# Conodont faunas from Portugal and southwestern Spain

## Part 6. A Lower Famennian conodont fauna at Monte do Forno da Cal (South Portugal)

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A Lower *marginifera* Zone conodont fauna is described from the Phyllite-Quartzite Group in the Estação de Ourique anticline in the Iberian Pyrite Belt. The composition of the fauna is indicative of a shallow to very shallow marine environment.

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## Introduction

The Monte do Forno da Cal (Lime Kiln Farm) region lies about 14 km SE of Castro Verde and 9 km NNE of Almodôvar, in the Baixo Alentejo. Here Famennian limestones crop out near the top of the Phyllite-Quartzite Group and this small area is the richest known in the entire Pyrite Belt in terms of abundance and size of carbonate bodies.

The area is situated near the southeast end of the Estação de Ourique anticline, and the complete Phyllite-Quartzite Group/Volcanic-Siliceous Complex/Culm Group succession of Pyrite Belt stratigraphy (Schermerhorn, 1971) is present. The overall structure is an anticlinorium of PQ and overlying VS, mantled by Culm. Neither the base nor the top of the succession is seen.

The limestone outcrops were mentioned by Delcy (1970, p. 204 - 205) as calcaires de Pardieiro. He had sent a small sample to J. le Fèvre for investigation but only one *Hindeodella* was found. The rock apparently had a low conodont content. Therefore one of us (L.J.G.S.) took a 24 kg sample from one of the limestone bodies (see Fig. 1). After processing it yielded 642 conodonts that is also no more than 27 a kg.

The specimens are stored in the Rijksmuseum van Geologie and Mineralogie at Leiden with the numbers RGM 295 569 - 295 612.

## Stratigraphy

The Phyllite-Quartzite Group (PQ) is present in normal lithology, except for an abundance of limestones, and was given the local name of Lançadoiras Quartzitic Formation (LQ) after a prominent quartzite ridge east of the area here discussed (Schermerhorn, 1975a). The formation consists mostly of medium grey, generally somewhat silty phyllites and phyllitic siltstones. Near or at the top the phyllites include limestone lenses and quartzite sheets, the latter mostly rather fine-grained pure orthoquartzites lacking cross-bedding.

The limestones occur in lenses up to 125 m long and up to 20 - 25 m thick. A total of 19 limestone occurrences has been mapped, of which 16 are found in the Monte do Forno da Cal area proper (Fig. 1) and three much smaller (a few metres long at most) outcrops in the Algaré area about 2 km to the east. The Algaré limestones are strongly sheared as they occur near a thrust along which LQ overrides Culm. The Monte do Forno da Cal limestones are disscussed below.

The Volcanic-Siliceous Complex (VS) is present in four lithofacies. VS-SL is a lithofacies of spilitic lavas, tuffs and breccias, here found at the base of VS. The eruptive centre appears to have been situated at Monte do Forno da Cal. VS-t consists of felsic tuffs displaying varying lithologies, from lapilli tuffs with small quartz phenocrysts over granular-textured tuffs to felsophyres of quartz-keratophyric composition in thin section. The slaty VS-s lithofacies is here subdivided into two distinct facies, one tele-volcanic and the other non-volcanic. VS-ss, the siliceous slate facies, contains siliceous slates (fine-grained volcaniclastic sediments or dust tuffs) interbedded with felsites, slates,

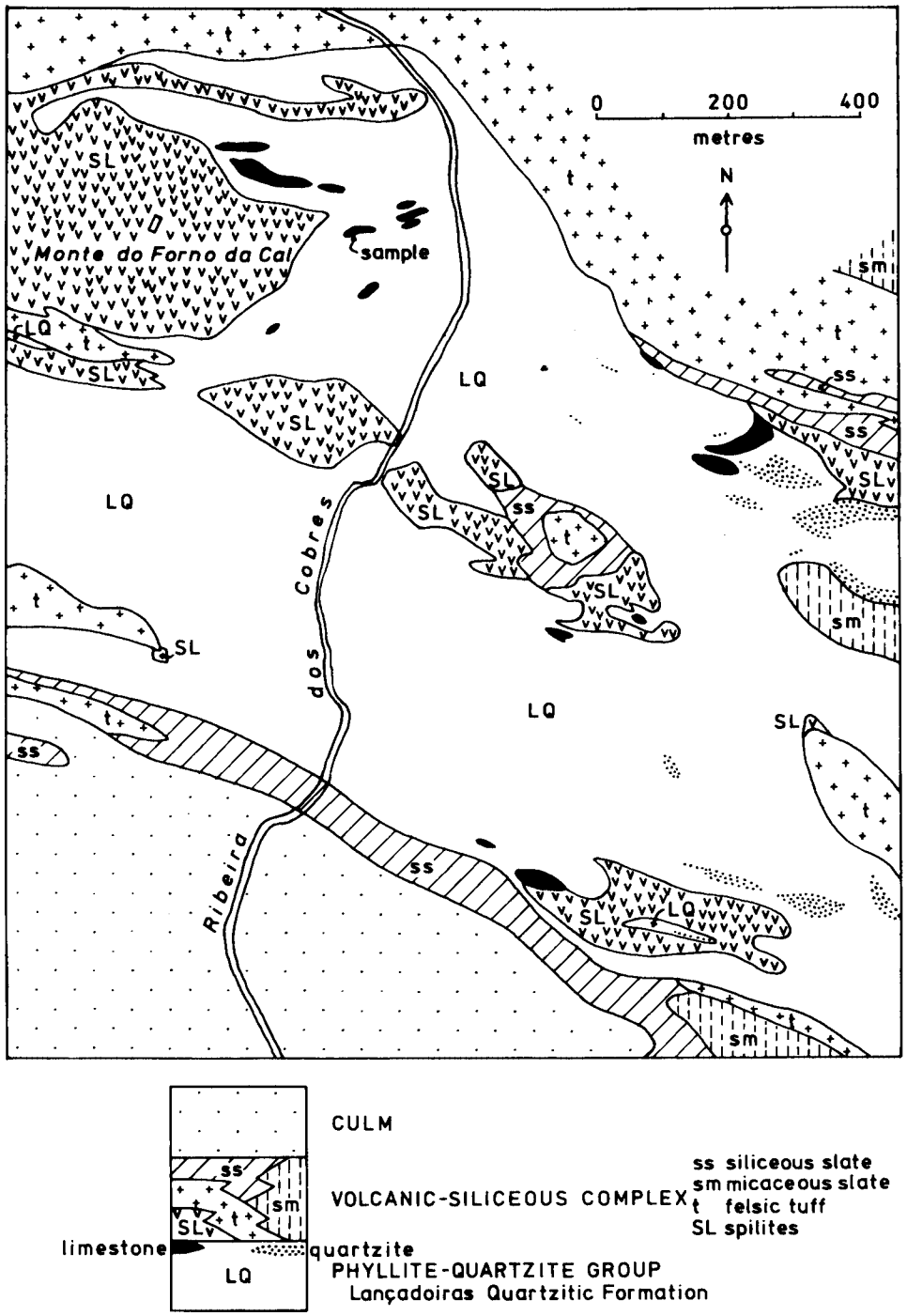


Fig. 1. Geological map of the Monte do Forno da Cal region, composed by L. J. G. Schermerhorn.

phyllites and occasional coarser tuffs. VS-sm, the micaceous slate facies, consists of epiclastic slates and siltstones, occasionally passing to fine-grained quartzwackes and greywackes. These rocks generally are rather strongly micaceous, that is, they contain abundant detrital muscovite flakes. VS-sm intertongues with the other lithofacies and represents a local influx of terrigenous material into a volcanic area. VS-t is a relatively proximal facies of felsic volcanics and VS-ss is a distal felsic facies.

The Culm Group is represented by its basal greywacke formation (C1) overlying VS conformably. It consists of turbidite greywackes interbedded with slates. The fossils found in this area include goniatites and *Posidonia becheri* (Upper Viséan).

## Metamorphism

The metamorphic grade attained in this area is very low. The metamorphic minerals are mostly sericite and chlorite. Although especially searched for, pumpellyite was only found in one outcrop in the spilite areas. Metamorphism to the pumpellyite facies (Schermerhorn, 1975b) appears likely, therefore. The colour of the conodonts is in accordance with this. They are greyish black and their surface is no longer smooth and vitreous. According to Epstein et al. (1977) this means that these conodonts were affected by metamorphism at a temperature of $300^0$ or more, a temperature which is within the stability range of pumpellyite.

## The limestones

Of the 16 limestone lenses known in this area, the largest number (9) is found surrounding the east end of the spilite syncline at Monte do Forno da Cal, in the north limb of the LQ anticlinorium. In the same zone occur three lenses several hundred metres farther east (and the three small Algaré occurrences referred to above). In the middle of the LQ anticlinorium are two more lenses, below spilites, and in the south flank another two, of rather more impure limestone.

Unfolded, the limestones are seen to occur in a roughly triangular area, with its base extending along the north side of the LQ outcrop. Also, where quartzites occur at the top of LQ no limestones are found (except at Algaré).

The larger occurrences in the Monte do Forno da Cal area have been quarried to produce lime in locally constructed small kilns. The rocks are mostly coarse bioclastic calcarenites, often somewhat crinoidal, and less frequent calcilutites. In a few places occurs a calcirudite forming a bed less than one metre thick, composed of rounded to subrounded cobbles up to 20 cm long of calcarenite in a calcilutite matrix. This denotes contemporaneous erosion and redeposition. The phyllites enclosing the limestone bodies frequently contain limestone nodules 1 - 4 cm in size.

Table 1. Natural species and form ('. . ') species present in the fauna from Monte do Forno da Cal.

| | Number of specimens |
|---|---|
| *Palmatolepis (Conditolepis) marginifera* Helms, 1959: P element | 2 |
| *Palmatolepis (Palmatolepis)* cf. *perlobata schindewolfi* Müller, 1956: P element | 22 |
| *Palmatolepis (Panderolepis?) distorta* Branson & Mehl, 1934: P element | 4 |
| *Palmatolepis (Panderolepis) falcata* (Helms, 1959): P element | 41 |
| *Palmatolepis (Panderolepis) pectinata* Ziegler, 1962: P element | 24 |
| *Palmatolepis (Tripodellus) minuta* Branson & Mehl, 1934: P element | 4 |
| *Palmatolepis* sp.: P element | 30 |
| *Palmatolepis* spp.: O element | 5 |
| *Palmatolepis* spp.: $N_1$ element | 2 |
| *Polygnathus glaber* Ulrich & Bassler, 1926: P element | 5 |
| *Polygnathus nodocostatus* Branson & Mehl, 1934: P element | 59 |
| *Polygnathus semicostatus* Branson & Mehl, 1934: P element | 250 |
| *'Polygnathus triphyllatus'* (Ziegler, 1960) | 3 |
| *Polygnathus* sp. P element | 94 |
| *'Polylophodonta gyratilineata'* (Holmes, 1928) | 3 |
| *'Polylophodonta linguiformis'* Branson & Mehl, 1934 | 14 |
| *Icriodus* spp.: I element | 20 |
| *'Ozarkodina'* spp. | 19 |
| *'Spathognathodus'* sp. | 1 |
| Other non-platform elements | 50 |

## Palaeontology

The conodont fauna of the Monte do Forno da Cal sample is listed in Table 1. Van den Boogaard and Kuhry (1979) have put the Linnean terms for separate elements (form species) between quotation marks, a custom which is continued in this paper. In the following part one of us (M.v.d.B.) will make some remarks upon several of the conodont species.

*Icriodus* cf. *I. cornutus* Sannemann, 1955
Pl. 1, fig. C.

cf. 1955 *Icriodus cornutus* n. sp. — Sannemann, p. 130, pl. 4, figs. 19 - 21.

The fauna contains a few specimens which resemble the I element of *I. cornutus* in having a posterior directed cusp which does not project above the median row of nodes (part of the cusp broken off in figured specimen). The discrete denticles of the middle row alternate with those of the lateral rows in the part above the symmetrical, rather large, basal cavity. The middle row is absent in the anterior part. Only the posterior part of the element is arched. *Icriodus cornutus* s.s ranges from the Upper *Palmatolepis triangularis* Zone to about the top of the Upper *marginifera* Zone (Klapper & Ziegler, 1979).

*Icriodus* cf. *I. symmetricus* Branson & Mehl, 1934
Pl. 1, fig. D.

cf. 1934 *Icriodus symmetricus* n. sp. — Branson & Mehl, p. 226, pl. 13, figs. 1 - 3.
cf. 1975 *Icriodus symmetricus* Branson & Mehl — Klapper in Ziegler, p. 151 - 153, *Icriodus*-plate 3, figs. 7 - 8.

The two specimens of this I element in our fauna conform to the description of Branson & Mehl (1934) and also show the feature mentioned by Klapper (in Ziegler, 1975) as being characteristic: the posterior half of the middle row is set distinctly higher than the lateral rows. A difference seems to be that the denticles of the middle row alternate with those of the lateral rows, a feature not mentioned for *I. symmetricus*. Our forms differ from *I. alternatus* Branson & Mehl, 1934 in being much less laterally compressed.

*I. symmetricus* s.s. is reported to occur in the Upper Devonian, Frasnian (Klapper in Ziegler, 1975).

*Icriodus* sp. a
Pl. 1, fig. E.

Some specimens of I elements in our fauna have the following characteristics: Large symmetrical basal cavity. The denticles of the median row are connected with each other by a low ridge. The denticles of the lateral rows are connected to the denticles of the median row by strong transverse ridges and decrease in size towards the posterior end. The median row is of equal height as the lateral rows in the anterior part of the element, distinctly higher in the posterior part, and ends with only a small denticle. The specimens show some resemblance to *Icriodus iowaensis* Youngquist & Peterson, 1947. However, they differ from that species by the absence of a large cusp at the posterior end.

*Icriodus* sp. b
Pl. 1, fig. B.

Our only specimen is characterized by an almost complete reduction of the median row of nodes. The posteriormost median denticle is enlarged and points slightly backwards. These features are the same as found in *I. arkonensis* subsp. a Druce, 1975. However, this latter species has a very different basal

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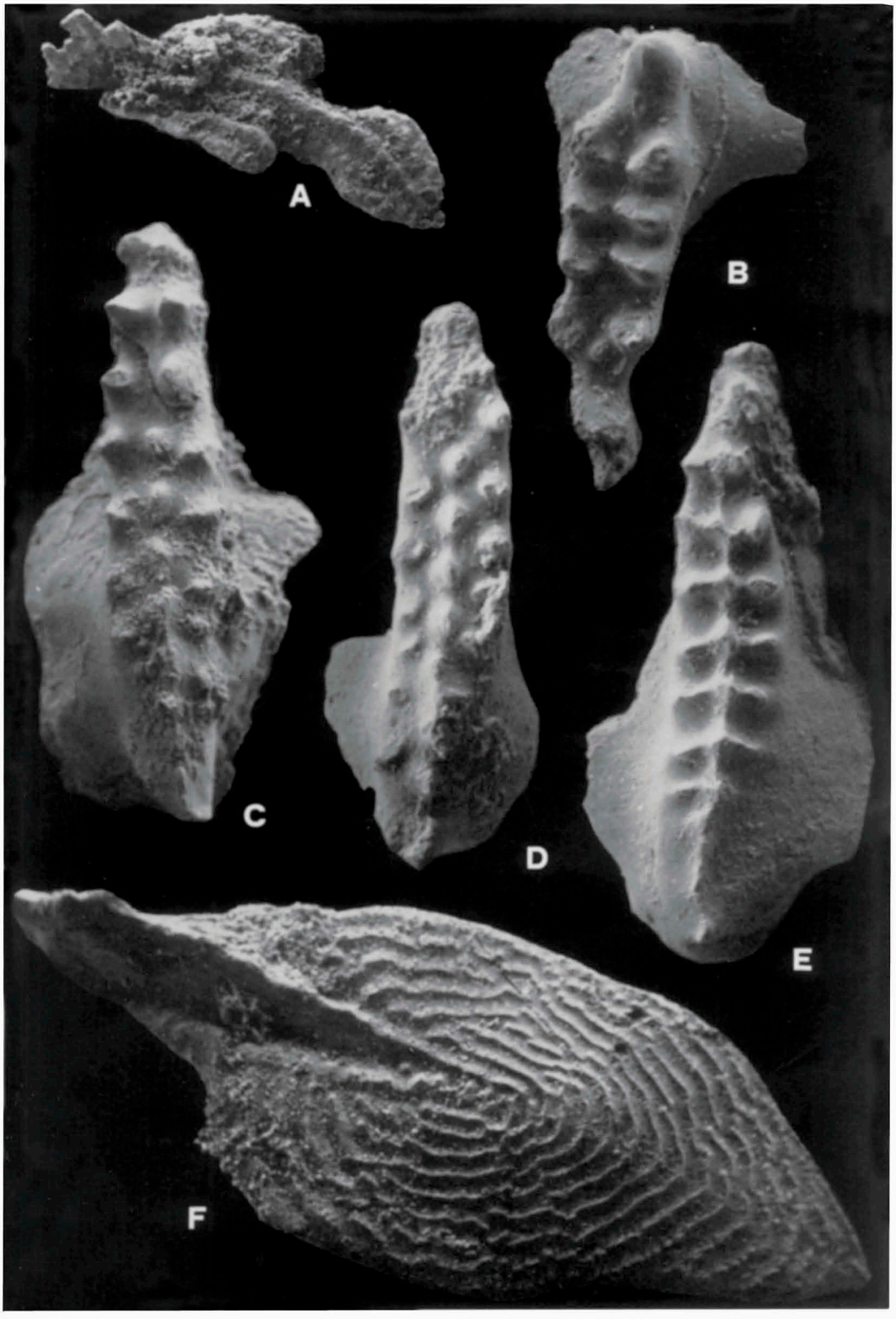
## Plate 1

Fig. A. *'Polygnathus triphyllatus'* (Ziegler, 1960). Specimen RGM 295 612 c, × 50.
Fig. B. *Icriodus* sp. b. Specimen RGM 295 611 b, × 83.
Fig. C. *Icriodus* cf. *I. cornutus* Sannemann, 1955. Specimen RGM 295 611 c, × 84.
Fig. D. *Icriodus* cf. *I. symmetricus* Branson & Mehl, 1934. Specimen RGM 295 611 d, × 81.
Fig. E. *Icriodus* sp. a. Specimen RGM 295 611 e, × 81.
Fig. F. *'Polylophodonta gyratilineata'* (Holmes, 1928). Specimen RGM 295 611 a, × 52.

Plate 1



cavity and is only reported from the Upper *Palmatolepis triangularis* Zone. Because of the almost complete absence of median row denticles the specimen also resembles *Icriodus iowaensis* Youngquist & Peterson, 1947 Morphotype I of Dreesen & Houlleberghs, 1980. The latter form, however, seems to have a smaller posterior cusp and moreover is only reported from the *P. triangularis* Zone. Consequently, we may be dealing with a specimen of another species (*I. cornutus*?) which shows a homeomorphic development.

*Palmatolepis (Conditolepis) marginifera* Helms, 1959

1959 *Palmatolepis quadrantinodosa marginifera* Ziegler — Helms, p. 649, pl. 5, figs. 22, 23.

1973 *Palmatolepis marginifera marginifera* Helms — Sandberg & Ziegler, p. 104 - 105, pl. 3, figs. 13 - 14.

1979 *Palmatolepis (Conditolepis) marginifera* Helms — van den Boogaard & Kuhry, p. 53 - 54, fig. 26.

The two specimens of the P element conform to the descriptions of Helms (1959) and Ziegler (1960, 1977). They were not well enough preserved to allow photographic reproduction. The species ranges through the Lower and Upper *marginifera* Zone into the Lower *velifer* Zone (Klapper & Ziegler, 1979).

*Palmatolepis (Palmatolepis)* cf. *P. (P.) perlobata schindewolfi* Müller, 1956
Pl. 2, figs. E, G.

cf. 1956 *Palmatolepis (Palmatolepis)* n. sp. — Müller, p. 27 - 28, pl. 8, figs. 22 - 31.
cf. 1977 *Palmatolepis perlobata schindewolfi* Müller — Ziegler, p. 361 - 364, pl. 11, figs. 1 - 7.
cf. 1979 *Palmatolepis (Palmatolepis) perlobata schindewolfi* Müller — van den Boogaard & Kuhry, p. 55, fig. 28.

## Plate 2

Fig. A. *Palmatolepis (Panderolepis) falcata* (Helms, 1959), P element. Specimen RGM 295 610 a, × 52.

Fig. B. *Palmatolepis (Panderolepis) falcata* (Helms, 1959), P element. Specimen RGM 295 612 a, × 50.

Fig. C. *Palmatolepis (Panderolepis) pectinata* Ziegler, 1962, P element. Specimen RGM 295 609 a, × 52.

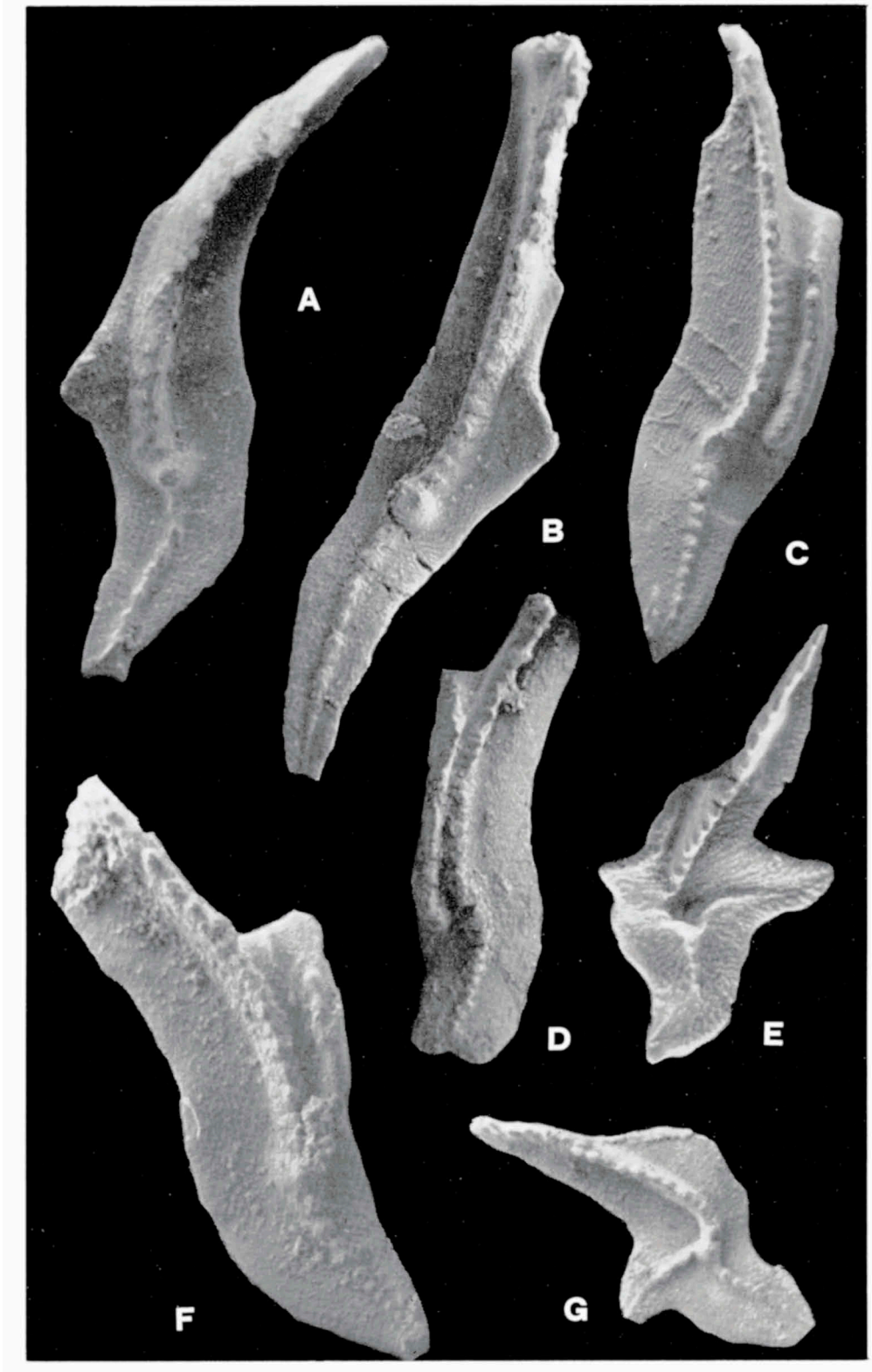
Fig. D. *Palmatolepis (Panderolepis?) distorta* Branson & Mehl, 1934, P element. Specimen RGM 295 610 b, × 52.

Fig. E. *Palmatolepis (Palmatolepis)* cf. *perlobata schindewolfi* Müller, 1956, P element. Specimen RGM 295 610 c, × 21.

Fig. F. *Palmatolepis (Panderolepis) pectinata* Ziegler, 1962, P element. Specimen RGM 295 609 b, × 52.

Fig. G. *Palmatolepis (Palmatolepis)* cf. *perlobata schindewolfi* Müller, 1956, P element. Specimen RGM 295 610 d, × 21.

Plate 2



The specimens of P elements are large and strongly undulated. They differ from those of *P. schindewolfi* s.s. in having a rather well developed secondary carina. In that aspect they resemble *P. maxima* Müller, 1956. However, they differ from this latter species in being much less slender and elongate. May be these forms represent a transitional form between *P. schindewolfi* and *P. maxima*. One specimen of the O element (cf. *'Nothognathella typicalis')* has been encountered.

The range of *P. (P.) perlobata schindewolfi* s.s. is from Upper *crepida* Zone into the Middle *costatus* Zone. That of *P. (P.) perlobata maxima* is from Upper *marginifera* Zone into Upper *styriacus* Zone.

*Palmatolepis (Panderolepis?) distorta* Branson & Mehl, 1934
Pl. 2, fig. D.

1934 *Palmatolepis distorta* n. sp. — Branson & Mehl, p. 237, 238, pl. 18, fig. 13.
1977 *Palmatolepis glabra distorta* Branson & Mehl — Ziegler, p. 297 - 300, pl. 6, figs. 4 - 6.
1979 *Palmatolepis (Panderolepis?) distorta* Branson & Mehl — van den Boogaard & Kuhry, p. 49, 50, fig. 22.

Only four P elements and one O element of this species were found in the fauna. The P elements conform to the descriptions given by Branson & Mehl (1934) and Ziegler (1977). The O element conforms to the description given by van den Boogaard & Kuhry (1979).

The species ranges from the base of the Lower *marginifera* Zone into the Middle *velifer* Zone (Klapper & Ziegler, 1979).

*Palmatolepis (Panderolepis) falcata* (Helms, 1959)
Pl. 2, figs. A, B.

1959 *Palmatolepis glabra elongata* Holmes — Helms, p. 649, pl. 2, fig. 12, pl. 5, fig. 25.
1969 *Palmatolepis glabra lepta* n. subsp. — Ziegler & Huddle, p. 380 - 381.
1977 *Palmatolepis glabra lepta* Ziegler & Huddle — Ziegler, p. 301 - 303, pl. 7, figs. 1 - 3.
1979 *Palmatolepis (Panderolepis) falcata* (Helms) - van den Boogaard & Kuhry, p. 49, fig. 21.

The P elements of this species conform to the descriptions of Helms (1959) and Ziegler (1960, 1977). One specimen of the O element (*'Nothognathella falcata'*) was encountered. That no more specimens of O elements have been found as might have been expected considering the number of P elements, is in my opinion due to the fact that in this fauna almost all delicate specimens are absent. Even the very adult specimens of non-platform elements are present as fragments only.

The species ranges from the Upper *crepida* Zone through the Upper *velifer* Zone (Klapper & Ziegler, 1979).

*Palmatolepis (Panderolepis) pectinata* Ziegler, 1962
Pl. 2, figs. C, F.

1962 *Palmatolepis glabra pectinata* n. sp. — Ziegler, p. 8 - 9, pl. 2, figs. 3 - 5 (preprint 1960).

Most specimens of the P element conform to the descriptions given by Ziegler (1962, 1977). Some specimens of the P element show tendencies towards the P element of *P. distorta* in having a longer parapet strictly parallel to the carina. They, however, miss the bulge of the outer platform. One incomplete O element was found which resembles the type described by van den Boogaard & Kuhry (1979, p. 48, fig. 20). This specimen probably belonged to the apparatus of *P. (Pand.) pectinata.*

The species ranges from high in the Upper *crepida* Zone through the Upper *marginifera* Zone (Klapper & Ziegler, 1979).

*Polygnathus glaber* Ulrich & Bassler, 1926
Pl. 3, figs. A, B.

1926 *Polygnathus glaber* n. sp. — Ulrich & Bassler, p. 46, pl. 7, fig. 13.

A few specimens of the P element occur in the fauna. They differ from *P. glaber glaber* in the absence of deep adcarinal troughs. The larger part of their platform is flat as in *P. glaber medius* Helms & Wolska, 1967. Also their carina is more like that of *P. glaber medius* in being partly composed of discrete nodes. However, in this latter subspecies the carina consists of discrete nodes over a greater part of the platform and is also slightly bent inwards. In our specimens the carina is straight. Therefore they are supposed to represent a transitional form.

The range of *P. glaber medius* is Lower to Upper *marginifera* Zone (Ziegler, 1975). That of *P. glaber glaber* is from Upper *rhomboidea* Zone into Middle *velifer* Zone (Klapper & Ziegler, 1979).

*Polygnathus nodocostatus* Branson & Mehl, 1934
Pl. 3, figs. C, D.

1934 *Polygnathus nodocostata* n. sp. — Branson & Mehl, p. 246, pl. 20, figs. 9 - 13, pl. 21, fig. 15.

The specimens of the P element conform to the descriptions given by Branson and Mehl and other authors i.a. Helms (1961).

Range of the species according to Klapper & Ziegler (1979): *crepida* Zone, *rhomboidea* Zone, *marginifera* Zone, and probably into the Lower *velifer* Zone.

*Polygnathus semicostatus* Branson & Mehl, 1934
Pl. 3, figs. E, G.

1934 *Polygnathus semicostata* n. sp. — Branson & Mehl, p. 247 - 248, pl. 21, figs. 1, 2.

Most of our specimens of the P element conform to the description of *Polygnathus semicostatus* s.s. (central "morphotype" 1) of Dreesen & Orchard, 1974. Some specimens belong to morphological trend 6 (Dreesen & Orchard) in that the carina does not end in the middle of the platform but has deviated somewhat to the inner rim of the platform. Some other specimens show the tendency of morphological trend 8 in having a longer carina and less transverse ridges (pl. 3, fig. E). Specimens with the features of morphological trend 3 (Dreesen & Orchard) — the sudden constriction of the posterior part of the platform — were observed also.

The species ranges from the Middle *crepida* Zone into the Middle *costatus* Zone (Sandberg & Ziegler, 1979).

*'Polygnathus triphyllatus'* (Ziegler, 1960)
Pl. 1, fig. A

1960 *Polylophodonta? triphyllata* n. sp. — Ziegler, p. 12, fig. 5; pl. 2, figs. 1, 2.
1961 *Polygnathus triphyllata* (Ziegler) — Helms, p. 696 - 697, fig. 13; pl. 1, figs. 2, 3; pl. 3, figs. 12, 15 - 17.
1962 *Polylophodonta? triphyllata* Ziegler — Ziegler, p. 97, pl. 9, fig. 15.
1974 *Polygnathus triphyllatus* (Ziegler) — Dreesen & Dusar, p. 19, pl. 4, figs. 14 - 16.

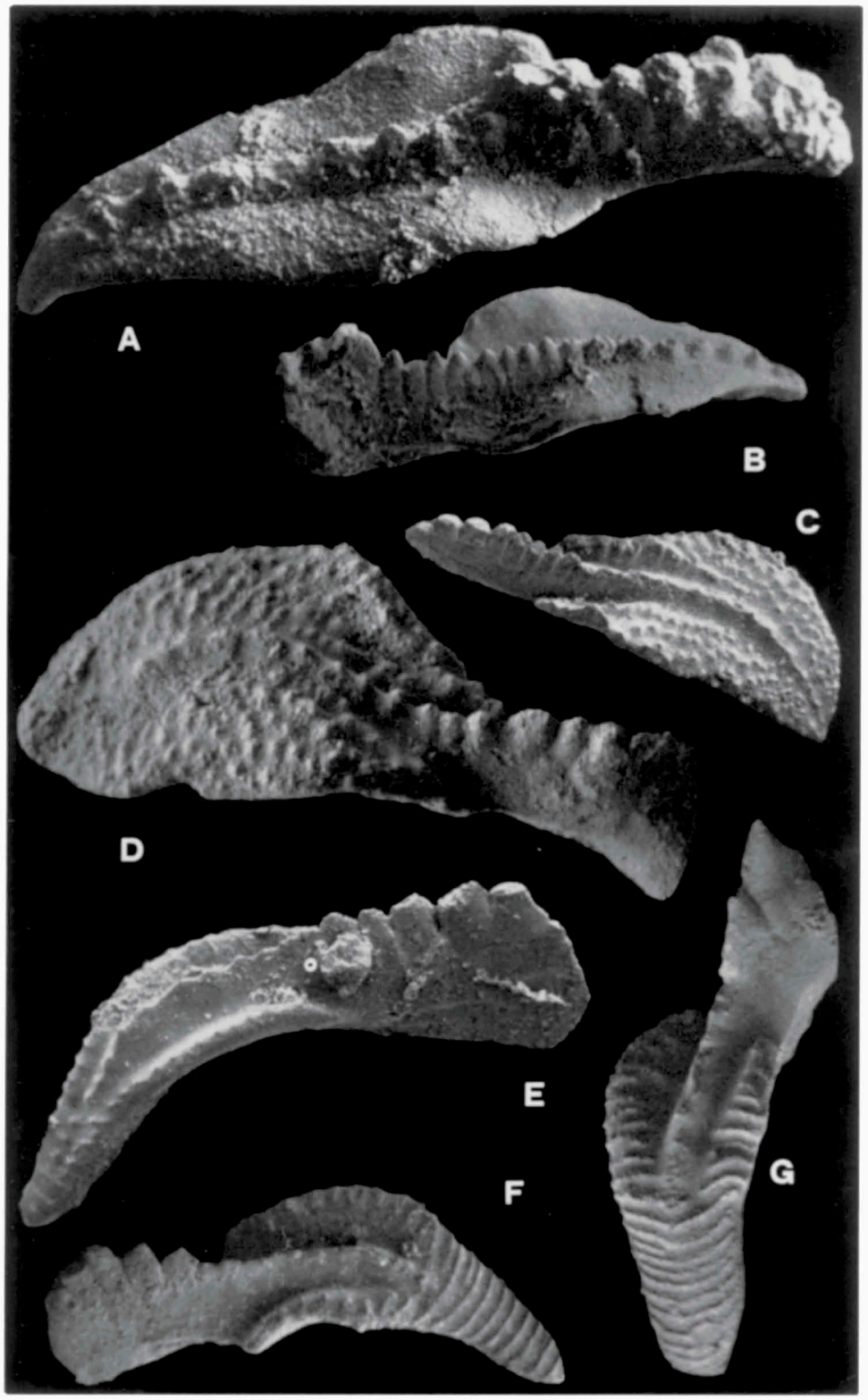
The three specimens in our fauna conform to the descriptions of Ziegler (1960) and Helms (1961).

Range according to Klapper & Ziegler (1979) upper part of the Upper *rhomboidea* Zone into lower part Lower *marginifera* Zone. According to Dreesen & Dusar (1974) the occurrence of the species in Belgium is restricted to the top of the Lower *marginifera* Zone.

## Plate 3

Fig. A. *Polygnathus glaber* Ulrich & Bassler, 1926. Specimen RGM 295 609 c, × 104.
Fig. B. *Polygnathus glaber* Ulrich & Bassler, 1926. Specimen RGM 295 609 d, × 52.
Fig. C. *Polygnathus nodocostatus* Branson & Mehl, 1934. Specimen RGM 295 609 f, × 52.
Fig. D. *Polygnathus nodocostatus* Branson & Mehl, 1934. Specimen RGM 295 609 e, × 52.
Fig. E. *Polygnathus semicostatus* Branson & Mehl, 1934. Specimen RGM 295 612 b, × 50.
Fig. F. *Polygnathus semicostatus* Branson & Mehl, 1934. Specimen RGM 295 610 e, × 52.
Fig. G. *Polygnathus semicostatus* Branson & Mehl, 1934. Specimen RGM 295 609 g, × 52.

Plate 3



*'Polylophodonta gyratilineata'* (Holmes, 1928)
Pl. 1, fig. F.

1928 *Polygnathus gyratilineatus* n. sp. — Holmes, p. 31, pl. 11, fig. 1.
1961 *Polylophodonta gyratilineata* (Holmes) — Helms, p. 699, fig. 15, pl. 1, fig. 8.
1962 *Polylophodonta gyratilineata* (Holmes) — Ziegler, p. 96 - 97, pl. 9, figs. 17, 19 - 20.

The few specimens conform to the descriptions given by Holmes, Helms and Ziegler.

Range of the species is upper part Upper *rhomboidea* Zone into Lower *marginifera* Zone (Klapper & Ziegler, 1979).

*'Polylophodonta linguiformis'* Branson & Mehl, 1934

1934 *Polylophodonta linguiformis* n. sp. — Branson & Mehl, p. 244, pl. 20, figs. 1, 6, 7.
1961 *Polylophodonta linguiformis* Branson & Mehl — Helms, p. 699 - 700, fig. 16, pl. 3, figs. 1, 2, 4.
1962 *Polylophodonta linguiformis* Branson & Mehl — Ziegler, p. 97, pl. 9, figs. 16, 18.

Our specimens conform to the descriptions of Branson & Mehl, Helms and Ziegler.

Range of the species probably *marginifera* Zone (Ziegler, 1962).

## Age of the limestone

The joint occurrence of *Palmatolepis (Conditolepis) marginifera, P. (Panderolepis?) distorta* and *P. (Panderolepis) pectinata* restricts the age of the fauna to the *marginifera* Zone. *'Polygnathus triphyllatus'* as well as *'Polylophodonta gyratilineata'* have not been reported from strata younger than the Lower *marginifera* Zone. Consequently we may assume that, expressed in conodont zonation, our fauna belongs to the Lower *marginifera* Zone (= top *Cheiloceras* stage in cephalopod-stratigraphy; early Famennian).

The limestone deposition at Monte do Forno da Cal thus has taken place during an earlier part of the Late Devonian than the Upper Devonian limestones deposited in more eastern parts of the Iberian Pyrite Belt. Those range from about Middle *velifer* Zone into the Upper *costatus* Zone (Höllinger, 1959; van den Boogaard, 1963; van den Boogaard & Schermerhorn, 1975, 1981; Fantinet et al., 1976).

## Biofacies

According to Sandberg (1976) *Polygnathus semicostatus* is the most common polygnathid in his polygnathid-icriodid biofacies and may be considered an indicator of shallow water. *Polygnathus nodocostatus* is most common in his palmatolepid-polygnathid biofacies and may be considered an indicator of mod-

erately deep water. *Palmatolepis* forms a large percentage of the total population of platform genera in the deeper waters of the continental rise, slope and shelf and decreases in percentage shorewards.

Dreesen & Thorez (1980) found in the Belgian Famennian the palmatolepid-polygnathid biofacies in a rather nearshore, relatively shallow subtidal environment. The polygnathid-icriodid biofacies was characteristic for the very shallow subtidal and intertidal marine environments. This latter biofacies was mainly composed of *Polygnathus* species of the *semicostatus* group and icriodids.

Considering the high percentage of *P. semicostatus* in our fauna (43.5%) against 22% of *Palmatolepis* and about 10% of *P. nodocostatus* we think that we can range the biofacies of our sample somewhere between the palmatolepid-polygnathid biofacies and the polygnathid-icriodid biofacies, thus indicating deposition in a relatively shallow to very shallow subtidal environment.

Judging from the small number of delicate forms in our fauna — all non-platform elements are heavily underrepresented — we assume that the energy of the environment was rather high, high enough either to destroy the more delicate forms or to transport them elsewhere.

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