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Famennian-Tournaisian neptunian dykes and their conodont fauna from Dalnia in the Holy Cross Mts

ABSTRACT: Neptunian dykes containing a unique fossil assemblage were found in the Upper Devonian limestones of a reef-complex on the Dalnia Hill in the Holy Cross Mts. Fissures of the tectonic origin were opened and filled under subaqueous conditions. The conodont fauna they contain indicates that a repeated filling and re-opening of the fissures took place in the Famennian and Tournaisian. The filling of a main dyke and the fauna it contains correspond to a condensed sequence deposited on a submarine rise. The reconstructed outline of the area of a condensed sedimentation in the Famennian and Tournaisian approximately coincides with the outline of a dead Frasnian table reef. The trace of facial boundaries in the Upper Devonian and Tournaisian is to a considerable degree determined by a block-faulting simultaneous with the sedimentation. The facies pattern here presented seems to exert a certain influence on later, post-Carboniferous tectonics. The paleontological part of the present paper includes a systematic description of 29 conodont species, mostly Tournaisian ones, which have not so far been described from the Lower Carboniferous of the Holy Cross Mts.

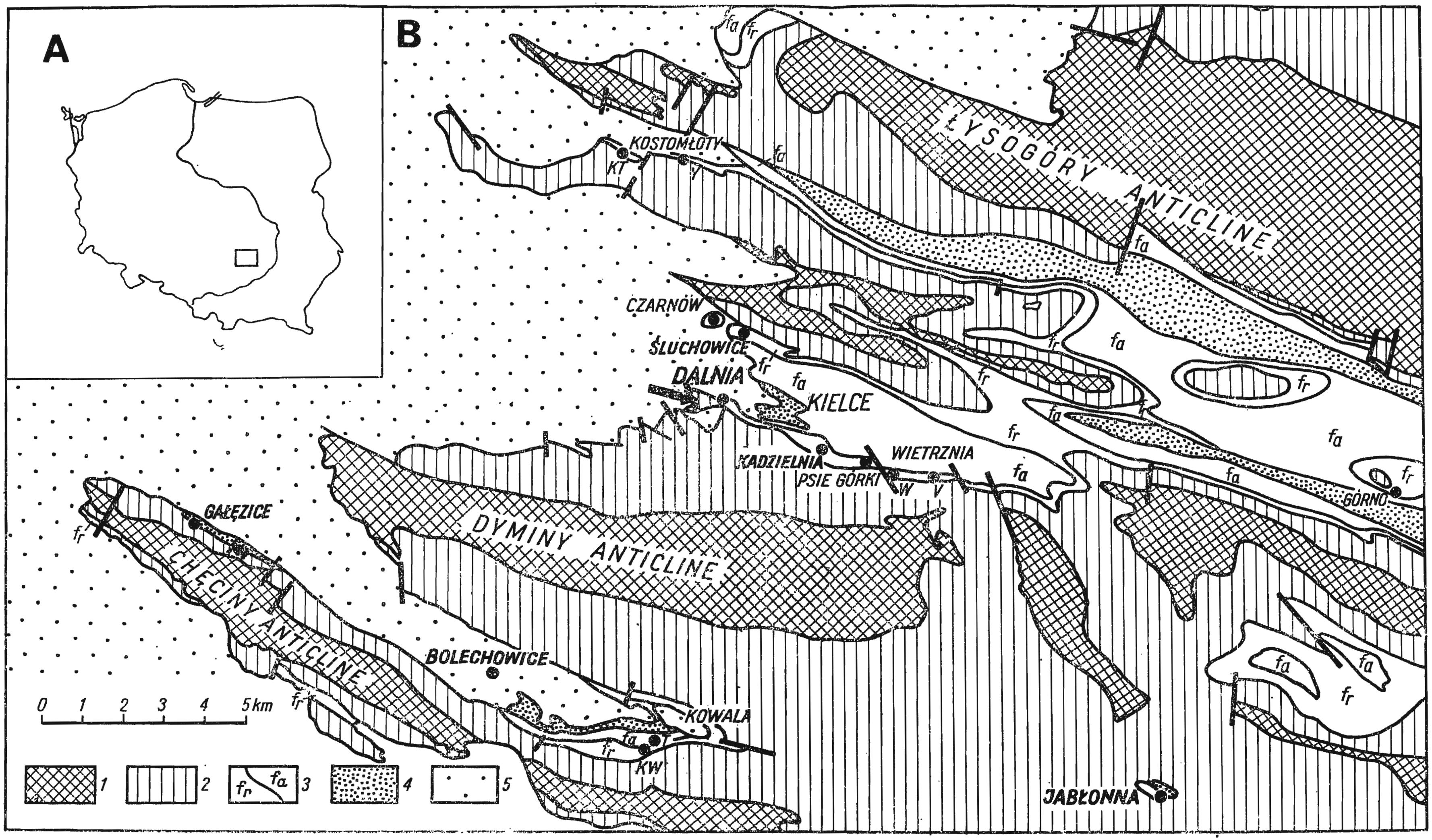
INTRODUCTION

In 1968, a new locality of abundant and unique fossil fauna was discovered in the course of work on the stratigraphy and sedimentation of the Upper Devonian in the western part of the Holy Cross Mts. The locality is situated in the western part of the Kadzielnia range of the Frasnian, at the Dalnia Hill on the outskirts of Kielce. This Frasnian chain belongs to the southern limb of the Kielce syncline connecting it with the Dyminy anticline (*cf.* Fig. 1) situated to the south. Preliminary information on the locality has been given earlier (Szulczewski 1971, pp. 63—64). This locality on the one hand has supplied a rich collection of fossils, most of them so far unknown from the Holy Cross Mts or being quite new taxa and, on the other, its nearly entire fauna occurs in a specific geological situation as it is contained in a neptunian dyke. The presence of the neptunian dykes rich in fossils throws a new light on several general, paleogeographic and paleotectonic problems. The manner of the occurrence of fossils hinders, however, to a considerable extent a stratigraphic analysis and in a way decreases the stratigraphic importance of the find. The material of the dykes does not display a distinct stratification and fauna varying in age is mixed in it, Famennian and Tournaisian forms occurring as well among the fossils. In 1969—1971, these fossils were exploited by the writer and, partly, Doc. A. Stasińska from the Polish Academy of Sciences. The elaboration of the material collected was undertaken by specialists from the Paleozoological Institute, Polish Academy of Sciences. A considerable part of the paleontological materials has already been studied and their descriptions are being published in the present volume of the ACTA GEOLOGICA POLONICA (Osmólska 1973, Stasińska 1973, Fedorowski 1973). Docent H. Osmólska elaborated the entire collection of trilobites and Docent A. Stasińska all the tabulates collected. Docent J. Fedorowski's paper concerns only part of the rugose corals. The rest of them, about 1,500 specimens, remaining at the disposal of Professor M. Różkowska and Docent J. Fedorowski, will be successively presented as further parts of the description of fauna from Dalnia. Relatively few holothurian sclerites from that locality, have enriched a collection which makes the subject of a separate description, also in the present volume of the ACTA GEOLOGICA POLONICA (Matyja, Matyja & Szulczewski 1973).

Acknowledgements. The writer's thanks are extended to Docent H. Osmólska, Docent A. Stasińska and Docent J. Fedorowski for their taking the trouble of the description of fauna from Dalnia and for a discussion of stratigraphic and facies problems dealt with in the paper. The writer feels also indebted to Professor M. Różkowska, now elaborating considerable part of corals from Dalnia, for giving preliminary information on which characteristics of the assemblage of corals have been based.

NEPTUNIAN DYKES

The neptunian dykes containing a rich fauna occur (Fig. 2) in the top of the Dalnia Hill. They appear in a section which approximates the horizontal one and, therefore, they are visible "in plan". The dykes are well exposed as the result of the exploitation of limestone in a small rural quarry. Unfortunately, the exogenic and exploitation processes removed considerable part of the dykes. The neptunian dykes (Fig. 2*B*) cut through the Upper Devonian oolitic limestones, which are thick-bedded and have dips of 30° and strike of 32°. The dykes run in principle



General map of Poland (*A*) and geological sketch map (*B*) of the western part of the Holy Cross Mts (*after* Czarnocki, 1938; simplified — *cf.* Szulczewski 1971, Text-fig. 1) showing location of the Dalnia Hill (arrowed) and other sections discussed in the present paper (bold-faced). The remaining profiles and their abbreviations are the same as used in the previous paper (Szulczewski 1971)

1 Cambrian, Ordovician and Silurian, *2* Lower and Middle Devonian, *3* Frasnian (*fr*) and Famennian (*fa*), *4* Lower Carboniferous, *5* post-Variscan cover (Zechstein — Upper Cretaceous) parallel to the strike of oolitic limestones and penetrate them nearly vertically. The network of dykes consists of two main dykes parallel to each other and separated by a 50 cm — wide ledge of the oolitic limestone cut by several small perpendicular dykes (Fig. 2*A*), which vary in width within limits of several scores of centimeters. The small dykes are a few *mm* to a few *cm* wide. They are tortuous and either connect the two main dykes, cutting through the oolitic limestone of the ledge which divides them, or penetrate into the outer parts of this limestone.

The fissures are filled with:

(1) a pink to green marly limestone;

(2) a gray crinoid limestone;

(3) a gray-green organodetrital limestone locally containing intraclasts of a pink marly limestone;

(4) black and olive-green clayey shales.

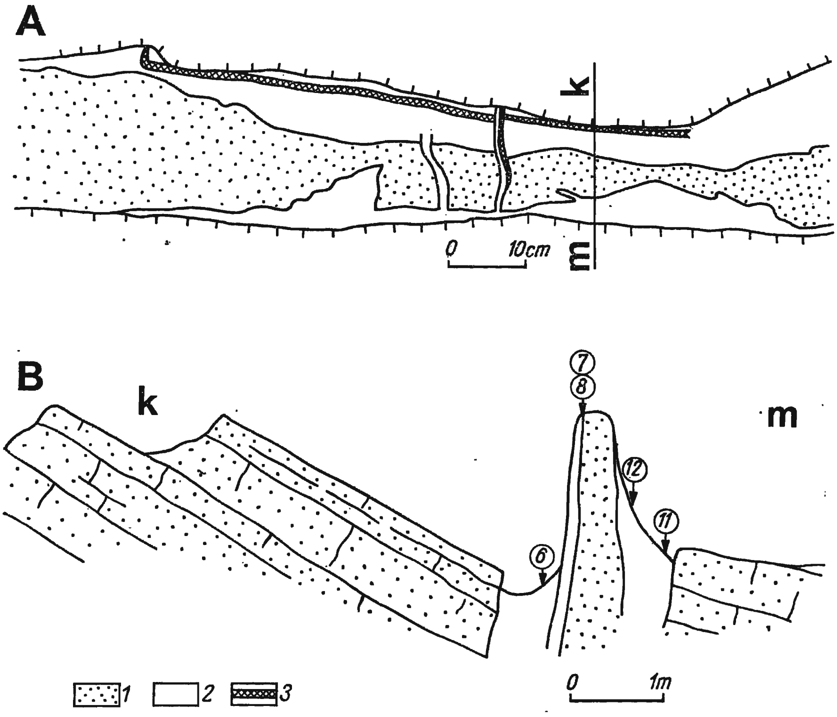


Fig. 2

Sketch plan of the outcrop (fragment) with neptunian dykes (*A*) and magnified section (*B* — along *k*-*m* in *A*) through the oolitic limestones cut by neptunian dykes at Dalnia

1 oolitic limestones, 2 neptunian dykes, 3 calcite veins; circled numbers denote the conodont samples

The crinoid limestone has been found only as a small lens separately embedded in oolitic limestones (Fig. 3). The clayey shales have been found only in the waste. On the other hand, the pink or greenish marly limestone is absolutely predominant in the filling of both main dykes. In the northern dyke it is the only type of deposit, but it does not contain any macrofossils, which occur, however, in the limestone of this type in the southern dyke (corals, brachiopods, trilobites, cephalopods). The marly limestone also makes up a filling of all small dykes.

The gray-green organodetrital limestone, probably exploited already, occurs in very small amounts. Most specimens come from the waste, that is, a limestone consisting primarily of fragmentary trilobites and a crinoid detritus, with intraclasts of a pink marly limestone, identical with that described above, which are embedded in it. The boundary between the two rocks, although visible in detached blocks only, is distinctly sedimentary (erosional) in character. It also indicates that the organodetrital limestone is older than the marly one.

The filling of the main southern dyke probably also contained at first a thin layer of red clay abounding in corals, as indicated by a rich occurrence of excellently separated corals accumulated in one place in the waste. It seems very unlikely that they could be so accurately sepa-

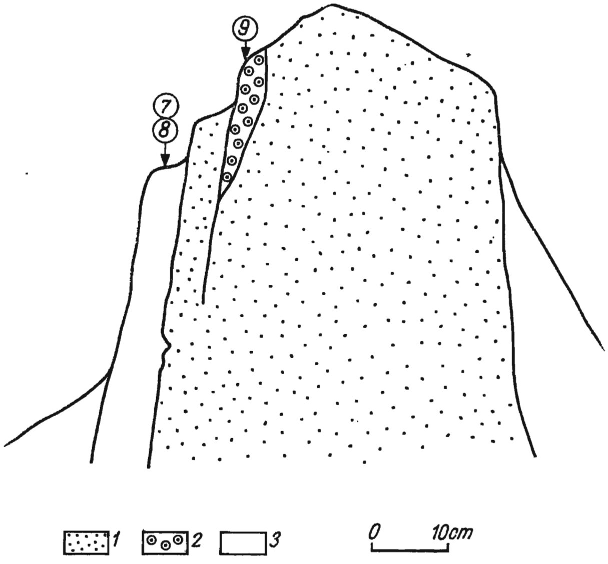


Fig. 3

Detailed section showing position of the crinoid limestone in the neptunian dykes at Dalnia

1 oolitic limestones — bedrock of the neptunian dykes, 2 crinoid limestone in one of the neptunian dykes, 3 marly limestone in other dykes; circled numbers denote the conodont samples

rated from marls by weathering. The red clay alone is clearly visible in the waste, but there is no certainty if at least part of it is not a karst-weathering waste.

GENERAL CHARACTERISTICS OF THE MACROFOSSIL ASSEMBLAGE

Conodonts and corals make up a predominant element of the collection under study, with trilobites being also abundant. Other fossils as cephalopods, brachiopods and crinoids (except for a lens of crinoid limestone) are rare. Concise characteristics of individual groups, in particular corals most of which are now only being studied, will be presented as follows.

Corals. Rugose and tabulate corals, as well as heterocorals are present in the collection. The first of them make up about 90 per cent of all corals. The heterocorals are the least numerous and rugose corals occur only as solitary forms. No colonial forms have been found. For this reason, as well as due to their small size and lack of dissepiments, they are of the type of the Cyathaxonia fauna (*sensu* Hill 1938, p. 5). The genera *Cyathaxonia* Michelin, *Neaxon* Kullmann, *Pseudomicroplasma* Soshkina, as well as metriophylloid, and cystophylloid forms predominate among them. The forms mentioned above were rare among the corals previously described from the Famennian of the Holy Cross Mts (Różkowska 1968, 1969). And on the contrary, the genera *Petraiella* Różkowska, *Nalivkinella* Soshkina and the forms assigned to the family Kielcephyllidae and to the order Heterocorallia are rare at Dalnia. Particularly important is a rare occurrence on Dalnia of the genera, which in other outcrops (Różkowska 1969) appeared only in the lower part of the Famennian, e.g. *Petraiella* Różkowska, *Kielcephyllum* Różkowska, *Kozlowskinia* Różkowska, *Nalivkinella* Soshkina. There are no representatives of the superfamily Phillipsastraeidae common in the Frasnian and very rare in the lower part of the Famennian. Instead, there appear new genera and several new species of the families Metriophyllidae and Laccophyllidae.

The state of preservation of the corals is variable. Excellently preserved are the representatives of the subfamilies Metriophyllinae and Cyathaxoniinae. Specimens of some genera (e.g. *Petraiella* Różkowska, *Amplexocarinia* Soshkina, *Gorizdronia* Różkowska and cystophyllid forms) are, on the other hand, frequently broken and, as the result of recrystallization, with a poorly preserved internal structure.

Tabulate corals are assigned (Stasińska 1973) to the following genera: *Emmonsia* Milne-Edwards & Haime, *Michelinopora* Yabe & Hayasaka, *Acaciapora* Moore & Jeffords and *Kueichowpora* Chi, which have hitherto not been known from the Holy Cross Mts. All species are new. These are without any exception small forms, corresponding in dimensions to rugose corals which they accompany, and are spherical, either club- or branch-shaped.

Trilobites are also the subject of a separate elaboration (Osmólska 1973). In the collection they are represented by 12 species and subspecies of six genera. One of them is clearly Devonian in character (*Phacops*) and four Carboniferous (*Globusia, Phillibole, Carbonocoryphe, Liobolina*). Most species are new. All trilobites are small. A high vaulting of cephalon, swollen genal spines and advanced reduction of eyes (Osmólska 1973), displayed by several species are considered the most striking characters of the assemblage.

Ammonoids are very rare; they are represented by a few fragments of *Wocklumeria* sp. only.

THE AGE OF INFILLING

There are two fundamental factors which make difficult an exact determination of the age of the neptunian dykes on the Dalnia Hill and of the fossil assemblage they contain. The first is a generally observed mixing of fauna varying in age and the second — the lack of stratification and a definite spatial orientation in the infilling of fissures with a simultaneous lithological similarities of deposits varying in age. Of the fossils contained in the dykes, conodonts are of a fundamental importance. A common assemblage of abundantly represented species, having narrow stratigraphic ranges well-known for most of the species, is decisive in this respect. The trilobites play an accessory role but they do not provide a possibility of such a precise stratigraphic division as do the conodonts. They are incomparably less numerous and most of their taxa are new. Due to their extensive stratigraphic ranges, usually not yet determined definitely and a great number of their new taxa, corals play here a small stratigraphic role only. In practice, the age of corals and, to a considerable extent, new species of trilobites is indicated by the assemblage of associated conodonts (Table 1). Thus, the nomenclature of the biostratigraphic units represented in the fissure infilling has been based on the conodont standard zonation. Some of the conodont samples contain a uniform-age assemblage and referring them to appriopriate conodont zones does not pose any problems. In mixed conodont faunas, elements coming from known zones have been determined only as far as possible on the basis of known ranges of species.

Conodont zonation

The reconstruction of stratigraphic conditions in the neptunian dykes on the Dalnia Hill (Fig. 4) is possible only due to a considerably advanced knowledge of the Upper Devonian and Lower Carboniferous

Distribution and frequency of conodonts and associated fossils in particular samples from neptunian dykes at Dalnia

			Samples																	
			6	6A	7	8	9	10	11	11B	12	12B	13	a	b	c	d	e	f	g
Conodonts from	Palmatolepis quadrantinodosa Zone	Icriodus alternatus Branson & Mehl				1	45													
		Icriodus cornutus Sannemann		16	1		580	45												
		Nothognathella cf. postsublaevis Helms & Wolska		1																
		Nothognathella/?/ falcata Helms		1		2	14													
		Palmatodella delicatula Ulrich & Bassler		1			1													
		Palmatolepis distorta Branson & Mehl		8	7	8	97	9												
		Palmatolepis glabra lepta Ziegler & Huddle		14	30	28	420	113												
		Palmatolepis glabra pectinata Ziegler					6	2												
		Palmatolepis gracilis gracilis Branson & Mehl *			8	1	6	1	3		8				5	16		5		
		Palmatolepis minuta minuta Branson & Mehl			6	3	91	9												
		Palmatolepis perlobata perlobata Ulrich & Bassler			13	5	68	10												
		Palmatolepis quadrantinodosa marginifera Helms		4	7	4	45	5			1									
		Polygnathus cf. flabellus Branson & Mehl			1															
		Polygnathus glaber glaber Ulrich & Bassler			2		27	1												
		Polygnathus glaber bilobatus Ziegler			3	1	2	2												
		Polygnathus glaber medius Helms & Wolska					3	1												
		Polygnathus lagowiensis Helms & Wolska						1												
		Polygnathus nodocostatus nodocostatus Branson & Mehl				2	17	2												
		Polygnathus nodoundatus Helms						1												
		Polygnathus perplexus /Thomas/					6													
		Polylophodonta linguiformis Branson & Mehl				1	7	2												
	Spathognathodus costatus Zone	Palmatolepis gonioclymeniae Müller							2											
		Palmatolepis gracilis sigmoidalis Ziegler							12							2		3		
		Pseudopolygnathus trigonicus Ziegler	2						1		1									
		Spathognathodus aculeatus /Branson & Mehl/							2		2			2		2				
		Spathognathodus costatus costatus /Branson/	9	8					78		4	2			6	10		13	1	
		Spathognathodus costatus spinulicostatus /Branson/	2	4					24		2				6	1				8
		Spathognathodus costatus ultimus Bischoff							2						1					
		Spathognathodus supremus Ziegler	12	6					2		1	4			1	6		3		
	Uppermost Famennian or Tournaisian Zones	Polygnathus communis communis Branson & Mehl	55	28					1	3	16	9	7		2	14	4		35	23
		Polygnathus inornatus Branson	6	5						1	2				1			2	6	2
		Polygnathus longiposticus Branson & Mehl	3	4							2									
		Polygnathus symmetricus Branson		2						1										
		Polygnathus vogesi Ziegler	3	3					1			2	1						9	
		Protognathodus collinsoni Ziegler	1	1																
		Protognathodus meischneri Ziegler		1																1
		Protognathodus kockeli /Bischoff/	2	3									1							
		Pseudopolygnathus dentilineatus Branson	6	2															3	1
		Pseudopolygnathus nodomarginatus /Branson/	12							3	8			2				1	10	9
		Spathognathodus disparilis /Branson & Mehl/							1							1				
		Spathognathodus stabilis /Branson & Mehl/	5									1			1	2			1	1
	Tournaisian Zones	Dinodus wilsoni Druce	1																	
		Polygnathus communis carinus Hass	4	3						1	1	1	1	3					18	5
		Polygnathus purus purus Voges	27	12						4	4	4	1	11		2	2		4	2
		Polygnathus purus subplanus Voges	10	15						6	2		1	3		2		1	13	14
		Pseudopolygnathus fusiformis Branson & Mehl		2						2	2	1					1		15	2
		Pseudopolygnathus marginatus /Branson & Mehl/	2							1										
		Pseudopolygnathus primus Branson & Mehl	9							1	2								2	3
		Pseudopolygnathus triangulus pinnatus Voges		2							3									
		Pseudopolygnathus sp. A	2	2							2									
		Pseudopolygnathus sp. B	3						1	1										
		Siphonodella duplicata /Branson & Mehl/	19	11							3	4		8			4		9	6
		Siphonodella lobata /Branson & Mehl/									1									
		Siphonodella obsoleta Hass	1	1								2	1	2						
		Siphonodella quadruplicata /Branson & Mehl/	2								3		1						2	2
		Siphonodella sulcata /Huddle/	9	7							1	4					1		4	
Trilobites		Phacops ex gr. granulatus			x															
		Waribole spp.			x															
		Globusia differtigena /Osmólska/												x					x	
		Phillibole drewerensis latipalpebrata Osmólska	x														x		x	x
		Phillibole nitida annosa Osmólska																	x	
		Phillibole prenes Osmólska																	x	
Corals		Cyathaxonia cornu Michelin													1					
		Cyathaxonia sp.																1		
		Hillaxon vesiculosus Różkowska																1		
		Neaxon regulus /Richter/																3		
		Neaxon sp.														1				
		Petraiella centralis Różkowska																		1
		Petraiella kielcensis Różkowska												1						
		Saleelasma sp.															1			
		Smithiphyllum sp.																1		
		Siringaxon sp.																		1
		Genus nov.													1					
		Acaciapora infracarbonica Stasińska															1			
Holothurians		Eocaudina subhexagona Gutschick, Canis & Brill	~15																	
		Eocaudina cf. hexagona Kristan-Tollmann	1																	

Determination of the rugose corals by Professor M. Różkowska (*paper in preparation*), tabulate corals after Stasińska (1973), trilobites after Osmólska (1973), and holothurian sclerites after Matyja, Matyja & Szulczewski (1973). Numbers of the trilobites not given as these are preserved as disarticulated parts of exoskeletons. Of the macrofossils, only the forms identified in the conodont-bearing samples are given. Numbered samples come from the neptunian dykes (cf. Text-figs 2—3), lettered ones come from loose blocks (waste of the dykes) containing the macrofossils

* *Palmatolepis gracilis gracilis* Branson & Mehl may belong either to the assemblage from the Palmatolepis quadrantinodosa Zone or from the Spathognathodus costatus Zone

conodont stratigraphy. On a world scale, Upper Devonian conodont zones are of a universal character. The succession and definitions of their zones have been adopted according to generally accepted principles introduced by Ziegler (1962, 1971). The stratigraphic division of the Lower Carboniferous based on conodonts is not, however, so uniform which seems to result in part from the existence of provinces. Due to the similarity of the conodont fauna and relatively strongest regional relationships, the conodont zonation has, therefore, been based on Voges' (1959) succession.

Upper Palmatolepis quadrantinodosa Zone (to IIIα). — The distinguishing of this zone is possible mostly on the basis of evolution within the *Palmatolepis quadrantinodosa* and *P. glabra* (Ziegler 1962, pp. 31 and 33, Table 2; 1971, Chart 6). The abundant occurrence of *Palmatolepis quadrantinodosa marginifera* Ziegler, with a simultaneous lack of the remaining subspecies of *P. quadrantinodosa,* indicates that the assemblage they are contained in represents the Upper P. quadrantinodosa Zone. The same conclusion is suggested by the mass occurrence of *Palmatolepis glabra lepta* Ziegler & Huddle, accompanied by *P. glabra pectinata* Ziegler and *P. distorta* Branson & Mehl, with a simultaneous lack of *P. glabra prima* Ziegler & Huddle and *P. glabra acuta* Helms. Also present are the polygnathid species *Polygnathus glaber bilobatus* Ziegler and *P. lagowiensis* Helms & Wolska, which are not known in higher beds than the Upper P. quadrantinodosa Zone (Ziegler 1971, Chart 6). On the other hand, except for a single transitional form from *P. perlobata* to *P. rugosa grossi* Ziegler, no *Palmatolepis rugosa* subspecies diagnostic for this zone has ever been found. Ziegler (1962, p. 33) ascertains, however, that this species, is not frequent. This is confirmed by a low frequency of the subspecies of *P. rugosa* in Wolska's (1967) collection from the Holy Cross Mts. The remaining species found in the samples referred to the Upper Palmatolepis quadrantinodosa Zone belong to typical and common elements of this zone, although they exceed it in their ranges. Noteworthy is the presence of *Polygnathus glaber medius* Helms & Wolska.

Samples 7 to *10* (Table 1) may be surely referred to the Palmatolepis quadrantinodosa Zone. They are sufficiently abundant (a total of about 2000 specimens) to give the certainty that they make up a representative material devoid of any admixtures of another age. Very characteristic is quantitative predominance of *Palmatolepis glabra lepta* in all the samples. Specimens belonging to this species make up more than 60 per cent of the entire collection of *Palmatolepis* coming from this zone.

Middle Spathognathodus costatus Zone (to ?V/VI—VI). — Only one (No. *11*) sample, devoid of the elements of another age, completely represents this zone. It is not abundant, but contains an assemblage very characteristic of this zone (Ziegler 1962, p. 41, Table 2; 1971, Chart 6). It includes *Palmatolepis gonioclymeniae* Müller, the only species known,

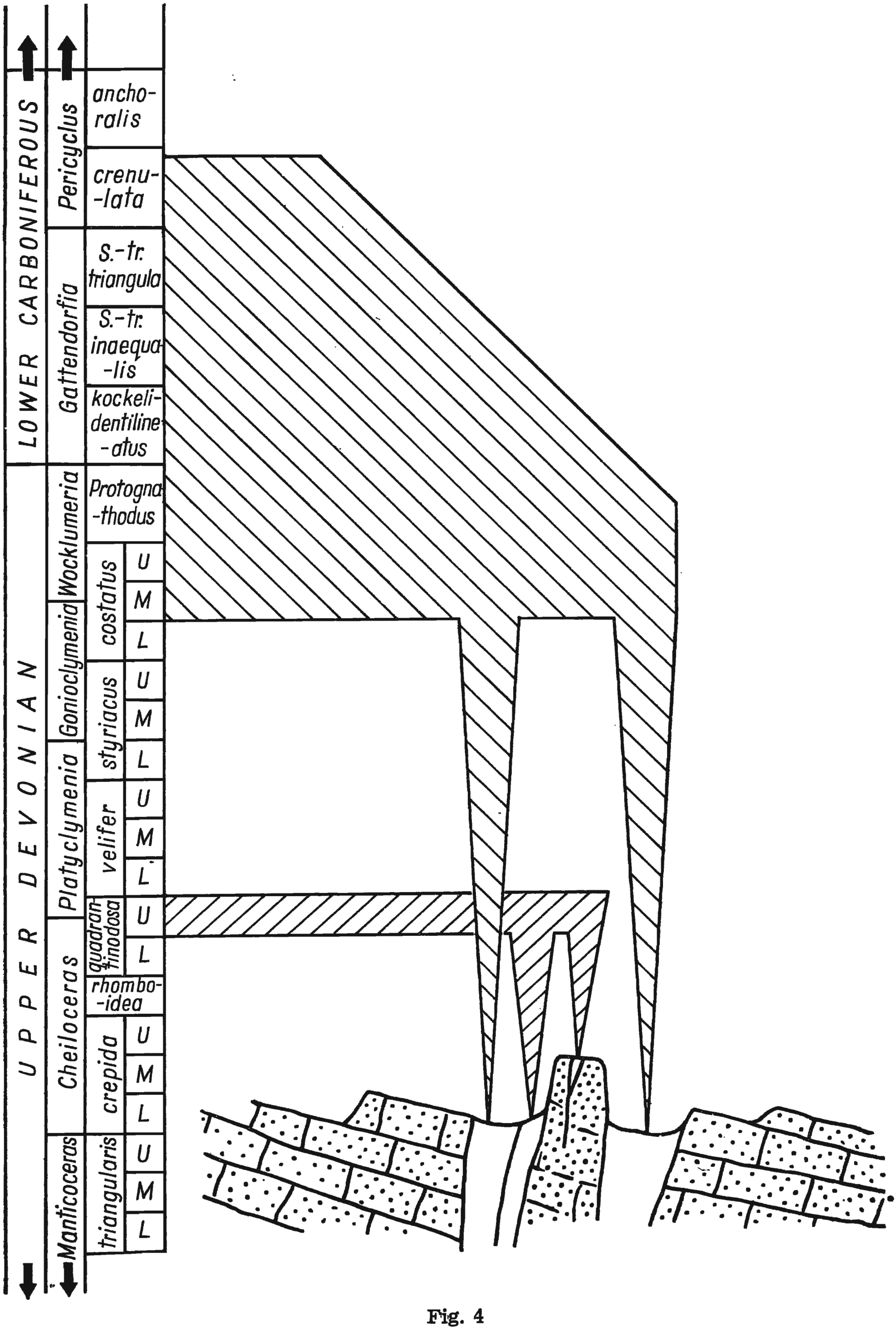


Fig. 4

Diagram showing the age of the neptunian dykes at Dalnia the range of which is confined to the Middle Spathognathodus costatus Zone. Concurring with it are *Spathognathodus costatus ultimus* Bischoff, *S. supremus* Ziegler, *Pseudopolygnathus nodomarginatus* (Branson) nad *Pseudopolygnathus trigonicus* Ziegler, whose ranges are limited to the Middle and Upper S. costatus Zone. The appearance of the first of them together with *P. gonioclymeniae* determines, according to Ziegler (1962, p. 41), the base of the Middle Spathognathodus costatus Zone. There also occur several other species common in this zone, but with more extensive stratigraphic ranges which include *Spathognathodus costatus costatus* (Branson) and *S. costatus spinulicostatus* (Branson). The concept of the last two species, conformable with Ziegler's (1962) views, has here been accepted for the reasons given in the remarks concerning subspecies, discussed above in the paleontological part of the present paper.

The Tournaisian conodont zones. — The Tournaisian conodonts are very abundant in the infilling of the fissure, but they occur either in mixed assemblages, or are so few in the samples that such a mixture cannot be precluded due to the insufficient frequency in the sample. Mixed faunas correspond to a considerable stratigraphic interval. Accompanying the species from the upper part of the Tournaisian, there occur not only the forms from the Lower Tournaisian but also from the Middle Spathognathodus costatus Zone and even from the Upper Palmatolepis quadrantinodosa Zone (sample *6A*). Under such circumstances, distinguishing particular conodont zones of the Tournaisian is obviously impossible. Nevertheless, we can reconstruct the interval of the Lower Carboniferous to which the whole of the mixed faunas correspond and the zones from which approximately come the elements of which they are composed.

Species of the genus *Protognathodus* are among the oldest forms. *Protognathodus collinsoni* Ziegler, *P. meischneri* Ziegler (= *Gnathodus* sp. *A* of Collinson, Scott & Rexroad) and *P. kockeli* (Bischoff), present on the Dalnia Hill, are the chief components of Ziegler's (1969) "Protognathodus-Fauna" which occurs in the uppermost Late Devonian of Stockum and Seiler (Ziegler 1969; Ziegler & Leuteritz — *in* Koch, Leuteritz & Ziegler 1970) between the Upper Spathognathodus costatus Zone *(to VI)* and the Siphonodella sulcata — Protognathodus kockeli Zone *(cu Ia)*. In Stockum (Weyer 1965), it is accompanied by *Prionoceras (Imitoceras) substriatum, P. (I.) carinatum and P. (I.) prorsum* and the position of the "Protognathodus-Fauna" corresponds in the standard profile of Hönnetal to the upper part of Hangenberg Schiefer (Ziegler 1969, Abb. 2; Austin & al. 1970; Bender & al. 1971). The range of none of the species of *Protognathodus* is, however, limited to the interval with the "Protognathodus-Fauna". They also occur in the Lower Tournaisian (Ziegler & Leuteritz — *in* Koch, Leuteritz & Ziegler 1970, Table 2). Since on the Dalnia Hill, specimens of *Protognathodus* occur among mixed faunas, the settlement of the question whether they come from the uppermost Late Devonian or from the Lower Tournaisian is impossible.

The genera *Siphonodella* and *Pseudopolygnathus* present at Dalnia are of a particular importance to the stratigraphy of the Tournaisian. The phylogenetic development of these genera provide a basis for the conodont zonation. The presence of *Siphonodella sulcata* (Huddle) seems to indicate that the conodonts from the Siphonodella sulcata — Protognathodus kockeli Zone (*cu Ia*) of the surely lowermost zone of the Tournaisian are present in the mixed faunas. This species, also related to the genus *Polygnathus,* is the oldest phylogenetically and makes up an ancestor of the younger *Siphonodella.* The species *S. duplicata* (Branson & Mehl), derived from it, allows to state the presence of conodonts coming from the next zone, *i.e.* Siphonodella — Pseudopolygnathus triangulus inaequalis Zone (*cu Ia/β*). On the other hand, it is difficult to decide whether the elements of the next two zones, Siphonodella — Pseudopolygnathus triangulus triangulus (*cu Iβ*) and Siphonodella crenulata (*cu I/II — cu IIa*), are present or whether only the upper one of the two zones is represented. *Siphonodella quadruplicata* (Branson & Mehl) and *S. lobata* (Branson & Mehl) are characteristic of these zones. *Pseudopolygnathus triangulus pinnatus* Voges and maybe also *Dinodus wilsoni* Druce are the youngest components of the mixed faunas on the Dalnia Hill. The former is particularly characteristic and typical of the Scaliognathus anchoralis Zone (*cu IIβ-γ*), but it also occurs in the upper part of the Siphonodella crenulata Zone (Voges 1959, Table 1). Specimens from Dalnia probably correspond to the last-named zone. *Dinodus wilsoni* has so far been known only from a type locality in Australia, where it occurs probably in the deposits which make up an equivalent of this same zone (Druce 1969, pp. 24 and 54).

The lack of the genera *Scaliognathus, Doliognathus* and *Geniculatus,* which appear in many European areas in the Scaliognathus anchoralis Zone, as well as the lack of the genus *Gnathodus,* which appears somewhat earlier, indicate that the entire Tournaisian assemblage from Dalnia makes up a pre-anchoralis fauna, which correlates in the cephalopod zonation (*cf.* Bender & al. 1971) with the entire Gattendorfia Zone and maybe also with the lowermost part of the Pericyclus Zone (P. princeps & Muensteroceras complanatum Subzone).

It is very likely that the sequence of the Tournaisian faunas corresponding to zones older than the Scaliognathus anchoralis Zone is not represented on the Dalnia Hill as a whole. The lack of late species of *Siphonodella,* such as *S. cooperi* Hass, *S. crenulata* (Cooper), *S. isosticha* (Cooper) and *S. obsoleta* Hass, as well as *Pseudopolygnathus triangulus triangulus* Voges and *P. triangulus inaequalis* Voges may be caused by the limited scope of the collection or by possible gaps.

Age of the coral fauna

A decided majority of corals has been collected from the waste. They probably come from a clayey deposit from which they were washed. Since it was part of the infilling of the neptunian dyke containing deposits varying in age, an exact dating of these corals by means of other fossils is impossible. The determination of age on the basis of the coral assemblage alone also encounters obstacles. The stratigraphic ranges of the species of corals are very extensive and so far insufficently studied as concerns the problems examined. In addition, there is no certainty that the entire collection is of equal age. Nevertheless, a small part of specimens come from the fragments of limestone, which could be dated by conodonts (Table 1). No dating of this type indicated the Palmatolepis quadrantinodosa Zone. In all cases, corals concurred either with an assemblage of the Middle Spathognathodus costatus Zone (*Cyathaxonia cornu* Michelin, *Neaxon* sp.), or with an assemblage of the Tournaisian conodonts (*Saleesma* sp., *Petraiella kielcensis* Różkowska), or else with a mixed conodont fauna of the Spathognathodus costatus Zone through the Siphonodella crenulata Zone. It seems, therefore, that the corals from Dalnia, or at least a predominant part of them, come from the uppermost Famennian (Spathognathodus costatus Zone) or from the Tournaisian conodont zones corresponding to the Gattendorfia Zone. The rare occurrence in the Dalnia assemblage of the genera which are common in the lower part of the Famennian (Różkowska 1968, 1969), with a simultaneous presence of markedly Carboniferous forms, suggest similar conclusions. On the other hand, a decidedly Carboniferous character is displayed by, e.g., *Saleesma* Weyer which has not been known from deposits older than the Gattendorfia Zone (Weyer 1970). Although new, the corals described by Fedorowski (1973) also seem to be younger then the Upper Devonian.

The heterocorals are not very helpful in determining the age of the assemblage. To be sure, until recently it has been recognized (*e.g.* Weyer 1967) that they appear immediately at the base of the Visean, but Różkowska (1969) found them also in the Famennian.

The tabulates belong as a whole to new species and their genera, except for *Acaciapora*, have their ranges widely exceeding the Lower Carboniferous. It is true that the Tournaisian age has been determined immediately by means of the accompanying conodonts only for *Acaciapora*, but it seems hardly probable that they might be older than the Spathognathodus costatus Zone, since they always accompany the tetracorals, for which such a limitation has previously been introduced.

Age of trilobites

The occurrence of trilobites in a limestone rich in conodonts allows one to date them by the last-named (Table 1). Of all these trilobites, *Phacops granulatus* (Münster) and *Waribole* sp. undoubtedly accompany the assemblage of conodonts from the Upper Palmatolepis quadrantinodosa Zone (Table 1, sample 7), which is in conformity with the stratigraphic ranges settled for them. Nearly all the remaining species or subspecies (Osmólska 1973) are new, but belong to Lower Carboniferous genera. Any more detailed examination of their age separately from the fossils accompany them is difficult not only on account of the newness of the species, but also on account of the inaccurate knowledge of the Lower Carboniferous trilobites (*cf.* Hahn & Paproth 1969, Gandl 1970). The genus *Liobolina* is characteristic of the Gattendorfia Zone, but at Zaręby near Łagów (Osmólska 1962) and at Köstenhof (Gandl 1968, p. 507; 1970) it reaches the base of the Pericyclus Zone (that is, the Siphonodella crenulata Zone). The species *Phillibole drewerensis* (Richter & Richter), formerly considered to be restricted to the Gattendorfia Zone, may also, very rarely, occur in younger beds up to the Scaliognathus anchoralis Zone (Gandl 1968, pp. 498—499; 1970). *Carbonocoryphe* reaches still higher stratigraphically. On the Dalnia Hill, *Phillibole drewerensis* occurs either together with the Tournaisian assemblage of conodonts or with a mixed assemblage containing Tournaisian elements, along with those coming from the Spathognathodus costatus Zone (Table 1). Such trilobite forms as *Globusia differtigena* (Osmólska), *Phillibole drewerensis latipalpebrata* Osmólska, *P. prenes* Osmólska and *P. nitida annosa* Osmólska, along with few conodonts representing the Gattendorfia Zone concur in one of the samples. Since the Tournaisian conodonts do not display a segregation corresponding to particular zones, we should confine ourselves to the statement that these four species come from the Gattendorfia Zone or from the lowermost part of the Pericyclus Zone corresponding to the conodont Siphonodella crenulata Zone. They are, therefore, older than or at most of the same age as the trilobite fauna from Köstenhof and older than the fauna from Geigen (Gandl 1968, 1970). This is probably true as well of the remaining species and subspecies of the genera *Carbonocoryphe, Globusia* and *Liobolina.*

GENESIS OF THE NEPTUNIAN DYKES

The infilling of the dykes is a relict of the youngest Devonian-Carboniferous sedimentary sequence presented on the Dalnia Hill. The deposits corresponding to it are not preserved in a normal sequence. The infilling of the dykes is, therefore, the only source of information on the history of the Famennian and Tournaisian sedimentation in this region.

At the same time, this information is incomplete and to a certain extent modified by a specific behavior of the deposits. The calcareous-marly sedimentation probably took place herein throughout the Famennian and the Gattendorfia Zone. The skeletal material played in it an unequal role, the maximum role being manifested in the sedimentation of the crinoid limestones. The assemblage of fossils may be termed as a coral-trilobitic one. The association of the Cyathaxonia coral fauna with the trilobites is a common phenomenon in the Carboniferous (Hill 1938), but on the Dalnia Hill there is no third element — the brachiopods which usually accompany the two groups mentioned above. Trilobites from Dalnia are comparable with the trilobitic fauna from what is known as "cephalopod--facies" (*cf.* Gandl 1970). They include the representatives of the subfamily Cyrtosymbolinae characteristic of this facies, while *Liobolina* (now Cummingellinae, formerly Cyrtosymbolinae) belonging to another family and a new genus *Globusia* (Proetinae?) have, the same as the Crystosymbolinae, reduced eyes and are small (Osmólska 1973). Despite a mass occurrence of specimens, the assemblage of rugose corals is distinctly of a non-reef character. The fauna of Cyathaxonia is indicative of a calm water with a normal salinity (Fedorowski 1971) and it is typical of a soft, muddy bottom, covered with a very fine deposit. It corresponds to larger depths than the reef fauna of the same age. The tabulate corals, the same as rugose ones, are small forms and the development of characteristic, narrow bases in *Emmonsia dalniae* Stasińska (*cf.* Stasińska 1973, Pl. 2, Figs 3 and 7) in contrast to overgrowing the rugose corals without developing the bases (*l.c.*, Pl. 3, Fig. 4) seems to be, the same as their small dimensions, determined by their growing on the soft, muddy bottom.

The trilobites from Dalnia display several adaptative characters connected with their growing on the soft, muddy bottom. According to Osmólska (1973), these are the reasons which cause their high vaulting of cephalon, swollen genal spines and advanced reduction of eyes characteristic of most of the species.

The entire fauna makes up in practice an assemblage of benthic organisms. Since ammonoids are very rare, only the abundant conodonts represent the remains of nectonic origin.

What is very characteristic is a great abundance of specimens occurring in the neptunian dykes on the Dalnia Hill. This probably results from both favorable conditions and a low rate of deposition corresponding to the original sequence. The favorable conditions to the development of fauna are indicated not only by the abundance of individuals but also and primarily by the abundance of species and higher taxa. In this respect the fauna of Dalnia widely departs from some, only slightly differentiated faunas described from other neptunian dykes (*e.g.* Schöll & Wendt 1971). The low rate of deposition may in the most obvious way be deduced from the frequency of conodonts. In the Upper Devonian of the Holy

Cross Mts, the frequency of conodonts is clearly inversely proportional to the rate of deposition. Such a high frequency as that on the Dalnia Hill (300 and more per 1 kg) is met with only in condensed sequences in which the rate of deposition was particularly low (Wolska 1967, Szulczewski 1971). All localities of an abundant Famennian coral fauna (Różkowska 1967, 1969) also come from condensed sequences, while they are exceptionally rare in the deposits of basin facies varying in age. It is likely, however, that a certain importance should also be here ascribed to the specificity of sedimentation in a fissure. Fossil-rich fillings of neptunian dykes are very common in the Triassic (Schlager 1969; Krystyn, Schäffer & Schlager 1971; Zankl 1971) and in the Mediterranean Jurassic (Sturani 1971, Wendt 1971, Schöll & Wendt 1971). The faunas from the neptunian dykes are frequently the most abundant in appropriate formations. As noted by Sturani (1971), this seemingly paradoxical phenomenon may easily be explained by the fact that the fossils were trapped within the open fissures, which made up the only places where the fossils could escape further removal or destruction.

The taphonomic character of the assemblage of trilobites contained in pink marly limestones might, according to Osmólska (1973), indicate that the open fissure was actually a trap accumulating organic remains. The pink marly limestone contains forms representing various ecologic adaptations, which indicates a parautochthonous agglomeration of trilobite exuviae derived from the different environments. A complete lack of librigenae of *Globusia differtigena* (Osmólska), which display swollen librigenal spines, may be caused by hydromechanical factors (*cf.* Osmólska 1973).

The gray organodetrital limestone contains, on the other hand, an almost monospecific assemblage of trilobites, in which the exuviae of cranidia, pygidia and the librigenae of *G. differtigena* occur almost in proper proportions. This assemblage was deposited in the same site in which the moulting had taken place (Osmólska 1973). Since specimens of the gray organodetrital limestone were not found *in situ*, it is impossible to decide if they reached the fissure already after consolidation of the deposit or were deposited in the dyke during the period when it was already nearly completely filled.

Thus, the original Famennian and Tournaisian sequence on the Dalnia Hill was formed under the conditions in which a sudden arrest of subsidence and, consequently, lowering of the rate of sedimentation were favorable to the development of the fauna under study. The manner of sedimentation in the Famennian and Tournaisian on the Dalnia Hill indicates that it corresponds to a submarine rise, on which a condensed sequence developed.

The formation of neptunian dykes which are correlated with the time of stratigraphic condensation following the reef sedimentation does not seem to be accidental. The development of neptunian dykes over the reef formations or carbonate platforms during the periods when the subsidence and sedimentation rates had come to an abrupt halt bears a character of a regularity regardless of the age of formation (*cf.* Sturani 1971; Wendt 1971; Schöll & Wendt 1971; Krystyn, Schäffer & Schlager 1971). The neptunian dykes connected with the capreef in the Devonian of the Rhine Shale Mts (Franke 1971, Krebs 1971) and the Holy Cross Mts (Szulczewski 1971 and the present paper) extend this regularity to the Devonian.

Three fundamental manners of fissure opening in carbonate rocks in principle exhaust the ways of their formation (Fischer 1964, p. 133). These are: tectonic fracturing, large scale mud-cracking and a karstic solution. The neptunian dykes on the Dalnia Hill are distinctly of tectonic origin. Their sharp margins and the lack of evidence of karstic solution confirm this fact. The supposed facial position of their filling also indicates that the opening and filling of fissures took place under submarine conditions. Here, it should be added that the opening and complete filling of fissures was repeated several times and took place in the process of sedimentation on a submarine ridge. This is indicated by a vertical trace of the boundaries of sediments of various ages which is parallel to the walls of fissure. The opening of the fissure occurred at least two times, that is, in the Upper Palmatolepis quadrantinodosa Zone and in the Middle Spathognathodus costatus Zone. It is difficult to say for certain whether the fissure was later gradually filled up to the end of the Gattendorfia Zone or was it several times opened and filled, but the former of the two possibilities seems to be more probable. The reopening of the Famennian dykes in the Tournaisian closely resembles the condition which were predominant in the neptunian dykes in the Gaudernbach quarry in the Rhine Shale Mts (Krebs 1971, p. 58). Thus, the neptunian dykes at Dalnia correspond only to fragments of the original condensed sequence.

PALEOGEOGRAPHICAL AND PALEOTECTONIC SIGNIFICANCE

The determination of the age of the neptunian dykes throws a new light on the stratigraphy and reconstruction of the profile at Dalnia. The oolitic limestones which make up the bedrock of neptunian dykes overlie the limestones of the stromatoporoid-coral facies. The thickness of the oolitic limestones amounts to about a bare 2 m. They were described and illustrated earlier (Szulczewski 1971, pp. 63 and 106; Pl. 29, Fig. 1). At first, the views were expressed (Szulczewski 1971, p. 63) that the oolitic limestones represent the entire Famennian or at least a considerable, strongly condensed part. This supposition was based on finding in an only positive sample of the oolitic limestone a scarce, mixed conodont fauna indicating *to III* and *to V/VI—VI*. Now, however, it has been found beyond any doubt that the deposits of *to IIIa* are situated even in the fissure infilling and, therefore, the oolitic limestones have to be as whole older than these deposits. The sample mentioned above contained probably certain conodonts coming not from the oolitic limestone but from a small neptunian dyke interesecting it. Thus, the oolitic limestones represent a higher, indeterminate part of the Frasnian or the lowermost Famennian.

In this connection there arises a new possibility of interpreting the block of cephalopod limestones, which rests at the foot of the Dalnia Hill (Szulczewski 1971, p. 64) and contains conodonts which indicate the Lower or Middle Palmatolepis crepida Zone (*to IIa*). Using the present stratigraphic interpretation of the oolitic limestones, it seems likely that the cephalopod limestones originally occurred on the Dalnia Hill directly on or, through some so far unknown members, over the oolitic limestones. Thus, the oolitic limestones would be most likely older than the Lower Palmatolepis crepida Zone. No information has hitherto been available on possibly existing deposits from the zones between the Lower or Middle Palmatolepis crepida Zone and the Upper Palmatolepis quadrantinodosa Zone on the Dalnia Hill.

The locality of the Famennian and Tournaisian on the Dalnia Hill is exceptional in the Holy Cross Mts and its presence results in several consequences of a regional importance.

The condensed profiles of the entire Famennian have so far been known in the western part of the Holy Cross Mts only from the southern part of this area, primarily from Gałęzice (Czarnocki 1928). Excluding the almost entire Cheiloceras Zone (*cf.* Wolska 1967), the Famennian of that locality is only 3 to 4 m in thickness. The character of a condensed sequence is also observed in the Famennian of Jabłonna (*cf.* Wolska 1967), which is about 8 m thick. Less condensed is the Famennian profile in the Bolechowice borehole *1* (*cf.* Żakowa 1967, Freyer & Żakowa 1967), where the deposits from the Upper Palmatolepis crepida Zone (not the Lower P. crepida Zone as regarded by Freyer & Żakowa 1967) up to the end of the Devonian are about 25 m thick. All the localities mentioned above are, however, situated on the southern side of the Dyminy anticline, while Dalnia, as an only locality of this type, is situated on the northern side some 9 km from a strip of so far known localities with the condensed Famennian. Between them and Dalnia, the Famennian deposits are eroded in the core of the Dyminy anticline and its eastern tectonic equivalents. Outside of this area, that is, in the north (Czarnów — Kielce — Zagórze — Radlin) and in the west (Daleszyce — Kowala — Wola Murowana), the Famennian is developed in the basin facies (*cf.* Szulczewski 1971) and is 100 to 200 m thick. In the south-west, the knowledge of the Famennian is strongly fragmentary and in the west the Paleozoic deposits are hidden under the Permian-Mesozoic formations (*cf.* Fig. 1).

Although our knowledge of the Famennian is for objective reasons fragmentary, it seems likely that the area corresponding to present-day Dyminy anticline, as well as to the central and eastern part of its southern neighbor, that is, the Gałęzice-Bolechowice syncline, made up in the Famennian a submarine rise, on which the conditions predominated of a low rate of deposition which led to the formation of condensed sequences. At the same time, this area coincides with the sedimentation area of the stromatoporoid-coral limestones in the Frasnian. This facies was bordered in the Frasnian, the same as in the Famennian, with deposits of deeper facies which outcrop (*cf.* Fig. 1) not only in the north-east (Śluchowice — Górno), but also in the south-east (at Kowala) and in the south -west (the chain of Mt. Zamkowa at Chęciny). It was already Czarnocki who suspected the area of the Dyminy anticline as a hypothetical zone of the development of the Frasnian reefs. The overlapping of the plan of facies in the Frasnian and Famennian here indicates the connection of the zone of the slowed-down Famennian sedimentation to an area which was occupied in the Frasnian by the reef complex. A relatively fast sedimentation which took place in the Famennian outside of this area tended to equal the relief inherited yet from the conditions which predominated in the Frasnian. Similar connections of heterochronous facies were suggested in the Rhine Region by Paproth & Streel (1970, p. 389) and Krebs (1971, p. 55).

The conditions observed on the Dalnia Hill indicate that the sedimentation of condensed deposits locally included not only the Famennian but also might include the entire Tournaisian Gattendorfia Zone. The Tournaisian on the Dalnia Hill is unique in character in the Holy Cross Mts. It is manifested in an extreme reduction of thickness, development in the facies and abundance of fossils. In its abundance of the fine Cyathaxonia fauna of solitary rugose corals, trilobites and conodonts, it decidedly differs from all so far known types of the development of the Lower Carboniferous. In its assemblage of fossils and in lithology, the Tournaisian of Dalnia does not resemble at all the Carboniferous limestone of the Visean at Gałęzice and, on the other hand, is distinctly related to the type of sedimentation and assemblage of fossils characteristic of condensed sequences in the Famennian. It distinctly stands in contrast with a common development of the Holy Cross Tournaisian which nearly everywhere is developed in the Culmian facies of clayey shales 100 to 250 m thick (Żakowa 1970). The Bolechowice *1* borehole in which the deposits of this age (Freyer & Żakowa 1967) are c. 5 m thick is the only locality where the Gattendorfia Zone is developed also as condensed calcareous-marly formations. However, dating the Carboniferous in this borehole is rather problematic since the few specimens of *Siphonodella* found there have not been described or illustrated and species to which they were assigned happen to be variously interpreted. Nevertheless, it should be mentioned that both localities with the condensed Tournaisian (Dalnia and Bolechowice) are situated in an area determined as a zone of the condensed Famennian.

We should also dwell on the subject of the character of a boundary between the facies of the Famennian-Tournaisian submarine rise and the basin facies which borders it (*cf.* Fig. 5). The transition from the former to the latter seems to be in the environs of Dalnia unusually abrupt. At the foot of this hill, between Dalnia and Karczówka, the Famennian occurs already in the basin facies (*cf.* Czarnocki 1938, Szulczewski 1971). The Famennian developed in this facies fills the axial zone of the Kielce syncline and reaches *c.* 150 to 200 m in thickness. A radical change in facies occur, therefore, over a space of some scores or at most several hundred meters. The desintegration of the carbonate platform by block-faulting was suggested (Szulczewski 1971, Text-fig. 11) to explain such sudden changes in facies. This early, synsedimentary block tectonics and facial changes caused by it were probably the basis for the general outline of the later fold tectonics.

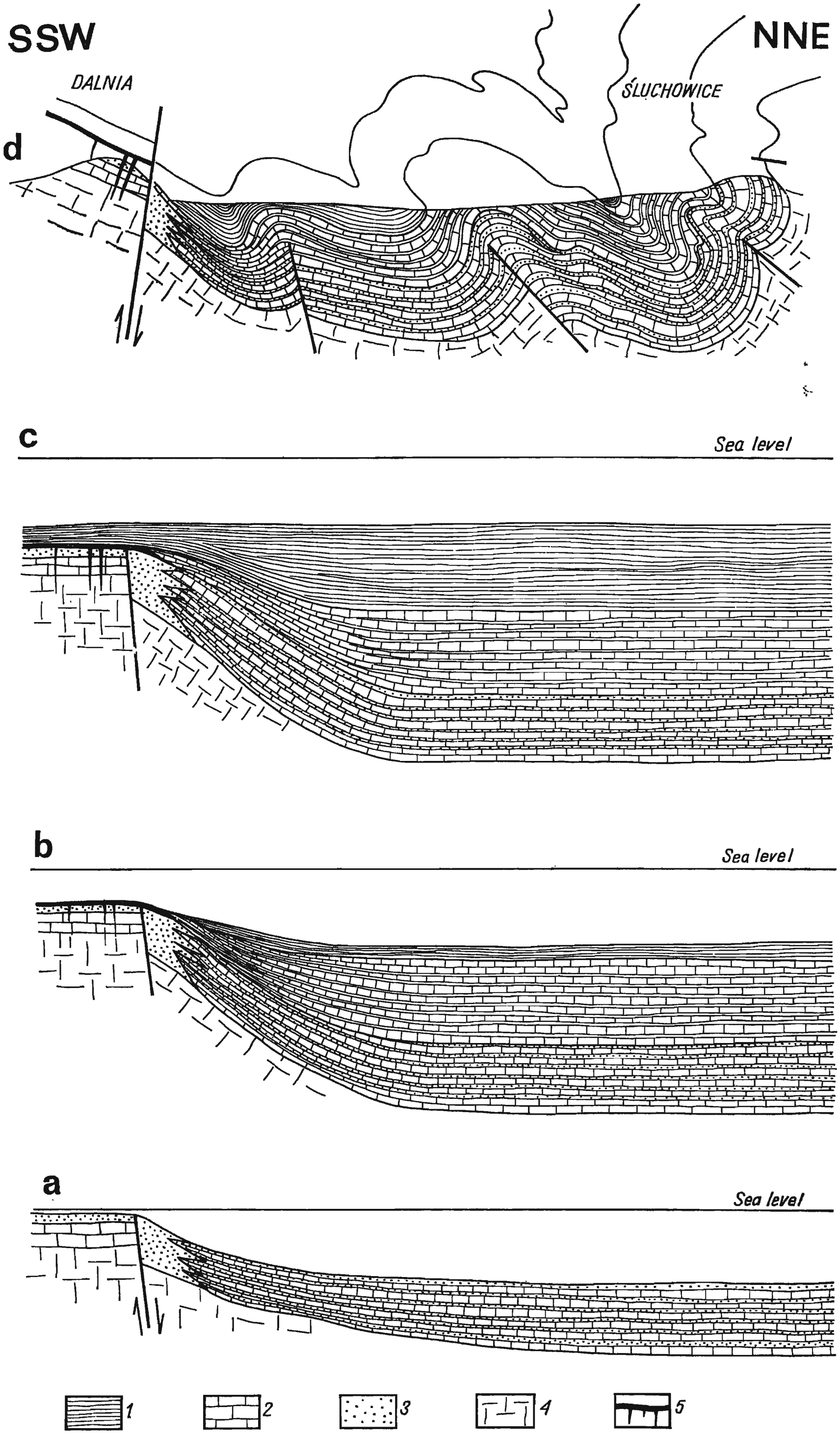
This obviously hypothetic conception requires recalling some facts. In the Frasnian, the axis of the Kielce syncline makes up a borderline between the northern basin facies (”Łysogóry facies” as termed by Czarnocki) and the reef complex (”Kielce facies” *sensu* Czarnocki). The Frasnian of the northern and southern limb of this syncline radically differ in character. In the southern limb the Frasnian is formed mostly by massive, non-bedded limestones, in the northern limb almost the entire Frasnian is developed as thin-bedded limestones with marly shales. The Frasnian deposits of both limbs differ, therefore, radically in their mechanical character. In this respect, only the limestones of the lower part of *to Ia* of the northern limb are an equivalent of the massive Frasnian limestones of the southern limb of the Kielce syncline. The massive stromatoporoid-coral limestones of the southern limb were formed in a shallow-

Fig. 5

Upper Devonian and Lower Carboniferous facies distribution and its consequences in the Variscan tectonic movements in the western part of the Holy Cross Mts, between Dalnia and Śluchowice (*cf.* Text-fig. 1)

Successive stages are shown for the time of:
a — Frasnian
b — Famennian through the Gattendorfia Zone of the Tournaisian
c — Visean
d — Variscan orogeny (lithology marked up to the Recent morphology)

1 shales, *2* pelitic and marly limestones, *3* detrital limestones, *4* biolithic limestones, *5* condensed sequence with neptunian dykes


SSW
NNE
DALNIA
ŚLUCHOWICE
d
c
Sea level
b
Sea level
a
Sea level
1
2
3
4
5

-water environment, while the thin-bedded formations of the northern limb were deposited in a deeper basin facies. A complete equalization of the differentiated relief of the bottom of the basin probably took place in the Pericyclus Zone. Up to that time, a *c.* 70 m thick layer of the thin-bedded Frasnian, *c.* 150 m thick marly Famennian and probably also several scores of meters of the Culmian were deposited in the northern basin. In the Famennian and in the Gattendorfia Zone, the increase in deposit in the Dalnia region was extremely reduced. From the beginning of the Pericyclus Zone, in the substrate of the sedimentary basin in the place corresponding to the present-day Kielce syncline, the deposits which were not strictly of the same age, but which were varying in age and having radically different mechanical characters, adjoined each other. To the south, the position of marly and thin-bedded deposits of the Frasnian, Famennian and parts of the Tournaisian was taken by massive limestones of the Frasnian and probably also Givetian. It is possible that the trace of this principal and distinct line of facial division predestinated to a certain extent the development of later tectonic forms, that is, the Kielce syncline and the Dyminy anticline in their rejuvenated shape.

A certain light is also thrown by the structural conditions in the substrate of the Culm deposits on the genesis of the Ślichowice fold (*cf.* Szulczewski 1971, Text-fig. 2). The Ślichowice fold or rather a complex of folds seems to be a particular case of the tectonics of the Upper Devonian deposits of the western part of the Holy Cross Mts. The folds of an impressive size considerably depart in their development from a usually small advanced and flexural tectonics of the Upper Devonian. The southern vergence of these folds is concordant with that of larger anticlinal units in the Holy Cross Mts, including the Łysogóry anticline (*cf.* Fig. 1). It seems likely that the Ślichowice folds in the northern limb of the Kielce syncline were formed in a place where the Frasnian, Famennian and Tournaisian competent deposits subjected to a pressure from the north encountered a resistance of a rigid block of massive Givetian and Frasnian limestones corresponding to the block of the present-day Dalnia Hill.

THE CONODONTS

The material collected comprises about 2,800 specimens of conodonts belonging to 11 genera and 56 species and subspecies.

The frequency of conodonts in particular samples is not uniform and varies from several scores to more than 1000 per kilogram of sample. Although the entire material comes from neptunian dykes and many samples contain mixed conodont faunas with elements from the deposits ranging from the Upper Palmatolepis quadrantinodosa Zone of the Upper

Devonian to the Siphonodella crenulata Zone of the Lower Carboniferous, that is, from a considerable stratigraphic interval, all conodonts are similarly translucent brown in color and do not display any physical evidence of reworking, such as abrasion or surface wear met with in some of the reworked conodonts from mixed faunas (*e.g.* Krebs 1964, Klapper 1966, Schumacher 1971). It is a characteristic phenomenon that in samples containing mixed faunas the youngest elements are inferior in number.

A similar state of preservation and a lack of differences between forms varying in age and coming from mixed faunas indicate that their accumulation was not the result of a redeposition along the bottom, but that it was caused by stratigraphic condensation (*cf.* Lindström 1964, pp. 71—73; Schumacher 1971, p. 73). Shifting the each conodont bearing deposit into a fissure in the bottom was a sudden and single occurrence, which obviously did not cause a physical destruction of conodonts. This conclusion is in a complete conformity with previous ones concerning the facial character of the deposit from the neptunian dykes on the Dalnia Hill, which was formed under the conditions of a very low rate of sedimentation and usually in a low-energy environment.

All the species found are listed in Table 1 which also presents their frequency in samples. The descriptive, paleontological part concerns only 29 species, the decisive majority of which have so far been never described or illustrated from the Holy Cross Mts or other regions of Poland. These are species confined to the Tournaisian or uppermost Devonian. Described are also some subspecies of *Spathognathodus costatus* Branson concept of which arouse considerable differences in views. The Famennian conodonts, a correct paleontological record of which was presented by Wolska (1967) and which do not cause any significant taxonomic controversies, have not been here described. Without discussing them in the text, such selected species are illustrated (Pl. 1) which beyond any doubt prove the presence of the Famennian condont faunas in the neptunian dykes at Dalnia.

All the photomicrographs of the conodonts (Pls 1—6) have been taken by L. Łuszczewska, M. Sc.

Genus *DINODUS* Cooper, 1939
(Type species: *Dinodus leptus* Cooper, 1939)

Dinodus wilsoni Druce, 1969
(Pl. 3, Fig. 11)

?1956. *Dinodus leptus* Cooper; Bischoff & Ziegler, p. 146, Pl. 14, Fig. 4.
1969. *Dinodus wilsoni* sp. nov.; Druce, p. 54, Pl. 3, Fig. 5*a*, *b*.

Remarks. — The specimen under study has a broken anterior bar which, in the type material, is three times as long as the posterior one. *Dinodus wilsoni* differs from other species of the genus, consisting of two bars, in having an upright arrangement of the denticles. *Dinodus youngquisti* Klapper has a similar dentition, but the three bars developed distinguish it well from *D. wilsoni* and other species of the genus.

Occurrence. — The scarce Australian type material comes from the upper *cu I* — lower *cu IIa*, probably from the lower *cu IIa* zone (Druce 1969, pp. 24, 54), but the range of the genus is restricted only to the Tournaisian of Europe, the Lower Mississippian (Kinderhook) of North America and to its equivalents in Australia.

Genus *POLYGNATHUS* Hinde, 1879

(Type species: *Polygnathus robusticostatus* Bischoff & Ziegler, 1957)

Polygnathus communis communis Branson & Mehl, 1934

(Pl. 3, Figs 1—3)

1934b. *Polygnathus communis* n. sp.; Branson & Mehl, p. 293, Pl. 24, Figs 1—4.
1957. *Polygnathus communis* Branson & Mehl; Bischoff, p. 42 [part], Pl. 5, Figs 24, 27 [non Figs 23, 25, 26 = *P. purus purus*].
1959. *Polygnathus communis* Branson & Mehl *bifurcata* n. var.; Hass, p. 390, Pl. 48, Figs 11—12.
1961. *Polygnathus communis bifurcata* Hass; Scott & Collinson, pp. 130—131, Pl. 1, Fig. 11.
1964. *Polygnathus communis* Branson & Mehl; Budurov & Tschunev, Pl. 5, Figs 1*a*, *b*; 2*a*, *b*; 12, 18.
1965. *Polygnathus communis* Branson & Mehl; Spasov, p. 95, Pl. 2, Figs 15, 15*a*.
1966. *Polygnathus pura subplana* Voges; Manzoni, p. 480 [part], Pl. 59, Fig. 12 [non Fig. 1 = *P. purus subplanus*].
1966. *Polygnathus pura* Voges; Manzoni, pp. 479—480, Pl. 60, Fig. 3.
1967. *Polygnathus communis communis* Branson & Mehl; van Boogaert, p. 183, Pl. 2, Fig. 37.
1967. *Polygnathus communis* Branson & Mehl; Wolska, p. 411, Pl. 14, Figs 1—2.
1968. *Polygnathus communis* Branson & Mehl; Mound, p. 505, Pl. 69, Figs 12, 13, 18.
1969. *Polygnathus communis* Branson & Mehl; Anderson, p. 923, Pl. 109, Figs 10, 11, 13, 14, 22, 24.
1969. *Polygnathus communis communis* Branson & Mehl; Druce, p. 94, Pl. 18, Figs 8—11.
1969. *Polygnathus communis dentatus* subsp. nov.; Druce, pp. 95—96, Pl. 18, Figs 13—14.

PLATE 1

1, 2 — *Palmatolepis quadrantinodosa marginifera* Ziegler; upper views of two hypotypes (IGP/S. 185, 186).
3 — *Palmatolepis distorta* Branson & Mehl; upper view of hypotype (IGP/S. 187).
4 — *Palmatolepis glabra lepta* Ziegler & Huddle; upper view of hypotype (IGP/S. 188).
5 — *Palmatolepis gonioclymeniae* Müller; upper view of hypotype (IGP/S. 189).
6 — *Palmatolepis gracilis gracilis* Branson & Mehl; upper-lateral view of hypotype (IGP/S. 190).
7a, b — *Spathognathodus disparilis* (Branson & Mehl); upper and inner lateral view of hypotype (IGP/S. 191) — note one node on the inner extension and two nodes on the outer extension.
8a, b — *Pseudopolygnathus trigonicus* Ziegler; upper and lower view of hypotype (IGP/S. 192) displaying bifurcate ridge of nodes and corresponding secondary carina on the inner platform.
9a, b — *Polygnathus symmetricus* Branson; upper-lateral and upper view of hypotype (IGP/S. 193).
10 — *Spathognathodus gradatus* (Youngquist); lateral view of hypotype (IGP/S. 194).
11 — *Polylophodonta pergyrata* Holmes; upper view of large hypotype (IGP/S. 194).

All photographs are X 36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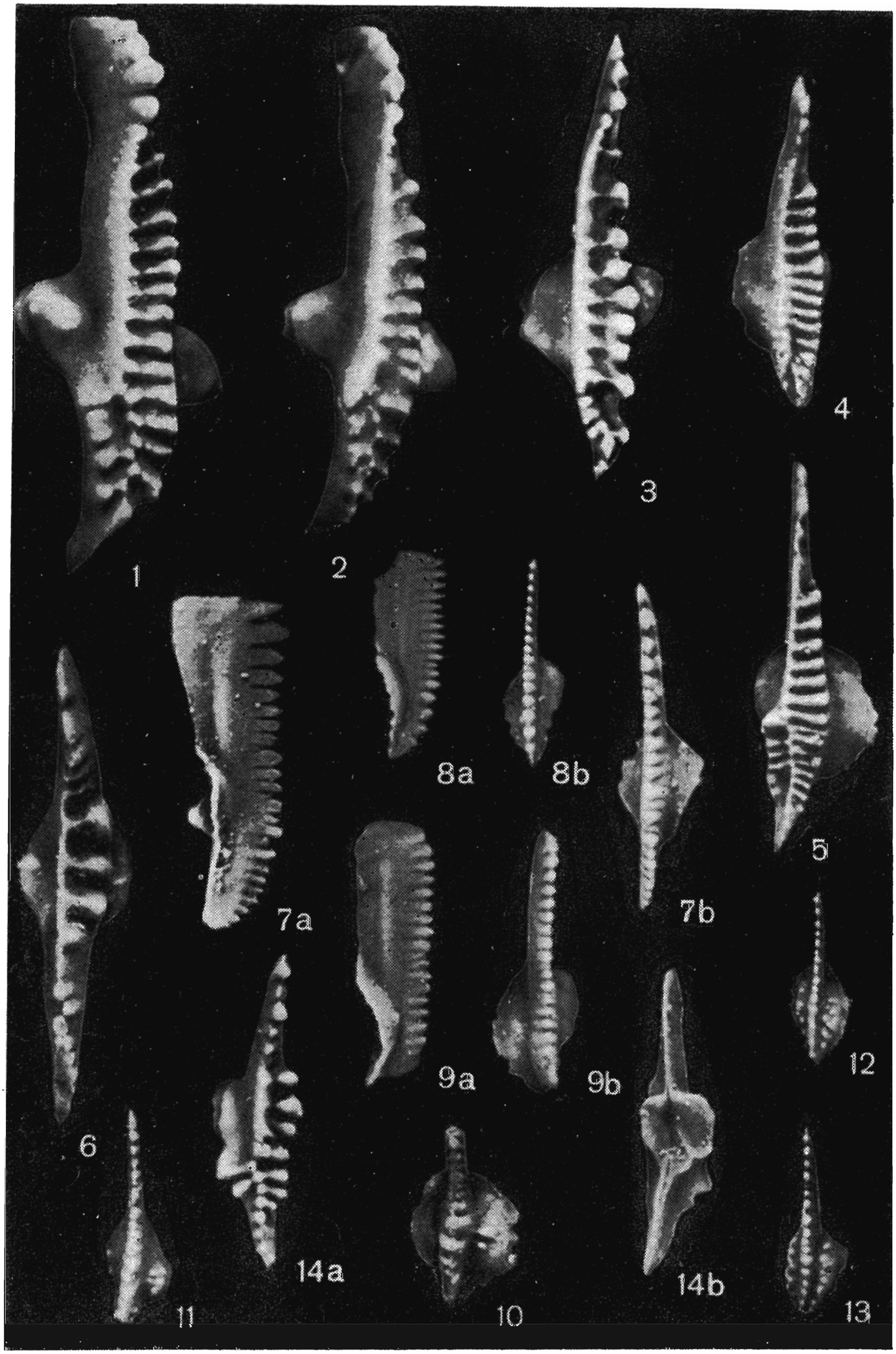
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1969b. *Polygnathus communis;* Matthews, Pl. 51, Fig. 11.
1969. *Polygnathus communis* Branson & Mehl; Olivieri, pp. 59—60, Pl. 24, Figs 1—2.
1969. *Polygnathus communis communis* Branson & Mehl; Rexroad, pp. 33—34, Pl. 5, Figs 7—10 [synonymy given].
1969. *Polygnathus communis communis* Branson & Mehl; Rhodes, Austin & Druce, pp. 182—184, Pl. 12, Figs 2—5.
1969. *Polygnathus communis communis* Branson & Mehl; Schönlaub, p. 333, Pl. 1, Figs 11—13.
1969. *Polygnathus communis* Branson & Mehl; Ziegler, Pl. 2, Figs 7—11.
1970. *Polygnathus communis* Branson & Mehl; Austin & Rhodes, *in* Austin & al., Pl. 1, Fig. 12*a*, *b*.
1970. *Polygnathus communis dentatus* Druce; Druce, p. 98, Pl. 17, Fig. 4*a*, *b*.
1970. *Polygnathus communis communis* Branson & Mehl; Stoppel, pp. 218—219, Pl. 29, Fig. 11.
1970. *Polygnathus communis bifurcatus* Hass; Thompson & Fellows, p. 92, Pl. 3, Figs 1, 5.

Remarks. — Some of the specimens collected are closely comparable with the Australian ones designated by Druce (1969) as *Polygnathus communis dentatus.* Druce considered a denticulate platform edge at the extreme anterior end of the platform as diagnostic of the subspecies. However, the specimens displaying this character fall within the range of variability of the nominate subspecies which displays a great variation in the platform outline and its edge ornamentation. They occupy a position between specimens with unornamented platform and those (*e.g.* Hass 1959, Pl. 49, Fig. 11; Voges 1959, Pl. 34, Fig. 1; Canis 1968, Pl. 72, Fig. 12; Anderson 1969, Pl. 109, Figs 13, 22) having nodose margins also in the posterior part of the platform.

Occurrence. — The earliest occurrence of *P. communis communis* ever recorded is in the Cantabrian Mts where it was found in the Palmatolepis quadrantinodosa Zone (Boogaert 1967, p. 183), but in Germany it was not found (Ziegler 1962, Tab. 5, 6) in deposits older than the Lower Polygnathus styriacus Zone (*to IV/V*). The wide range of the subspecies reaches the Scaliognathus anchoralis Zone (Voges 1959, Tab. 1) or even *cu IIIa* (Bischoff 1957, Tab. 2). The range of the subspecies in North America given by Canis (1968, p. 544) and Anderson (1969, Tab. 1) extends from the Upper Devonian to the Middle Mississippian. For a detailed list of the occurrences of the subspecies — see Olivieri (1969, p. 60).

PLATE 2

1, 2, 5 — *Spathognathodus costatus spinulicostatus* (Branson); upper-lateral views of large hypotype (IGP/S. 195), and hypotype (IGP/S. 196) transitional to *S. costatus costatus* (Branson); upper view of hypotype (IGP/S. 199).
3, 4 — *Spathognathodus costatus costatus* (Branson); upper views of two hypotypes (IGP/S. 197, 198).
6 — *Spathognathodus aculeatus* (Branson & Mehl); upper view of hypotype (IGP/S. 200).
7a, b — *Spathognathodus stabilis* (Branson & Mehl); lateral and upper views of hypotype (IGP/S. 201).
8a, b — *Protognathodus meischneri* Ziegler; lateral and upper views of hypotype (IGP/S. 202).
9, 10 — *Protognathodus collinsoni* Ziegler; lateral and upper views of hypotype (IGP/S. 203) with incipient ornamentation; upper view of large hypotype (IGP/S. 204) with broken blade.
11-13 — *Protognathodus kockeli* (Bischoff); upper views of three hypotypes (IGP/S. 205, 206, 207) showing differences in the upper surface ornamentation.
14a, b — *Pseudopolygnathus* sp. *A.;* upper and lower views of hypotype (IGP/S. 208).

All photographs are × 36

Polygnathus communis carinus Hass, 1959
(Pl. 3, Figs 5—6)

1959. *Polygnathus communis* Branson & Mehl *carina* Hass n. var.; Hass, p. 391, Pl. 47, Figs 8—9 [Footnote 3: "This variety is a subspecies"].
1959. *Polygnathus communis* Branson & Mehl var. *carina* Hass; Voges, pp. 288—290 [part], Pl. 34, Figs 5—6.
1964. *Polygnathus communis carina* Hass; Rexroad & Scott, p. 34, Pl. 2, Figs 24—25.
1967. *Polygnathus communis carina* Hass; van Boogaert, p. 184, Pl. 2, Fig. 43.
1967. *Polygnathus communis carina* Hass; Thompson, pp. 45—46, Pl. 2, Figs 7, 10; Pl. 4, Figs 6, 9.
1968. *Polygnathus communis carina* Hass; Canis, p. 544, Pl. 72, Figs 18—20.
1968. *Polygnathus communis* var. *carina* Hass; Manzoni, p. 664, Pl. 61, Figs 2—3.
1969. *Polygnathus communis carinus* Hass; Druce, p. 95, Pl. 18, Fig. 12*a*—*c*.
1970. *Polygnathus communis carinus* Hass; Thompson & Fellows, pp. 92—93, Pl. 3, Fig. 14.

Remarks. — *Polygnathus communis carinus* differs from the nominate subspecies in having nodose ridges in the anterior part of the upper surface. Specimens transitional to *Polygnathus vogesi* frequently occur in the material collected. For a comparison with *P. vogesi* — see Voges (1959, p. 294).

Occurrence. — According to Voges (1959, pp. 27, 209), *Polygnathus communis carinus* occurs in Sauerland from the Protognathodus kockeli — Pseudopolygnathus dentilineatus Zone (*cu I*) to the Scaliognathus anchoralis Zone (*cu IIβ/γ*). Rexroad & Scott (1964, p. 15) and Thompson (1967, p. 46) record this subspecies in North America from the Gnathodus semiglaber Zone to the Pseudopolygnathus multistriatus Zone. It was also found in Australia, probably in the lower *cu IIα* Zone (Druce 1969, p. 24).

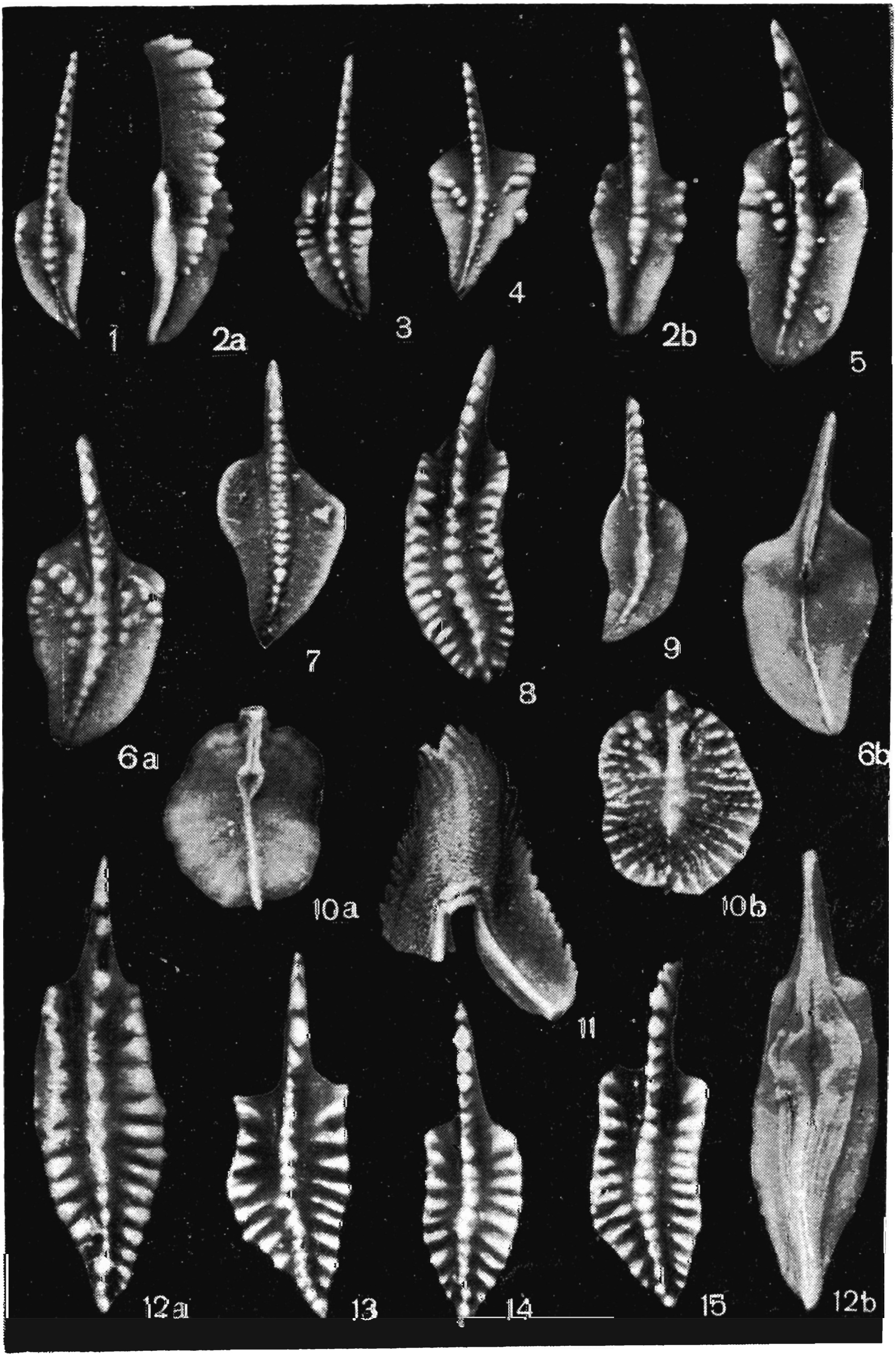
Polygnathus cf. *flabellus* Branson & Mehl, 1938
(Pl. 3, Fig. 10*a*—*b*)

cf. 1938. *Polygnathus flabella* n. sp.; Branson & Mehl, p. 147, Pl. 34, Fig. 48.
1968. *Polygnathus flabella* (Branson & Mehl); p. 665 [part], Pl. 62, Fig. 17 [only].

PLATE 3

1-3 — *Polygnathus communis communis* Branson & Mehl; upper view of hypotype (IGP/S. 209), upper-lateral and upper views of hypotype (IGP/S. 210), upper view of hypotype (IGP/S. 211).
4 — *Polygnathus vogesi* Ziegler; upper view of hypotype (IGP/S. 212).
5, 6 — *Polygnathus communis carinus* Hass; upper view of hypotype (IGP/S. 213), upper and lower views of hypotype (IGP/S. 214).
7 — *Polygnathus purus purus* Voges; upper view of hypotype (IGP/S. 215).
8 — *Polygnathus inornatus* Branson; upper view of hypotype (IGP/S. 216).
9 — *Polygnathus purus subplanus* Voges; upper view of hypotype (IGP/S. 217).
10a, b — *Polygnathus* cf. *flabellus* Branson & Mehl; lower and upper views of hypotype (IGP/S. 218) with broken blade.
11 — *Dinodus wilsoni* Druce; outer lateral view of hypotype (IGP/S. 219).
12, 14, 15 — *Polygnathus symmetricus* Branson; upper and lower views of hypotype (IGP/S. 220), upper views of two hypotypes (IGP/S. 222, 223).
13 — *Polygnathus longiposticus* Branson & Mehl; upper view of hypotype (IGP/S. 221).

All photographs are × 36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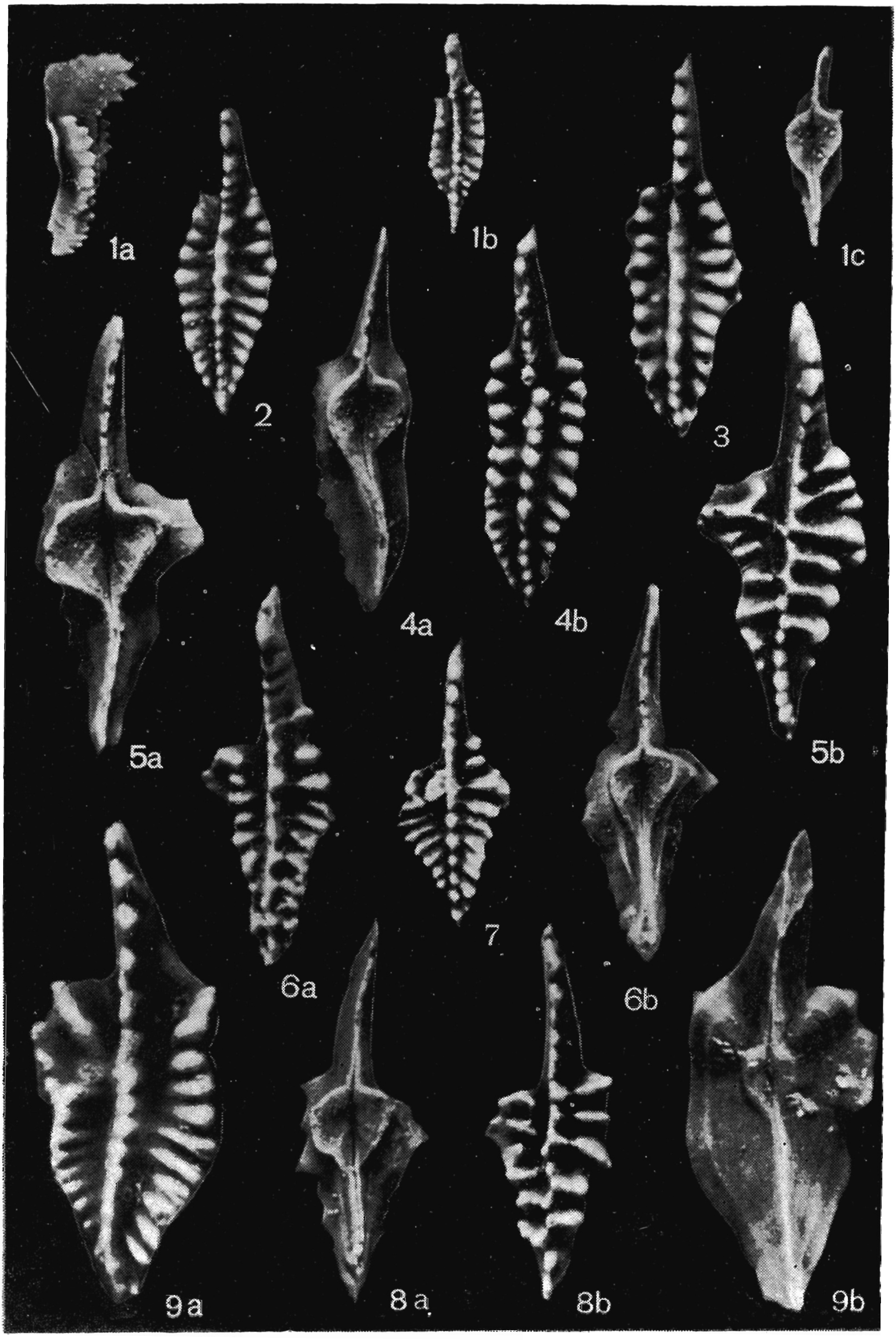
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Remarks. — The only specimen available displays a wide, nearly circular platform with a gently rounded posterior margin. The upper surface ornamented with radial, narrow ridges. Carina separated from the anterior part of platform by deep troughs. Anterior parts of platform are ornamented between the troughs and margin of platform with a few nodes and not ridges. Carina does not reach the posterior end of platform. In having more circular platform and partly nodose ornamentation the specimen in hand differs from the holotype.

Occurrence. — The holotype of Branson & Mehl (1938) comes from the Lower Mississippian of Missouri, but the specimen in hand concurs with the conodont assemblage diagnostic for Palmatolepis quadrantinodosa Zone.

Polygnathus inornatus Branson, 1934
(Pl. 3, Fig. 8)

1934b. *Polygnathus inornata* n. sp.; Branson, p. 309, Pl. 25, Figs 8, 26 [Fig. 8 = lectotype selected by Klapper, 1971].
1966. *Polygnathus inornata* Branson; Klapper, pp. 19—20, Pl. 1, Figs 9, 10, 13, 14 [only; synonymy to 1966 given].
1967. *Polygnathus inornata* Branson; van Boogaert, p. 184, Pl. 2, Figs 39—40.
1969. *Polygnathus inornata* Branson; Schönlaub, p. 335, Pl. 1, Figs 18—19.
1970. *Polygnathus ignoratus* [sic] Branson & Mehl; Austin & Rexroad, *in* Austin & al., Pl. 1, Figs 15, 19.
1971. *Polygnathus inornatus* Branson; Klapper, pp. 6—7 [synonymy given].

Remarks. — As pointed out by Klapper (1971, p. 7), there is no coincidence in the concept of *Polygnathus inornatus* in Branson (1934) and Branson & Mehl (1934) and two separate species were sometimes described under that name. E. R. Branson is considered to be the author of *P. inornatus* and, consequently, *P. inornatus* sensu Branson & Mehl is temporarily left without a name. The concept of *P. inornatus* is here restricted to *P. inornatus* sensu Branson. According to Klapper (*l. c.*), *P. inornatus* Branson has an asymmetrical platform and characteristically sinuous posterior carina, whereas *P. inornatus* sensu Branson & Mehl has a straight blade and carina, its platform being almost symmetrical. For the reasons also given by Klapper (1971) *P. lobatus* is here included in *P. inornatus.*

Occurrence. — According to Klapper (1966, p. 20), the range of *P. inornatus,* which also includes forms now regarded as *P. inornatus* sensu Branson & Mehl, extends from *to V* strata (Bischoff & Ziegler 1956) to the Scaliognathus anchoralis Zone (Voges 1959) or *cu IIIa* (Bischoff 1957).

PLATE 4

1a-c — *Pseudopolygnathus* sp. *B;* lateral, upper and lower views of hypotype (IGP/S. 224).
2-4 — *Pseudopolygnathus nodomarginatus* (Branson); upper views of two hypotypes (IGP/S. 225, 226); lower and upper views of hypotype (IGP/S. 227).
5-8 — *Pseudopolygnathus primus* Branson & Mehl; lower and upper views of hypotype (IGP/S. 228), upper and lower views of hypotype (IGP/S. 229), upper view of hypotype (IGP/S. 230), lower and upper views of hypotype (IGP/S. 231).
9a, b — *Polygnathus symmetricus* Branson; upper and lower views of hypotype (IGP/S. 232).

All photographs are × 36

Polygnathus longiposticus Branson & Mehl, 1934
(Pl. 3, Fig. 13)

1934b. *Polygnathus longipostica* n. sp.; Branson & Mehl, p. 294, Pl. 24, Figs 8—11, 13.
1966. *Polygnathus longipostica* Branson & Mehl; Klapper, pp. 20—21, Pl. 4, Figs 1, 5 [synonymy given].
1968. *Polygnathus longipostica* Branson & Mehl; Canis, p. 545, Pl. 72, Fig. 26.
1968. *Polygnathus longipostica* Branson & Mehl; Straka, p. 32, Pl. 1, Figs 1—3, 10, 14, 15, 18; Pl. 2, Figs 1—3, 6, 7.
1969. *Polygnathus longiposticus* Branson & Mehl; Anderson, p. 923, Pl. 107, Figs 1, 5, 8, 12.
1969. *Polygnathus longiposticus* Branson & Mehl; Rexroad, pp. 35—36, Pl. 5, Figs 11—12.
1970. *Polygnathus lobatus* Branson & Mehl; Austin & Rexroad, *in* Austin & *al.*, Pl. 1, Fig. 22*a, b*.

Remarks. — Differences between *Polygnathus longiposticus* and *P. inornatus* were listed by Branson & Mehl (1934, p. 293). Klapper (1966) considers the degree of upturning of the anterolateral margins of the platform as the main ones. Accordingly *P. longiposticus* has its anterolateral margins upturned about to the level of carina. Prominent denticles at the posterior end of the carina are also characteristic of the species.

Occurrence. — According to Rexroad (1964), this species is restricted to the Lower Mississippian (Kinderhookian) of North America. Canis (1968, Tab. 2) records its range from the *Gnathodus* sp. *B* (= *Protognathodus kuehni* Ziegler & Leuteritz) — Protognathodus kockeli Zone to the Siphonodella quadruplicata — S. crenulata Zone of Missouri. *P. longiposticus* has not been reported from Europe.

Polygnathus purus purus Voges, 1959
(Pl. 3, Fig. 7)

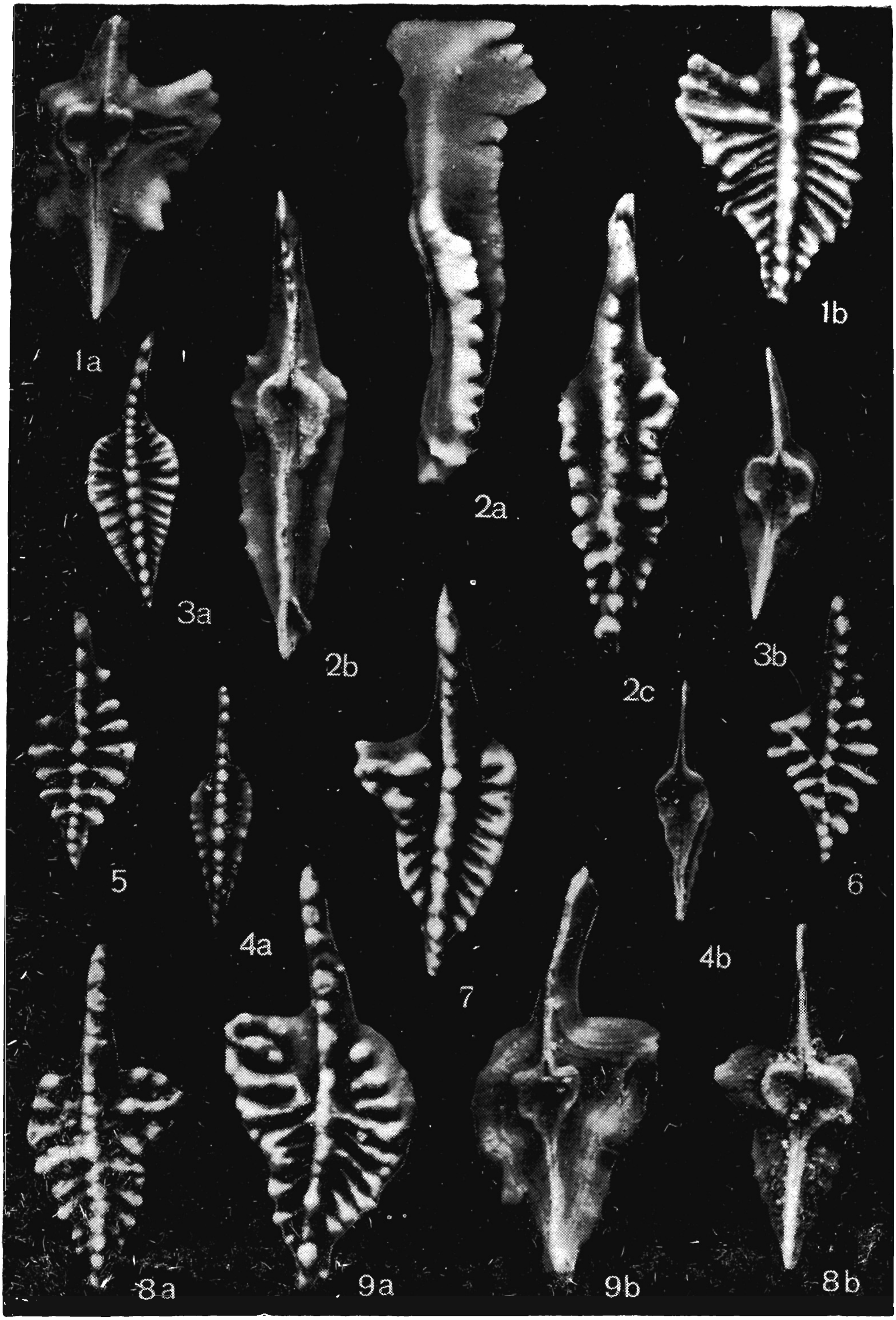
1939. *Polygnathus marginata* Branson & Mehl; Cooper, p. 401, Pl. 41, Figs 15—16.
1957. *Polygnathus communis* Branson & Mehl; Bischoff, p. 42 [part], Pl. 5, Figs 23, 25, 26 [non Figs 24, 27 = *P. communis communis*].
1959. *Polygnathus pura pura* n. subsp.; Voges, pp. 291—292, Pl. 34, Figs 21—26.
[non] 1966. *Polygnathus pura pura* Voges; Manzoni, pp. 479—480, Pl. 60, Fig. 3 [= *P. communis communis*].
1967. *Polygnathus pura pura* Voges; Spasov & Filipović, p. 75, Pl. 6, Figs 1, 2, 11, 12.
1968. *Polygnathus pura pura* Voges; Manzoni, p. 668, Pl. 62, Figs 5—6.
1969. *Polygnathus purus purus* Voges; Olivieri, pp. 67—68, Pl. 11, Figs 9—11; Pl. 25, Figs 1—5.
1969. *Polygnathus pura pura* Voges; Schönlaub, p. 336, Pl. 1, Fig. 16.

Remarks. — The nominate subspecies of *Polygnathus purus* displays a nearly flat, asymmetrical platform. Its upper surface is unornamented. The specimens collected conform with the original diagnosis and description of Voges (1959).

PLATE 5

1, 7-9 — *Pseudopolygnathus triangulus pinnatus* Voges; lower and upper views of hypotype (IGP/S. 233) with broken blade, upper view of hypotype (IGP/S. 239), upper and lower views of two hypotypes (IGP/S. 240, 241).
2, 4 — *Pseudopolygnathus fusiformis* Branson & Mehl; lateral, lower and upper views of large hypotype (IGP/S. 234), upper and lower views of small hypotype (IGP/S. 236).
3a, b — *Pseudopolygnathus marginatus* (Branson & Mehl); upper and lower views of hypotype (IGP/S. 235).
5, 6 — *Pseudopolygnathus dentilineatus* Branson; upper views of two hypotypes (IGP/S. 237, 238).

All photographs are × 36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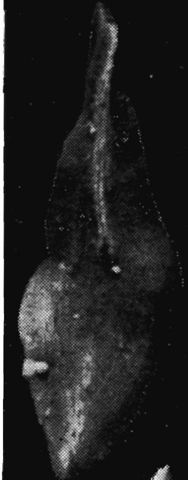
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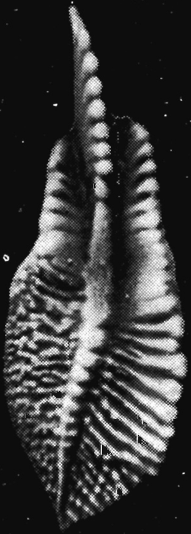
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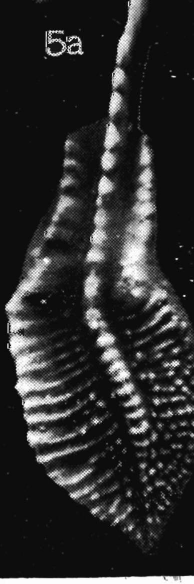
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Occurrence. — Voges (1959, Tab. 1) records the range of the subspecies in Sauerland from the upper part of the Protognathodus kockeli — Pseudopolygnathus dentilineatus Zone to the top of the Siphonodella — triangulus triangulus Zone, but the subspecies ranges as high as Siphonodella crenulata Zone in the Carnic Alps (Schönlaub 1969, Tab. 1).

Polygnathus purus subplanus Voges, 1959
(Pl. 3, Fig. 9)

1959. *Polygnathus pura subplana* n. sp., Voges, pp. 292—293, Pl. 34, Figs 27—33.
1966. *Polygnathus pura subplana* Voges; Manzoni, p. 480 [part], Pl. 59, Fig. 1 [non Fig. 12 = *P. communis communis*].
1968. *Polygnathus pura subplana* Voges; Manzoni, p. 669, Pl. 62, Fig. 7.
1969. *Polygnathus pura subplana* Voges; Schönlaub, p. 336, Pl. 62, Fig. 7.

Remarks. — The subspecies *Polygnathus purus* is characterized by strongly upturned margins of the platform, particularly so in its anterior and middle part. The upper surface of the platform is unornamented. For differences with the nominate subspecies and *Polygnathus communis* — see Voges (1959, p. 293). The specimen under study assigned to this subspecies conforms with the original diagnosis and description of the type material. Voges (*l.c.*) stated *P. purus subplanus* to be the ancestor of the nominate subspecies.

Occurrence. — Voges (1959, Tab. 1) records the range of *P. purus subplanus* from the Protognathodus kockeli — Pseudopolygnathus dentilineatus Zone to the Siphonodella — triangulus inaequalis Zone in Sauerland. Schönlaub (1969, Tab. 1) confirms such a range of this subspecies in the Carnic Alps.

Polygnathus symmetricus Branson, 1934
(Pl. 1, Fig. 9*a*—*b*; Pl. 3, Figs 12, 14—15; Pl. 4, Fig. 9*a*—*b*)

1934. *Polygnathus symmetrica* n. sp.; Branson, p. 310, Pl. 25, Fig. 11.
1966. *Polygnathus symmetrica* Branson; Klapper, p. 21, Pl. 4, Figs 7, 9; Pl. 6, Figs 1, 5 [synonymy given].
1966. *Polygnathus symmetrica* Branson; Anderson, Pl. 51, Figs 1, 5.
1968. *Polygnathus symmetrica* Branson; Straka, p. 35, Pl. 1, Figs 6, 9 [non Figs 11, 13 = *P. inornatus* sensu Branson & Mehl].

PLATE 6

1, 2 — *Siphonodella sulcata* (Huddle); lower and upper views of hypotype (IGP/S. 242), upper view of hypotype (IGP/S. 243).
3-5, 8, 10 — *Siphonodella duplicata* (Branson & Mehl); upper views of two small hypotypes (IGP/S. 244, 245), lower and upper views of hypotype (IGP/S. 246) showing a tendency to *S. lobata* (Branson & Mehl), upper views of two large hypotypes (IGP/S. 249, 251).
6, 7 — *Siphonodella quadruplicata* (Branson & Mehl); upper views of two hypotypes (IGP/S. 247, 248).
9 — *Siphonodella obsoleta* Hass; lower and upper views of small hypotype (IGP//S. 250).
11, 12 — *Siphonodella lobata* (Branson & Mehl); lower and upper views of hypotype (IGP/S. 252), upper view of hypotype (IGP/S. 253).

All photographs are × 36

1969. *Polygnathus symmetricus* Branson; Anderson, p. 924, Pl. 107, Figs 2, 4, 14, 15 [non Figs 9, 11 = *P. inornatus* sensu Branson & Mehl].
1969. *Polygnathus anidus* Cooper; Druce, pp. 91—92, Pl. 22, Figs 1—4.
?1969. *Polygnathus symmetrica* Branson; Schönlaub, p. 337, Pl. 1, Fig. 27; Pl. 2, Fig. 23.
1970. *Polygnathus symmetricus* Branson; Austin & Rhodes, *in* Austin & al., Pl. 1, Figs 20—21.
1970. *Polygnathus symmetricus* Branson; Thompson & Fellows, p. 97, Pl. 4, Figs 17—18.

Remarks. — *Polygnathus symmetricus* is markedly related to *P. inornatus* and *P. longiposticus*. Many transitional specimens between *P. symmetricus* and *P. longiposticus* (e.g., type material of former *P. anida* Cooper, *P. biclavula* Youngquist & Patterson, *P. spicata* Branson, *P. macra* Cooper) placed by Klapper (1966) in the synonymy of *P. symmetricus*, are regarded by other authors as *P. longiposticus*. The limit here drawn between the two species is, however, according to Klapper's (1966) practice as arbitrary as other concepts.

Occurrence. — *P. symmetricus* has been recorded in Europe from *to VI* strata (Bischoff 1957, Tab. 2), *cu I* strata (Schönlaub 1969, Tab. 1; Austin & al. 1970, Fig. 2) and *cu II* strata (Bischoff & Ziegler 1956).

Polygnathus vogesi Ziegler, 1962
(Pl. 3, Fig. 4)

1962. *Polygnathus vogesi* n. sp.; Ziegler, pp. 94—95, Pl. 11, Figs 5—7 [synonymy given].
[non] 1967. *Polygnathus vogesi* Ziegler; Spasov & Filipović, pp. 75—76, Pl. 6, Fig. 3.
1969. *Polygnathus vogesi* Ziegler; Schönlaub, p. 337, Pl. 1, Fig. 10.

Remarks. — For diagnosis of *Polygnathus vogesi* — see Ziegler (1962, p. 95). The differences between *P. vogesi* and *P. communis carinus* are examined by Voges (1959, p. 294).

Occurrence. — *P. vogesi* occurs in the uppermost part of the Upper Devonian and in the lowermost part of the Lower Carboniferous. Ziegler (1962, p. 95) records it in the Upper Devonian, beginning from the Middle Spathognathodus costatus Zone. Voges (1959, Tab. 1, as *Polygnathus* cf. *styriaca*) found it in the Lower Carboniferous Protognathodus kockeli — Pseudopolygnathus dentilineatus Zone to the Siphonodella — triangulus triangulus Zone.

Genus *PROTOGNATHODUS* Ziegler, 1969
(Type species: *Gnathodus kockeli* Bischoff, 1957)

Protognathodus collinsoni Ziegler, 1969
(Pl. 2, Figs 9—10)

1961. *Gnathodus* cf. *commutatus* (Branson & Mehl); Scott & Collinson, p. 123, Pl. 1, Figs 23—25 [non Figs 26, 27 = *P. meischneri*].
1969. *Protognathodus collinsoni* n. sp.; Ziegler, pp. 353—354, Pl. 1, Figs 13—18.

Remarks. — This species of *Protognathodus* displays a slightly asymmetrical platform ornamented on the upper surface of its inner or outer part by a few nodes. In its platform outline and ornamentation, *P. collinsoni* may be placed between *P. meischneri* and *P. kockeli*. According to Ziegler (1969, p. 354), *P. collinsoni* differs from *P. meischneri* in having an asymmetrical platform which is rather symmetrical in the latter and in a slightly nodose ornamentation being in contrast to an unornamented upper surface of the platform in *P. meischneri*. One of the specimens illustrated (Pl. 2, Fig. 9) displays an only incipient nodose ornamentation on the outer side of the platform but a definitely asymmetrical platform outline is characteristic of the species.

P. collinsoni is morphologically nearly identical with *Gnathodus commutatus nodosus*, but the two species are considered as homeomorphs for the same reasons as those in *P. meischneri* and *Gnathodus commutatus commutatus*.

Occurrence. — Ziegler & Leuteritz, in Koch and Leuteritz & Ziegler (1970, Tab. 2), record *P. collinsoni* in Seiler from the interval with the "Protognathodus-Fauna", as well as from the Siphonodella sulcata — Protognathodus kockeli Zone.

Protognathodus meischneri Ziegler, 1969
(Pl. 2, Fig. 8*a*—*b*)

1961. *Gnathodus* cf. *commutatus* (Branson & Mehl); Scott & Collinson, p. 123, Pl. 1, Figs 26—27 [only].
1962. *Gnathodus* n. sp. *A*; Collinson, Scott & Rexroad, pp. 18—19, Chart 3.
1964. *Gnathodus* sp. *A*; Higgins, *in* Higgins, Wagner-Gentis & Wagner, p. 227, Pl. 5, Fig. 28.
1967. *Gnathodus* sp. *A* Collinson, Scott & Rexroad; van Boogaert, p. 180, Pl. 2, Fig. 22.
1968. *Gnathodus* sp. *A* Collinson, Scott & Rexroad; Canis, p. 539, Pl. 74, Fig. 11.
1969. *Gnathodus* n. sp.; Rexroad, pp. 19—20 [part], Pl. 4, Fig. 2 [only].
1969. *Protognathodus meischneri* n. sp.; Ziegler, p. 353, Pl. 1, Figs 1—13.

Remarks. — A nearly symmetrical unornamented platform characterizes this species of *Protognathodus*. Morphologically it is nearly identical with *Gnathodus commutatus commutatus* Branson & Mehl, but the two homeomorph species, as well as corresponding genera are separated by a considerable gap, since *Protognathodus meischneri* occurs in the lower part of the Tournaisian, while *Gnathodus commutatus commutatus* is not known in beds older than Visean. According to Rexroad (1969), the main difference between the two species is in the shape of denticles on the carina which are elliptical, their greatest dimension being transverse to the axis of *G. commutatus* as opposed to the laterally compressed denticles of the forms now assigned to *Protognathodus meischneri* and *P. collinsoni*. Such forms have been considered (but unnamed) by Rexroad (1969) as a species probably divided into four subspecies. One of them is exactly comparable with *P. meischneri*. The specimen illustrated displays a similarity to *P. collinsoni* in its slightly asymmetrical platform outline.

Occurrence. — Ziegler & Leuteritz, *in* Koch, Leuteritz & Ziegler (1970, Tab. 2), record *P. meischneri* in the Seiler from the interval with "Protognathodus-Fauna" and from the lower part of the Siphonodella — triangulus inaequalis Zone.

Protognathodus kockeli (Bischoff, 1957)
(Pl. 2, Figs 11—13)

1957. *Gnathodus kockeli* n. sp.; Bischoff, p. 25, Pl. 3, Figs 27—32.
1964. *Gnathodus kockeli* Bischoff; Higgins, *in* Higgins, Wagner-Gentis & Wagner, Pl. 5, Fig. 27.
1967. *Gnathodus kockeli* Bischoff; van Boogaert, p. 179, Pl. 2, Figs 17—18.
1968. *Gnathodus kockeli* Bischoff; Canis, p. 538, Pl. 74, Figs 12, 22.
1968. *Gnathodus kockeli* Bischoff; Manzoni, pp. 659—660, Pl. 62, Figs 2, 4.
1969. *Gnathodus* n. sp.; Rexroad, pp. 19—20 [part], Pl. 4, Figs 4—7 [only].
1969. *Gnathodus kockeli* Bischoff; Schönlaub, p. 330, Pl. 1, Figs 1—2.
1970. *Protognathodus kockeli* (Bischoff); Ziegler & Leuteritz, *in* Koch, Leuteritz & Ziegler, Pl. 8, Figs 1—3, 5.

Remarks. — Ziegler (1969) included this species, previously assigned to the genus *Gnathodus*, in the new genus *Protognathodus* which is a homeomorph of the former. The two genera are separated by a considerable gap. For remarks on the variability of *Protognathodus kockeli* and differences between it and *P. collinsoni* — see Ziegler (1969, pp. 354—355).

Occurrence. — Ziegler & Leuteritz, *in* Koch, Leuteritz & Ziegler (1970, Tab. 2), record the species in the Seiler from the interval with "Protognathodus-Fauna" to Siphonodella — triangulus triangulus Zone. Other European occurrences fall within the range of the species. In North America, *Protognathodus kockeli* occurs in the Louisiana Limestone in a position corresponding to the interval with "Protognathodus-Fauna" of Germany (Scott & Collinson 1961, Klapper & al. 1971) and in the Hannibal Shale (*cu I*) in Missouri (Canis 1968, p. 538).

Genus *PSEUDOPOLYGNATHUS* Branson & Mehl, 1934

(Type species: *Pseudopolygnathus primus* Branson & Mehl, 1934)

Pseudopolygnathus dentilineatus Branson, 1934

(Pl. 5, Figs 5—6)

1934. *Pseudopolygnathus dentilineata* n. sp.; Branson, p. 317, Pl. 26, Fig. 22.
1966. *Pseudopolygnathus dentilineata* Branson; Klapper, pp. 14—15, Pl. 5, Figs 10—11 [synonymy given].
1967. *Pseudopolygnathus dentilineata* Branson; van Boogaert, p. 185, Pl. 3, Fig. 8.
1967. *Pseudopolygnathus dentilineata* Branson; Spasov & Filipović, p. 77, Pl. 5, Figs 4, 6, 9.
1968. *Pseudopolygnathus dentilineata* Branson; Canis, p. 546 [part], Pl. 73, Figs 10, 29 [non Figs 30, 31 = *P. primus*].
1968. *Pseudopolygnathus dentilineata* Branson; Manzoni, p. 670, Pl. 61, Figs 11, 18, 19.
1969. *Pseudopolygnathus dentilineatus* Branson; Olivieri, pp. 73—74, Pl. 24, Fig. 7*a*—*c*.
1969. *Pseudopolygnathus dentilineatus* Branson; Rexroad, p. 38, Pl. 4, Figs 8—10.
1969. *Pseudopolygnathus dentilineatus* Branson; Rhodes, Austin & Druce, pp. 208—209, Pl. 5, Figs 10, 12, 13; Pl. 6, Fig. 8 [non Pl. 5, Fig. 9 = indet. juv. specimen of *Spathognathodus* or *Pseudopolygnathus* (?); non Fig. 11 = *Spathognathodus* sp. indet].
1969. *Pseudopolygnathus expansus* sp. nov.; Rhodes, Austin & Druce, pp. 209—210, Pl. 5, Figs 2, 4.
1969. *Pseudopolygnathus vogesi* sp. nov.; Rhodes, Austin & Druce, pp. 216—217, Pl. 5, Figs 1, 3, 5—8.
1969. *Pseudopolygnathus dentilineata* Branson; Schönlaub, p. 338, Pl. 3, Figs 30—31.
1970. *Pseudopolygnathus dentilineatus* Branson; Austin & Rhodes, *in* Austin & al., Pl. 1, Figs 1, 5, 10, 14.
1970. *Pseudopolygnathus vogesi* Rexroad, Austin & Druce; Austin & Rhodes, in Austin & al., Pl. 1, Fig. 16*a*—*b*.
1970. *Pseudopolygnathus dentilineatus* Branson; Thompson & Fellows, p. 99, Pl. 5, Figs 1, 5.

Remarks. — For differences between *Pseudopolygnathus dentilineatus* and *P. primus* — see remarks on the latter species.

P. dentilineatus was recorded formerly not higher than at the top of the Gattendorfia Zone (*cu I*) until Rexroad, Austin & Druce (1969) found specimens nearly identical with Branson's holotype of *P. dentilineatus* also in Avonian conodont zones correlatable with *cu IIβ-γ*. Because of a gap between them, Rhodes, Austin & Druce (*l.c.*) regarded the specimens from *cu I* and the younger Avonian form from *cu IIβ-γ* as two discrete and homeomorphic species. They considered the younger one as *P. dentilineatus* and the older, including with reservation some forms formerly described from Sauerland, as falling into the newly created species *P. vogesi*. Austin & Rhodes (*in* Austin & al., 1970) found, however, specimens of both species together in the Etroeungt limestones of Hoyoux valley. If the ranges of the two species, regarded as discrete only on the basis of their unoverlapping ranges, in fact overlap a considerable interval I do not see any reason for regarding *P. vogesi* as a distinct species. Morphologically, there are no remarkable differences between *P. dentilineatus* and *P. vogesi*, which would allow one to regard the latter as a distinct species.

Occurrence. — The range of *P. dentilineatus* extends from the Polygnathus styriacus Zone to the top of the Gattendorfia Zone in Germany (Ziegler 1962, p. 92). The species was recorded in the Avonian (Rhodes, Austin & Druce 1969) from the Patrognathus variabilis — Spathognathodus plumulus Zone to the Siphonodella — Polygnathus inornatus Zone (designated as *P. vogesi*) and, after a gap, from the Spathognathodus "costatus costatus" Zone to the Gnathodus delicatus Zone. Sandberg & Klapper (1967) record this species from the Siphonodella sulcata Zone and Siphonodella sandbergi — S. duplicata Zone in Wyoming. Collinson, Rexroad & Thompson (1971, Fig. 5) record the range of the species from the Upper Devonian to the top of the Kinderhookian.

Pseudopolygnathus fusiformis Branson & Mehl, 1934
(Pl. 5, Figs 2, 4)

1934b. *Pseudopolygnathus fusiformis* n. sp.; Branson & Mehl, p. 298, Pl. 23, Figs 1—3.

[non] 1966. *Pseudopolygnathus fusiformis* Branson & Mehl; Manzoni, p. 481, Pl. 60, Figs 4—5.

1967. *Pseudopolygnathus fusiformis* Branson & Mehl; van Boogaert, p. 185, Pl. 3, Fig. 7.

1969. *Pseudopolygnathus fusiformis* Branson & Mehl; Rexroad, pp. 38—39, Pl. 4, Figs 15—19 [synonymy given].

1969. *Pseudopolygnathus fusiformis* Branson & Mehl; Schönlaub, p. 339, Pl. 1, Fig. 14.

1970. *Pseudopolygnathus fusiformis* Branson & Mehl; Thompson & Fellows, pp. 99—100, Pl. 5, Figs 10, 12, 14.

Remarks. — The specimens available accurately correspond to the diagnosis given by Rexroad & Scott (1964, p. 39). According to these authors, *Pseudopolygnathus fusiformis* gave rise to *P. itha* (Cooper) [= *P. allocatus* (Cooper)]. According to Rexroad & Scott, the platform sharply tapering posteriorly and the distinctly differentiated free blade serve to distinguished *P. fusiformis* from *P. allocatus.*

In the present material, predominant forms are small and have a very narrow platform and undistinct ornamentation.

Occurrence. — Voges (1959) records this species in Sauerland from the Siphonodella — triangulus inaequalis Zone and Siphonodella — triangulus triangulus Zone, but in the Carnic Alps it is also known (Schönlaub, 1969, Tab. 1) from the upper part of the Protognathodus kockeli — Pseudopolygnathus dentilineatus Zone. In North America, Canis (1968, Tab. 3) described *P. fusiformis* from the Siphonodella sulcata Zone to the lower part of the Siphonodella quadruplicata — S. crenulata Zone of Missouri. Rexroad & Scott (1964, Tab. 2) do not record it higher than the Siphonodella isosticha — S. cooperi Zone of Indiana.

Pseudopolygnathus marginatus (Branson & Mehl, 1934)
(Pl. 5, Fig. 3*a*—*b*)

1934b. *Polygnathus marginata* n. sp.; Branson & Mehl, pp. 294—295, Pl. 23, Figs 25—27.

1968. *Pseudopolygnathus triangula inaequalis* Voges; Manzoni, pp. 669—670, Pl. 61, Fig. 7 [only].

1969. *Pseudopolygnathus marginatus* (Branson & Mehl); Rexroad, p. 39, Pl. 4, Figs 11—13 [synonymy given].

[non] 1969. *Pseudopolygnathus marginata* (Branson & Mehl); Schönlaub, pp. 339—340, Pl. 2, Fig. 24.

1970. *Pseudopolygnathus marginatus* (Branson & Mehl); Thompson & Fellows, p. 100, Pl. 5, Figs 11, 13, 17.

Remarks. — A lachrimiform outline of the platform, its upper surface ornamented with transverse ridges and basal cavity with characteristic sinus in its flared margins (*cf.* Klapper 1966, p. 13) are among the main characters of this species. The specimens available display all the charcters. Its platform is reaching the posterior end of the unit.

Occurrence. — Canis (1968, Tab. 3) records *P. marginatus* from the Siphonodella sulcata Zone to the Siphonodella quadruplicata — S. crenulata Zone of Missouri, but Rexroad & Scott (1964, Tab. 2) found is in the Siphonodella isosticha — S. cooperi of Indiana.

Pseudopolygnathus nodomarginatus (Branson, 1934)
(Pl. 4, Figs 2—4)

1934. *Polygnathus nodomarginata* n. sp.; Branson, p. 310, Pl. 25, Fig. 10.
1969. *Polygnathus nodomarginatus* Branson; Olivieri, pp. 64—65, Pl. 23, Fig. 8*a*—*b* [synonymy given].
1969. *Pseudopolygnathus nodomarginatus* (Branson); Rhodes, Austin & Druce, pp. 212—213, Pl. 9, Figs 1—4; Pl. 12, Figs 6—8, 10.
1969. *Pseudopolygnathus nodomarginatus* (Branson); Druce, p. 113, Pl. 35, Figs 1—3.
[non] 1970. *Pseudopolygnathus nodomarginatus* (Branson & Mehl); Austin & Rhodes, *in* Austin & al., Pl. 1, Fig. 18.

Remarks. — According to the original description of the species given by Branson (1934, p. 310), each platform of *P. nodomarginatus* is ornamented with about seven large ridges not reaching the carina and terminating as rounded nodes on the margins of platforms. The present specimens display this very type of ornamentation, but they are relatively longer and have more nodes (up to 11), much the same as the material presented by some authors (Olivieri 1969; Rhodes, Austin & Druce 1969; Druce 1969). The range of variability of the species is not yet satisfactorily established. Most of the previously illustrated specimens, placed into the synonymy of *P. nodomarginatus* by Rhodes, Austin & Druce (1969), are ornamented with regular ridges and their platform margins are not nodose. They are not assigned here to *P. nodomarginatus.* The illustration of the holotype in Branson (1934) shows only the upper surface of the specimen, but "an exceptionally large pit with thick lateral lips" on the lower surface, mentioned in the original description, seems to confirm the assignment of the species by Rhodes, Austin & Druce (1969) to the genus *Pseudopolygnathus* rather than to *Polygnathus.* Specimens described have definitely pseudopolygnathid, large basal cavity.

Occurrence. — Its lowermost occurrence was found by Ziegler (1962, p. 41) in the Middle Spathognathodus costatus Zone of Germany. In Great Britain, Rhodes, Austin & Druce (1969) give the range of *P. nodomarginatus* as Upper Zaphrentis (Z) Zone corresponding to the *cu* *II*β-γ strata. Other occurrences fall within the same range of the species.

Pseudopolygnathus primus Branson & Mehl, 1934
(Pl. 4, Figs 5—8)

1934b. *Pseudopolygnathus prima n. sp.;* Branson & Mehl, p. 298, Pl. 24, Figs 24—25.
1966. *Pseudopolygnathus prima* Branson & Mehl; Klapper, p. 14, Pl. 4, Fig. 8 [synonymy given].
1968. *Pseudopolygnathus prima* Branson & Mehl; Canis, p. 547, Pl. 73, Figs 12, 17, 32.
1968. *Pseudopolygnathus dentilineata* Branson; Canis, p. 546 [part], Pl. 73, Figs 30—31 [only].
1969. *Pseudopolygnathus primus* Branson & Mehl; Rhodes, Austin & Druce, pp. 214—215, Pl. 6, Figs 4, 5, 7, 10—12.
1969. *Pseudopolygnathus primus* Branson & Mehl; Rexroad, pp. 39—40, Pl. 4, Fig. 14.
1970. *Pseudopolygnathus primus* Branson & Mehl; Thompson & Fellows, pp. 101—102, Pl. 5, Figs 15, 16, 18, 19.

Remarks. — An extensive variety of forms formerly described as separate species were included in *Pseudopolygnathus primus* by Klapper (1966) who also drew clear distinctions between *P. primus* and some related species previously grouped by Voges (1959) in a "group of *Pseudopolygnathus primus*". According to Voges (1959) and Klapper (1966), the main difference between *P. primus* and *P. dentilineatus* is in the size of the basal cavity relative to the width of the platform which is larger in the latter and not covering the entire width of the platform of the former species.

The present material contains an extensive variety of forms; some of them are illustrated. Forms transitional to *P. dentilineatus* occur among specimens displaying an alate interior margin of the platform. The last-named are similar to *Pseudopolygnathus triangulus pinnatus,* but as suggested by Klapper (1966), the demarcation between the two species should be based on the size of basal cavity which is smaller in the latter species.

Occurrence. — Bischoff (1957, Tab. 2) records *Pseudopolygnathus irregularis* (= *P. primus*) in *cu I.* The species *P. primus* occupied a position in the phylogenic lineage between *P. dentilineatus* and *P. triangulus triangulus* (Voges 1959, pp. 395—398, Text-figs 4—5; reinterpreted by Klapper 1966, p. 14) and, therefore, it undoubtly occurs in Sauerland in beds *IIb* and *IIIa* of Voges, which correspond to the lower part of *cu I,* below Siphonodella — triangulus triangulus Zone. Rhodes, Austin & Druce (1969, p. 215) found *P. primus* in the upper part of the Avonian Spathognathodus costatus — Gnathodus delicatus Zone and in the Polygnathus lacinatus Zone. Sandberg & Klapper (1967, pp. 52, 55) record the species in the Siphonodella sandbergi — S. duplicata Zone of Wyoming. Collinson, Rexroad & Thompson (1971, Fig. 5) mark the range *P. primus* as reaching the Chouteau Formation in the northern Midcontinent of North America.

Pseudopolygnathus triangulus pinnatus Voges, 1959
(Pl. 5, Figs 1, 7—9)

1959. *Pseudopolygnathus triangula pinnata* n. subsp.; Voges, pp. 302—304, Pl. 34, Figs 59—66; Pl. 35, Figs 1—6 [synonymy given].
1964. *Pseudopolygnathus triangula pinnata* Voges; Higgins, *in* Higgins, Wagner-Gentis & Wagner, Pl. 4, Fig. 16.
1964. *Pseudopolygnathus triangula* Voges; Rexroad & Scott, p. 42, Pl. 2, Fig. 28.
1966. *Pseudopolygnathus triangula pinnata* Voges; Manzoni, p. 482, Figs 6—7 [non Fig. 8 = *P. triangula triangula*].
1967. *Pseudopolygnathus triangula pinnata* Voges; van Boogaert, p. 185, Pl. 3, Figs 9—10.
1967. *Pseudopolygnathus triangula* Voges; Thompson, pp. 49—50, Pl. 4, Figs 17, 18.
1969. *Pseudopolygnathus triangulus triangulus* Voges; Druce, p. 114, Pl. 37, Fig. *2a—b* [only].
1969a. *Pseudopolygnathus triangula pinnata* Voges; Matthews, p. 271, Pl. 48, Figs 3, 4, 8, 10, 11.
1969b. *Pseudopolygnathus triangula pinnata* Voges; Matthews, Pl. 51, Fig. 8.
1970. *Pseudopolygnathus triangulus pinnatus* Voges; Thompson & Fellows, pp. 102—103, Pl. 6, Figs 6, 11, 12.

Remarks. — This subspecies of *Pseudopolygnathus triangulus* is characterized by a strongly alate anterolateral corner on the inner side of its platform. The specimens under study differ slightly from the holotype in platform outline, but fall within the range of variability of the subspecies shown by Voges (1959) and subsequent authors. Some of the specimens (*e.g.* Pl. 5, Fig. 9) are similar to *P. triangulus inaequalis* in having a rounded outer anterolateral margin and only indistinctly alate inner anterolateral corner of the platform. It is, however, assigned to *P. triangulus pinnatus* on the basis of a small basal cavity, which is relatively large in *P. triangulus inaequalis.*

Occurrence. — According to Voges (1959, Tab. 1), *P. triangulus pinnatus* occurs in Sauerland from the Siphonodella crenulata Zone (except for its lowermost part) to the Scaliognathus anchoralis Zone, but it is aboundant only in the latter zone. In Cornwall it was also found by Matthews (1969a) together with a conodont assemblage of the Scaliognathus anchoralis Zone. Collinson, Rexroad & Thompson (1971, Fig. 5) give the range of the subspecies in the northern Midcontinent of North America as restricted to the upper part of the Osagean.

Pseudopolygnathus sp. *A*
(Pl. 2, Fig. 14*a*—*b*)

Description. — The relatively narrow platform is bisected by a median carina which is continuous with the anterior and a short, posterior free blades. The right side of the platform extends farther anteriorly than does the left. The ornamentation differs on the two halves of the platform. The entire right side of the platform is ornamented in its posterior part with coarse transverse ridges separated by deep troughs and, in the anterior part, with large, transverse, elongate nodes. The posterior part of the left side bears the same ornamentation as the right side, but the anterior part is unornamented. The margin of the right side is chevron-like, much the same as the posterior part of the margin of the left side. The margin of the unornamented part of the left side is parallel to carina. In its part corresponding to the unornamented platform carina is composed of completely fused denticles. The anterior free blade consists of laterally compressed, fused (except at the tips) and gradually decreasing denticles. The posterior free blade consists of small denticles, circular in section.

The large basal cavity is situated in the anterior part of platform and it covers the entire width of the latter. The cavity is asymmetrical, gradually narrowing posteriorly and with anterior margins nearly perpendicular to the keel. A groove runs along the axis of cavity and extends posteriorly within the keel.

Remarks. — These forms retain the same type of ornamentation as that of *Spathognathodus costatus spinulicostatus*, but differ from the latter in having basal cavity of the polygnathid type, restricted in extent, in contrast to the cavity of *S. costatus* which is wider than the platform. *Pseudopolygnathus* sp. *A* is probably transitional from *S. costatus* to *Pseudopolygnathus dentilineatus* and in the phylogenetic series discussed by Voges (1959, Text-fig. 5) probably falls between the forms from *I* and *II* beds. The last-named differ from *Pseudopolygnathus* sp. *A* only in having the entire upper surface of the platform sculptured. Some forms described by Druce (1969, p. 114), as *Pseudopolygnathus vogesi* are similar to the specimens described, but differ in having a considerable protrusion on the left margin of the platform, which, in *Pseudopolygnathus* sp. *A* is parallel to the carina.

Pseudopolygnathus sp. *B*
(Pl. 4, Fig. 1*a*—*c*)

Description. — Platform small, restricted only to the middle part of the unit. A medial, nodose carina is continuous with denticulate anterior and posterior free blades. The unit is slightly asymmetrical because the outer platform extends farther anteriorly than does the inner. The posterior termination of the outer platform is also posterior to that of the inner platform. The margins of platform strongly upturned and reaching the level of carina. Both platforms ornamented with large transverse ridges projecting from a crenulate margin of platform as chevron-like denticles. The anterior free blade is somewhat longer than a half of platform. It consists of 5 laterally compressed, free-tipped denticles; the 3 anterior ones are exceptionally high. The posterior free blade is half the length of the platform and consists of 5 small, laterally compressed denticles.

Basal cavity large, covering the entire width of platform, slightly asymmetrical, narrowing rapidly anteriorly and gradually posteriorly, and developed in the anterior half of platform. It extends posteriorly as a groove in the keel.

Remarks. — In its outline and ornamentation of the upper surface *Pseudopolygnathus* sp. *B* is nearly identical with the forms described by Druce (1969, pp. 105—106) as *Polygnathus toxophorus* Cooper. The latter is, however, regarded by Klapper (1966) as a junior subjective synonym of *Polygnathus longiposticus.* The basal cavity of the holotype of *P. toxophorus*, actually small and of the polygnathid type, strongly differs from the exceptionally large pseudopolygnathid type cavity of the specimen under study. Specimens illustrated by Druce (1969) considerably differ in the size of basal cavity, but none of them displays a cavity as wide as in the specimen described.

Genus *SIPHONODELLA* Branson & Mehl, 1934

(Type species: *Siphonognathus duplicata* Branson & Mehl, 1934)

Siphonodella duplicata (Branson & Mehl, 1934)

(Pl. 6, Figs 3—5, 8, 10)

1934b. *Siphonognathus duplicata* n. sp.; Branson & Mehl, pp. 296—297, Pl. 24, Figs 16—17.
1966. *Siphonodella duplicata* (Branson & Mehl); Klapper, p. 18, Pl. 4, Fig. 13 [synonymy given].
[non] 1966. *Siphonodella duplicata* (Branson & Mehl); Manzoni, p. 484, Pl. 60, Figs 1, 2 [Fig. 2 = *S. quadruplicata*].
1968. *Siphonodella duplicata* (Branson & Mehl); Canis, pp. 548—549, Pl. 72, Fig. 7 [non Figs 3, 4 = *S. quadruplicata*].
[non] 1968. *Siphonodella duplicata* (Branson & Mehl); Manzoni, p. 673, Pl. 61, Figs 5, 14.
1968. *Siphonodella* cf. *sulcata* (Huddle); Manzoni, pp. 673—674, Pl. 61, Figs 4, ?10.
1968. *Siphonodella duplicata* (Branson & Mehl); Straka, p. 42, Pl. 6, Figs 14—15.
[non] 1969. *Siphonodella duplicata* (Branson & Mehl); Rexroad, p. 43, Pl. 2, Fig. 13 [= *S. sulcata*].
[non] 1969. *Siphonodella duplicata* (Branson & Mehl); Schulze, p. 221, Pl. 20, Fig. 26 [= *S. cooperi*].
1969. *Siphonodella duplicata* (Branson & Mehl); Schönlaub, pp. 344—345, Pl. 2, Figs 9—10.
1970. *Siphonodella duplicata* (Branson & Mehl); Thompson & Fellows, p. 106, Pl. 7, Figs 1, 3, 5.

Remarks. — The original concept (Branson & Mehl 1934b) of *Siphonodella duplicata* and other siphonodellids was based on the number of rostral ridges. In addition to the number of rostral ridges, Hass (1959) and Klapper (1966) considered the taxonomic significance of the ornamentation of platform and restricted the concept of *S. duplicata.* Transverse ridges on both sides of platform and two rostral ridges, usually forming margins of a strongly developed rostrum, are regarded after this concept here accepted as the main diagnostic characters of the species. *Siphonodella duplicata* stands closely to *S. sulcata* and probably arose from the latter (*cf.* Canis 1968, p. 551). Both species are ornamented by transverse ridges on both sides of the platform but according to Canis (1968), the ridges on the inner side of *S. duplicata* may be composed of closely spaced nodes. According to Klapper (1966, p. 18), *S. sulcata* differs from *S. duplicata* in having an only incipiently developed rostrum. On this basis it seems advisable to include to *S. sulcata* the specimen assigned by Rexroad (1969, Pl. 2, Fig. 13) to *S. duplicata.*

All specimens in hand have a differentiated rostrum, asymmetrical outline of the platform, small and slitlike basal cavity. Most of them did not developed true rostral ridges but have strongly upturned anterior margins of the platform. The platforms are usually ornamented, particularly so on the inner side with interrupted ridges or closely spaced nodes arranged in rows.

Occurrence. — Samples collected by Klapper (Sandberg & Klapper 1967, p. B46) at Hönnetal show the lowest occurrence of *S. duplicata* s. s. in the lowermost part of the Siphonodella — triangulus inaequalis Zone. Ziegler & Leuteritz, *in* Koch Leuteritz & Ziegler (1970), record *S. duplicata* in Seiler from the Siphonodella — triangulus inaequalis Zone and Siphonodella — triangulus triangulus Zone.

In the zonation used by Sandberg & Klapper (1970), the first finding of *S. duplicata* marks the base of the Siphonodella sandbergi — S. duplicata Zone. According to Collinson, Rexroad & Thompson (1971, Fig. 3), the range of the species reaches the Lower Chouteau Formation [= Siphonodella quadruplicata — S. crenulata Zone] in the northern Midcontinent of North America.

Siphonodella lobata (Branson & Mehl, 1934)
(Pl. 6, Figs 11—12)

1934b. *Siphonognathus lobata* n. sp.; Branson & Mehl, p. 297, Pl. 24, Figs 14—15.
1969. *Siphonodella lobata* (Branson & Mehl); Rexroad, pp. 43—44, Pl. 2, Figs 5—8 [synonymy given].
1969. *Siphonodella lobata* (Branson & Mehl); Schönlaub, p. 345, Pl. 2, Figs 11—12.
1970. *Siphonodella lobata* (Branson & Mehl); Thompson & Fellows, p. 107, Pl. 7, Figs 2, 4.

Remarks. — The specimens in hand conform with the holotype of Branson & Mehl and Klapper's diagnosis (1966, p. 16), except for the lack of the secondary keel on the lower side of the outer lateral lobe. The main keel is also less distinct then in most of the previously illustrated specimens, but more typical of the genus. This character relates the specimens with *Siphonodella duplicata* from which *S. lobata* probably developed (*cf.* Klapper 1966, p. 17).

Occurrence. — Voges (1959, Tab. 1) records the range of *Siphonodella lobata* in Sauerland from the Siphonodella — triangulus triangulus Zone to the Lower (or Upper) Siphonodella crenulata Zone. Such a range of this species is confirmed by Schönlaub (1969, Tab. 1) in the Carnic Alps. In North America (Canis, p. 549, Tab. 3; Collinson, Rexroad & Thompson 1971, Fig. 3). *S. lobata* ranges from the Siphonodella sulcata Zone to the Siphonodella crenulata — S. quadruplicata Zone.

Siphonodella obsoleta Hass, 1959
(Pl. 6, Fig. 9*a*—*b*)

1959. *Siphonodella obsoleta* n. sp.; Hass, pp. 392—393, Pl. 47, Figs 1—2.
1971. *Siphonodella obsoleta* Hass; Klapper, p. 12, Pl. 1, Fig. 25 [synonymy given].

Remarks. — The specimens investigated are small juvenile forms. In having only incipiently ornamented platform, except for two rostral ridges, they are similar to *Siphonodella* cf. *S. isosticha* (sensu Klapper 1971) but a long rostral ridge that extends nearly to the posterior end of the outer platform is a diagnostic character of *S. obsoleta*.

Occurrence. — Voges (1959, Tab. 1) records *S. obsoleta* in Sauerland from the Siphonodella — triangulus inaequalis Zone to the Scaliognathus anchoralis Zone. In the northern Midcontinent of North America (Collinson, Rexroad & Thompson 1971), the species range from the Siphonodella duplicata Zone through the Siphonodella isosticha — S. cooperi Zone.

Siphonodella quadruplicata (Branson & Mehl, 1934)
(Pl. 6, Figs 6—7)

1934b. *Siphonognathus quadruplicata* n. sp.; Branson & Mehl, pp. 295—296, Pl. 24, Figs 18—20 [non Fig. 21 = *S. cooperi*].
1966. *Siphonodella quadruplicata* (Branson & Mehl); Klapper, pp. 17—18, Pl. 2, Figs 5—8; Pl. 3, Figs 9—12; Pl. 4, Figs 16, 20 [synonymy to 1966 given].
1968. *Siphonodella duplicata* (Branson & Mehl); Canis, pp. 548—549, Pl. 72, Figs 3—4 [non Fig. 7 = *S. duplicata*].
1971. *Siphonodella quadruplicata* (Branson & Mehl); Klapper, p. 12, Pl. 1, Figs 22—24 [synonymy given].

Remarks. — The material available consists of rather small specimens having two or three rostral ridges. The specimens comparable with the same number of rostral ridges, formerly designated as *S. duplicata* var. *A* of Hass (1956), have been interpreted by Klapper (1966, p. 18) as early growth stages of *S. quadruplicata*.

Occurrence. — The correct range of *S. quadruplicata* in Europe is not clear because of changes in concept of the species. Schönlaub (1969, Tab. 1) found it in the Siphonodella — triangulus triangulus Zone and in the Siphonodella crenulata Zone of the Carnic Alps.

In North America, Sandberg & Klapper (1967, p. B55) noted the lowest position of *S. quadruplicata* in the upper part of the Siphonodella sandbergi — S. duplicata Zone. Canis (1968, Tab. 3) records it in Missouri from the Siphonodella sulcata Zone to the Siphonodella isosticha — S. cooperi Zone. Druce (1969, p. 122) records this species in Australia from the lowermost part of the Siphonodella quadruplicata — S. cooperi Zone.

Siphonodella sulcata (Huddle, 1934)
(Pl. 6, Figs 1—2)

1934. *Polygnathus sulcata* n. sp.; Huddle, p. 101, Pl. 8, Figs 22—23.
1962. *Siphonodella sulcata* (Huddle); Collinson, Scott & Rexroad, Chart 2.
1968. *Siphonodella sulcata* (Huddle); Canis, pp. 550—551, Pl. 72, Figs 5, 22, 23.
[non] 1969. *Siphonodella sulcata* (Huddle); Druce, pp. 122—123, Pl. 39, Fig. 1*a*—*b* [= *S. duplicata*].
?1969. *Siphonodella sulcata* (Huddle); Schönlaub, p. 346, Pl. 2, Figs 16—20.
1969. *Siphonodella duplicata* (Branson & Mehl); Rexroad, p. 43, Pl. 2, Fig. 13.

Remarks. — This species of *Siphonodella* is characterized by an only incipiently developed rostrum. It is only marked by slightly upturned margins of the platform in its anterior part, but true rostral ridges running parallel to the carina are not developed. The upper surface of the platform is covered with ridges, but it may be also ornamented partly with nodes arranged in rows. This species is closely related to the genus *Polygnathus*, but the lack of a definite basal cavity indicates that this species should be placed in *Siphonodella* (*cf.* Canis 1968, p. 551). Specimens designated by Schönlaub (1969) as *S. sulcata* are here included into this species with reservation as having polygnathid aspects of the lower surface. The differences between *S. sulcata* and *S. duplicata* — see remarks on the latter. The differentiation between the two species is, however, strongly arbitrary.

Occurrence. — *S. sulcata* have not been described by Voges (1959) from Sauerland, but Klapper found it at Hönnetal railroad cut in the Protognathodus kockeli — Pseudopolygnathus dentilineatus Zone (Sandberg & Klapper 1967, p. B46). It occurs in Wyoming and Montana in the Siphonodella sulcata Zone and it is rare in the lower part of Siphonodella sandbergi — S. duplicata Zone (Sandberg & Klapper 1967). Canis (1968, Tab. 3) records this species in Missouri from the Gnathodus sp. B (= *Protognathodus kuehni* Ziegler & Leuteritz, 1970) — P. kockeli Zone to the lower part of the Siphonodella quadruplicata — crenulata Zone.

Genus *SPATHOGNATHODUS* Branson & Mehl, 1941

(Type species: *Ctenognathus murchisoni* Pander, 1856)

Spathognathodus costatus costatus (Branson, 1934)

(Pl. 2, Figs 3—4)

1934. *Spathodus costatus* n. sp.; Branson, p. 303, Pl. 27, Fig. 13.
1962. *Spathognathodus costatus costatus* (Branson); Ziegler, pp. 107—108, Pl. 14, Figs 1—6, 8—10 [synonymy given].
1964. *Spathognathodus costatus costatus* (Branson); Higgins, *in* Higgins, Wagner-Gentis & Wagner, Pl. 5, Fig. 21.
1966. *Spathognathodus costatus costatus* (Branson); Manzoni, p. 485, Pl. 60, Figs 11—12.
1967. *Spathognathodus costatus costatus* (Branson); van Boogaert, pp. 186—187, Pl. 3, Figs 20, 22.
1967. *Spathognathodus costatus costatus* (Branson); Wolska, p. 426, Pl. 19, Figs 9—12.
[non] 1969. *Spathognathodus costatus costatus* (Branson); Druce, p. 126, Pl. 29, Figs 3—4.
1969. *Spathognathodus costatus costatus* (Branson); Olivieri, pp. 81—82, Pl. 12, Fig. 4*a*—*b*; Pl. 26, Figs 7—8.
[non] 1969. *Spathognathodus costatus costatus* (Branson); Rhodes, Austin & Druce, p. 225, Pl. 3, Figs 13—15.
1969. *Spathognathodus bischoffi* n. sp.; Rhodes, Austin & Druce, pp. 223—224, Pl. 4, Figs 1—4.

Remarks. — According to Ziegler (1962), p. 108) and some subsequent authors (see synonymy), *Spathognathodus costatus costatus* is confined to the Spathognathodus costatus Zone of the Upper Devonian and maybe to the lower part of the Gattendorfia Zone (Voges 1959). However, Rhodes, Austin & Druce (1969) and Druce (1969) found very similar specimens within conodont zones of the Avonian and in Bonaparte Gulf Basin (Australia), probably correlatable with the upper part of *cu IIα* and *cu IIβ-γ*. Rhodes & al. (*l.c.*) considered them as *S. costatus costatus* (Branson) and included all the Upper Devonian forms formerly described as this species in a newly erected species *S. bischoffi*. These two taxa are regarded as homeomorphic forms.

These are, however, some doubts if the holotype of Branson actually conforms with *S. costatus costatus* sensu Rhodes & al. (1969) and not with the form designated by the latter as *S. bischoffi*. Branson's holotype was found in the Hannibal Formation of Missouri, an equivalent of *cu I* except for its uppermost part (*cf.* Canis 1968, Tab. 3). The *locus typicus* of *S. costatus* does not correspond with an interval comprising *S. costatus costatus* sensu Ziegler (1962) [= *S. bischoffi*] or *S. costatus costatus* sensu Rhodes & al., but it falls within the intermediate interval. In addition, Prof. W. Ziegler and Dr. Ch. Sandberg (written communication of Prof. W. Ziegler 1972) after examining the holotype of *S. costatus* and comparing it with *S. costatus costatus* sensu Ziegler (1962) could not find any significant differences between them.

Consequently, the concept of *S. costatus costatus* sensu Ziegler (1962) is accepted here temporarily and the forms designated as the same species by Rhodes & al. (1969) are excluded from the synonymy of *S. costatus costatus*. The taxonomic problem presented above ramains open until types will be scrutinized and compared in detail.

The specimens in hand are closely comparable with the forms from the Upper Devonian and differ from *S. costatus costatus* sensu Rhodes & al. (1969). The last-

-named have nearly symmetrical, narrower and elongated basal cavity which is asymmetrical, wider in its anterior part and abruptly tapering posteriorly in *S. costatus costatus* sensu Ziegler (1962).

Occurrence. — See remarks.

Spathognathodus costatus spinulicostatus (Branson, 1934)
(Pl. 2, Figs 1—2, 5)

1934. *Spathodus spinulicostatus* n. sp.; Branson, p. 305, Pl. 27, Fig. 19.
1962. *Spathognathodus costatus spinulicostatus* (Branson); Ziegler, pp. 108—109, Pl. 14, Figs 11—18 [synonymy given].
1967. *Spathognathodus costatus spinulicostatus* (Branson); van Boogaert, p. 187, Pl. 3, Fig. 25.
1967. *Spathognathodus costatus spinulicostatus* (Branson); Wolska, p. 427, Pl. 19, Figs 13—16.
1967. *Spathognathodus costatus spinulicostatus* (Branson); Spasov & Filipović, p. 80, Pl. 4, Figs 1—2 [non Fig. 3 = *S. costatus costatus*].
[non] 1968. *Spathognathodus costatus spinulicostatus* (Branson); Canis, p. 552, Pl. 73, Fig. 15.
1969. *Spathognathodus costatus spinulicostatus* (Branson); Olivieri, p. 145, Pl. 12, Fig. 7; Pl. 26, Figs 9—10.
1969. *Spathognathodus costatus spinulicostatus* (Branson); Schönlaub, p. 348, Pl. 3, Fig. 19.

Remarks. — Rexroad, Austin & Druce (1969) included all the Upper Devonian specimens, formerly assigned to *Spathognathodus costatus spinulicostatus,* in the newly erected species *S. ziegleri.* They regarded the last-named as a junior subjective synonym of *S. sulciferus* which they considered to be a subspecies of *S. costatus.* According to Rexroad & al. (1969), *S. costatus sulciferus* is confined in the Avonian to the conodont zones, probably correlatable with the upper part of *cu IIα* and *cu IIβ-γ*. However, the holotype of *S. spinulicostatus* differs from the holotype of *S. sulciferus* especially in the outline of the basal cavity. Some undoubtly Upper Devonian specimens (*e.g.* Wolska 1967, Pl. 19, Fig. 16) closely resemble Branson's holotype of *S. spinulicostatus* in the ornamentation of upper surface. Unfortunately, the outline of the basal cavity of the holotype (Branson 1934, Pl. 27, Fig. 19) is not fully exposed on the illustration. Not having an oportunity to see the type material of any species under study the writer does not present definite conclusions, but until holotypes are scrutinized in detail he is inclined to regard *S. costatus* spinulicostatus sensu Ziegler (1962) as a valid and disinct subspecies. All specimens investigated fall within the range of variability of the subspecies.

Occurrence. — Ziegler (1962, Tab. 2; 1971, Chart 6) records the range of the subspecies from the Lower (except for the lowermost part) to the Upper Spathognathodus costatus Zone.

Spathognathodus disparilis (Branson & Mehl, 1934)
(Pl. 1, Fig. 7*a*—*b*)

1934a. *Spathodus disparilis* n. sp.; Branson & Mehl, pp. 189—190, Pl. 17, Fig. 18.
?1957. *Spathognathodus disparilis* (Branson & Mehl); Cloud, Barnes & Hass, p. 809, Pl. 5, Fig. 1.
?1959. *Branmehla disparilis* (Branson & Mehl); Hass, p. 381, Pl. 50, Fig. 6 [the same specimen as that illustrated by Cloud, Barnes & Hass 1957].

Remarks. — The illustrated specimens of *Spathognathodus disparilis* available displays short and exceptionally wide lateral extensions, of which the inner is conspicuously shorter than the outer. The upper surface of the outer extension bears two isolated nodes and only one low node occurs on the upper surface of the inner extension. The blade is nearly straight.

Only two specimens previously illustrated have been assigned to *Spathognathodus disparilis.* The specimen illustrated differs from the holotype of Branson &

Mehl in a nearly straight blade, which in the holotype is curved more laterally. In contrast to the illustrated specimen, the upper surface of the inner extension in the holotype and in the second specimen in hand is unornamented. The specimen illustrated by Cloud, Barnes & Hass (1957) has an unornamented upper surface of both extensions and for this reason it is placed in the synonymy of the species with reservation.

Spathognathodus disparilis is a homeomorph of *S. sannemanni* Bischoff & Ziegler. A few subspecies of the latter were erected by Pollock (1968) on the basis of differences in the ornamentation of the lateral extentions. The division on the same basis of *S. disparilis* into subspecies may also be possible, but this requires a richer material.

Occurrence. — Hass (1959, p. 381) records *S. disparilis* in the Chappel Limestone, but it is considered to have been redeposited, as its actual range is believed to be a high Upper Devonian.

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FAMEŃSKO-TURNEJSKIE ŻYŁY NEPTUNICZNE Z FAUNĄ KONODONTOWĄ NA DALNI W GÓRACH ŚWIĘTOKRZYSKICH

(Streszczenie)

Przedmiotem pracy jest analiza sedymentologiczno-facjalna oraz stratygraficzna żył neptunicznych (tj. osadów, które w warunkach podmorskich wypełniły synsedymentacyjne szczeliny tektoniczne), występujących na wzgórzu Dalnia koło Kielc (*vide* fig. 1—5), gdzie przecinają one wapienie oolitowe wieńczące profil franu (*por.* Szulczewski 1971). Znalezione żyły neptuniczne zawierają bardzo bogaty i unikalny zespół skamieniałości, na który składają się przede wszystkim koralowce, trylobity i konodonty, zaś brachiopody, amonity i strzykwy stanowią element towarzyszący. Szczeliny prowadzące do utworzenia żył były kilkakrotnie rozwierane i wypełniane w warunkach podmorskich, a zawarta w obrębie żył fauna konodontowa wskazuje, że procesy te zachodziły zarówno w famenie jak i w turneju. Wypełnienie żył odpowiada skondensowanej sekwencji wapiennej osadzonej na grzbiecie podmorskim. Zrekonstruowany zarys obszaru zwolnionej sedymentacji w famenie i w turneju zachodniej części Gór Świętokrzyskich pokrywa się w przybliżeniu z zarysem obumarłej frańskiej rafy płytowej (*por.* Szulczewski 1971); sedymentacja sekwencji skondensowanej jest zatem tutaj zjawiskiem potomnym w stosunku do sedymentacji rafowej. Przebieg granic facjalnych w górnym dewonie i w turneju był tutaj natomiast w znacznym stopniu wyznaczany przez równoczesne z sedymentacją dyslokacje blokowe. Przedstawiona zmienność facjalna wydaje się mieć także wpływ na ukształtowanie późniejszych (hercyńskich) form tektonicznych, m. in. fałdów śluchowickich i synkliny kieleckiej.

W części paleontologicznej pracy opisano 29 gatunków i podgatunków konodontów (*vide* pl. 1—6), głównie turnejskich, które z obszaru Gór Świętokrzyskich nie były dotychczas opisywane. Pozostałe grupy faunistyczne rozpatrzono w nawiązaniu do równoczesnych opracowań szczegółowych, poświęconych koralom denkowym (Stasińska 1973), części korali czteropromiennych (Fedorowski 1973) oraz trylobitom (Osmólska 1973). Cały rozpatrywany zespół faunistyczny, będący najbogatszym z dotychczas znanych w turneju Gór Świętokrzyskich, zdaje się być niepowtarzalnym z tego także względu, że obszar Dalni jest jedynym, gdzie osady turnejskie są niemal w całości wykształcone w facji wapiennej.

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