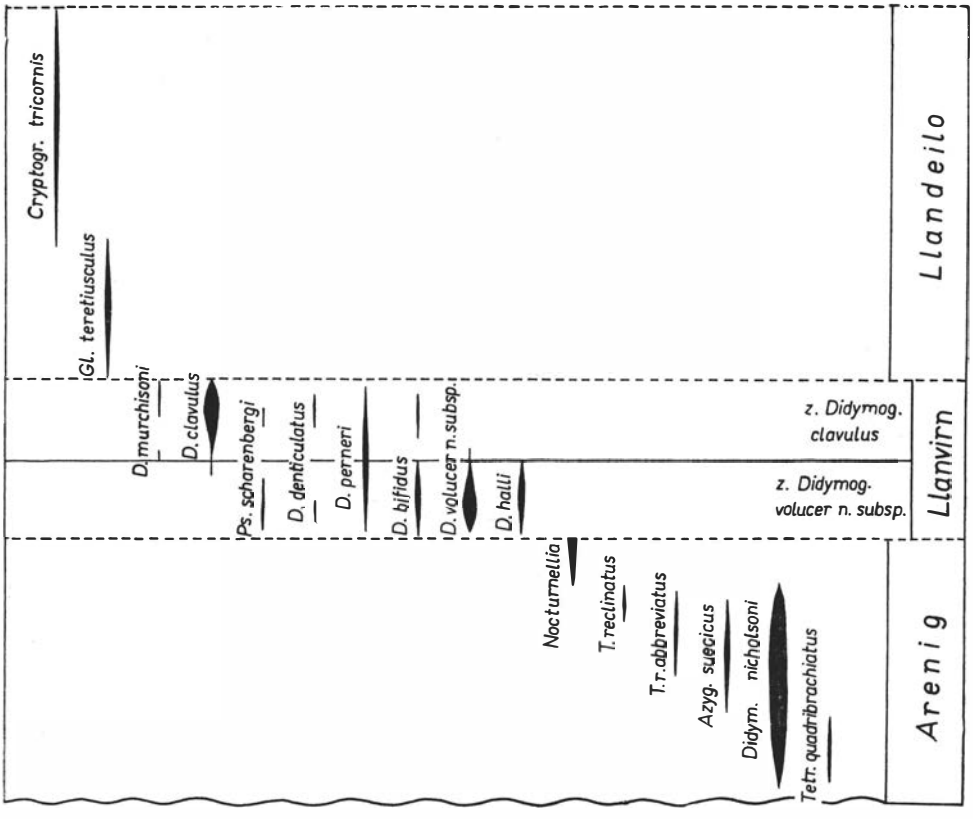
Of clearly Mediterranean character is the Llanvirn of Bulgaria (the core of the Svoge anticline – H. Spasov 1958) where all the graptolite and trilobite species agree with those of Bohemia or are closely related to them. The same age as the Šárka Formation has been established in the Griffelschiefer of Thuringia, in which the Bohemian species *Colpocoryphe inopinata*, *Pharostoma pulchrum vokovicense* (identified by R. and E. Richters [1927] as *Pharostoma pulchrum*), *Megistaspis* (*Nerudaspis*) *aliena* (= *Megalaspis gladiator* as designated by B. Freyberg 1922) occur in association with the species *Hungioides graphicus.*

The Llanvirn of Spain and Portugal also show a close relationship to the Šárka

Formation. Both contain the species and genera *Bathycheilus perplexus*, *Colpocoryphe*, *Placoparia*, *Uralichas* and others.

The fauna from Wales (Shropshire, Shelve Inlier) described by W. F. WHITTARD (1956–1964) is well-known. Many species occur in the Llanvirn of Bohemia as well as that of Wales; they are *Selenopeltis buchi macrophthalma*, *Pricyclopyge binodosa binodosa*, *Novakella bergeroni*, *Ormathops nicholsoni*, *Pharostoma pulchrum vokovicense*, *Stapeleyella inconstans* and others. In spite of this considerable agreement, in Wales there are many species and genera which do not occur in the Ordovicianof Bohemia. For instance, in the Bohemian Ordovician the trilobite *Neseuretus* (= *Synhomalonotus*) widely distributed in the Ordovician of Great Britain, Portugal, Spain, France and Morocco is totally absent. According to N. SPJELDNAES (1961), *Neseuretus* represents one of the most important fossils of the Mediterranean Province.

On the basis of graptolites and other fauna the Šárka Formation can also be correlated with the bed l'assise de Huy (bande silurienne de Sambre-et-Meuse,



5. Distribution of graptolites in the graptolite facies of the Arenig, Llanvirn and Llandeilo in the Ejpovice and Klabava areas (Instead of *Didymograptus volucer* n. subsp. should be: *Didymograptus retroflexus*)

Belgium) from which E. MAILLIEUX reported *Didymograptus bifidus*, *Cyclopyge prisca longicephala* (recte *Pricyclopyge binodosa longicephala*), *Placoparia*, *Lamprocaris*) (=*Cariocaris*) and others.

In the Massif Armoricain, Bohemian species and genera are abundant. J. PÉNEAU (1947) mentioned from Schistes d'Angers a number of species and genera characteristic of the Llanvirn and Llandeilo of Bohemia.

Llandeilo

In Bohemia the Llandeilo is represented by the Dobrotivá Formation. Its most widely distributed and palaeontologically richest facies are the black micaceous Dobrotivá Shales. The Skalka Quartzites represent a special facies, and attain their greatest thickness in the proximity of the ancient coast, where they represent (the Bechlov Mt., the Brdské Hřebeny Mts. and others) the whole Llandeilo. On the other hand, in the centre of the sedimentation basin the Llandeilo is developed only in a shale facies. The pyroclastic sediments, considerably widespread in the central parts of the sedimentation basin, have not yet yielded any fauna. Finally, in the Llandeilo of Bohemia iron ore lenses also occur.

Well-known localities of the Dobrotivá Shales are those in Vokovice and Malé Přílepy where the fauna is well-preserved in carbonate concretions. Rich finds were made in the gallery of Kozojedy (= Sv. Dobrotivá locality) and in workings and boreholes in Ejpovice, near Komárov, Těně, Strašice, Březina and other places. In the Dobrotivá Shales trilobites are very numerous, represented by more than 30 species. Of them the most common are *Parabarrandia crassa*, *Degamella princeps princeps*, *Microparia* (*M.*) *kloučeki*, *Cyclopyge umbonata bohemica*, *Ectillaenus benignensis*, *Placoparia* (*P.*) *zippei*, *Zeliszkella oriens*. Articulate brachiopods are an almost insignificant component of the Llandeilo fauna: compared with the Šárka Formation, a further decrease in their numbers can be observed. In the Dobrotivá Shales only *Leptellina primula* and the very rare *Paurorthis* n. sp. are known. Inarticulate brachiopods are not abundant either; they are represented by *Paterula bohemica*, *Lingulella trimera* etc.

Compared with the Llanvirn, lamellibranchs are more frequent (*Praeleda pulchra*, *Ctenodonta* (*C.*) *applanans* and others). Of the gastropods *Tropidodiscus* (*Peruniscus*) *pusillus*, *Sinuites reticulatus*, *Palaeoscurria ordoviciana*, *Pentalina prantli* should be noted.

Other fairly abundant fossils are conulariids, namely: *Archaeoconularia distincta*, *A. primula*, *Metaconularia imperialis imperialis* etc. Hyolithids are being studied by L. Marek. In the Llandeilo the number of graptolites diminished compared with the Šárka Formation. *Glyptograptus teretiusculus* occurs in the lower half of the Dobrotivá Formation, and is known from the facies of the normal black Dobrotivá Shales, as well as from thin shale partings within the Skalka Quartzites (for instance, on the Žižkov – according to P. RÖHLICH 1960). *Glyptograptus teretiusculus* is

abundant near Ejpovice and Klabava, where it occurs at the margin of the quartzite facies in dark grey, often strongly sandy shales alternating with dark grey greywackes (established by a net of bores). Of importance is a find of the same species in the iron ore mine at Mníšek, in a layer of shale overlying the deposit; it is associated here with a Llandeilo fauna, including *Placoparia* (*P.*) *zippei*, *Archaeoconularia kolihai*, *Pseudoconularia grandissima* and others (see B. BOUČEK 1944). At Mníšek a sequence of quartzite which is of Llandeilo and lower Caradoc age overlies layer of shale with *Glyptograptus teretiusculus.*

In the upper half of the Llandeilo a fairly abundant species, *Cryptograptus tricornis*, occurs locally; it was encountered in borings in Ejpovice, Klabava, Komárov, Těně and other places. J. PERNER (1895) recorded it also from Sv. Dobrotivá.

Less abundant is the fauna in the facies of the Skalka Quartzites. A fauna, found in shale intercalations several metres thick between beds of quartzite, agrees with that of the shale facies (for instance, a rich assemblage in a layer of shale in the quartzite quarry on the Karabinský vrch Hill recorded by J. ŠUF and F. PRANTL 1946).

Organic remains in quartzites are sporadic. In the Brdské Hřebeny Mts. in addition to some columnals of crinoids the trilobites *Cyclopyge umbonata bohemica* and *Selenopeltis buchi macrophthalma* have been found rarely. In the quartzites of Llandeilo age on the Chrbina Mt., valves (often fragmentary) of the species *Svobodaina dalmanelloides* occur. *Leptellina primula* is fairly abundant in the facies of shale, but only one specimen was found in a quartzite bed on the Velíz Hill. One specimen of the species *Calix purkyněi* comes from Skalka Quartzites of Ejpovice.

The fauna of the iron ores of Llandeilo age is known only from a small lens near Kařízek which yielded the following species: *Paterula bohemica*, *Metaconularia imperialis imperialis*, *Metaconularia munita munita*, *Mourlonia desiderata*, *Zbirovia arata*, *Dindymene plasi*, *Eoharpes benignensis*, *Hemicystites lipoldi* and others.

The biostratigraphic evaluation of the Llandeilo: the fauna of the Llandeilo of Bohemia is well-defined and is more distinct from that of the later Caradoc than from the earlier Llanvirn. Many genera represented in the Šárka Formation pass also into the Dobrotivá Formation, for instance, *Paterula*, *Patelliconus*, *Sinuites*, *Tropidodiscus* (*Peruniscus*), *Mourlonia*, *Sphaeragnostus*, *Corrugatagnostus*, *Leiagnostus*, *Kodymaspis*, *Parabarrandia*, *Lichas*, *Pateraspis*, *Eoharpes*, *Trinucleoides*, *Caryocaris*, *Mitrocystites.* Important genera which do not continue from the Llanvirn into the Llandeilo are as follows: *Eodalmanella*, *Euorthisina*, *Babinka*, *Asaphellus*, *Novakella*, *Uralichas*, *Plasiaspis*, *Bathycheilus*, *Stapeleyella* and *Mitrocystella.* In the Dobrotivá Formation the genera *Svobodaina*, *Synek*, *Dceruška*, *Emmrichops*, *Lehua*, *Dionidella* appear for the first time in our country.

A detailed biostratigraphic division of the Dobrotivá Formation has not been carried out, and the fauna is, on the whole, of uniform character. Differences can best be observed in the quantitative representation of species at single localities.

As the Dobrotivá Formation is developed throughout its whole thickness as black shales, it can be established that in its lower half *Glyptograptus teretiusculus* is abundant, though not reaching the upper layers. In the upper half of the Dobrotivá Formation *Cryptograptus tricornis* is locally abundant.

The correlation of the Ordovician of Bohemia with the classical area of Great Britain has been made on the basis of the characteristic species *Glyptograptus teretiusculus*. From the latest papers on the Ordovician (A. WILLIAMS 1953; W. F. WHITTARD 1960) it follows that only one graptolite zone, that of *Glyptograptus teretiusculus* corresponds to the Llandeilo.

The Llandeilo fauna of the Mediterranean Province is imperfectly known. The Bohemian area shows a close relationship to the Anti-Atlas mountain range (Morocco) where les grès du premier Bani (J. DESTOMBES 1963) contain similar fossils. In the Llandeilo of Morocco some genera occur which are characteristic of the Dobrotivá Formation. In addition, les grès du premier Bani contain some genera (*Dalmanitina*, *Kloučekia*) which in Bohemia for the first time appear in the lower Caradoc.

A similar "mixed" character of fauna is found in Belgium in the Sart-Bernard Formation (E. MAILLIEUX 1939) where species and genera occur, which are important for the Bohemian Llandeilo as well as the Bohemian Caradoc.

Caradoc

In central Bohemia, the Caradoc consists of a sequence of sandstones, greywackes and black shales which in the central parts of the sedimentation basin attains a thickness from 1500 to 2000 m. The lower part of the Caradoc consists of the Libeň and the Letná Formation; the middle Caradoc comprises the Vinice and the Zahořany Formations. The Bohdalec Formation is assigned to the upper Caradoc. In the biostratigraphic investigation of the Bohemian Caradoc the work of B. BOUČEK (1928) is especially important.

The Libeň Formation

The Libeň Shales and the "Drabov" Quartzites (= Řevnice Quartzites in the present concept) were originally regarded as two separate stratigraphic members (R. KETTNER and F. PRANTL 1948 and others). V. HAVLÍČEK (1961, 1962) has, however, established that the "Drabov" Quartzites and the Libeň Shales represent two facies of equal age. In extreme cases the whole lower part of the Caradoc is formed of quartzites only or (E of Prague) of black shales (except for one single bed of quartzite 2 m thick). V. Havlíček suggested, therefore, that the two facies should be termed the Libeň Formation. A very widespread facies of the Libeň Formation comprises poorly fossiliferous black shales. The second facies—the Řevnice Quartzites—occupies the borders of the sedimentation basin and in the

western Barrandian area forms the whole thickness of the Libeň Formation. The last facies of the Libeň Formation—the volcanic complex—has not yet yielded any organic remains.

In the Řevnice Quartzites the fauna is confined to some localities, the most important of which are the following: Kařízek, Zbiroh—railway station, the forest Koželuška near Lhota pod Račem, the mountains Rumpál, Čilina and others. The fauna consists mainly of trilobites and brachiopods, but fairly abundant are also lamellibranchs, conulariids, ostracods, columnals of crinoids etc. The fauna is restricted to quartzites with clay-galls, and is frequently crushed; this accounts for its rapid transport.

Important trilobites are *Zbirovia arata*, *Primaspis* (*P.*) *primordialis*, *Colpocoryphe grandis*, *Dalmanitina čilinensis*, *Ormathops inflatus* (= *O. mirus*). Compared with the earlier Dobrotivá Formation, the number of brachiopods increased, representatives of the genera *Drabovia* and *Hirnantia* especially predominating. Further, *Mesodalmanella flava*, *Svobodaina svobodai*, *Giraldiella sp. n.* are also of importance. There occur the first representatives of the subfamily *Aegiromeninae* i.e. *Aegiromena aquila praecursor*. Inarticulate brachiopods (*Paterula bohemica*, *Petrocrania obsoleta* and others) are rare in the Řevnice Formation.

Lamellibranchs are poorly preserved, but *Ctenodonta* (*Ct.*) *bohemica* and *Praeleda incola* have been determined. Gastropods are not abundant and are preserved in the form of internal moulds; they can be identified only with difficulty. The same holds good for the orthoconic nautiloids. Because of their bad preservation bryozoa (about 4 species) are unidentifiable.

In contrast to the other fauna of the Řevnice Quartzites, conulariids are well-preserved: their tests, often 10 to 20 cm long, do not show traces of damage, which contrasts with the crushed carapaces of the trilobites. The tests of freely swimming conulariids were evidently spared long transport in fine sand.

The second facies of the Libeň Formation — the black micaceous Libeň Shales — contains considerably fewer organic remains. A not very numerous fauna has been collected in Motol, Libeň and other localities. Of stratigraphic importance is the species *Dalmanitina čilinensis*, occurring in the shale facies as well as that of quartzite. In the Libeň Shales an undeterminable debris of graptolites has rarely been established.

Notes: The fauna of the Libeň Formation differs strikingly from that of the older Dobrotivá Formation: for the first time there appear characteristic genera such as *Heterocyclopyge*, *Stenopareia*, *Cekovia*, *Calymenella*, *Dalmanitina*, *Kloučekia*, *Eccoptochile*, *Actinopeltis*, *Marrolithus* and other trilobites. For the first time and in comparatively large numbers brachiopods of the subfamilies *Draboviinae* and *Aegiromeninae* are encountered. *Mesodalmanella* newly appears. Of echinoderms – in contrast to the older Dobrotivá Formation – in the Libeň Formation the genus *Rhombifera* is represented.

The following trilobite genera common to the Dobrotivá and the Libeň Formations are: *Zbirovia*, *Selenopeltis*, *Placoparia*, *Pharostoma*, *Colpocoryphe*, *Ormathops*, *Zeliszkella*. Several genera do not pass from the Llandeilo into the Libeň Formation; these are *Parabarrandia*, *Kodymaspis*, *Emmrichops*, *Pateraspis*, *Lehua*, *Eoharpes* and *Trinucleoides*.

The Letná Formation is made up predominantly of greywackes alternating locally with black shales. In places quartzite intercalations are abundant. The volcanic centre is small (near the villages Žebrák and Chlustina).

In the Letná Formation fossils are rare as a rule. Palaeontological localities are concentrated mainly in the Beroun area, whence comes the well-known fauna which was assigned by J. Barrande to the stage Dd 2. Of the main localities Knížkovice, Trubská, Zahořany, the mountain Děd (= Drabov as designated by J. Barrande), the mountain Ostrý, Chrustenice and others are mentioned. The fossils contained in the Letná Formation are very similar to those of the Libeň Formation, but the number of the species represented here is somewhat greater. The fauna is often crushed just as in the earlier Řevnice Quartzites. In the Letná Formation, however, layers of quartzose sandstones also occur in which the fauna is well-preserved and not broken; complete trilobites can often be found (especially on the Děd Mt.). The palaeontological localities in the Beroun area are concentrated in the upper part of the Letná Formation. The single layers differ from each other in the preservation of fauna as well as in the different faunal associations. The quartzose sandstones of the upper portions on the mountains Děd and Ostrý contain especially *Dalmanitina socialis*, *Onnia goldfussi*, *Eccoptochile* (*E.*) *clavigera*, *Calymenella parvula*, *Selenopeltis buchi buchi* and others. Of brachiopods the most abundant here are *Drabovia redux* and *Drabovinella draboviensis*. The upper layers of the Letná Formation (the localities on the mountains Děd and Ostrý) have yielded some unusual arthropods, such as *Furca bohemica* (*Marellomorpha*), aglaspid merostomes *Zonozoe drabowiensis*, *Drabovaspis complexa*, *Caryon bohemicum*, *Triopus draboviensis* and a trilobitomorph arthropod of the order *Cheloniellida*, *Duslia insignis*.

From the quartzose sandstones on the mountains Děd and Ostrý come abundant conulariids, *Anaconularia anomala*, *Metaconularia consobrina* etc., lamellibranchs "*Grammysia*" *catilloides*, *Modiolopsis draboviensis*, the crinoid *Ascocystites draboviensis* and others.

The characteristic faunal horizon occurs in greywackes in the uppermost layers directly underlying the Nučice ore horizon; the localities in question are especially those near Trubská, Zahořany and Chrustenice. The faunal assemblage in the uppermost parts of the Letná Formation changes rapidly from place to place. In some localities brachiopods prevail, but in others trilobites and ostracods are also abundant. In addition to the trilobites (*Stenopareia panderi*, *Pharostoma pulchrum mendax*) there are *Bicuspina cava*, *B. multicostellata*, *Dactylogonia blyskavensis*, *Aegiromena aquila praecursor*, *Mesodalmanella flava*, *Hirnantia ulrichi* and other brachiopods. *Mespilocystites bohemica*, *Dendrocystites sedgwicki*, *Rhombifera bohemica*, *Macrocystella bohemica* are also abundant in the uppermost parts of the Letná Formation. Locally numerous are *Ptychopeltis incola*, the gastropods *Holopea*

antiqua, *Versispira contraria*, *Bucanella bohemica*, *Sinuitopsis neglecta*, the ostracods *Ceratopsis hastata*, *Crescentilla pugnax*, *Tallinella bohemica* and others.

Notes: The fauna of the Letná Formation is closely related to that of the Libeň Formation (especially its quartzite facies). The predominant trilobites, brachiopods, molluscs, conulariids and others are the same in both formations. In contrast to the Libeň Formation, *Dalmanitina socialis* occurs in the Letná Formation; it is a descendent of the species *D. čilinensis*. Of brachiopods *Drabovinella drabovensis*, *Bicuspina cava*, *B. multicostellata*, *Dactylogonia blyskavensis* occur for the first time. *Hirnantia ulrichi* is a direct descendant of the earlier species *H. index* from the Řevnice Quartzites. In the top parts of the Letná Formation the genera *Rafinesquina* and *Dalmanella*, which are typical of the middle Caradoc of Bohemia, are rarely found. In the Letná Formation the gastropods *Cyrtodiscus procer* and *Bucanopsis roemeri* occur for the first time. The Letná Formation also differs from the Libeň Formation in the presence of some bizarre genera such as *Ascocystites*, *Furca*, *Duslia*, *Triopus*, *Zonozoe* and *Drabovaspis*.

Only one important species is confined to the quartzite facies of the Libeň Formation and does not occur in the Letná Formation – *Svobodaina svobodai*. The Letná Formation is also devoid of *Dalmanitina čilinensis*, known from the Libeň Shales as well as from the Řevnice quartzites.

The Vinice Formation

(Synonym: the Černín Formation)

In central Bohemia the Vinice Formation consists mainly of black micaceous shales which show a common fauna in all outcrops. A somewhat different faunal assemblage is present in the Nučice ore horizon at the base of the Vinice Formation. In some places (near Zdice and Chrustenice) the Vinice Formation is intercalated with sandstones and greywackes; this facies has not yielded any characteristic fauna.

The fauna of the shales comprises everywhere only a small number of species. Localities rich in fossils are those between Trubín and Beroun (the foot of the mountain Děd) from which came a considerable part of Barrande's original material. Of trilobites the following species are abundant: *Opsimasaphus* (*Nobiliasaphus*) *nobilis nobilis*, *Cyclopyge rediviva*, *Heterocyclopyge pachycephala*, *Stenopareia panderi*, *Selenopeltis buchi buchi*, *Zeliszkella deshayesi*, *Dalmanitina proeva*, *Eudolatites angelini*, *Marrolithus ornatus senftenbergi*, *Dionide formosa*. In the shales of the Vinice Formation articulate brachiopods are very rare ("*Mesodalmanella*" *bancrofti*, "*Orthis*" *granulifera*). Lamellibranchs, gastropods and hyolithids are more abundant.

In the Vinice Formation graptolites do not appear in great numbers; they are represented by *Glyptograptus trubinensis trubinensis*, *Rectograptus truncatus truncatus* and others.

A different faunal assemblage occurs in the Nučice ore horizon: in addition to the species current in the Vinice Formation the trilobites *Cekovia götzi* and *Marrolithus ornatus paulisper* are found and are not known from other places. In contrast to the shale facies, in the Nučice ore horizon echinoderms (*Heliocrinites helmhackeri*, *Echinosphaerites infaustus*, *Aristocystites bohemicus*, *Fungocystites rarissimus*, *Hippocystis batheri*), brachiopods (*Rostricellula ambigena*, *Giraldiella*

cf. *partita*, *Dalmanella chrustenicensis*, *Drabovia transgrediens*) and gastropods (*Ferrogyra antiqua*, *Versispira ferrigena* and *V. rugosa*) are abundant.

Notes: The Černín Shales were introduced by R. KETTNER and F. PRANTL (1948) and are identical with the Vinice Formation in the sense of J. KREJČÍ and V. M. LIPOLD (1860) and J.KREJČÍ (1860, 1862). Therefore, the name of Černín Shales is rejected as a younger synonym.

The fauna of the Vinice Formation is essentially more closely related to the later Zahořany Formation than to the preceding Letná Formation. Some species are common to the Letná Formation, such as *Stenopareia panderi*, *Zbirovia arata*, *Eccoptochile* (*E.*) *clavigera*, *E.* (*Eccoptochiloides*) *tumescens*. In contrast to the earlier beds in the Vinice Formation the following species appear for the first time: the trilobites *Cekovia salteri*, *Primaspis* (*Chlustinia*) *keyserlingi*, *Zeliszkella deshayesi*, *Eudolatites angelini*, *Marrolithus ornatus senftenbergi* etc., the brachiopods *Drabovia transgrediens*, *Rostricellula ambigena* and others.

Certain differences in the fossil content of the Letná and Vinice Formations are due to their different age and differing petrographic composition. Many genera for which a firm sandy bottom was more convenient (for instance, brachiopods) are relatively poorly represented in the Vinice Formation compared with the earlier Letná Formation and the later Zahořany Formation.

The Zahořany Formation

(Synonym: the Chlustina Formation)

In all outcrops the Zahořany Formation is predominantly formed of siltstones and is fossiliferous practically everywhere. The best-known palaeontological localities are those in the Beroun area (for instance, Praskolesy, Zahořany, Vráž, Loděnice) and in Prague (Libeň, Strašnice). The fauna occurs in compact siltstones or in intercalations and lenses of greyish blue sandy limestones. The best-preserved fauna comes from weathered pelocarbonate concretions (especially at Libeň, Spořilov, Loděnice, Běchovice) occurring locally in the upper half of the Zahořany Formation. A somewhat different assemblage occurs at the eastern border of Prague in layers of grey shales with a slight admixture of silt.

The fauna of the Zahořany Formation is, on the whole, closely related to the Vinice Formation, but is richer in the number of species. Of trilobites the following species dominate: *Selenopeltis buchi buchi*, *Primaspis* (*Chlustinia*) *keyserlingi*, *Flexicalymene incerata*, *Pharostoma pulchrum pulchrum*, *Dalmanitina proeva*, *Actinopeltis globosa* and *Marrolithus ornatus ornatus*. Brachiopods, which in places are abundant, belong to *Onniella frequens*, *Howellites altera*, *Drabovia transgrediens*, *D. latior*, *Svobodaina inclyta*, *Rafinesquina pseudoloricata*, *Aegiromena aquila aquila*, *Triplesia deformata* and others. The mollusc fauna is characterized by the species *Praeleda compar*, *Ctenodonta* (*Ct.*) *ponderata*, *C.* (*C.*) *incisa*, *C.* (*C.*) *praecox*, *C.* (*C.*) *bohemica*, *Palaeoneilo magna*, *Sinuitopsis neglecta*, *Grandostoma bohemicum*, *Lophospira viator*, *Holopea vermiculosa*; in addition several species of orthoconic nautiloids have been established, but have not been revised. In the siltstones with calcitic cement the bryozoa *Monotrypa affinis*, *M. certa*, *M. disculus*, *M. pragensis*, *Batostoma lamellata* and *B. počtai* are fairly abundant.

Rarely there occur graptolites, especially *Glyptograptus trubinensis extensus*, *G. insculptus*, *Rectograptus truncatus truncatus* and *R. bohemicus*.

Of other groups *Archaeoconularia fecunda*, *Pseudoconularia grandissima nobilis*, *P. grandissima grandissima*, "*Hyolithes*" *elegans*, "*H.*" *solitarius*, *Anatifopsis bohemica*, *Ribeirella sharpei*, *Ribeiria apusoides*, *Plumulites fraternus* should be mentioned. The solid bottom built of siltstones was suitable for echinoderms which are abundant in the Zahořany Formation. Noteworthy are *Codiacystites bohemica*, *C. moneta*, *Aristocystites bohemica*, *Echinosphaerites infaustus*, *E. barrandei*; in Zahořany peculiar species such as *Cardiocystites bohemica*, *Fungocystites solitaria* etc. have been found.

A somewhat different fauna occurs in the clayey shales with a small admixture of silt, which forms rather thick layers in the upper part and locally in the middle part of the Zahořany Formation, especially in the eastern part of Prague. The species *Bohemilla pragensis*, *Declivolithus alfredi*, *Geragnostella* sp., *Neklania* etc. are confined to these shales.

Notes: Chlustina Formation was introduced by R. KETTNER and F. PRANTL (1948); it corresponds to the Zahořany Formation in the sense of J. KREJČÍ and M. V. LIPOLD (1860) and J. KREJČÍ (1860, 1862). Owing to the complicated facies development of the Ordovician the conception of the stratigraphic extent of the Zahořany Formation was often changing. In this paper the authors return to the original concept of the Zahořany Formation and reject the name Chlustina Formation as a younger synonym[3].

The general character of the fauna in the Zahořany Formation agrees with that of the Vinice Formation; the differences in their fossil content are due to their diverse lithological character influencing the faunal assemblages. In the Zahořany Formation – owing to the compact bottom – fairly numerous species of sessile benthos (brachiopods, bryozoa, cystoids) are encountered. On the other hand, the species adapted better to the bottom of soft hydroplastic mud, for instance the trilobites of the family *Cyclopygidae*, *Dionididae*, are almost lacking in this formation.

The Vinice and Zahořany Formations can be distinguished from each other by some trilobites and graptolites. In the Vinice Formation *Marrolithus ornatus senftenbergi* is abundant, while in the Zahořany Formation *Marrolithus ornatus ornatus* occurs.

The graptolite *Glyptograptus trubinensis trubinensis* is typical of the Vinice Formation, while in the Zahořany Formation a younger subspecies, *Glyptograptus trubinensis extensus* is present.

The Bohdalec Formation

The Bohdalec Formation, as a rule, is made up of dark grey thinly bedded clayey shales. In the Prague area and near Běchovice the so-called Polyteichus facies occurs which consists of siltstones (often with calcitic cement) alternating with layers of silty and clayey shales. The Polyteichus facies is to be found in the upper half of the Bohdalec Formation and was earlier termed Polyteichus Horizon. A fauna occurs also in the Karlík ore horizon lying at the base of the Bohdalec Formation.

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[3] The re-examination of Barrande's Drabov Formation and Lipold and Krejčí's Vinice and Zahořany Formations has been dealt with in greater detail by V. HAVLÍČEK (1967 - in press) in a special paper concerning the revision of some stratotypes.

The fossil content of the Bohdalec Formation was studied especially by B. BOUČEK (1928), P. RÖHLICH and I. CHLUPÁČ (1952) and P. RÖHLICH (1957). Compared with the earlier Zahořany Formation the number of trilobites in the Bohdalec Formation diminished, but that of molluscs and brachiopods increased.

The trilobites *Eudolatites angelini*, *Phacopidina solitaria*, *Kloučekia phillipsi*, *Declivolithus alfredi* and *Onnia abducta* are characteristic of the clayey shales of the Bohdalec Formation. The brachiopods *Aegiromena descendens* and *Drabovia postrema* are typical of this facies. The clayey shales also contain abundant minute inarticulate brachiopods (*Paterula*, *Lingulella*), lamellibranchs (*Synek antiquus*, *Dceruška primula*), gastropods (*Archinacella tarda*, *Sinuitopsis neglecta*, *Bucanella bohemica*, *Lophospira viator*, *Holopea vermiculosa*) and hyolithids (*"Hyolithes" striatulus*, *"H." solitarius*) and other fossils.

Compared with the Polyteichus facies in the facies of clayey shales bryozoa are rare. Ostracods of the Bohdalec Formation have been described by E. A. SCHMIDT (1941). In some places Chitinozoa are very abundant.

The graptolites, which are not abundant here, belong to the species *Diplograptus vulgatus*, *Rectograptus bohdalecensis*, *R. lingulitheca* and *Orthograptus spinosus* (see A. PŘIBYL 1949). At the base of the Bohdalec Formation (closely overlying the iron ore horizon of Karlík) *Dicranograptus* cf. *clingani* has been found again.

The Polyteichus facies was distinguished by better conditions of life for sessile benthos than the shale facies. Some intercalations of calcitic siltstones and sandy limestones are crowded by bryozoa (see R. KETTNER 1913), of which *Monotrypa kettneri*, *Batostoma počtai*, *B. prantli*, *Polyteichus nováki* are common. Columnals of the crinoids *Caleidocrinus artifex* and *C. anonymus* are abundant. The following species of brachiopods dominate: *Rafinesquina pseudoloricata*, *Heterorthina notata*, *Heterorthis sosia*, *Horderleyella boučeki*, *Rostricellula ambigena* and the sofar not described species of the genera *Drabovia* and *Hirnantia*. The trilobite *Calymenella media* is characteristic of this facies, and the lamellibranchs *Orthonota antecedens*, *Palaeoneilo flectens* and *P. magna* should especially be mentioned. *Kloučekia phillipsi*, *Flexicalymene incerta*, *Svobodaina inclyta*, *Horderleyella boučeki* abound particularly in places where the Polyteichus facies passes laterally into the shale facies.

The Karlík iron ore horizon carries a fauna that of the Bohdalec Formation; the species *Stenopareia vaněki* and *Onniella* sp. n. are, however, so far known from this horizon only.

Notes: The fauna contained in the Bohdalec Formation is closely related to the earlier Zahořany Formation, but differs markedly from that of Králův Dvůr which is younger. Most of the trilobites reported from the Bohdalec Formation are also known from the Zahořany Formation, with the exception of *Stenopareia vaněki* and *Onnia abducta*, which occur in the Bohdalec Formation only. In evaluating the brachiopods, similar conditions can be observed, as the majority of species are common to the Zahořany and the Bohdalec Formations. The species *Aegiromena descendens*, *Heterorthis sosia* and *Drabovia postrema* are found only in the Bohdalec Formation. In order to distinguish the Zahořany Formation from that of Bohdalec, graptolites may be used.

Of the important species which disappear in the Zahořany Formation, not extending into the Bohdalec Formation, *Marrolithus ornatus ornatus*, *Howellites altera*, *Onniella frequens*, *Aegiromena aquila aquila*, *Bucanopsis calypso* and *B. roemeri* should be noted.

The biostratigraphic evaluation of the Caradoc: In the Caradoc of Bohemia – starting with the Libeň Formation and ending with the Bohdalec Formation – the fauna has, on the whole, a uniform character. The faunal assemblages of the individual Caradoc beds differ from each other only in detail, the general character being preserved. *Cekovia*, *Stenopareia*, *Primaspis*, *Calymenella*, *Dalmanitina*, *Kloučekia*, *Eudolatites*, *Actinopeltis*, *Eccoptochile*, *Marrolithus*, *Onnia* etc. are trilobite genera typical of the Caradoc. Of these genera *Dalmanitina*, *Kloučekia*, *Actinopeltis*, *Onnia* and *Stenopareia* extend up into the Ashgill. Of brachiopods the development of the family *Dalmanellidae* should be emphasized; even abroad this development occurs in the Caradoc, though the first representatives of this family appear as early as in the Llanvirn. Very characteristic of the Bohemian Caradoc is the subfamily *Draboviinae*, occurring as early as the Libeň Formation and disappearing as late as the upper Ashgill. Another subfamily characteristic of the Bohemian Caradoc is the *Aegiromeninae*, which can be traced from the Libeň Formation to the end of the Ashgill. Species of *Aegiromena* are used for the detailed biostratigraphic division of the Caradoc and also the Ashgill. The genus *Svobodaina* is also typical of the Bohemian Caradoc; it has been established for the first time in the Skalka Quartzites (Llandeilo). *Svobodaina* is to be found during the whole Caradoc, it does not, however, extend into the Ashgill.

Compared with the Anglo-Scandic and Scoto-Appalachian Provinces, in the Caradoc (as in the Llanvirn and Llandeilo) of Bohemia the absence of some of the brachiopod superfamilies spread throughout the world, such as *Orthacea* and *Clitambonitacea*, is striking. By contrast with other areas, the *Strophomenacea* are represented in Bohemia to only a small extent, by *Rafinesquina* and the rare genus *Dactylogonia*. Of lamellibranchs the genera *Pseudocyrtodonta*, *Palaeoneilo*, *Praenucula*, *Dceruška*, *Orthonota*, *Ctenodonta* etc. occur in Bohemia and a similar lamellibranch assemblage has been reported from Belgium by E. MAILLIEUX (1939). The gastropod genera *Sinuitopsis*, *Versispira* and *Grandostoma* are also important.

Compared with the Arenig and the Llanvirn, the graptolite fauna is, unfortunately, relatively poor and little known. In the lower Caradoc (in the Libeň and the Letná Formations) graptolites have not yet been found. According to A. PŘIBYL (1949), the graptolites from the Vinice, Zahořany and Bohdalec Formations are represented by species which — except for a few cases — are known only from Bohemia.

B. BOUČEK (1937) assigned to the Caradoc only the Loděnice Formation (i.e. The Vinice and the Zahořany Formations in the present-day concept) and the Bohdalec Formation and equated them with the British graptolite zones of *Climatograptus wilsoni*, *Dicranograptus clingani* and *Pleurograptus linearis*. The Drabov

and Chrustenice Formations (i.e. the Libeň and Letná Formations as they are termed today) have been referred by B. Bouček to the upper Llandeilo as an equivalent of the zones of *Nemagraptus gracilis* and *Climacograptus peltifer*. Bouček's correlation with the British zones is still correct, but the boundary between the Caradoc and the Llandeilo is now considered differently. B. BOUČEK (1937) based his conclusion on the papers by G. ELLES and E. WOOD (1901–1918) who assigned the graptolite zones with *Nemagraptus gracilis* and *Climacograptus peltifer* to the upper Llandeilo. At present, due to a revision of the Llandeilo type area (A. WILLIAMS 1953), the opinions on the definition of the stages under consideration have somewhat changed. The Llandeilo (see W. F. WHITTARD 1960) ranges within the Glyptograptus teretiusculus Zone only, while Caradoc involves a sequence of five zones, starting with the Nemagraptus gracilis Zone and ending with that of Pleurograptus linearis. It is, therefore, necessary to revise even in Bohemia the assignment of some formations to the respective stages. In Bohemia, no doubt, the Caradoc is represented by a thick sequence of sandstones, greywackes and shales overlying the Glyptograptus teretiusculus Zone (i.e. above the Dobrotivá Formation) and underlying the Králův Dvůr Shales with their important Ashgill fauna.

In this broad sense the definition of the Caradoc meets with difficulties; especially striking is the difference between the ranges of the individual Ordovician stages. In Bohemia about almost two thirds of the total thickness of the Ordovician belongs to the Caradoc, while the remaining five stages take up about one-third of the total thickness of the Ordovician. The present-day definition of the Caradoc causes another difficulty, when the Ordovician of Bohemia and Britain is correlated with the Scandinavian and Baltic areas. In the Baltic area (see R. MÄNNIL 1959, 1963, A. RÕÕMUSOKS 1960 et al.) the boundary is drawn between the Viruan (i.e. the Middle Ordovician) and the Harjuan (i.e. the Upper Ordovician) at the junction of the Dicranograptus clingani and the Pleurograptus linearis Zones. This boundary does not agree with the boundaries of the stages established in Great Britain, but it falls within the Caradoc. It is evident that the Caradoc in the present-day concept is too wide; the present authors, therefore, suggest that the Caradoc in Bohemia be divided into three substages which certainly will hold good in a still wider area of the Mediterranean Province. The substages proposed are as follows: the Chrustenice Substage (lower Caradoc), the Loděnice Substage (middle Caradoc) and the Bohdalec Substage (upper Caradoc).

To the Chrustenice Substage are assigned the Libeň Formation (both its facies—the Libeň Shales and the Řevnice Quartzites) and the Letná Formation. The type area is the vicinity of Chrustenice on the left bank of the brook Kačák. The Chrustenice Substage begins with whitish-grey quartzites of Řevnice overlying the Dobrotivá Shales (Llandeilo) and extends beneath the Nučice ore horizon which forms the base of the succeeding Loděnice Substage.

The Loděnice Substage is made up of the Vinice and the Zahořany Formations;

the type area lies in the wide valley near Loděnice where the section of the substage begins with the Nučice ore horizon (still mined) and continues beneath the Karlík ore horizon which forms here the base of the succeeding Bohdalec Substage.

The Bohdalec Substage consists of the Bohdalec Formation; its type area is the southern foothills of the Bohdalec Hill where this substage commences at the Karlík ore horizon and extends beneath the Podolí ore horizon belonging to the Ashgill.

The Chrustenice Substage has not yet yielded any graptolite fauna; but Bouček's assumption (1937) that this substage corresponds to the Nemagraptus gracilis and Climacograptus peltifer Zones is probably correct. Important index fossils of this substage are *Onnia goldfussi* and the brachiopods *Aegiromena aquila praecursor* and *Mesodalmanella flava*. The Chrustenice Substage can be divided into two zones, a lower—with the typical trilobite *Dalmanitina čilinensis* and an upper—with *Dalmanitina socialis*. Likewise, on the basis of brachiopods two zones can be defined, the earlier with *Hirnantia index* and the later with *Hirnantia ulrichi*. The lower zone corresponds to the Libeň Formation, the upper to the Letná Formation.

The Loděnice Substage contains a graptolite fauna which—probably owing to its poor preservation—has not yet been satisfactorily studied. A. Přibyl (1949) quotes several species of the genus *Climacograptus*, *Glyptograptus* and *Rectograptus*. On the basis of graptolites A. Přibyl established in the Černín (= Vinice) Formation the Glyptograptus trubinensis Zone; the upper part of the Loděnice Substage, the Zahořany Formation, corresponds to the Glyptograptus insculptus Zone. A. Přibyl (1949) correlated the Černín (= Vinice) Formation (i.e. the G. trubinensis Zone) with the British Climacograptus wilsoni Zone and the Chlustina (= Zahořany) Formation (i.e. the G. insculptus Zone) with the Dicranograptus clingani Zone.

Recently, *Dicranograptus* cf. *clingani* has been found in Bohemia in the lower part of the Bohdalec Formation closely overlying the Karlík ore horizon, so that it is now possible to carry out a more accurate correlation of the Bohemian Caradoc with that of Britain. In our opinion the Loděnice Substage (i.e. the Vinice and the Zahořany Formations) only corresponds to the British Climacograptus wilsoni Zone. Our assumption is supported by the occurrence of the species *Climacograptus* cf. *wilsoni* quoted by A. Přibyl in the Černín (= Vinice) as well as the Chlustina (= Zahořany) Formations. The graptolites designated by A. Přibyl (1949) as *C.* cf. *wilsoni* are very closely related to the typical British *C. wilsoni* or may even be identical with it.

A species characteristic of the Loděnice Substage is *Aegiromena aquila aquila* which is abundant in practically all outcrops. The Loděnice Substage can be divided into two zones on the basis of graptolites (see above) as well as trilobites. The trilobite zone of Marrolithus ornatus senftenbergi corresponds to the Vinice Formation and the Zahořany Formation belongs to the Marrolithus ornatus ornatus Zone.

According to A. Přibyl the latest substage of the Caradoc—the Bohdalec Substage—belongs to the *Diplograptus vulgatus* Zone; compared with the British area, the Bohdalec Substage corresponds to the Dicranograptus clingani Zone as well as—from its position directly below the Ashgill—to the Pleurograptus linearis Zone. The Bohdalec Substage, made up of the Bohdalec Formation, is well-defined by the important widespread species *Aegiromena descendens. Drabovia postrema* and *Heterorthis sosia* are also typical, whilst the index trilobite species is *Onnia abducta.*

The "Bohemian" Caradoc fauna is widely distributed in the Mediterranean Province. Assise de Sart-Bernard in Belgium, containing a characteristic "Bohemian" Cadaroc fauna with predominating lamellibranchs is of Caradoc age. In the Sart-Bernard Formation, trilobites, especially *Dalmanitina proeva* (figured by E. MAILLIEUX 1939 and designated as *Dalmanites atavus*) and *Cyclopyge rediviva*, are present.

A typical "Bohemian" Caradoc fauna is also represented in Morocco (the Anti-Atlas), from where it has been reported by J. DESTOMBES (1963) from the sequence Série du Ktaoua inférieure and the lower part of the sequence Série du Ktaoua supérieure. In the Caradoc of the Montagne Noire (France) a considerable number of species differs from those of Bohemia. The correlation of the Caradoc of Bohemia with the greywackes of Languedoc was made possible by the occurrence of *Dalmanitina proeva.* Another element of the Bohemian Caradoc is represented in the greywackes of Languedoc by the genus *Svobodaina* (= *Orthis* [*Rhipidomella*] aff. *inclyta* as designated by M. DREYFUSS [1948]).

Ashgill

In central Bohemia the Ashgill is divided into two petrographically and palaeontologically different Formations. They are the Králův Dvůr Formation (below) and the Kosov Formation (above). In our country O. KODYM (1919), I. CHLUPÁČ (1951, 1952), L. MAREK (1951, 1963) and others were engaged in the biostratigraphy of the Ashgill.

The Králův Dvůr Formation

The Králův Dvůr Formation consists predominantly of grey or greyish-green shales; pyroclastic sediments are only locally developed near Beroun. At the base of the Králův Dvůr Formation, in the close vicinity of Prague, the oolitic slightly mineralized Podolí Horizon occurs locally.

The fauna of the Králův Dvůr Formation is rich, involving more than 40 species of trilobites. The sessile and vagrant benthos are represented by abundant lamellibranchs, hyolithids, gastropods, brachiopods and others. Some minute brachiopods

(*Chonetoidea radiatula* and *Ch. tenerrima*) belonged to plankton and may have been attached to algae. In the Králův Dvůr Formation the fauna is not uniformly distributed; its abundance and character, however, vary in both the vertical (i.e. depending on various stratigraphic altitudes) and horizontal (depending on the lithological development) directions. The richest occurrences can be found near Králův Dvůr and Zdice; in the direction towards Prague the basin became moderately deeper, as is shown by less numerous faunal assemblages (especially striking is the decreasing number of sessile benthos).

A rich assemblage has been recorded in the lower half of the Králův Dvůr Formation at the well-known Barrande's locality Lejškov near Zdice. Many species found in this locality have not been recorded from the upper layers of the Králův Dvůr Formation. From the Lejškov locality *Chonetoidea radiatula*, *Comatopoma barrandei*, *Grandostoma grande*, *Synek antiquus*, *Ctenodonta* (*C.*) *expansa*, *Trinodus tardus*, *Amphitryon radians*, *Microparia* (*M.*) *speciosa*, *Symphysops armata*, *Dysplanus wahlenbergianus*, *Zdicella zeidleri*, *Phillipsinella parabola*, *Flexicalymene declinata*, *Brongniartella inexspectata*, *Carmon mutillus*, *Dalmanitina mucronata*, *Actinopeltis gryphus*, *Areia* (*Areia*) *bohemica*, *Pseudosphaerexochus pectinifer*, *Dionide speciosa*, *Tretaspis granulata*, *Raphiophorus tenellus*, *R. gratus*, *Lonchodomas portlocki*, *Glyptograptus teres* have been noted; ostracods, orthoconic nautiloids, hyolithids and others are also abundant. The rich fauna of the lower half of Králův Dvůr Formation is also known in addition to Lejškov from two other localities. The "Lejškov" assemblage of fauna was established by I. Chlupáč (1952) at the base of the Králův Dvůr Shales near Svinaře and by V. Havlíček and L. Marek at Spořilov in beds closely overlying the Bohdalec Formation. In other parts of the Barrandian area the lower half of the Králův Dvůr Formation consists of greyish green fine clayey shales carrying a generally uniform fauna. In it the prevailing trilobite *Amphitryon radians* is associated with the species *Microparia* (*M.*) *speciosa*, *Octillaenus hisingeri*, *Lonchodomas portlocki*, *Bucanella bohemica*, *Lingulella lejskoviensis*, *Chonetoidea tenerrima*, "*Atrypa*" *inanis* etc. In the upper part of this monotonous assemblage *Dicellograptus anceps* occurs fairly frequently.

Another important assemblage appears in the upper half, 15 to 25 m under the base of the Kosov Formation. This assemblage is confined to compact, greyish green micaceous shales with a silty admixture which—contrary to the underlying and overlying fine clayey shales—were a more favourable environment for the development of sessile benthos. Barrande's localities near Králův Dvůr are situated in the shales mentioned. These compact shales have also been reported by I. Chlupáč from Karlík (bed No. 4 in his concept) and from Velká Chuchle (bed No. 5). The faunal assemblage is characterized by *Kozlowskites nuntius*, *Leptestiina prantli*, *Foliomena folium*, *Dedzetina macrostomoides*, "*Atrypa*" *abscondita*, "*A.*" *inanis*, *Grandostoma grande*, *Dicellograptus anceps* and others.

According to I. Chlupáč the compact shales are overlain by olive green shales

with abundant *Climacograptus angustus* which in the whole south-eastern limb of the Barrandian region forms a persistent horizon (it has not been traced in the north-western limb). With *Climacograptus angustus* are associated *Trinodus tardus*, *Kloučekia phillipsi*, *Tretaspis seticornis seticornis*, *Lonchodomas portlocki*, *Parapyxion prunellus*, "*Atrypa*" *inanis*, minute lingulellae, orthoconic nautiloids and others.

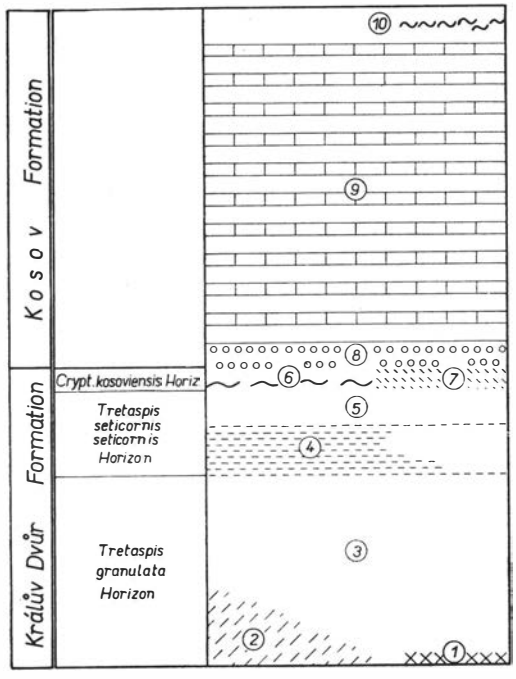
A very characteristic assemblage occurs in the top portions of the Králův Dvůr Formation, in a layer of greyish-green pelocarbonate and in beds directly overlying it. The above-mentioned 0.5 to 1.0 m thick pelocarbonate rests about 3 m under the base of the Kosov Formation; it is known primarily from Králův Dvůr (a quarry at the foot of the Kosov mountain); it has also been reported by I. Chlupáč near Liteň and Zadní Třebáň and thins out to the east. It appears again near Malá Chuchle in the form of a thin parting carrying the important fossil *Cryptolithus kosoviensis*. Near Prague, the uppermost parts of the Králův Dvůr Formation are represented by greyish green chondritic shales (for instance, at Velká Chuchle) in which fossils are rare. The pelocarbonate bed and the layers closely overlying it yield a rich fauna, of which the following species have been recorded: *Aegironetes tristis*, *Anoptambonites moneta*, *A. quaesita*, *Kozlowskites nuntius*, *Dedzetina honorata*, *Zdicella* aff. *bornholmensis*, *Stenopareia oblita*, *Bronteopsis sola*, *Gravicalymene asperula*, *Dalmanitina mucronata*, *Duftonia morrisiana*, *Actinopeltis insocialis*, *Staurocephalus clavifrons*, *Cryptolithus kosoviensis*, ostracods, hyolithids and others. In the uppermost beds near Zadní Třebáň *Glyptograptus teres* (I. CHLUPÁČ 1951) is associated with *Dalmanitina mucronata* and other important fossils.

In the Prague area the oolitic horizon of Podolí is developed at the base of the Králův Dvůr Formation, and is of lenticular character, with a variable thickness of up to 10 m locally. The poor faunal assemblage includes among others *Aegiromena ultima*, *Octillaenus* cf. *hisingeri* and *Actinopeltis gryphus*.

Notes: The difference in the fossil content of the Bohdalec Formation and that of the Králův Dvůr Formation is considerable, so that in our country the boundary between the Caradoc and the Ashgill is sharp. In the Králův Dvůr Formation appear for the first time the following genera of trilobites: *Amphitryon*, *Telephina*, *Octillaenus*, *Dysplanus*, *Zdicella*, *Bronteopsis*, *Phillipsinella*, *Carmon*, *Brongniartella*, *Stubblefieldia*, *Leonaspis*, *Duftonia*, *Cheirurus* (*Cheirurus*), *Pseudosphaerexochus*, *Zazvorkaspis*, *Staurocephalus*, *Cryptolithus*, *Tretaspis*. A considerable difference can also be observed in the occurrence of articulate brachiopods, compared with that in the earlier Bohdalec Formation. The genera *Anoptambonites*, *Kozlowskites*, *Leptestiina*, *Anisopleurella*, *Foliomena*, *Fardenia*, *Dedzetina*, *Comatopoma* appear for the first time in Bohemia. Some of the above-mentioned genera of trilobites and brachiopods are characteristic of the Ashgill. Others, however, are known from the Caradoc of Great Britain or the lower Harjuan and Viruan of the Baltic Province and include, for instance, *Telephina*, *Dysplanus*, *Staurocephalus*, *Lonchodomas*, *Tretaspis*, *Cryptolithus*, *Anoptambonites*, *Anisopleurella* etc. These genera do not belong to the original elements of the Mediterranean Province, but came to Bohemia during the Ashgill with the immigration of a warm water fauna from Great Britain and the Baltic Province. The genera of gastropods such as *Temnodiscus*, *Strangulites* and *Pterotheca* occur in our country for the first time in the Králův Dvůr Formation.

The genera whose occurrence ends in the Bohdalec Formation and does not extend into that of Králův Dvůr are as follows: the trilobites *Opsimasaphus* (*Nobiliasaphus*), *Declivolithus*, *Eccoptochile*,

Pharostoma, *Primaspis* (*Chlustinia*) and the brachiopods *Svobodaina*, *Howellites*, *Heterorthis* and *Heterorthina*. The Caradoc genera *Rafinesquina*, *Drabovia*, *Hirnantia*, *Dalmanella* etc. do not occur in the Králův Dvůr Formation, but they reappear in the Kosov Formation. Their absence from the Králův Dvůr Formation is, no doubt, due to less suitable conditions for the development of sessile benthos. *Triplesia* ends also in the Bohdalec Formation and is not represented in the Ashgill of Bohemia. Beyond the frontiers (in the Baltic area) it extends upwards to the Silurian.



6. Detailed stratigraphy of the Ashgill of Bohemia

1 – Karlík ore horizon; *2* – shales with fauna of the "Leiškov type"; *3* – greyish-green shales with poor fauna; *4* – compact silty shales with *Foliomena folium*, *Kozlowskites nuntius* etc.; *5* – yellowish-brown shales with *Climacograptus angustus*; *6* – layer of pelocarbonates with abundant fauna; *7* – chondritic shales with poor fauna; *8* – two conglomerate intercalations at the base of the Kosov Formation; *9* – alternation of quartzose sandstones, greywackes and shales; *10* – greyish-green shales, in places with intercalations and concretions of pelocarbonates

The study of faunal assemblages carried out by I. Chlupáč yielded a synopsis of the fossils included in the Králův Dvůr Shales. On the basis of the revision of trilobites in the Králův Dvůr Formation three horizons may be established:

3. Cryptolithus kosoviensis Horizon
2. Tretaspis seticornis seticornis Horizon
1. Tretaspis granulata Horizon

The first horizon with Tretaspis granulata takes up the lower half (in places even more) of the Králův Dvůr Formation and the typical faunal assemblage is that of Lejškov. The palaeontologically poor shales of the lower half of the Králův Dvůr Formation are also assigned to this first horizon.

The Tretaspis seticornis seticornis Horizon (the second) already rests on the upper half of the Králův Dvůr Formation. In its lower part are compact shales with the important *Foliomena folium* and *Dedzetina macrostomoides*; in the upper part olive green shales with *Climatograptus angustus* occur (the faunal assemblages have been given in detail above).

The uppermost (third) horizon directly underlies the Kosov Formation; the typical fauna is that of pelocarbonates with the abundant species *Cryptolithus kosoviensis* and *Aegironetes tristis* (for the list of fauna see above).

The Králův Dvůr Formation belongs to a single graptolite zone, that of Dicellograptus anceps (the latter appears for the first time at about 10 to 12 m above the base). Earlier, B. Bouček (1928) assumed that *Glyptograptus teres* forms a separate zone in the lower part of the Králův Dvůr Formation. Later, however, I. Chlupáč (1951) found this graptolite even in the upper layers of this formation.

The Kosov Formation

A sequence of sandstones, greywackes and silty shales is assigned to the Kosov Formation, their lower boundary is marked lithologically by the appearance of a first conglomerate intercalation 15 to 20 cm thick. Not far from it, at about 1.5 to

3 m distance, another conglomerate layer is developed, ranging from 0.5 to 10 m in thickness. The Kosov Formation has been evaluated from the lithological point of view by B. Bouček and A. Přibyl (1958) and Z. Kukal (1961).

The rhythmical sedimentation of the Kosov Formation was not suitable for the development of fauna. The palaeontological localities occur mostly in the uppermost portions of this formation; the fauna occurs there partly in quartzose sandstones (mainly lamellibranchs) and partly, in shales and pelocarbonate concretions. The palaeontological localities were discovered by L. Marek (1951, 1963) in Nová Ves near Prague and in Běchovice.

At the base of the Kosov Formation, in a layer of shale between the first and the second conglomerate intercalations, L. Marek found the species *Glyptograptus bohemicus* (N of Běchovice). Except for this isolated find no other organic remains are known from the lower half of the Kosov Formation.

More favourable palaeontological conditions exist in the upper layers. Several metres under the lower boundary of the Silurian in Nová Ves, Běchovice and other places light coarse-grained quartzose sandstone with abundant lamellibranchs (*Modiolopsis* sp.), *Dalmanitina mucronata* etc. is developed. The sandstone bank is overlain by greyish green shales attaining several metres in thickness and including pelocarbonate lenses. Fossils occur in the shales as well as, and especially, in pelocarbonates; they have so far been described only in part (a detailed study is being prepared by L. Marek). Of brachiopods *Leptaena rugosa*, *Bracteoleptaena polonica*, *Eostropheodonta hirnantensis*, *Hirnantia sagittifera*, *H. kielanae*, *Dalmanella testudinaria*, *Plectothyrella platystrophoides* and representatives of the genera *Aegiromena*, *Rafinesquina*, *Onniella*, *Drabovia*, *Cliftonia*, *Zygospira*, *Trematis*, *Philhedra* are reported. The trilobites *Brongniartella platynota* and *Dalmanitina mucronata* are of importance. Lamellibranchs, gastropods, *Tentaculites* sp., *Mespilocystites* n.sp., collumnals of crinoids etc. are also abundant. The shales of the top portions of the Kosov Formation are rich in *Glyptograptus bohemicus*.

Notes: Due to its different lithological character the fauna of the Kosov Formation is very distinct from the underlying Králův Dvůr Formation. In particular the number of brachiopod species is far greater, and among them many genera new to Bohemia appear as a result of the immigration of a warm water fauna from the Baltic area. On the other hand, compared with the Králův Dvůr Formation the number of trilobites decreased substantially. In the Kosov Formation in Bohemia after an interruption certain genera which lived here in the Caradoc reappear; they are *Tentaculites*, *Trematis*, *Rafinesquina*, *Dalmanella*, *Drabovia*, *Hirnantia*, *Mespilocystites* and others.

The biostratigraphic evaluation of the Ashgill: The Ashgill in Bohemia can be divided on the basis of graptolites into two zones, the earlier Dicellograptus anceps Zone corresponding to the Králův Dvůr Formation and the later Glyptograptus bohemicus Zone corresponding to the Kosov Formation. *Dicellograptus complanatus*, characteristic of the lower Ashgill of Great Britain, is not yet known in Bohemia.

The boundary between the Caradoc and the Ashgill is sharp not only in the palaeontological but also in the petrographical sense. At the base of the Králův Dvůr Formation in the Prague area the oolitic Podolí Horizon is developed. The boundary between the Ashgill and the Llandovery (i.e. the boundary of the Ordovician and the Silurian) is well marked petrographically and palaeontologically. Above the top beds of the Kosov Formation (i.e. micaceous shales, locally with Ashgill fauna) Silurian black graptolite shales begin. In the south-eastern flank of the Barrandian basin and east of Prague (Běchovice) the Silurian, consisting of the lower Llandovery zones with Akidograptus ascensus and Akidograptus acuminatus (L. MAREK 1951, R. HORNÝ 1962), rests on the Ordovician. The boundary between the Ashgill and the Llandovery is sharp here, but devoid of a stratigraphic hiatus. Other conditions exist in the north-western flank and in the Prague area where sedimentation was temporarily interrupted and a gap arose, so that in some places the Kosov Formation is overlain by graptolite shales of upper Llandovery or lower Wenlock age.

The presence of *Dalmanitina mucronata*, *Brongniartella platynota*, *Leptaena rugosa* and *Dalmanella testudinaria* known from the Ashgill of the Baltic area bears witness to the Ashgill character of the fauna in the Kosov Formation.

The fauna of the Llanvirn, Llandeilo and Caradoc of Bohemia was of pronounced Mediterranean character. During the Ashgill, however, the character of fauna changed. In the lower Ashgill (in the lower part of the Králův Dvůr Formation) the first striking immigration of a warm water fauna from Great Britain and the Baltic area (across the Holy Cross Mts.) showed itself. It is for the first time that in our country the genera *Amphitryon*, *Dysplanus*, *Pseudosphaerexochus*, *Telephina*, *Tretaspis*, *Anisopleurella* etc. appear. The immigration of fauna then continued during the Ashgill. In the bed of compact pelocarbonates close under the base of the Kosov Formation new elements of the British and Baltic fauna in the shape of the genera *Anoptambonites*, *Fardenia*, *Cryptolithus* and the characteristic species *Staurocephalus clavifrons* appear.

The fauna of the Králův Dvůr Formation is, therefore, of a mixed character: in addition to the above-mentioned British and Baltic elements, the influence of the original Mediterranean fauna is shown especially by the occurrence of the genera *Aegiromena*, *Dalmanitina*, *Kloučekia*, *Areia*, *Actinopeltis*, *Opsimasaphus* and the family *Cyclopygidae*.

The greatest influx of a warm water Baltic fauna began in Bohemia in the uppermost Ashgill, the Kosov Formation. The originally Mediterranean character of the fauna was strongly reduced and replaced by new elements, strangers to the Mediterranean Province. Of the original "Bohemian" fauna the following genera should be mentioned: *Aegiromena*, *Hirnantia*, *Drabovia* and *Dalmanitina*. In consequence of the upper Ashgill immigration in the Kosov Formation the genera *Paracraniops*, *Cliftonia*, the species *Leptaena rugosa*, *Eostropheodonta hirnantensis*, *Plectothyrella platystrophoides*, *Dalmanella testudinaria* and others appeared. The mixing of the

Baltic and Mediterranean fauna on the territory of Bohemia is due to palaeogeographic as well as to climatic conditions.

During the Ashgill not only the influx of the British and the Baltic fauna into Bohemia can be observed, but a migration in an opposite direction can also be traced. Z. KIELAN (1959) calls attention to the presence of the genera of the *Cyclopygidae* family, as well as the genera *Stubblefieldia*, *Dindymene*, *Dionide*, *Opsimasaphus*, *Placoparia* (*Hawleia*) and others in Poland and Scandinavia whose origin should be sought in Bohemia.

The fauna of Bohemia shows a close relationship not only to the fauna of Poland and Scandinavia—as has been discussed in greater detail by Z. KIELAN (1959) but also to some areas of the Mediterranean Province. A very closely related faunal assemblage occurs in the Anti-Atlas (Morocco) in the upper part of the sequence Série du Ktaoua supérieure (J. DESTOMBES 1963). On the other hand the Ashgill of the Montagne Noire area (M. DREYFUSS 1948) displays very few elements in common with the Králův Dvůr or the Kosov Formations.

The brachiopod assemblage of the latest Ashgill (upper layers of the Kosov Formation) is very similar to the *Hirnantia* fauna from North Wales and the English Lake District, as well as to that of the upper Ashgill beds of the Holy Cross Mts. (J. TEMPLE 1965). The greater part of the brachiopod species mentioned from the Kosov Formation occur in beds of the same age in England, Wales and Poland.

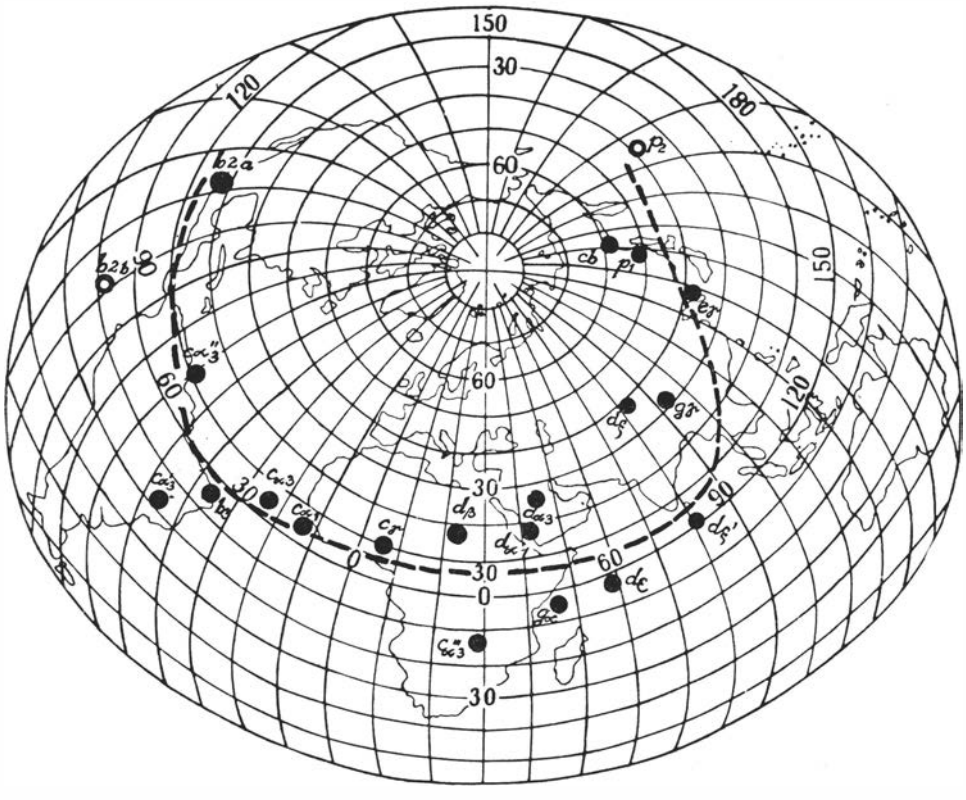
Conclusion

N. SPJELDNAES (1961) was engaged in the study of faunal assemblages of the European Ordovician with a special view to their regular distribution. According to this author the Ordovician faunas form marked zones affected by geographic conditions and the climate; these zones are the basis of palaeozoogeographical provinces. N. Spjeldnaes discerns in the direction from the north-west to the south-east

a) the American-Arctic Province,
b) the Appalachian Province (fauna of Scoto-Appalachian type),
c) the Anglo-Scandic Province which contains fauna of the Anglo-Scandic type (namely, geosyncline-facies) and that of the Baltic type,
d) the Mediterranean Province to which the area of Bohemia also belongs.

According to N. Spjeldnaes the individual provinces are defined geographically. The northernmost American-Arctic Province is of a pronouncedly warm character, as is shown by the presence of a fauna with thick-walled valves, numerous species of cephalopods, gastropods, corals etc. South-eastwards the character of the fauna changes through the cold temperate fauna to that of Arctic seas to which the Mediterranean Province incontestably belongs. The Mediterranean fauna is distinguished (as compared with other provinces) by a relative paucity of species, a very

small number of bryozoa, cephalopods and an almost total bsence of corals. N. Spjelpnaes based his conclusions on the climatic character of individual provinces on the analysis of fauna and palaeomagnetic measurements; starting from the knowledge of that time in the sphere of paleomagnetism this author placed the



7. Position of the North Pole during the Ordovician established on the basis of palaeomagnetic measurements in the Lower Palaeozoic of Bohemia (taken over from V. BUCHA 1961)
b_2 – Algonkian; c – Cambrian; d – Ordovician; e, g – Silurian and Devonian; cb – Carboniferous; p – Permian

South Pole roughly in the area of the present-day Central Africa. According to him the Mediterranean fauna should be regarded as Antarctic. The latest studies in palaeomagnetism carried out in the Palaeozoic of central Bohemia by V. BUCHA (1961) have, however, shown a somewhat different picture of the placing of poles. During the Ordovician the North Pole migrated approximately across Central Africa eastwards and then continued its course in the same direction during the Silurian and the Devonian. The pronouncedly cold temperate character of the Mediterranean fauna is, therefore affected by the proximity of the North Pole (see fig. 7).

The gradual shifting of the North Pole eastwards during the Ordovician brought about some substantial climatic changes; a striking influx of the Baltic warm water fauna into central Bohemia at the close of the Ordovician was undoubtedly conditioned by climatic changes as a consequence of the gradual removal of the Pole from the Bohemian area.

The Arctic character of the Mediterraen Province has not only been proved by palaeomagnetic measurements and the character of fauna, but the cold climate also made possible the origin of glaciers in some areas. During the Middle Ordovician (Llandeilo or Caradoc) a mountain glacier, no doubt, existed on the ridge of a geanticline on the present-day territory of the German Democratic Republic. Ice-worn boulders with distinct striae are in some places present in the "Lederschiefer" shales (written communication by RAINER HÄHNEL, Jena, German Democratic Republic).

In the Ordovician, the Mediterranean Province took up an extensive geosynclinal area stretching from the Iberian Peninsula through western Europe to central Europe and farther to the Balkans. The northern coast of Africa also belongs to this area. The Ordovician of the Mediterranean Province (contrary to the Anglo-Scandic Province) is little known. Vast portions of the Mediterranean geosyncline were affected by strong tectonic movements, a considerable amount of fossils have been obliterated, due to the regional metamorphism of sediments. In addition, the Palaeozoic complexes are today concealed under the Mesozoic and the Tertiary of the Alpine and Carpathian systems. Of the originally extensive geosyncline only ruins remain to be studied. One of the best-preserved areas of the Mediterranean Province is, no doubt, the area of central Bohemia, where a complete non-metamorphosed sequence of the Ordovician carrying a well-preserved fauna still exists. Although the abundance of the fauna is far less than that of the Baltic area or elsewhere, a satisfactorily detailed stratigraphy can be traced.

Less known is the Ordovician of Belgium, the Massif Armoricain and the Montagne Noire, probably because of a less favourable preservation and in places due to an incomplete succession of beds. Palaeontologically very poor is the Ordovician in Thuringia. A palaeogeographical and biostratigraphical evaluation is still more difficult in the occurrences of the Ordovician appearing in the cores of anticlines in the Alpine system (Carnic Alps, Rhodope Massif, Bulgaria and other places). Difficulties arise even in the palaeogeographical evaluation of the Ordovician on the territory of Czechoslovakia. The Ordovician of central Bohemia (of the Barrandian basin), the evidence of which is well-furnished by fauna, passes gradually eastwards into a monotonous sequence of black clayey shales in which fauna occurs extraordinarily rarely (perhaps due to a deep-water environment). In addition, the Ordovician east of Prague has been affected by a strong schistosity and locally even by a slight regional metamorphism. In eastern Bohemia a fauna has been found in the Železné hory (Tremadoc, Caradoc) only and in fragments of black shales included in the volcanic breccia near Semtín. The Ordovician at other places in

Czechoslovakia (the Krušné hory [Erzgebirge], the Sudeten, the Spišsko-gemerské rudohorie etc.) has not been palaeontologically proved; conclusions as to the Ordovician age can be made with more or less great probability only according to the lithological development and on the basis of the palaeogeographical position etc.

The Ordovician of Bohemia is in close relationship to other areas of the Mediterranean Province as regards palaeogeography (it belongs to the same geosynclinal area) as well as its fauna. The common palaeontological characteristics have been briefly pointed out in the discussion of the fossil content of the individual stages.

A comparison of the Ordovician of the Mediterranean Province with the adjacent provinces is difficult and can for the present only be carried out approximately. Difficulties arise from the very differing fossil content in various areas as well as a great number of names introduced for newly established stages. The correlation of individual areas becomes difficult because the extent of the classical British stages is interpreted by various authors in different ways. The present state of knowledge is shown in table 4.

Table 4
Correlation of the Ordovician of Bohemia with areas abroad

Estonian S. S. R. Rõõmusoks 1960			Russian Platform T. N. Alichova 1960	Kazakstan B. M. Keller 1960	Bohemia		Great Britain
series	stage	horizon	stage	stage	stage	substage	Graptolite zones
Harju		Pirgu	Ashgill	Ashgill	Ashgill		Dicellograptus anceps Dicellograptus complanatus
		Vormsi					
		Nabala	Plüs	Dulankarine	Caradoc	Bohdalec	Pleurograptus linearis
		Rakvere					
Viru	Kurna	Oandu	Ieve (Jõhvi)	Anderken			Dicranograptus clingani
		Keila				Loděnice	Climacograptus wilsoni
		Jõhvi					
		Idavere	Llandeilo	Llandeilo		Chrustenice	Climacograptus peltifer Nemagraptus gracilis
	Purtse	Kukruse					
		Uhaku			Llandeilo		Glyptograptus teretiusculus
		Lasnamägi					
		Aseri		Llanvirn	Llanvirn		Didymograptus murchisoni Didymograptus bifidus
Oeland	Ontika	Kunda	Arenig				
		Volchov		Arenig	Arenig		Didymograptus hirundo Didymograptus extensus Dichograptus
	Iru	Leetse	Tremadoc	Tremadoc	Tremadoc		Bryograptus Dictyonema flabelliforme
		Pakerort					

Třenice Formation

Lingulobolus feistmanteli (BARR.)
Thysanotos siluricus (EICHW.)
Westonia lamellosa (BARR.)
„Obolus" giganteus KOL.
Lingulella expulsa (BARR.)
Lingulella libečovensis KOL.
Lingulella bukovensis KOL.
Lingulella arachne (BARR.)
Lingulella wirthi (BARR.)
Acrotreta minima (BARR.)
Acrotreta inchoans (BARR.)
Siphonotreta krafti RŮŽ.
Siphonotreta simulans RŮŽ.
Apheoorthina ferrigena HAVL.
Apheoorthina bohemica HAVL.
Jivinella praecendens PRANTL - RŮŽ.
Ocnerorthis soror (BARR.)
Ocnerorthis filia HAVL.
Orthambonites růžičkai HAVL.
Angusticardinia zelenkai (PTL. RŮŽ.)
Nanorthis rara HAVL.
Nanorthis? bavarica (BARR.)
Poramborthis kettneri HAVL.
Poramborthis lamellosa (RŮŽ.)
Poramborthis grimmi (BARR.)
Poramborthis anomala HAVL.
Tritoechia kolihai HAVL.
Tritoechia kodymi HAVL.
Mimospira aff. *helmhackeri* (PER.)
Holubaspis perneri (RŮŽ.)
Hemibarrandia holoubkovensis (RŮŽ.)
Platylichas kloučeki (RŮŽ.)
Bavarilla hofensis (BARR.)
Eulomina granulatum (RŮŽ.)
Eulomina mitratum (RŮŽ.)
Pilekia bohemica (RŮŽ.)
Pharostomina cf. *öpiki* SDZUY
Paleosphaeronites crateriformis (RŮŽ.)
Glyptosphaerites ferrigena (RŮŽ.)
Dictyonema flabellaforme intermedium PTL.-PŘ.
Callograptus (*C.*) *kodymi* PRANTL - PŘ.

Mílina Formation

Pyritonema feistmanteli POČ.
Thysanotos siluricus (EICHW.)
Lingulella insons (BARR.)
Orbiculoidea sodalis sodalis (BARR.)
Orbiculoidea sodalis undulosa (BARR.)
Acrotreta minima (BARR.)
Jivinella incola (BARR.)
Jivinella slavíki (KLOU.)
Poramborthis kloučeki HAVL.
Geragnostus bavaricus (BARR.)
Leiagnostus franconicus SDZUY
Dikelokephalina ulrichi RŮŽ.
Diceratopyge troedssoni SDZUY
Holubaspis perneri (RŮŽ.)
Hemibarrandia holoubkovensis RŮŽ.
Niobella innotata (BARR.)
Leimitzia bavarica (BARR.)
Curiaspis notabilis SDZUY
Parabolina frequens (BARR.)
Platylichas kloučeki (RŮŽ.)
Eulomina mitratum (RŮŽ.)
Proteuloma geinitzi (BARR.)
Pharostomina ferentaria SDZUY
Apatokephalus asarkus SDZUY
Pilekia olešnaensis (RŮŽ.)
Orometopus kloučeki VANĚK
Harpides grimmi BARR.

Klabava Formation

Protospongia nováki POČ.
Pyritonema barrandei POČ.
Archaeoconularia insignis (BARR.)
Metaconularia munita munita (BARR.)
Conulariella sulca (ŽEL.)
Berenicea vetera PRANTL
Obolus punctatus KLOU.
Obolus complexus (BARR.)
Obolus kloučeki KOLIHA
Lingulella insons (BARR.)
Lingulella rugosa (BARR.)
Lingulella sulcata (BARR.)
Orbiculoidea sodalis undulosa (BARR.)
Acrotreta minima (BARR.)
Paterula prima KLOU.
Siphonotreta verrucosa (EICHW.)
Ranorthis lipoldi HAVL.
Ranorthis? grossi (BARR.)
Archaeorthis přibyli HAVL.
Prantlina desiderata (BARR.)
Prantlina bohemica (BARR.)

Prantlina oolithica HAVL.
Nocturnellia nocturna (BARR.)
"Hyolithes" klabavensis HOL.
Mimospira helmhackeri (PER.)
Geragnostus splendens (HOL.)
Geragnostella consors (HOL.)
Rokycania primula (HOL.)
Symphysurus pater (HOL.)
Bohemopyge decorata (HOL.)
Megistaspis (?n. subg.) *cuspidatus* (HOL.)
Asaphellus bohemicus ŽEL.
Aspidaeglina miranda HOL.
Microparia bröggeri (HOL.)
Lichas praecursor HOL.
Euloma bohemicum HOL.
Euloma inexspectatum HOL.
Colpocoryphe sp. n.
Ormathops sp. n.
Pliomerops lindaueri (BARR.)
Pseudopetigurus hofmanni (PER.)
Caryocaris cf. *marri* HICKS
Caryocaris cf. *wrighti* SALT.
Dictyonema krafti BOUČ.
Callograptus (*C.*) cf. *expansus* BUL.
Callograptus (*C.*) *rokycanensis* BOUČ.
Callograptus (*Alternograptus*) *holubi* BOUČ.
Dendrograptus horáki BOUČ.
Dendrograptus irregularis BOUČ.
Dendrograptus kloučeki BOUČ.
Desmograptus callograptoides BOUČ.
Thamnograptus rokycanensis BOUČ.
Schizograptus tardifurcatus ELLES
Holograptus expansus HOLM
Azygograptus suecicus MOB.
Tetragr. (*T.*) *reclinatus reclinatus* ELL. WOOD
Tetragr. (*T.*) *reclinatus abbreviatus* BOUČ.
Tetragr. (*T.*) *bigsbyi* (SALT.)
Tetragr. (*Eotetragraptus*) *harti* (HALL)
Tetragr. (*E.*) *quadribrachiatus* (HALL)
Tetragraptus (*E.*) *headi* (HALL)
Expansograptus cf. *goldschmidti* (MON.)
Didymograptus nicholsoni LAPW.
Didymograptus strangulatus BOUČ.
Didymograptus minutus TÖRNQ.
Didymograptus simulans ELL. et WOOD
Didymograptus V-fractus SALT.
Didymograptus volucer volucer NICH.
Didymograptus deflexus ELL. et WOOD
Phyllograptus angustifolius HALL

Šárka Formation

Archaeoconularia insignis (BARR.)
Archaeoconularia primula (BARR.)
Exoconularia exquisita exquisita (BARR.)
Metaconularia imperialis imperialis (BARR.)
Metaconularia munita munita (BARR.)
Plectoconularia proteica proteica (BARR.)
Pseudoconularia grandissima grandissima (BARR.)
Pseudoconularia grandissima nobilis (BARR.)
Conulariella robusta (BARR.)
Conulariella purkyně (ŽEL.)
Conchicolites primus (BARR.)
Obolus complexus (BARR.)
Lingulella debilis (BARR.)
Lingulella curta (BARR.)
Paterula bohemica BARR.
Euorthisina minor HAVL.
Euorthisina šarkaensis HAVL.
Euorthisina moesta (BARR.)
Eodalmanella socialis (BARR.)
Eodalmanella mimica (BARR.)
"Hyolithes" cinctus BARR.
"Hyolithes" euglyphus NOV.
"Hyolithes" pauxillus NOV.
"Hyolithes" hanuši ZÁZV.
"Hyolithes" fortis BARR.
"Hyolithes" giganteus NOV.
Bactrotheca teres (BARR.)
Orthotheca šárkaensis NOV.
Praenucula dispar dispar PFAB
Praenucula dispar expansa PFAB
Pseudocyrtodonta obtusa (BARR.)
Pseudocyrtodonta ala (BARR.)
Praeleda amica (BARR.)
Praeleda compar (BARR.)
Redonia bohemica BARR.
Babinka prima BARR.
Patelliconus primulus (PER.)
Pygmaeoconus porrectus (PER.)
Pygmaeoconus kettneri (ŘÍHA)
Palaeacmaea latiuscula PER.
?Pentalina prantli HORNÝ
Hypseloconus? bohemicus HORNÝ
Gamadiscus nitidus (PER.)
Tropidodiscus (*Peruniscus*) *pusilus* (PER.)
Trochonema atava PER.
Sinuites sowerbyi PER.
Sinuites reticulatus PER.

Simuitopsis neglecta PER.
Lesuerella prima (PER.)
Mourlonia desiderata (PER.)
Archinacella ovata PER.
Leiogyra bohemica PER.
Cyrtonellopsis elevata (PER.)
Holopea incola (PER.)
"*Helicotoma*" *oriens* (PER.)
Ophileta prima (PER.)
Bathmoceras complexum BARR.
Bathmoceras praeposterum BARR.
Eobactrites sandbergeri (BARR.)
Endoceras peregrinum (BARR.)
Endoceras conquassatum (BARR.)
Endoceras novator (BARR.)
Tretoceras parvulum (BARR.)
"*Orthoceras*" *bonum* BARR.
Geragnostella tullbergi (NOV.)
Geragnostus dusli (NOV.)
Geragnostus friči (HOL.)
Sphaeragnostus similaris (BARR.)
Corrugatagnostus sp. n.
Leiagnostus bohemicus (BARR.)
Leiagnostus accedens (PER.)
Hungioides bohemicus (KL.)
Hungioides nováki KOBAYASHI
Symphysurus calvus (BARR.)
Parabarrandia bohemica (KLOU.)
Kodymaspis puer (BARR.)
Megistaspis (*Nerudaspis*) *aliena* (BARR.)
Bohemopyge discreta (BARR.)
Asaphellus desideratus (BARR.)
Pricyclopyge binodosa (SALT.)
Pricyclopyge synophthalma (KLOU.)
Pricyclopyge obscura MAREK
Microparia prantli MAREK
Degamella princeps praecedens (KL.)
Novakella bergeroni (KLOU.)
Cyclopyge kössleri (KLOU.)
Ellipsotaphrus triangulatus MAREK
Symphysops sulcata (BARR.)
Symphysops mitrata (NOV.)
Protostygina bohemica (BARR.)
Ectillaenus katzeri (BARR.)
Ectillaenus šárkaensis (NOV.)
Ectillaenus parabolinus (NOV.)
Ectilaenus advena (BARR.)
Svobodapeltis avus (HOL.)
Uralichas avus (BARR.)
Uralichas giganteus (HOL.)
Lichas incola BARR.
Selenopeltis buchi macrophthalma (KL.)
Colpocoryphe bohemica VANĚK
Colpocoryphe inopinata (NOV.)
Pharostoma pulchrum vokovicense ŠN.
Bohemilla praecedens KLOU.
Bohemilla stupenda BARR.
Bathycheilus perplexus (BARR.)
Ormathops atava (BARR.)
Ormathops nicholsoni (SALT.)
Ormathops transiens (PER.)
Ormathops microphthalma (PER.)
Pliomerops senilis (BARR.)
Placoparia (*P.*) *barrandei* PTL. - ŠN.
Plasiaspis bohemica (BARR.)
Osekaspis comes (BARR.)
Pateraspis pater (BARR.)
Areia (*Areiaspis*) *barrandei* PER.
Dionide prima KLOU.
Trinucleoides reussi (BARR.)
Eoharpes primus (BARR.)
Stapeleyella inconstans WHITTARD
Caryocaris wrighti SALT.
Anatifopsis prima BARR.
Ribeiria apusoides SCH. - WAAG.
Archeolimulus hanusi CHLUPÁČ
Parapyxion prunellus (BARR.)
Tallinnella complicata (SALT.)
Lagynocystites pyramidalis (BARR.)
Archaeocystites medusa BARR.
Balanocystites lagenula BARR.
Mitrocystella barrandei JAECKEL
Mitrocystites mitra BARR.
Pyrocystites pyrum BARR.
Archegocystites desiderata JAECKEL
Anatiferocystites barrandei CHAUV.
Plumulites bohemicus BARR.
Plumulites contrarius BARR.
Eoophiura bohemica JAECKEL
Archegonaster pentagonus SPENC.
Asterias primula BARR.
Palaeura bohemica JAECK.
Dendrograptus vokovicensis BOUČ.
Dendrograptus constrictus PER.
Acanthograptus sp.
Callograptus (*C.*) sp.
Dictyonema? dubium POČ.
Ptilograptus? suavis POČ.
Didymograptus retroflexus PER.
Didymograptus geminus (HIS.)

Didymograptus murchisoni (BOECK)
Didymograptus clavulus PER.
Didymograptus bifidus HALL.
Didymograptus denticulatus PER.
Didymograptus perneri BOUČ.
Didymograptus artus ELL. - WOOD
Didymograptus halli BOUČ.
Nicholsonograptus fasciculatus (NICH.)
Expansograptus lonchotheca (PER.)
Expansograptus leptotheca (PER.)
Pseudoclimacograptus scharenbergi (L.)
Climacograptus paradoxus BOUČ.
Bojophyton pragensis OBERHEL

Dobrotivá Formation
Pirania plasi PŘIBYL
Archaeoconularia insignis (BARR.)
Archaeoconularia fecunda (BARR.)
Archaeoconularia distincta (BOUČ.)
Archaeoconularia primula (BARR.)
Exoconularia exquisita exquisita. (B.)
Metaconularia imperialis imperialis (BARR.)
Metaconularia imperialis conjucta (BOUČ.)
Metaconularia munita munita (BARR.)
Metaconularia munita concreta (BOUČ.)
Metaconularia kettneri kettneri (BOUČ.)
Mataconularia consobrina (BARR.)
Plectoconularia proteica proteica (BARR.)
Plectoconularia proteica raricosta (BOUČ.)
Pseudoconularia grandissima grandissima (BARR.)
Pseudoconularia grandissima nobilis (BARR.)
Pseudoconularia kloučeki (BOUČ.)
Lingulella trimera (BARR.)
Lingulella impar (BARR.)
Paterula bohemica BARR.
Leptellina primula (BARR.)
Svobodaina dalmanelloides HAVL.
Paurorthis sp. n.
"*Hyolithes*" *benignensis* NOV.
"*Hyolithes*" *cinctus* BARR.
"*Hyolithes*" *euglyphus* NOV.
"*Hyolithes*" *giganteus* NOV.
"*Hyolithes*" *hanuši* ZÁZV.
"*Hyolithes*" *kloučeki* ZÁZV.
"*Hyolithes*" *kolihai* ZÁZV.
"*Hyolithes*" *latus* ZÁZV.
Bactrotheca novaki ZÁZV.
Bactrotheca teres (BARR.)
Orthotheca šárkaensis NOV.
Synek antiquus BARR.
Dceruška primula primula BARR.
Pseudocyrtodonta ala (BARR.)
Ctenodonta (*C.*) *bohemica* (BARR.)
Ctenodonta (*C.*) *applanans* (BARR.)
Praeleda pulchra PFAB
Praeleda amica (BARR.)
Praenucula dispar dispar PFAB
Redonia bohemica BARR.
Helminthochiton aequivoca ROBS.
Pentalina prantli HORNÝ
Plectonotus(?) *vokovicensis* HOR.
Patelliconus primulus (PER.)
Palaeoscurria ordoviciana HOR.
Archinacella tarda PER.
Archinacella ovata PER.
Mourlonia desiderata (PER.)
Tropidodiscus (*Peruniscus*) *pusillus* (PER.)
Sinuites sowerbyi PER.
Sinuites reticulatus PER.
Sinuitopsis neglecta PER.
"*Orthoceras*" *arcitenens* BARR.
Geragnostella tullbergi (NOV.)
Sphaeragnostus similaris (BARR.)
Corrugatagnostus caducus (BARR.)
Corrugatagnostus morea (SALT.)
Corrugatagnostus fortis (NOV.)
Leiagnostus bohemicus (NOV.)
Parabarrandia crassa (BARR.)
Kodymaspis puer (BARR.)
Opsimasaphus (*Nobiliasaphus*) *nobilis repulsus* PŘ. - VAN.
Petrbokia longicauda (KLOU.)
Microparia lusca MAREK
Microparia plasi MAREK
Microparia kloučeki (RICHTER)
Microparia brachycephala (KLOU.)
Degamella princeps princeps (BARR.)
Pricyclopyge binodosa longicephala (KLOU.)
Emmrichops planicephala MAREK
Cyclopyge umbonata bohemica MAREK
Ellipsotaphrus monophthalmus (KLOU.)
Raymondaspis rubensi PŘIBYL - VANĚK
Ectillaenus benignensis (NOV.)
Zbirovia arata (BARR.)
Lichas cf. *incola* BARR.
Selenopeltis buchi macrophthalma (KL.)
Primaspis (*Primaspis*) sp. n.
Colpocoryphe grandis ŠNAJDR

Pharostoma pulchrum mendax VANĚK
Bohemilla stupenda BARR.
Bohemilla kloučeki MAREK
Ormathops novaki (KLOU.)
Zeliszkella (*Z.*) *oriens* (BARR.)
Zeliszkella (*Mytocephala*) *mytoensis* (KLOU.)
Placoparia (*P.*) *zippei* (BOECK)
Dindymene plasi KIELAN
Lehua vincula (BARR.)
Pateraspis sp. n.
Areia (*Areia*) *fritschi* BARR.
Šárkia bohemica KLOU.
Phaseolops primulus BARR.
Shumardia bohemica MAREK
Raphiophorus sp. n.
Trinucleoides reussi BARR.
Onnia sp. n.
Bergamia? *praecedens* (KLOU.)
Dionidella incisa PRANTL - PŘIBYL
Dionide jubata RAYM.
Eoharpes benignensis (BARR.)
Caryocaris wrighti SALT.
Parapyxion (?) *transiens* (BARR.)
Parapyxion prunellus (BARR.)
Anomalocystites incipiens BARR.
Mitrocystites mitra BARR.
Calix purkyněi (KLOU.)
Hemicystites lipoldi KLOU.
Plumulites compar BARR.
Turrilepas serrata NOV.
Glyptograptus teretiusculus (HIS.)
Cryptograptus tricornis CARR.
Nemagraptus cf. *explanatus* (LAPW.)

Libeň Formation

Metaconularia kettneri ssp. n.
Exoconularia exquisita exquisita (BARR.)
Anaconularia anomala (BARR.)
Pseudoconularia imperialis imperialis (BARR.)
Archaeoconularia insignis (BARR.)
Conchicolites měskai PRANTL
Petrocrania obsoleta (BARR.)
Orbiculoidea inaequalis (BARR.)
Paterula bohemica BARR.
Aegiromena aquila praecursor (HAVL.)
Bicuspina cf. *cava* (BARR.)
Mesodalmanella flava HAVL.
Svobodaina svobodai HAVL.
Drabovia redux (BARR.)
Hirnantia index HAVL.
Giraldiella sp. n.
"*Ctenodonta*" *incola* (BARR.)
Ctenodonta (*C.*) *bohemica* (BARR.)
Sinuitopsis neglecta PER.
"*Orthoceras*" *fractum* BARR.
Geragnostella sp. n.
Opsimasaphus (*O.*) *ingens* (BARR.)
Heterocyclopyge pachycephala (H. et C.)
Stenopareia panderi (BARR.)
Zbirovia arata (BARR.)
Cekovia transfuga (BARR.)
Ectillaenus holubi (ŠNAJDR)
Primaspis (*P.*) *primordialis* (BARR.)
Selenopeltis buchi macrophthalma (KL.)
Colpocoryphe grandis ŠNAJDR
Pharostoma pulchrum mendax VANĚK
Calymenella parvula (BARR.)
Ormathops inflatus (ŽEL.)
Dalmanitina čilinensis ŠNAJDR
Zeliszkella (*Z.*) *hawlei* (BARR.)
Kloučekia phillipsi (BARR.)
Placoparia (*Hawleia*) *grandis* (H. et C.)
Actinopeltis completa (BARR.)
Eccoptochile (*E.*) *clavigera* (BEYR.)
E. (*Eccoptochiloides*) *tumescens* (BARR.)
Onnia goldfussi (BARR.)
Marrolithus ornatus parviporus PŘ. - VAN.
Anatifopsis acuta BARR.
Nothozoe pollens BARR.
Crescentilla pugnax BARR.
Ceratopsis hastata (BARR.)
Tallinnella bohemica (BARR.)
Trubinella latens (BARR.)
Hemicystites bohemicus (BARR.)
Rhombifera bohemica BARR.
Aristocystites cf. *bohemicus* BARR.
Ascocystites drabowiensis BARR.
Fungocystites sp. n.

Letná Formation

Archaeoconularia fecunda (BARR.)
Archaeoconularia insignis (BARR.)
Exoconularia exquisita exquisita (BARR.)
Metaconularia munita munita (BARR.)
Metaconularia consobrina (BARR.)

Metaconularia pyramidata (HOENINGH.)
Anaconularia anomala (BARR.)
Pseudoconularia grandissima grandissima (BARR.)
Pseudoconularia grandissima nobilis (BARR.)
"*Conularia*" *rugulosa* (BARR.)
Serpulites bohemicus BARR.
Conchicolites confertus (BARR.)
Chasmatoporella havlíčeki PRANTL
"*Orbiculoidea*" *grandis* (BARR.)
"*Lingula*" *deleta* BARR.
Petrocrania obsoleta (BARR.)
Bicuspina cava (BARR.)
Bicuspina multicostellata HAVL.
Aegiromena aquila praecursor (HAVL.)
Dactylogonia blyskavensis HAVL.
Rafinesquina occulata (BARR.)
Mesodalmanella flava HAVL.
Dalmanella chrustenicensis HAVL.
Svobodaina inclyta (BARR.)
Drabovia redux (BARR.)
Drabovia asperula (BARR.)
Drabovia fascicostata HAVL.
Hirnantia ulrichi (HAVL.)
Drabovinella draboviensis (BARR.)
Modiolopsis veterana BARR.
Modiolopsis drabowiensis BARR.
Modiolopsis antiquior BARR.
Modiolopsis primula BARR.
Synek antiquus BARR.
"*Astarte*" *convergens* BARR.
"*Astarte*" *flexa* BARR.
„*Grammysia*" *catilloides* BARR.
Ctenodonta (*C.*) *bilunata bilunata* PFAB
"*Ctenodonta*" *incola* (BARR.)
"*Ctenodonta*" *librans* (BARR.)
"*Ctenodonta*" *pragensis* (BARR.)
Praenucula dispar dispar PFAB
Praeleda amica (BARR.)
Ptychopeltis incola PER.
Sinuitopsis neglecta PER.
Cyrtodiscus procer (PER.)
Bucanopsis roemeri (PER.)
Bucanopsis comata (PER.)
Bucanella bohemica (PER.)
Antispira praecox PER.
Versispira contraria (PER.)
Holopea antiqua (PER.)
Leptodesma patricia (BARR.)
Opsimasaphus (*O.*) *ingens* (BARR.)
Stenopareia panderi (BARR.)
Cekovia transfuga (BARR.)
Primaspis (*P.*) *primordialis* (BARR.)
Selenopeltis buchi buchi (BARR.)
Platycoryphe bohemica (BARR.)
Platycoryphe draboviensis (NOV.)
Calymenella parvula (BARR.)
Plaesiacomia rara Hawle et Corda
Colpocoryphe grandis ŠNAJDR
Pharostoma pulchrum mendax VANĚK
Dalmanitina socialis (BARR.)
Zeliszkella (*Z.*) *hawlei* (BARR.)
Kloučekia phillipsi (BARR.)
Eudolatites dubia (BARR.)
Placoparia (*Hawleia*) *grandis* (H. et C.)
Actinopeltis completa (BARR.)
Eccoptochile (*E.*) *clavigera* (BEYR.)
E. (*Eccoptochiloides*) *tumescens* (BARR.)
Onnia goldfussi (BARR.)
Duslia insignis JAHN
Triopus draboviensis BARR.
Anatifopsis acuta BARR.
Quasicaris bohemica (BARR.)
Zonozoe drabowiensis BARR.
Drabovaspis complexa (BARR.)
Chacharejocaris ? *novaki* CHLUPÁČ
Caryon bohemicus BARR.
Nothozoe pollens BARR.
Furca bohemica FRITSCH
Ceratopsis hastata (BARR.)
Tallinnella bohemica (BARR.)
Trubinella latens (BARR.)
Crescentilla pugnax BARR.
"*Cytherina*" *graegaria* BARR.
"*Cytheropsis*" *testis* BARR.
Hemicystites bohemicus (BARR.)
Hemicystites velatus (BARR.)
Dendrocystites sedgwicki BARR.
Mitrocystites mitra BARR.
Rhombifera bohemica BARR.
Ascocystites drabowiensis BARR.
Ascocystites cf. *micraster* BARR.
Mespilocystites bohemicus BARR.
Macrocystella bohemica (BARR.)
Echinosphaerites infaustus BARR.
Plumulites folliculum BARR.
"*Cystidea*" *obscondita* BARR.
Caleidocrinus multiramus WAAG. - J.

Vinice Formation

Archaeoconularia fecunda (BARR.)
Archaeoconularia insignis (BARR.)
Exoconularia exquisita exquisita (BARR.)
Exoconularia exquisita bohemica (BARR.)
Metaconularia imperialis imperialis (BARR.)
Metaconularia kettneri kettneri (BOUČ.)
Plectoconularia proteica proteica (BARR.)
Pseudoconularia grandissima grandissima (BARR.)
Pseudoconularia grandissima nobilis (B.)
"Conularia" holubi BOUČ.
Conchicolites confertus (BARR.)
Batostoma lamellata (POČ.)
Lingulella simplex (BARR.)
Paterula bohemica BARR.
"Orthis" trubinensis BARR.
"Orthis" granulifera BARR.
Bicuspina multicostellata HAVL.
Rostricellula ambigena (BARR.)
"Mesodalmanella" bancrofti HAVL.
Dalmanella chrustenicensis HAVL.
Drabovia transgrediens HAVL.
Giraldiella cf. *partita* (BARR.)
Aegiromena aquila aquila (BARR.)
Rafinesquina vinicensis (BARR.)
"Hyolithes" striatulus BARR.
"Hyolithes" solitarius BARR.
"Hyolithes" magister BARR.
"Hyolithes" undulatus BARR.
Dceruška primula primula BARR.
Ctenodonta (C.) praecox (BARR.)
Ctenodonta (C.) bilunata bilunata PFAB
Ctenodonta (C.) protensa (BARR.)
Ctenodonta (C.) domina (BARR.)
Ctenodonta (C.) ponderata (BARR.)
"Ctenodonta" similaris (BARR.)
"Ctenodonta" coercita (BARR.)
"Ctenodonta" decurtata (BARR.)
"Ctenodonta" perplectens (BARR.)
"Ctenodonta" neglecta (BARR.)
"Ctenodonta" major (BARR.)
Praeleda amica (BARR.)
Praeleda pulchra PFAB
Pseudocyrtodonta ala (BARR.)
Praenucula dispar dispar PFAB
Palaeoneilo flectens (BARR.)
Synek antiquus BARR.
Synek nasutus BARR.
"Grammysia" catilloides BARR.
Eochelodes bergenhayni MAREK
Archinacella tarda PER.
Sinuitopsis neglecta PER.
Grandostoma bohemicum (PER.)
Holopea vermiculosa (PER.)
Holopea antiqua (PER.)
Ferrogyra antiqua (PER.)
Versispira ferrigena PER.
Versispira rugosa PER.
Lophospira viator PER.
"Orthoceras" bisignatum BARR.
"Orthoceras" importunum BARR.
Opsimasaphus (Nobiliasaphus) nobilis nobilis (BARR.)
Heterocyclopyge pachycephala (H. et C.)
Ellipsotaphrus infaustus (BARR.)
Cyclopyge rediviva (BARR.)
Stenopareia panderi (BARR.)
Cekovia salteri (BARR.)
Cekovia götzi ŠNAJDR
Zbirovia arata (BARR.)
Primaspis (?P.) tremenda (BARR.)
Selenopeltis buchi buchi (BARR.)
Pharostoma pulchrum pulchrum (BARR.)
Dalmanitina proaeva (EMMRICH)
Zeliszkella (Z.) deshayesi (BARR.)
Eudolatites angelini (BARR.)
Actinopeltis aff. completa (BARR.)
Eccoptochile (E.) clavigera (BEYR.)
E. (Eccoptochiloides) scuticauda (BARR.)
E. (Eccoptochiloides) tumescens (BARR.)
Dionide formosa (BARR.)
Marrolithus ornatus senftenbergi (H. et C.)
Marrolithus ornatus paulisper PŘ. - VANĚK
Anatifopsis bohemica BARR.
Ribeiria apusoides SCH. et WAAG.
Ribeirella sharpei BARR.
Tallinnella bohemica (BARR.)
Trubinella latens (BARR.)
Ceratopsis hastata (BARR.)
Crescentilla pugnax BARR.
"Cytheropsis" bohemica BARR.
Mirochilina jonesiana SCHMIDT
Ulrichia? perforata (BARR.)
Ulrichia? timida (BARR.)
Heliocrinites helmhackeri (BARR.)
Echinosphaerites infaustus BARR.
Aristocystites bohemicus BARR.
Fungocystites rarissimus BARR.
Anomalocystites ansifer BARR.
Hippocystis batheri CHAUV.

Rhombifera bohemica BARR.
Mespilocystites bohemicus BARR.
Plumulites fraternus BARR.
Plumulites bohemicus BARR.
Desmograptus attextus POČ.
Ptilograptus ramale POČ.
Ptilograptus glomeratus POČ.
Ptilograptus ? suavis POČ.
Callograptus (?C.) parvus POČ.
Climacograptus cf. *wilsoni* LAPW.
Glyptograptus trubinensis trubinensis (PER.)
Rectograptus truncatus (LAPW.)

Zahořany Formation

Exoconularia exquisita exquisita (BARR.)
Exoconularia exquisita bohemica (BARR.)
Exoconularia exquisita tenella (BARR.)
Metaconularia munita concreta (BOUČ.)
Metaconularia kettneri kettneri (BOUČ.)
Metaconularia consobrina (BARR.)
Archaeoconularia fecunda (BARR.)
Archaeoconularia insignis (BARR.)
Plectoconularia proteica proteica (BARR.)
Pseudoconularia grandissima grandissima (BARR.)
Pseudoconularia grandissima nobilis (BARR.)
Conchicolites měskai PRANTL
Conchicolites confertus (BARR.)
Monotrypa affinis (POČ.)
Monotrypa certa (POČ.)
Monotrypa crassa (POČ.)
Batostoma horrida (POČ.)
Batostoma lamellata (POČ.)
Batostoma subtilis (POČ.)
Batostoma počtai (KETT.)
Monotrypa disculus POČ.
Monotrypa pragensis RÖHL.
Lingulella davidsoni (BARR.)
Paterula bohemica BARR.
Orbiculoidea inaequalis (BARR.)
Trematis hamifera (BARR.)
Trematis scrobiculosa (BARR.)
"*Discina*" *miranda* BARR.
Petrocrania obsoleta (BARR.)
"*Petrocrania*" *inexspectata* (BARR.)
Triplesia deformata (BARR.)
Bicuspina cava (BARR.)
Rostricellula ambigena (BARR.)
Howellites altera (BARR.)
Onniella frequens HAVL.
Heterorthina notata (BARR.)
Heterorthis quaerenda (BARR.)
Svobodaina inclyta (BARR.)
Horderleyella boučeki (HAVL.)
Reuschella macrostoma (BARR.)
Drabovia transgrediens HAVL.
Drabovia latior HAVL.
Drabovia breviseptata HAVL.
Crassiorina crassior (BARR.)
Giraldiella partita (BARR.)
Aegiromena aquila aquila (BARR.)
Rafinesquina pseudoloricata (BARR.)
"*Atrypa*" *nuntia* BARR.
"*Hyolithes*" *striatulus* BARR.
"*Hyolithes*" *elegans* BARR.
"*Hyolithes*" *solitarius* BARR.
"*Hyolithes*" *magister* BARR.
Praeleda compar (BARR.)
Praeleda contrastans (BARR.)
Praeleda pulchra PFAB
Praeleda amica (BARR.)
Ctenodonta (C.) *ponderata* (BARR.)
Ctenodonta (*C.*) *incisa* (BARR.)
Ctenodonta (*C.*) *praecox* (BARR.)
Ctenodonta (*C.*) *disputabilis* (BARR.)
Ctenodonta (*C.*) *bilunata bilunata* PFAB
Ctenodonta (*C.*) *bohemica* (BARR.)
Ctenodonta (*C.*) *protensa* (BARR.)
"*Ctenodonta*" *neglecta* (BARR.)
"*Ctenodonta*" *major* (BARR.)
"*Ctenodonta*" *tumescens* (BARR.)
"*Ctenodonta*" *similaris* (BARR.)
"*Ctenodonta*" *coercita* (BARR.)
"*Ctenodonta*" *incola* (BARR.)
Pseudocyrtodonta obtusa (BARR.)
Praenucula dispar dispar PFAB
Palaeoneilo magna PFAB
Palaeoneilo flectens (BARR.)
Dceruška primula primula BARR.
Goniophorina cardiformis (BARR.)
Leptodesma? improvisa (BARR.)
Synek antiquus BARR.
Synek nasutus BARR.
"*Grammysia*" *catilloides* BARR.
Modiolopsis veterana BARR.
Orthonota antecedens BARR.
Archinacella tarda PER.
Sinuitopsis neglecta PER.

Sinuitopsis nodosa PER.
Grandostoma bohemicum (PER.)
Bucanopsis calypso PER.
Bucanopsis comata (PER.)
Lophospira viator PER.
Lophospira spoliata PER.
Lophospira dubia PER.
Trochonema excavatum PER.
Holopea vermiculosa (PER.)
Ferrogyra antiqua (PER.)
"*Orthoceras*" *bisignatum* BARR.
Geragnostella sp. n.
Trinodus tardus (BARR.)
Opsimasaphus (*Nobilisaphus*) *nobilis nobilis* (BARR.)
Cyclopyge rediviva (BARR.)
Stenopareia panderi (BARR.)
Cekovia salteri (BARR.)
Primaspis (*?P.*) *tremenda* (BARR.)
Primaspis (*Chlustinia*) *keyserlingi* (B.)
Selenopeltis buchi buchi (BARR.)
Pharostoma pulchrum pulchrum (BARR.)
Flexicalymene incerta (BARR.)
Calymenella media (BARR.)
Dalmanitina proaeva (EMMR.)
Kloučekia phillipsi (BARR.)
Phacopidina solitaria (BARR.)
Eudolatites angelini (BARR.)
Bohemilla pragensis MAREK
Actinopeltis globosa (BARR.)
Eccoptochile (*E.*) *clavigera* (BEYR.)
Eccoptochile (*Eccoptochiloides*) *tumescens* (BARR.)
Marrolithus ornatus ornatus (STNBG.)
Declivolithus alfredi (ŽEL.)
Anatifopsis bohemica BARR.
Anatifopsis longa BARR.
Ribeiria apusoides SCH. et WAAG.
Ribeiria pholadiformis SHARPE
Ribeirella sharpei BARR.
Mirochilina jonesiana SCHMIDT
Ceratopsis hastata (BARR.)
Tallinnella hloubetinensis JAANUSSON
"*Cytheropsis*" *melonica* (BARR.)
„*Leperditia*" *fragilis* BARR.
Hemicystites bellulus (BARR.)
Hemicystites confertus (BARR.)
Echinosphaerites infaustus BARR.
Echinosphaerites barrandei JAECK.
Hippocystis batheri CHAUV.
Cheirocrinus alter (BARR.)
Mespilocystites bohemicus BARR.
Aristocystites bohemicus BARR.
Cardiocystites bohemicus BARR.
Codiacystites bohemicus (BARR.)
Codiacystites moneta (BARR.)
Dendrocystites batheri JAECK.
Fungocystites solitarius BARR.
Rhombifera bohemica BARR.
Plumulites fraternus BARR.
Plumulites regius BARR.
Turrilepas striatula NOV.
Bohemura jahni JAECK.
Climacograptus cf. *wilsoni* LAPW.
Glyptograptus trubinensis extensus PŘ.
Glyptograptus insculptus (PER.)
Rectograptus truncatus truncatus (LAPW.)
Rectograptus bohemicus PŘ.

Bohdalec Formation

Archaeoconularia fecunda (BARR.)
Exoconularia exquisita exquisita (BARR.)
Metaconularia kettneri densissima (BOUČ.)
Pseudoconularia grandissima grandissima (BARR.)
Pseudoconularia grandissima nobilis (BARR.)
Conchicolites měskai PRANTL
Conchicolites bohemicus (BARR.)
Tentaculites cf. *anglicus* SALT.
Monotrypa kettneri PRANTL
Monotrypa pragensis RÖHL.
Monotrypa certa (POČ.)
Monotrypella glomerata POČ.
Batostoma počtai (KETT.)
Batostoma prantli (POUBA)
Batostoma fertile (KETT.)
Batostoma bifida (POČ.)
Batostoma radiata (KETT.)
"*Batostoma*" *circularis* (BARR.)
Polyteichus nováki (PER.)
Polyteichus (*?*) *pusillus* KETT.
Diplotrypa? *conica* (KETT.)
"*Holopora*" *foliacea* POČ.
Lingulella davidsoni (BARR.)
Paterula bohemica BARR.
Trematis scrobiculosa (BARR.)
Petrocrania obsoleta (BARR.)
Triplesia deformata (BARR.)

Rostricellula ambigena (BARR.)
Heterorthina notata (BARR.)
Heterorthis sosia (BARR.)
Svobodaina inclyta (BARR.)
Horderleyella boučeki (HAVL.)
Drabovia latior HAVL.
Drabovia cf. *transgrediens* HAVL.
Drabovia postrema HAVL.
Hirnantia sp. n.
Aegiromena descendens HAVL.
Sericoidea homolensis HAVL.
Rafinesquina pseudoloricata (BARR.)
Rafinesquina vinicensis (BARR.)
"*Hyolithes*" *elegans* BARR.
"*Hyolithes*" *striatulus* BARR.
"*Hyolithes*" aff. *solitarius* BARR.
Synek antiquus BARR.
Dceruška primula primula BARR.
Dceruška primula curtior BARR.
Leptodesma? improvisa (BARR.)
"*Aviculopecten*" *quadrarius* BARR.
Orthonota antecedens BARR.
Ctenodonta (*C.*) *praecox* (BARR.)
Ctenodonta (*C.*) *bilunata perdentata* PFAB
Ctenodonta (*C.*) *bohemica* (BARR.)
Ctenodonta (*C.*) *disputabilis* (BARR.)
Ctenodonta (*C.*) *protensa* (BARR.)
Ctenodonta (*C.*) *ponderata* (BARR.)
Ctenodonta (*C.*) *incisa* (BARR.)
"*Ctenodonta*" *coercita* (BARR.)
"*Ctenodonta*" *neglecta* (BARR.)
"*Ctenodonta*" *major* (BARR.)
"*Ctenodonta* "*incola* (BARR.)
Palaeoneilo flectens (BARR.)
Palaeoneilo magna (BARR.)
Praeleda amica (BARR.)
Praeleda compar (BARR.)
Praearca kosoviensis (BARR.)
Praearca contrastans (BAAR.)
Eochelodes bergenhayni MAREK
Archinacella tarda PER.
Versispira bohemica PER.
Sinuitopsis neglecta PER.
Grandostoma bohemicum (PER.)
Bucanella bohemica PER.
Trochonema excavatum (PER.)
Lophospira viator PER.
Lophospira spoliata (PER.)
Holopea vermiculosa (PER.)
"*Orthoceras*" *bisignatum* BARR.
Geragnostella sp. n.
Opsimasaphus (*Nobiliasaphus*) *nobilis nobilis* (BARR.)
Cyclopyge rediviva (BARR.)
Stenopareia vaněki (ŠNAJDR)
Primaspis (*Chlustinia*) *keyserlingi* (BARR.)
Selenopeltis buchi buchi (BARR.)
Pharostoma pulchrum pulchrum (B.)
Flexicalymene incerta (BARR.)
Calymenella media (BARR.)
Dalmanitina proaeva (EMMRICH)
Kloučekia phillipsi (BARR.)
Phacopidina solitaria (BARR.)
Eudolatites angelini (BARR.)
Actinopeltis globosa (BARR.)
Eccoptochile (*E.*) *clavigera* (BEYR.)
Onnia abducta PŘIBYL - VANĚK
Declivolithus alfredi (ŽEL.)
Eodindymene pulchra (OLIN)
Ribeiria pholadiformis SHARPE
Ribeiria apusoides SCH. et WAAG.
Ribeirella sharpei BARR.
Anatifopsis cf. *acuta* BARR.
Anatifopsis bohemica BARR.
Mirochilina jonesiana SCHMIDT
Parapyxion prunellus (BARR.)
Ceratopsis hastata (BARR.)
Tallinnella hloubetinensis JAANUSSON
Ulrichia? timida (BARR.)
Ulrichia bicornis (JONES)
Ulrichia nodosa paupera SCHMIDT
Haploprimitia pragae SCHMIDT
Paraschmidtella dicoscinata SCHM.
Pseudulrichia bivertex (ULRICH)
Pseudulrichia cf. *bipunctata* (J. - H.)
Parulrichia diversa antiqua SCHM.
Parulrichia mucronata SCHMIDT
Macronotella bohemica SCHMIDT
Paraschmidtella? densipunctata densipunctata SCHMIDT
Paraschmidtella? densipunctata longior SCHMIDT
Paraschmidttella? obscura SCHMIDT
Ctenentoma quadrinoda SCHMIDT
Pyxiprimitia epsilonis SCHMIDT
Aechmina kolihai SCHMIDT
Parulrichia bohemica SCHMIDT
Crescentilla pugnax BARR.
Plumulites fraternus BARR.
Plumulites tardus NOV.
Caleidocrinus multiramus JAHN

Caleidocrinus subpartitus (BARR.)
Caleidocrinus artifex (BARR.)
Diplograptus vulgatus PER.
Rectograptus bohdalecensis PŘIBYL
Rectograptus lingulitheca (PER.)
Orthograptus spinosus PŘIBYL
Dicranograptus cf. clingani L.
Coelosphaeridium aff. *sphaericum* (KJER.)

Králův Dvůr Formation

Plectoconularia proteica proteica (BARR.)
Pseudoconularia grandissima nobilis (BARR.)
Archaeoconularia fecunda (BARR.)
Archaeoconularia insignis (BARR.)
Metaconularia kettneri kettneri (BOUČ.)
Serpulites bohemicua BARR.
Kettnerites (?) hebes ŠNAJDR
Lingulella jejuna (BARR.)
Lingulella lejskoviensis (BARR.)
Lingulella incongrua (BARR.)
Lingulella sublaevis (BARR.)
Lingulella ovum (BARR.)
Orbiculoidea squammosa (BARR.)
Rostricellula ambigena (BARR.)
Dedzetina macrostomoides HAVL.
Dedzetina honorata (BARR.)
Comatopoma barrandei HAVL.
Resserella sp.
Leptestiina prantli HAVL.
Anoptambonites moneta (BARR.)
Anoptambonites quaesita (BARR.)
Aegiromena urbana HAVL.
Aegiromena ultima MAREK
Aegironetes tristis (BARR.)
Chonetoidea tenerrima HAVL.
Chonetoidea radiatula (BARR.)
Kozlowskites nuntius (BARR.)
Anisopleurella ovalifera HAVL.
Strophomena rigida BARR.
Foliomena folium (BARR.)
Fardenia scotica LAMONT
"*Dayia*" *barrandei* (COOPER)
"*Catazyga*" *primula* (BARR.)
"*Atrypa*" *obscondita* BARR.
"*Atrypa*" *inanis* BARR.
"*Atrypa*" *perplana* BARR.
"*Hyolithes*" *indistinctus* BARR.
"*Hyolithes*" *decipiens* BARR.
"*Hyolithes*" *sulcatulus* NOV.
Synek antiquus BARR.
Synek deformatus BARR.
Leptodesma? ancilla (BARR.)
Leptodesma? novella (BARR.)
Leptodesma? gratissima (BARR.)
Leptodesma? improvisa (BARR.)
Dceruška primula primula BARR.
Dceruška primula curtior BARR.
Goniophorina primula (BARR.)
Modiolopsis antiqua BARR.
Edmondia obscura BARR.
"*Aviculopecten*" *quadrarius* BARR.
Modiolopsis faba BARR.
Modiolopsis drabowiensis BARR.
Modiolopsis tumescens BARR.
Modiolopsis minuta BARR.
Modiolopsis lenticularis BARR.
Modiolopsis veterana BARR.
Modiolopsis consors BARR.
Ctenodonta (C.) praecox (BARR.)
Ctenodonta (C.) bilunata perdentata PFAB
Ctenodonta (C.) bohemica (BARR.)
Ctenodonta (C.) incisa (BARR.)
Ctenodonta (C.) expansa (BARR.)
Ctenodonta (C.) disputabilis (BARR.)
"*Ctenodonta*" *similaris* (BARR.)
"*Ctenodonta*" *coercita* (BARR.)
"*Ctenodonta*" *incola* (BARR.)
"*Ctenodonta*" *neglecta* (BARR.)
"*Ctenodonta*" *librans* (BARR.)
Praenucula dispar dispar PFAB
Praeleda compar (BARR.)
Praeleda amica (BARR.)
Praeleda pulchra PFAB
Praeleda innotata (BARR.)
Praearca kosoviensis (BARR.)
Palaeoneilo flectens (BARR.)
Archinacellina modesta (PER.)
Archinacella mitra PER.
Sinuites aff. *bilobatus* (SOW.)
Strangulites strangulatus (PER.)
Grandostoma grande (PER.)
Pterotheca consobrina BARR.
Bucanella bohemica (PER.)
Temnodiscus evolvens (PER.)
Lophospira tropidophora MEEK
Lophospira infausta PER.
Lophospira nuda PER.
Holopea infida (PER.)

Trochonema tricincta PER.
Murchisonia (Hormotoma) prospera (P.)
Murchisonia (Hormotoma) timida. PER.
Murchisonia (?Hormotomina) matrona (P.)
Lesuerella inchoans (PER.)
"*Orthoceras*" *exspectans* BARR.
"*Gomphoceras*" *primus* BARR.
Ceratiocaris primus BARR.
Trinodus tardus (BARR.)
Amphitryon radians (BARR.)
Telephina fracta (BARR.)
Opsimasaphus (O.) jaanussoni KIELAN
Cyclopyge marginata HAWLE et CORDA
Degamella gigantea (BARR.)
Microparia speciosa HAWLE et CORDA
Symphysops armata (BARR.)
Octillaenus hisingeri (BARR.)
Dysplanus wahlenbergianus (BARR.)
Stenopareia oblita (BARR.)
Zdicella zeidleri (BARR.)
Zdicella aff. *bornholmensis* KIELAN
Ectillaenus hospes (BARR.)
Bronteopsis sola (BARR.)
Phillipsinella parabola (BARR.)
Cyphoproetus solus (BARR.)
"*Primaspis*" *peregrina* (BARR.)
Selenopeltis buchi vultuosa Př. - VAN.
Leonapsis (L). mirka MAREK
Platycoryphe foveolata (PRANTL et PŘIBYL)
Brongniartella inexpectata (BARR.)
Flexicalymene declinata (HAWLE et CORDA)
Gravicalymene asperula VANĚK
Carmon mutilus BARR.
Dalmanitina mucronata (BRONG.)
Kloučekia phillipsi (BARR.)
Duftonia morrisiana (BARR.)
Actinopeltis insocialis (BARR.)
Actinopeltis gryphus (BARR.)
Actinopeltis barrandei KIELAN
Cheirurus (Ch.) fortis BARR.
Stubblefieldia neglecta (BARR.)
Zazvorkaspis neutra (BARR.)
Pseudosphaerexochus pectinifer (B.)
Areia (A.) bohemica BARR.
Dindymene haidingeri BARR.
Dindymene fridericiaugusti H. et C.
Staurocephalus clavifrons ANG.
Onnia ultima (BARR.)
Tretaspis granulata (WAHL.)
Tretaspis seticornis seticornis (HIS.)
Cryptolithus kosoviensis MAREK
Dionide speciosa (HAWLE et CORDA)
Lonchodomas portlocki (BARR.)
Raphiophorus tenellus (BARR.)
Raphiophorus gratus (BARR.)
Ribeirella sharpei BARR.
Ribeiria pholadiformis SHARPE
Anatifopsis bohemica BARR.
Parapyxion prunellus (BARR.)
Parapyxion (?) fugax (BARR.)
"*Beyrichia*" *barbara* BARR.
Ceratopsis hastata (BARR.)
Crescentilla pugnax BARR.
"*Cytheropsis*" *derelicta* (BARR.)
"*Entomozoe*" *rara* (BARR.)
Mirochilina jonesiana SCHMIDT
Paraschmidtella (?) densipunctata SCHM.
Ulrichia bicornis (JONES)
Echinosphaerites quaerendus BARR.
Plococystites bohemica (BARR.)
Eucystis chlupáči PROKOP
Turrilepas squammatula (BARR.)
Plumulites regius BARR.
Plumulites fraternus BARR.
Caleidocrinus artifex (BARR.)
Dicellograptus anceps NICH.
Climacograptus angustus (PER.)
Glyptograptus teres (PER.)
Plegmatograptus (?) chuchlensis PŘ.
Rectograptus truncatus fritschi (PER.)
Ptilograptus sp.

Kosov Formation
Sphenothallus sp.
Tentaculites sp. n.
Philhedra sp. n.
Trematis sp.
Paracraniops sp. n.
Cliftonia sp. n.
Drabovia sp. n.
Hirnantia sagittifera (M'COY)
Hirnantia kielanae TEMPLE
Giraldiella sp. n.
Onniella sp. n.
Comatopoma sp. n.
Dalmanella testudinaria (DALM.)

Aegiromena ultima MAREK
Rafinesquina sp. n.
Eostropheodonta hirnantensis (M'COY)
Bracteoleptaena polonica (TEMPLE)
Leptaena rugosa DALMAN
Zygospira sp. n.
Cryptothyrella sp.
Plectothyrella platystrophoides TEMPLE
Prearca kosoviensis (BARR.)
Cleidophorus sp.
Goniophorina sp.
Mytilarca aff. *amii* Mc LEARN
Modiolopsis sp.
Bucanella bohemica (PER.)
Temnodiscus evolvens (PER.)
Sinuitopsis hornýi MAREK
Grandostoma taconicum MAREK
Leonaspis (L.) cf. *olini* TROEDS.
Brongniartella platynota (DALM.)
Dalmanitina mucronata (BRONG.)
Bollia sp.
Mespilocystites sp. n.
Glyptograptus bohemicus MAREK
Ischadites sp. n.

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Explanation of Plates

Important species of the Ordovician of Bohemia shown on plates:

Pl. I

Tremadoc, Lipoltice Beds, the Železné hory

1. *Bavarilla hofensis* (BARR.); 2 ×.
2. *Angusticardinia zelenkai.* (PTL. RŮŽ.) and *Nanorthis? bavarica* (BARR.); 2 ×.

Pl. II

Tremadoc

1, 2. *Thysanotos siluricus* (EICHW.); Třenice Formation, 1 ×.

3. *Lingulobolus feistmanteli* (BARR.); Třenice Formation, 1,5 ×.

4. *Poramborthis kettneri* HAVL.; Třenice Formation (haematite), 1.5 ×.
5. *Tritoechia kodymi* HAVL.; Třenice Formation, 1.5 ×.
6. *Poramborthis lamellosa* (RŮŽ.); Třenice Formation (haematite), 2 ×.
7. *Apheoorthina ferrigena* HAVL.; Třenice Formation (haematite), 3 ×.
8. *Eulomina mitratum* (RŮŽ.); Mílina Formation, 1 ×.
9. *Holubaspis perneri* (RŮŽ.); Mílina Formation, 1 ×.
10. *Tritoechia kodymi* Havl.; Třenice Formation, 3.5 ×.
11. *Hemibarrandia holoubkovensis* (RŮŽ); Mílina Formation, 1.5 ×.
12. Compact haematite from Holoubkov carrying fauna, esp. *Apheoorthina bohemica* Havl.; Třenice Formation, 3 ×.

Pl. III

Tremadoc, Arenig

1, 2, 3. *Jivinella incola* (BARR.); Mílina Formation, 1.5 ×.
4. *Pharostomina ferentaria* SDZUY; Mílina Formation, 3 ×.
5. *Proteuloma geinitzi* (BARR.); Mílina Formation, 2 ×.
6, 7. *Pilekia olešnaensis* (RŮŽ.); Mílina Formation, 1.5 ×.
8, 9. *Poramborthis kloučeki* HAVL.; Mílina Formation, 2 ×.
10. *Harpides grimmi* BARR.; Mílina Formation, 1 ×.
11, 12, 13. *Prantlina desiderata* (BARR.); Klabava Formation, 1.6 ×.

Pl. IV

Arenig, Euloma Shales

1. *Euloma inexspectatum* HOLUB, 1 ×.
2. *Plaesiacomia* sp. n., 2 ×.
3. *Asaphellus bohemicus* ŽEL. 1 ×.
4. *Azygograptus suecicus* MOB., 1.5 ×.
5. *Didymograptus nicholsoni* LAPW., 1 ×.
6. *Schizograptus tardifurcatus* Elles, 1 ×.

Pl. V

Llanvirn, Šárka Formation

1. *Eodalmanella socialis* (BARR.), 1.5 ×.
2. *Eurothisina moesta* (BARR.), 1.5 ×.
3. *Stapeleyella inconstans* WHITT., 1 ×.
4. *Mitrocystella barrandei* JAECKEL, 1 ×.
5. *Trinucleoides reussi* (BARR.), 1 ×
6. *Colpocoryphe bohemica* VAŇ. in a quartzose concretion, 1.2 ×.
7. *Bathycheilus perplexus* (BARR.), 1 ×.
8. *Pricyclopyge binodosa binodosa* (SALTER), 1.5 ×.
9, 10. *Ormathops atava* (BARR.), 1.5 ×.
11. *Pharostoma pulchrum vokovicense* ŠN., 2 ×.
12. *Didymograptus clavulus* PERNER, 2 ×.

Pl. VI

Llanvirn, Šárka Formation

1. *Lichas incola* BARR., 2 ×.
2. *Uralichas avus* (BARR.), 1.5 ×.
3. Siliceous concretion with *Eodalmanella socialis* (BARR.), *Lesuerella prima* (PERNER) and *Tropidodiscus* (*Gamadiscus*) *pusillus* (PERNER), 2 ×.
4. *Didymograptus retroflexus* PER., 1 ×.

Pl. VII

Llanvirn, Šárka Formation

1. *Asaphellus desideratus* (BARR.), 1 ×.
2. *Mitrocystites mitra* BARR., 1 ×.
3. *Selenopeltis buchi macrophthalma* (KLOUČEK), 1.5 ×.
4. *Parabarrandia bohemica* (KLOUČEK), 1 ×.
5. *Ectillaenus šarkaensis* (NOVÁK), 1 ×.
6. *Placoparia (P.) barrandei* PTL. ŠN., 1 ×.
7. *Megistaspis (Nerudaspis) aliena* (BARR.), 1 ×.
8. *Ectillaenus katzeri* (BARR.), 1.2 ×.

Pl. VIII

Llandeilo, Dobrotivá Formation

1, 2, 3. *Svobodaina dalmanelloides* HAVL. (facies of the Skalka Quartzites), 2 ×.
4. *Ormathops oriens* (BARR.), 3 ×.
5. *Colpocoryphe grandis* ŠNAJDR, 1 ×.
6. *Dindymene plasi* KIELAN, 3 ×.
7. *Degamella princeps princeps* (BARR.), 1 ×.
8. *Pricyclopyge binodosa longicephala* (KLOUČEK), 2 ×.
9. *Areia (A.) fritschi* BARR., 2 ×.
10, 11. *Eoharpes benignensis* (NOV.), 2 ×.
12. *Placoparia (P.) zippei* (BOECK), 2 ×.
13. *Ectillaenus benignensis* (PERNER), 2 ×.
14. *Corrugatagnostus morea* (SALTER), 3 ×.
15. *Leptellina primula* (BARR.), 2 ×.

Pl. IX

Caradoc, the Chrustenice Substage

1, 2. *Hirnantia index* HAVL.; Řevnice Quartzites, 2 ×.
3. *Drabovia redux* (BARR.); Letná Formation, 1.2 ×.
4. *Drabovinella draboviensis* (BARR.); Letná Formation, 1 ×.
5. *Bicuspina cava* (BARR.); Letná Formation, 1 ×.
6. *Svobodaina svobodai* HAVL.; Řevnice Quartzites, 1,5 ×.
7. *Calymenella parvula* (BARR.); Letná Formation, 1 ×.
8. *Placoparia (Hawleia) grandis* (H. et C.); Letná Formation, 1 ×.
9. *Onnia goldfussi* (BARR.); Letná Formation, 2 ×.
10. *Ormathops inflatus* (ŽEL.); Libeň Shales, 2 ×.
11. *Marrolithus ornatus parviporus* Př. et VAŇ.; Libeň Shales, 2 ×.
12. *Opsimasaphus (O.) ingens* (BARR.); Libeň Shales, 1 ×.
13, 14. *Mesodalmanella flava* HAVL.; Letná Formation, 2 ×.

Pl. X

Caradoc, the Chrustenice and the Loděnice Substages

1, 2. *Aegiromena aquila praecursor* (HAVL.); Letná Formation, 2 ×.
3, 4. *Dactylogonia blyskavensis* HAVL.; Letná Formation, 2 ×.
5. *Eccoptochile (E.) clavigera* (BEYR.); Letná Formation, 1 ×.
6. *Pharostoma pulchrum mendax* VAŇ.; Letná Formation, 2 ×.
7, 8. *Dalmanitina socialis* (BARR.); Letná Formation, 1 ×.
9. *Actinopeltis globosa* (BARR.); Zahořany Formation, 1.5 ×.

Pl. XI

Caradoc, the Loděnice Substage

1. *Marrolithus ornatus ornatus* (STBG.); Zahořany Formation, 1 ×.

2, 3. *Onniella frequens* HAVL.; Zahořany Formation, 1.5 ×.
4. *Marrolithus ornatus senftenbergi* (H. et C.); Vinice Formation, 1 ×.
5. *Cyclopyge rediviva* (BARR.); Vinice Formation, 2 ×.
6. *Howellites altera* (BARR.); Zahořany Formation, 1.5 ×.
7, 8. *Dalmanitina proeva* (EMMR.); Zahořany Formation, 1.5 ×.
9, 10. *Dionide formosa* (BARR.); Vinice Formation, 1 × and 1.5 ×.
11. *Selenopeltis buchi buchi* (BARR.); Vinice Formation, 1 ×.
12. *Stenopareia panderi* (BARR.); Zahořany Formation, 2 ×.
13. *Pharostoma pulchrum pulchrum* (BARR.); Zahořany Formation, 1 ×.
14. *Rafinesquina pseudoloricata* (BARR.); Zahořany Formation, 1.5 ×.
15. *Aegiromena aquila auquila* (BARR.); Zahořany Formation, 3 ×.

Pl. XII

Caradoc, the Bohdalec Substage

1, 2, 3. *Svobodaina inclyta* (BARR.), 1.5 ×.
4. *Drabovia postrema* HAVL., 1.5 ×.
5. *Onnia abducta* PŘIB. et VAŇ., 1 ×.
6. *Calymenella media* (BARR.), 1 ×.
7. *Synek antiquus* BARR., 2 ×.
8. *Declivolithus alfredi* (ŽEL.), 1 ×.
9, 11. *Aegiromena descendens* (HAVL.), 2.5 ×.
10. *Stenopareia vaněki* (ŠNAJDR), 1.5 ×.
12. *Tentaculites* cf. *anglicus* SALTER, 1 ×.
13. *Caleidocrinus artifex* (BARR.) and *Batostoma počtai* (KETT.), 1 ×.
14. *Heterorthis sosia* (BARR.), 1 ×.

Pl. XIII

Caradoc, the Bohdalec Substage

1, 2. *Dicranograptus* cf. *clingani* L., slightly enlarged.
3. *Eudolatites angelini* (BARR.), 1 ×.
4. *Flexicalymene incerta* (BARR.), 1 ×.
5. *Polyteichus nováki* (PER.), 1.5 ×.
6. *Kloučekia phillipsi* (BARR.), 1.5 ×.
7. Lumachella with *Heterorthina notata* (BARR.) and *Drabovia latior* HAVL., 1.5 ×.

Pl. XIV

Ashgill, Králův Dvůr Formation

1. *Flexicalymene declinata* (H. et C.), 1.2 ×.
2. *Foliomena folium* (BARR.), 2 ×.
3. *Phillipsinella parabola* (BARR.), 2.5 ×.
4. *Kloučekia phillipsi* (BARR.), 2 ×.
5. *Dysplanus wahlenbergianus* (BARR.), 4 ×.
6. *Opsimasaphus (O.) jaanussoni* KIELAN, 0.5 ×.
7. *Lonchodomas portlocki* (BARR.), 2 ×.
8. *Raphiophorus tenellus* (BARR.), 2 ×.
9. *Cyclopyge marginata* H. et C., 4 ×.
10. *Zdicella zeidleri* (BARR.), 1.5 ×.
11. *Selenopeltis buchi vultuosa* PŘ. et VAŇ., 1 ×

Pl. XV

Ashgill, Králův Dvůr Formation

1. *Tretaspis granulata* (WAHL.), 2 ×.

2, 3. *Chonetoidea radiatula* (BARR.), 5 ×.
4. *Anoptambonites moneta* (BARR.), 5 ×.
5. *Dedzetina macrostomoides* HAVL., 1.5 ×.
6. *Chonetoidea tenerrima* HAVL., 7 ×.
7. *Carmon mutillus* BARR., 2.5 ×.
8. *Amphitryon radians* (BARR.), 2 ×.
9. *Tretaspis seticornis seticornis* (HIS.), 3 ×.
10. *Cryptolithus kosoviensis* MAREK, 2 ×.
11. *Kozlowskites nuntius* (BARR.), 2 ×.
12. *Staurocephalus clavifrons* ANGELIN, 7 ×.
13. *Leptestiina prantli* HAVL., 3.5 ×.

Pl. XVI

Ashgill, Králův Dvůr and Kosov Formations

1, 5. *Leptaena rugosa* (HIS.); Kosov Formation, 1.5 ×.
2. *Dalmanitina mucronata* (BRONGN.); Králův Dvůr Formation, 1 ×.
3, 7, 8. *Dalmanella testudinaria* (DALM.); Kosov Formation, 1.5 ×.
4. *Glyptograptus bohemicus* MAREK; Kosov Formation, 2 ×.
6. *Brongniartella platynota* (DALM.); Kosov Formation, 1 ×.
9, 10, 11. *Aegiromena ultima* MAREK; Kosov Formation, 5 ×.
12. *Modiolopsis* sp.; Kosov Formation, 1 ×.
13. *Tentaculites* sp.; Kosov Formation, 2 ×.

Biostratigrafie českého ordoviku

(*Résumé anglického textu*)

VLADIMÍR HAVLÍČEK - JIŘÍ VANĚK

Předloženo 18. května 1964

Detailní stratigrafie českého ordoviku se opírá o výsledky podrobného geologického mapování a vyhledávacích prací na Fe-rudy, dále o studia petrografická, faciální, paleogeografická a paleontologická, prováděná řadou odborníků. Pro biostratigrafické a paleozoogeografické hodnocení bylo použito hlavně graptolitů, trilobitů a brachiopodů, kteří patří k nejrozšířenějším živočišným skupinám v českém ordoviku.

Graptolitové zóny byly stanoveny v arenigu, llanvirnu, llandeilu a částečně v caradoku a ashgilu. V těch stupních, kde graptolitová fauna chybí, nebo je vzácná, byly vymezeny obzory na základě brachiopodů nebo trilobitů (tremadok, zčásti caradok a ashgil). Mimořádně mocný stupeň caradok (1500 až 2000 m), odpovídající sledu pěti graptolitových zón počínaje z. Nemagraptus gracilis a konče z. Pleurograptus linearis, byl rozdělen na tři podstupně (chrustenický, loděnický a bohdalecký podstupeň).

Fauna českého ordoviku má výrazný mediterránní charakter. Mediterránní provincie, do níž náleží i oblast Čech, má vysloveně chladnovodní ráz fauny, který je ovlivňován blízkostí severního pólu (viz obr. 7). Poslední práce v oboru paleomagnetismu prováděné V. BUCHOU (1961) ukazují na postavení severního pólu v ordoviku přibližně v oblasti střední Afriky. Postupné přemísťování severního pólu během ordoviku směrem k V mělo za následek i některé zásadní změny klimatické. Nápadný příliv teplovodní fauny baltické do středních Čech na konci ordoviku (v ashgilu) je nesporně podmíněn klimatickými změnami jako důsledek postupného vzdalování pólu od české oblasti.

Биостратиграфия ордовика Чехии

В работе дается детальная стратиграфия чешского ордовика, основывающаяся на результатах детальной геологической съемки и поисковых работ на месторождения железных руд, а также на данных петрографических, фациальных, палеогеографических и палеонтологических исследований, проводимых рядом специалистов. Уделяется внимание отношениям между чешской областью и зарубежными областями средиземноморской провинции. Отмечается иммиграция теплолюбивой фауны в ашгиллъском ярусе из балтийской и британской областей. Карадокский ярус подразделяется на три подъяруса.

Přeložila K. Morávková


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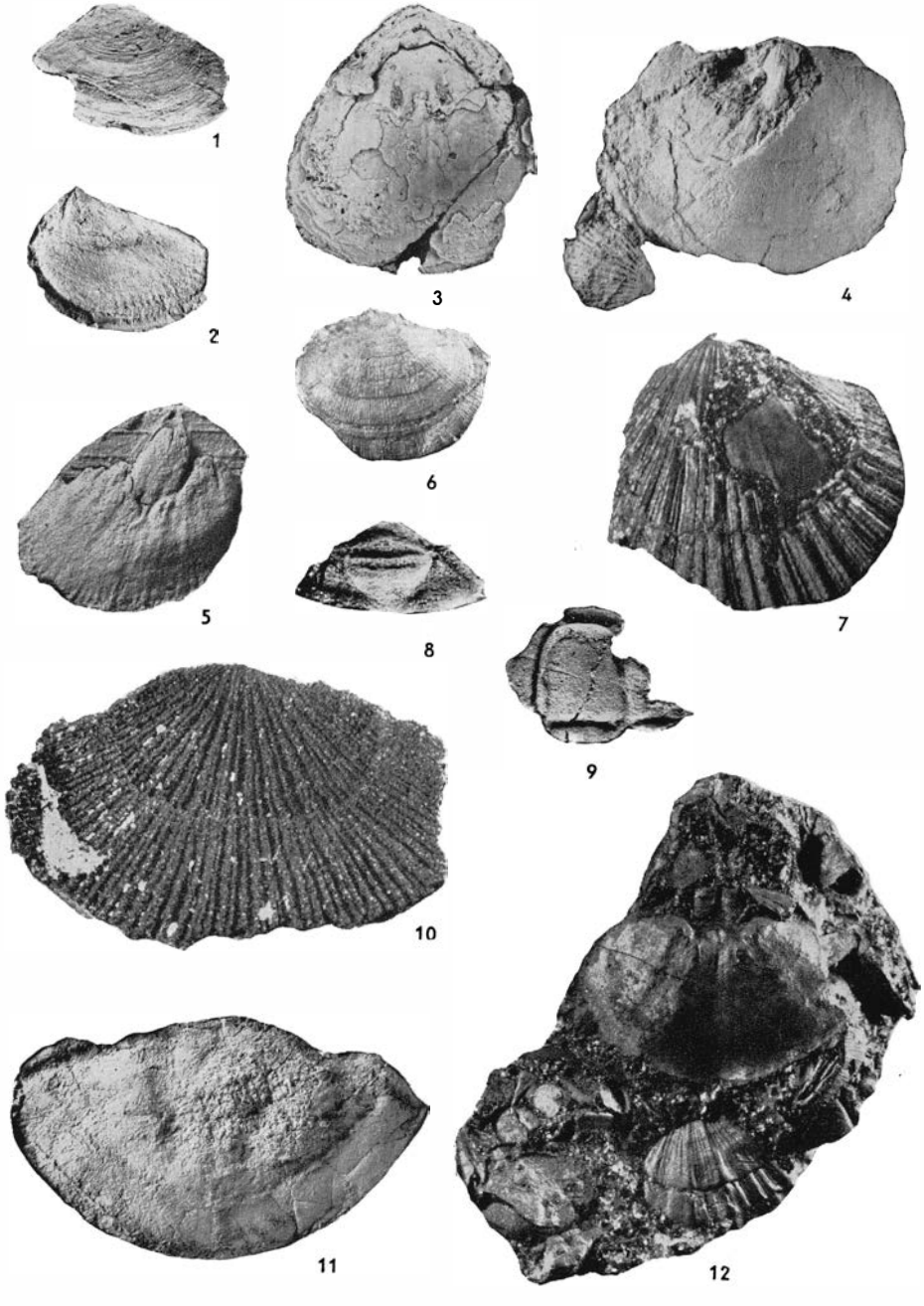
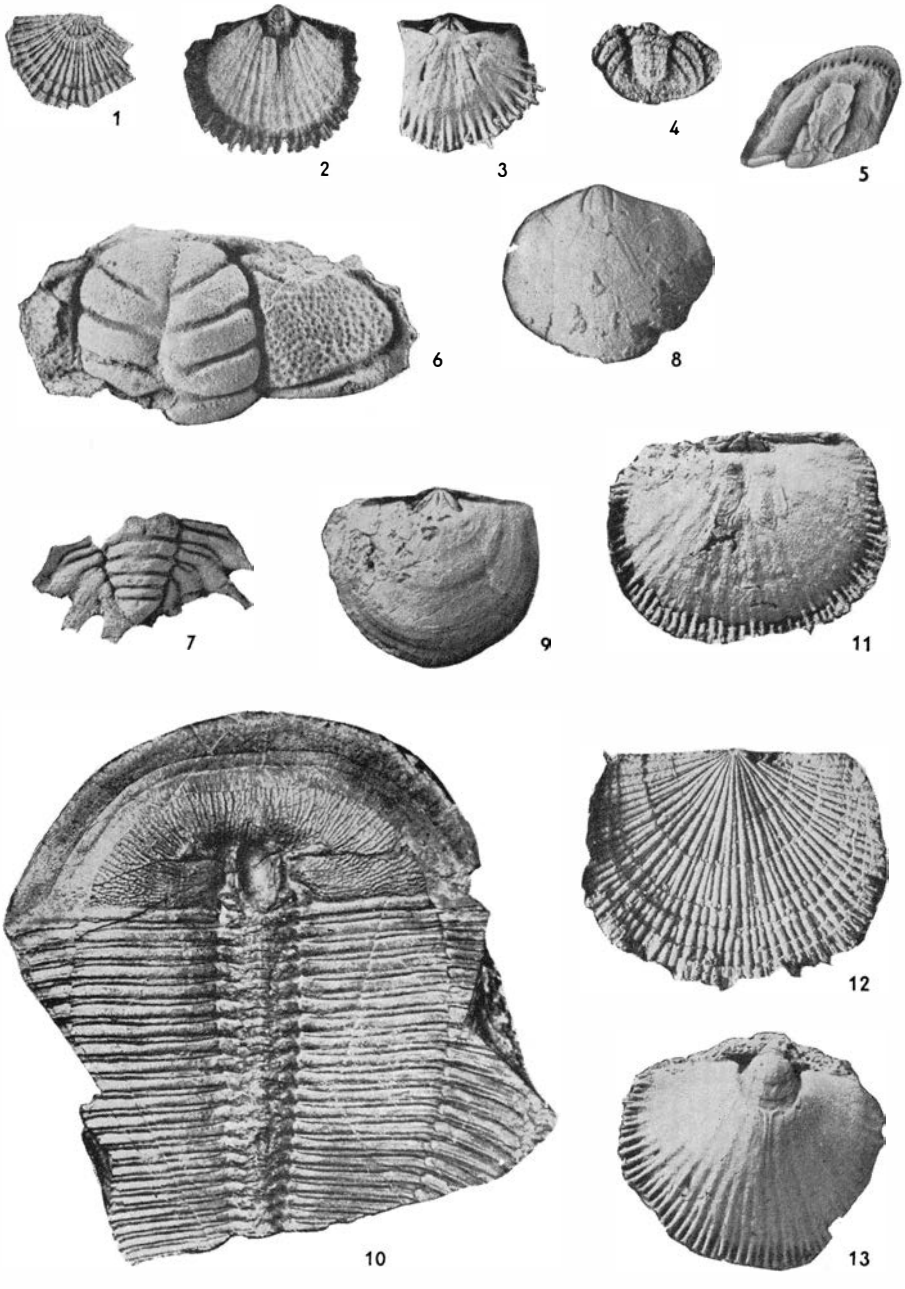
Pl. II

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Pl. IV

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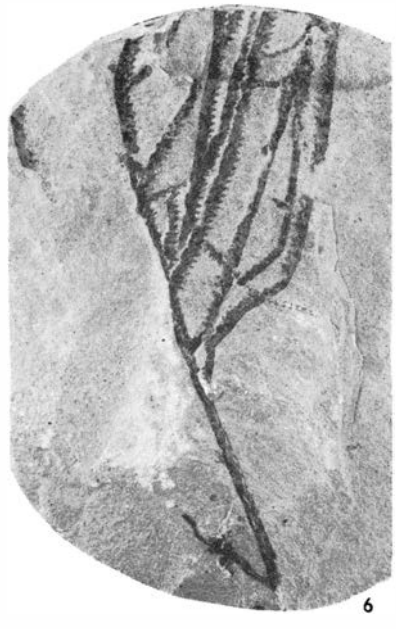

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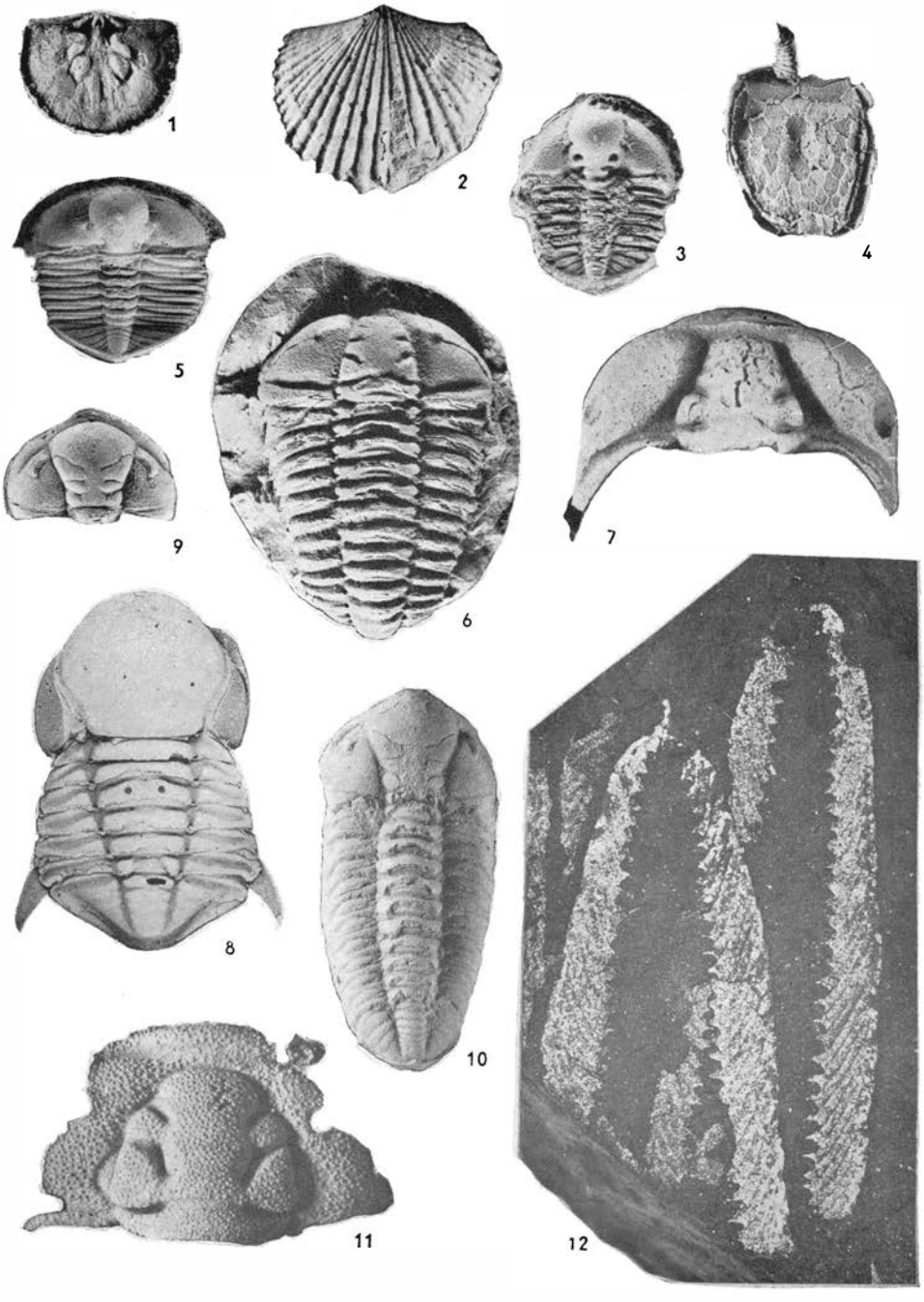
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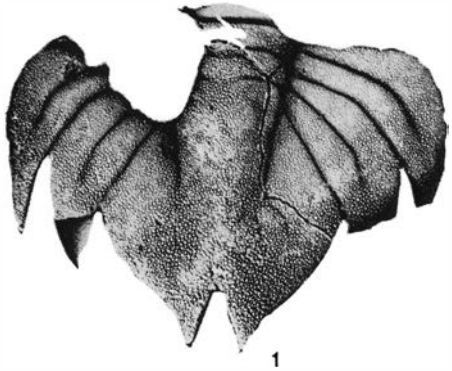
Pl. VI



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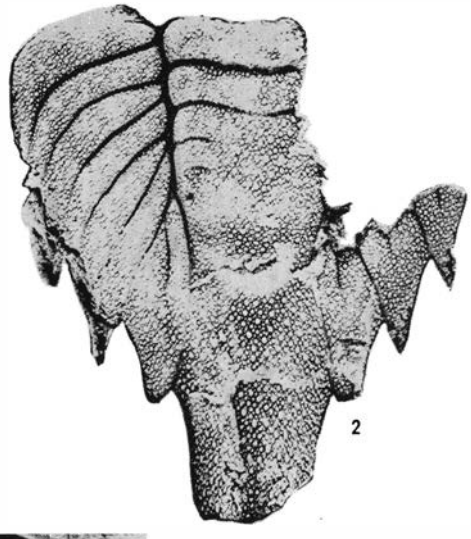

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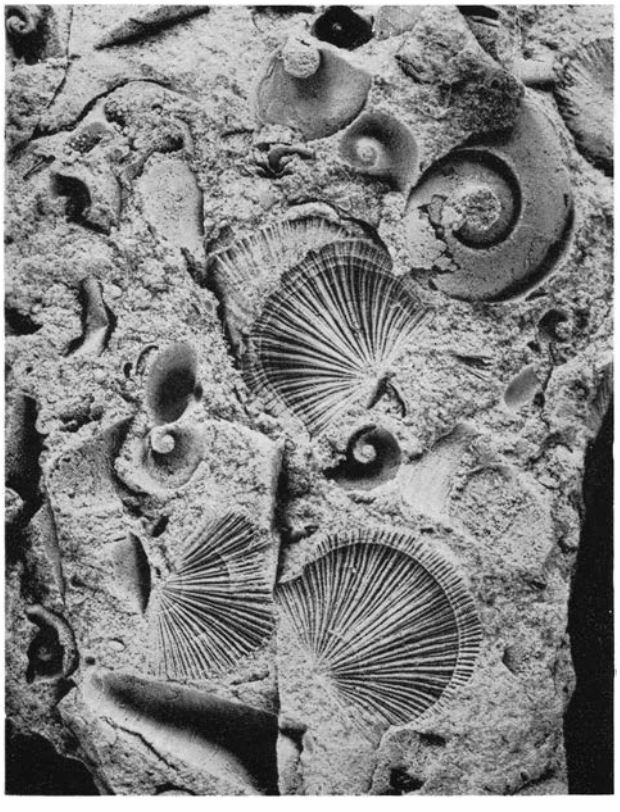

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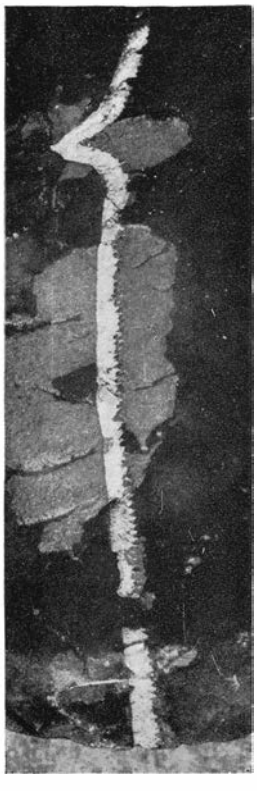

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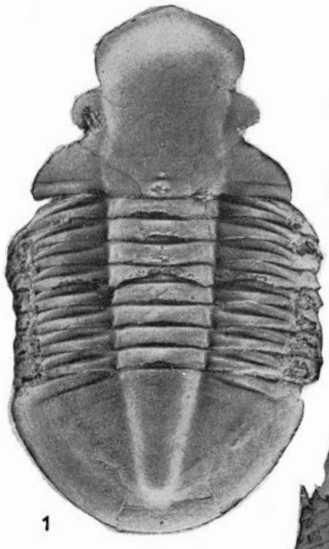

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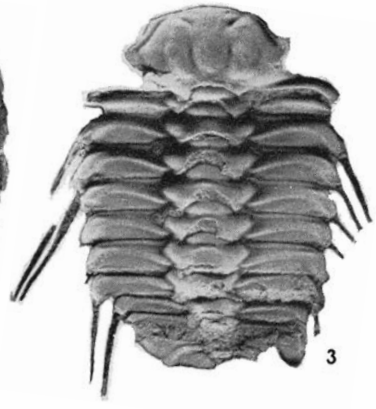

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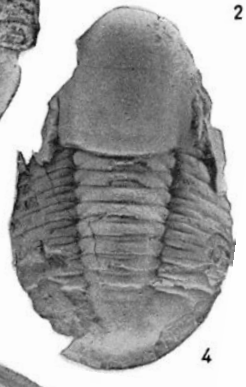

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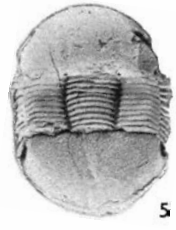

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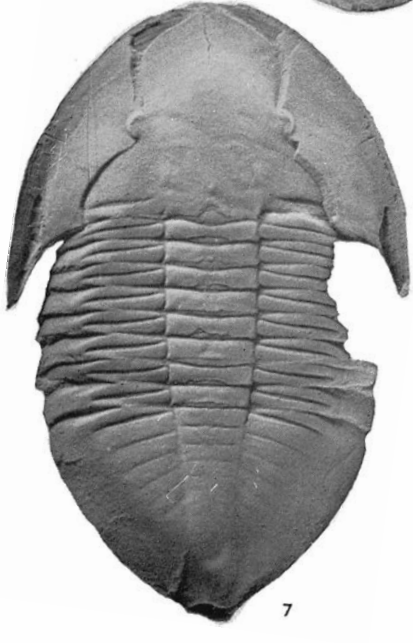

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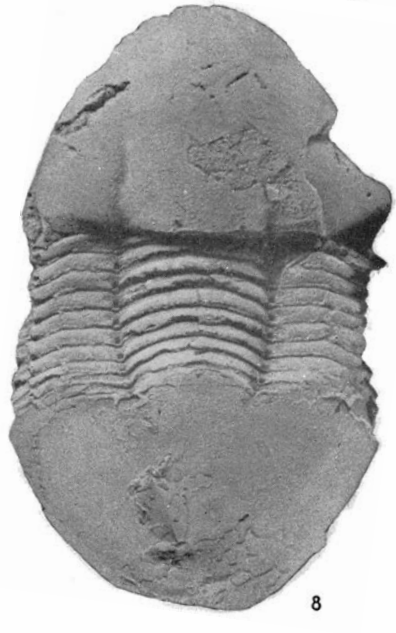

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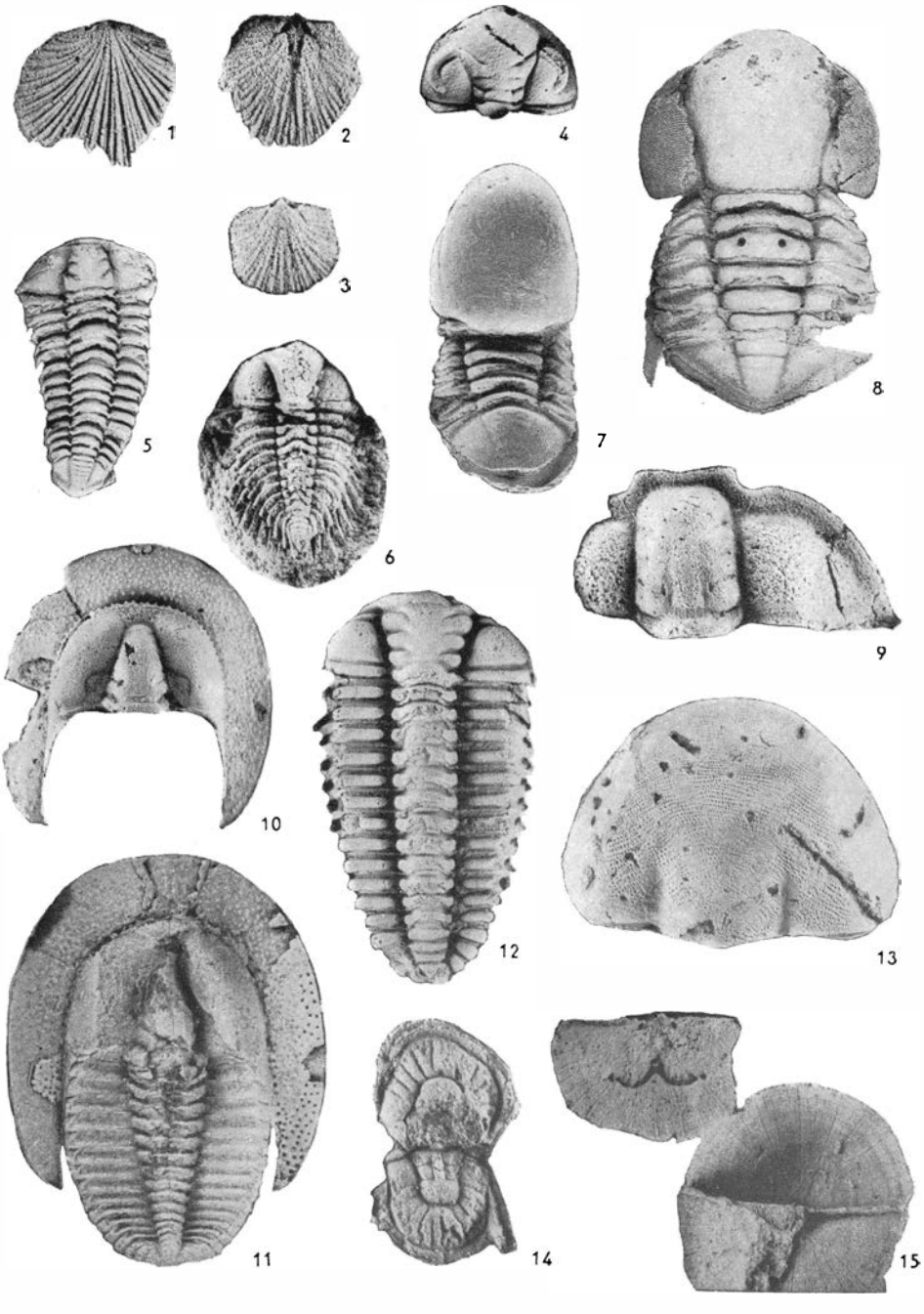
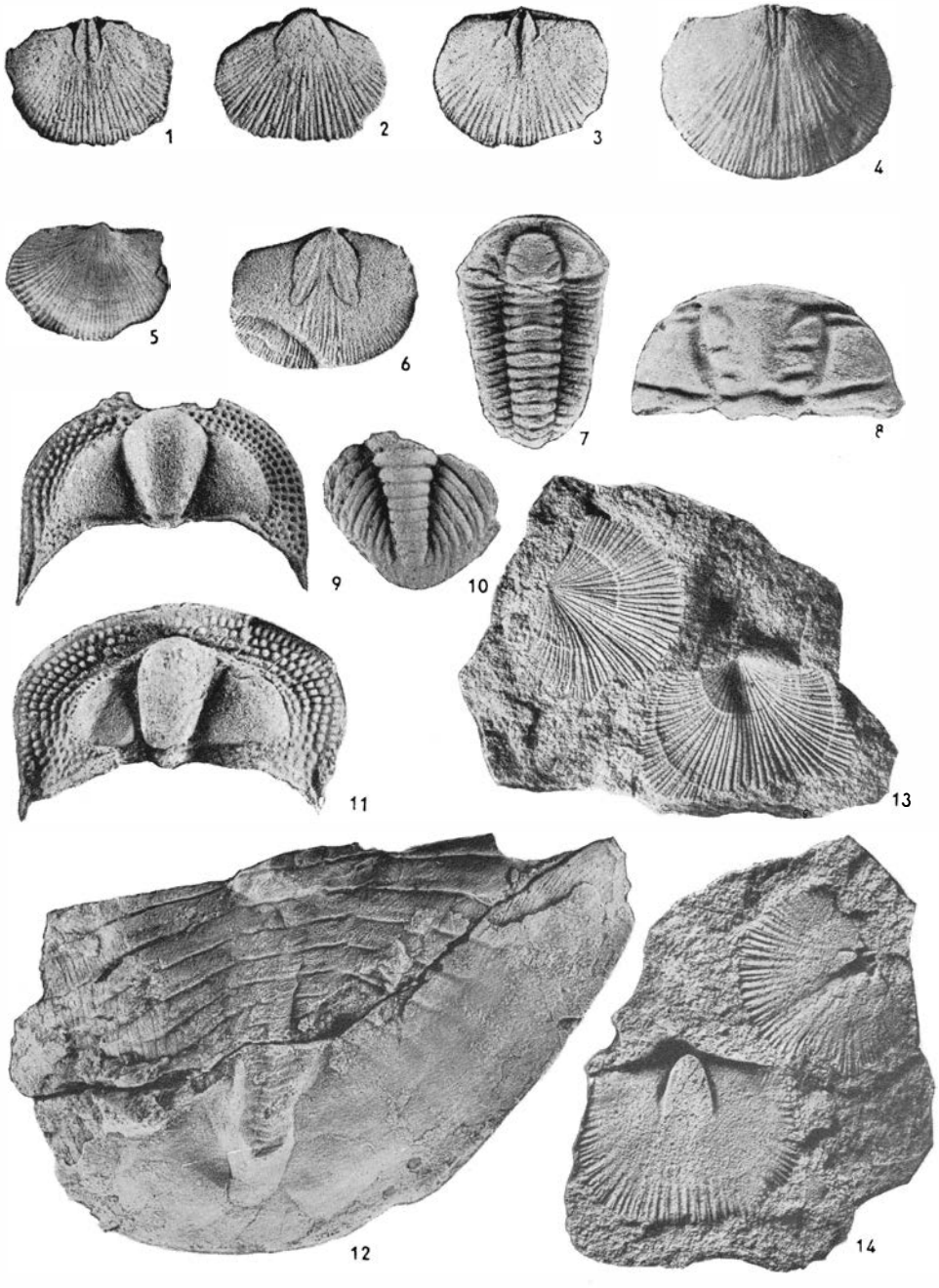
Pl. VIII

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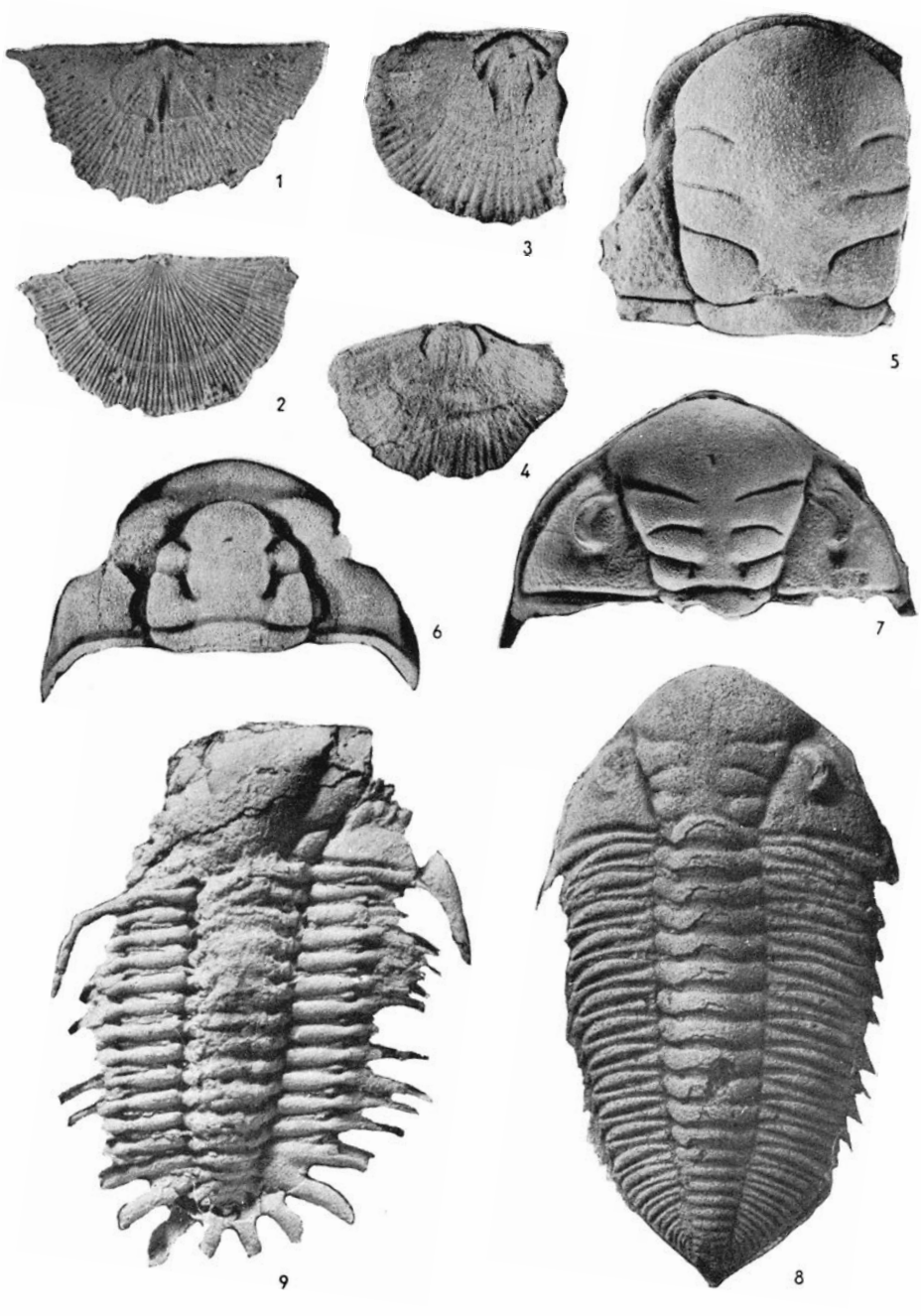
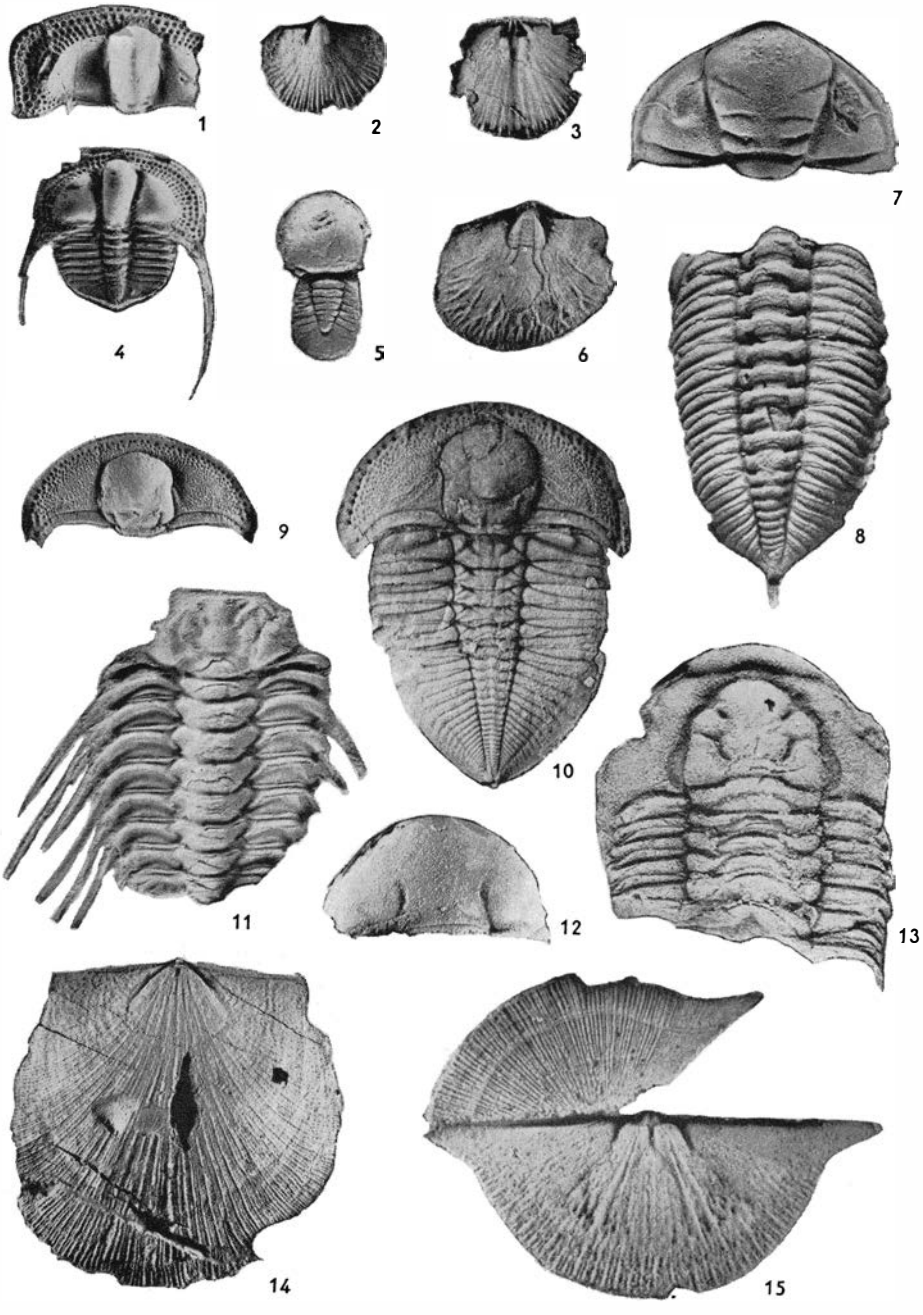
Pl. X

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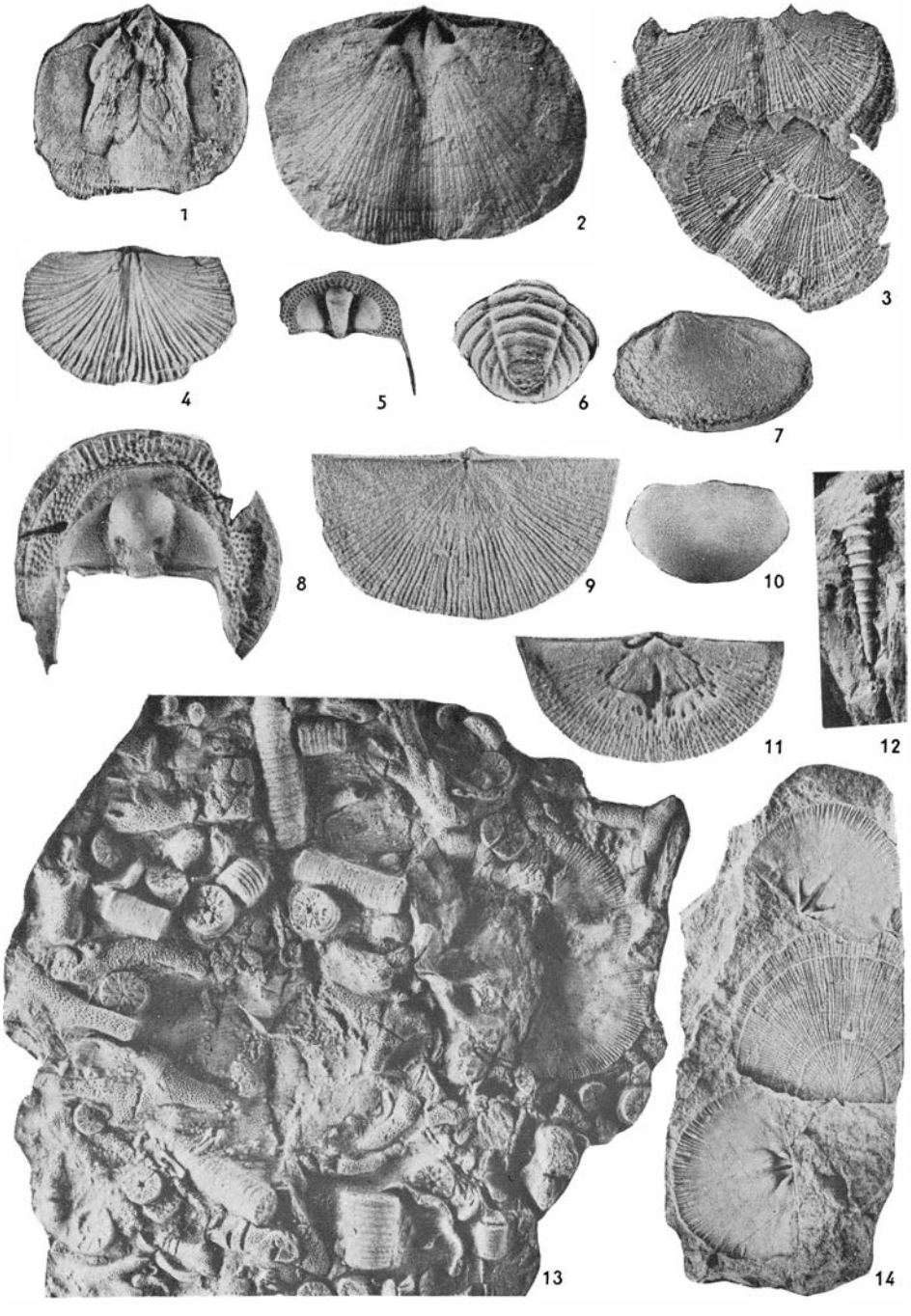
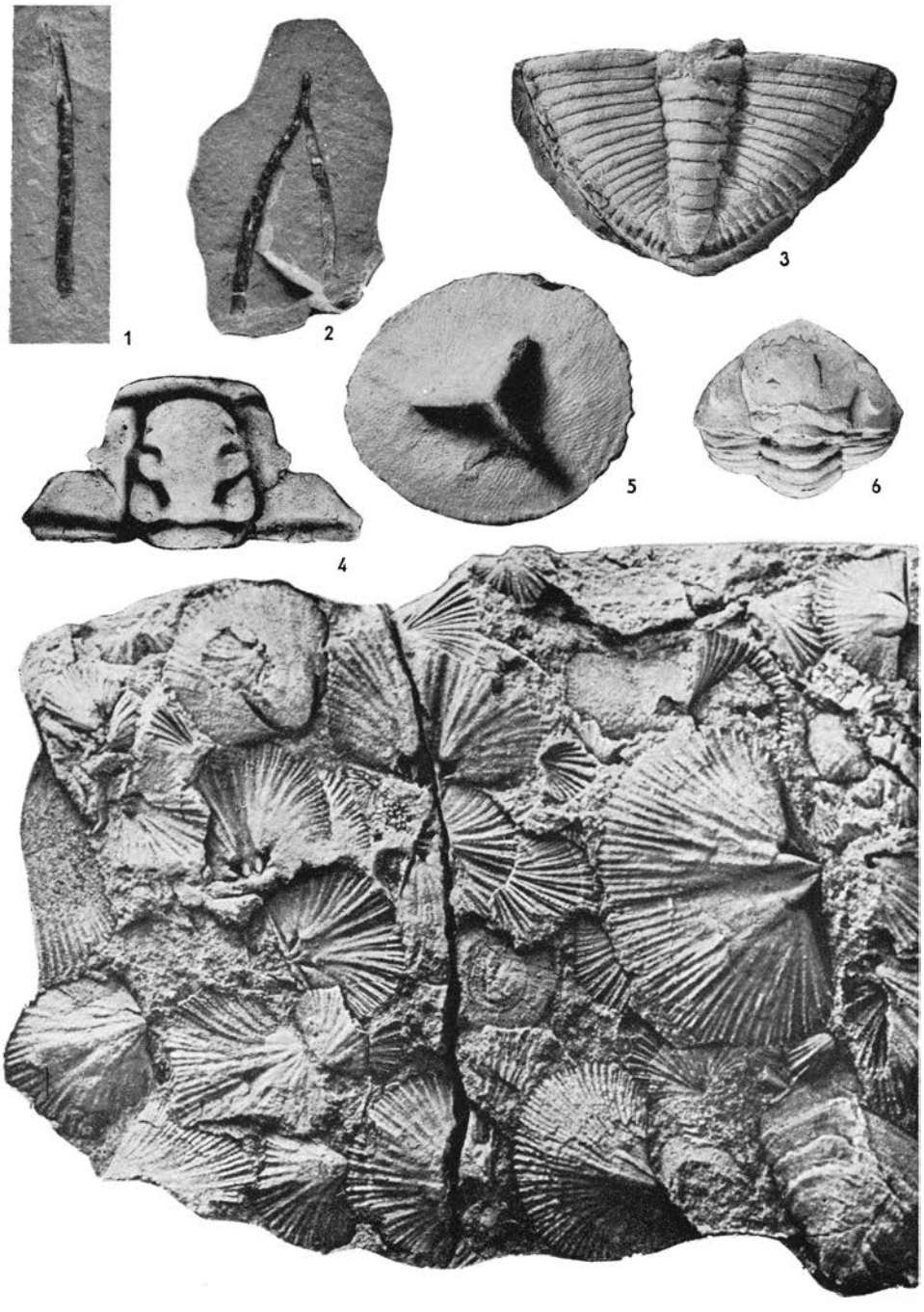
Pl. XII

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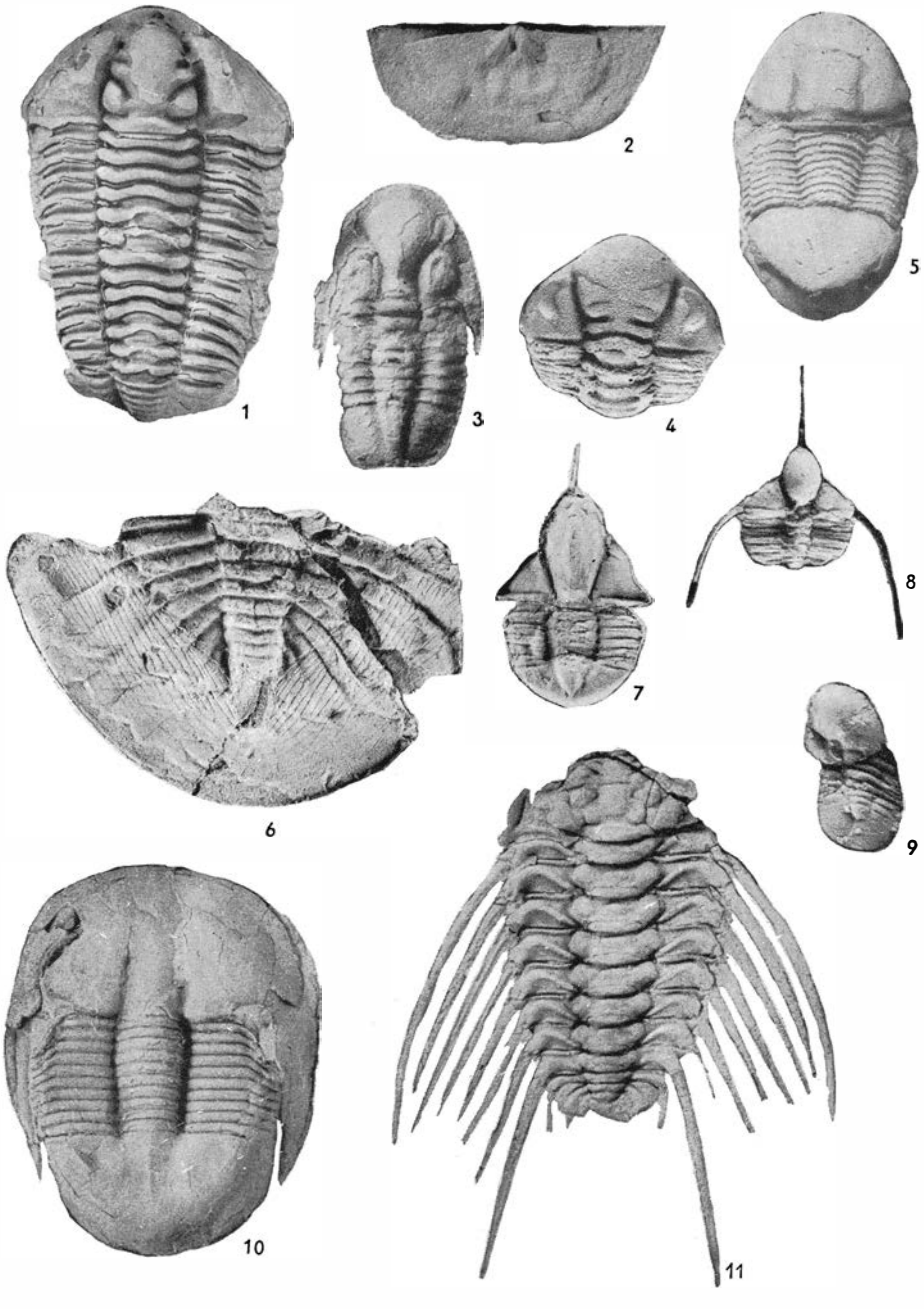
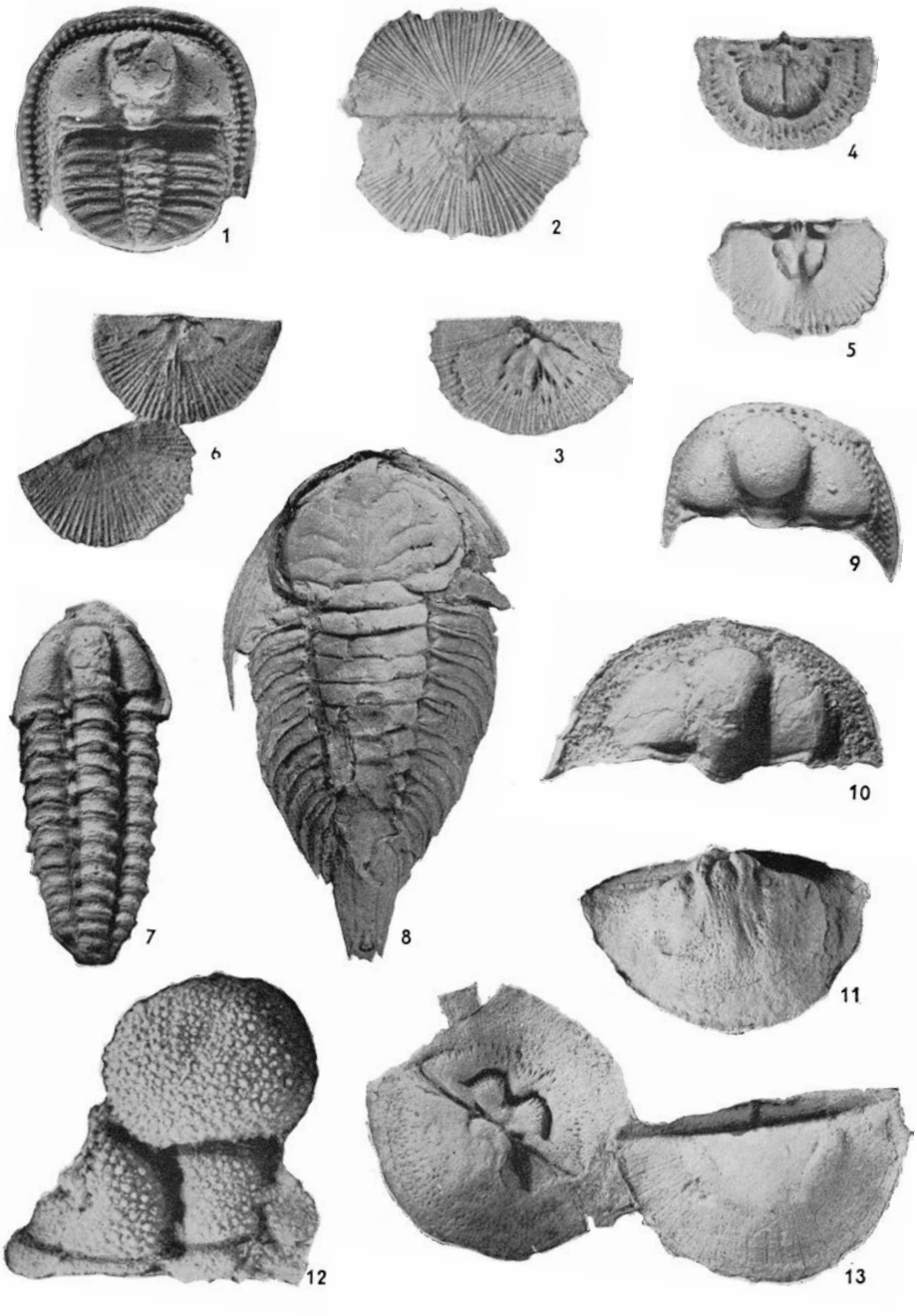
Pl. XIV

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Pl. XVI