Pseudofurnishius (Conodonta) in the Triassic of the Betic Cordilleras, SE Spain

M. van den Boogaard and O. J. Simon

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The stratigraphical position and the fossil content of several Triassic carbonate beds in the Betic Cordilleras are described. Three different conodont faunas have been found: one with *Pseudofurnishius murcianus* as the dominant species, a second in which *Pseudofurnishius murcianus* occurs together with *Tardogondolella mungoensis mungoensis* and a third in which *Pseudofurnishius huddlei* sp. nov. is the characteristic species.

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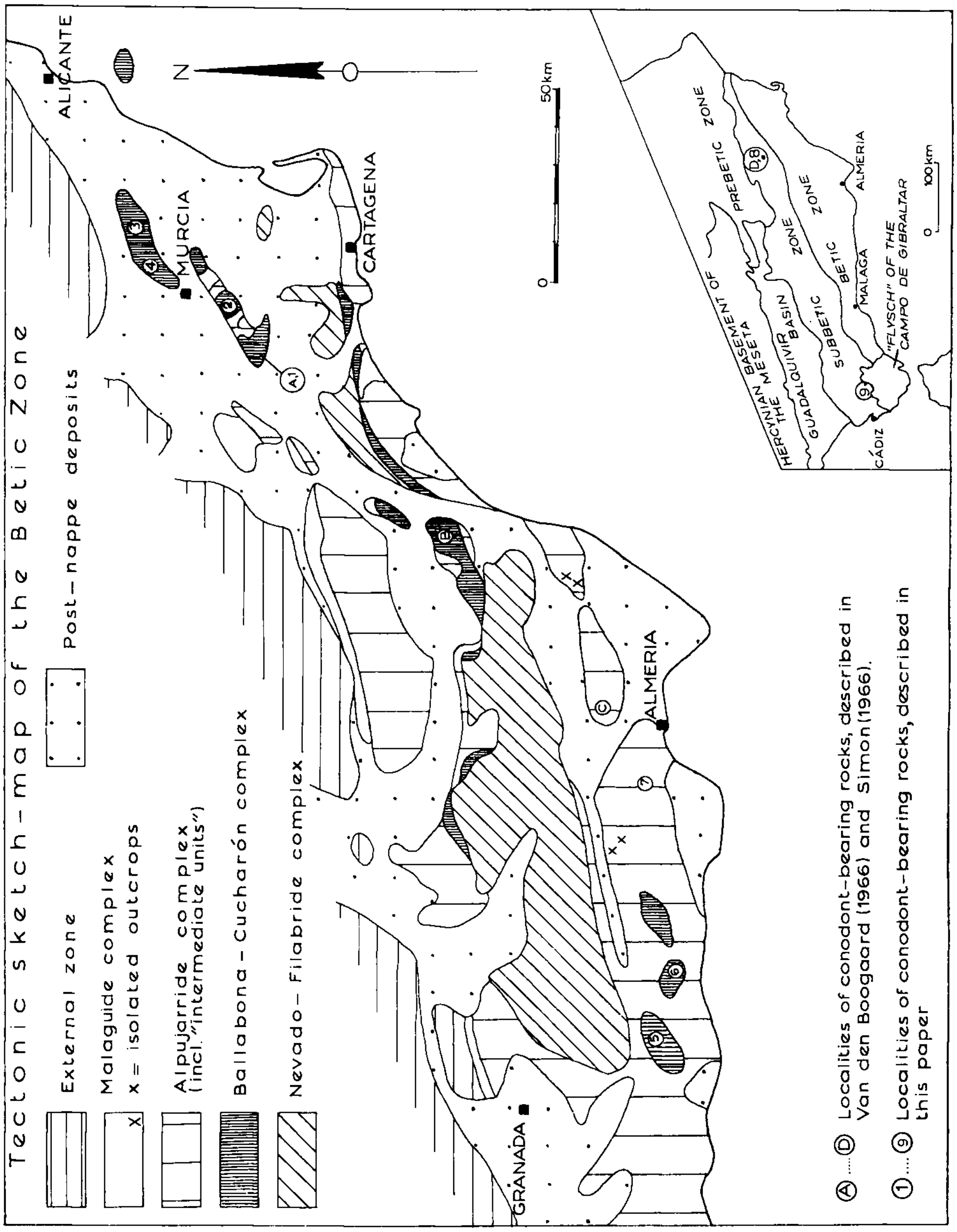

Fig.1. Map showing the regions in which conodont-bearing rocks have been found.

Introduction

Within the Betic Cordilleras, the alpine-fold belt of southern Spain, two major zones can be distinguished: the External Zone (comprising the Subbetic and Prebetic Zones) and the Internal or Betic Zone (Fig. 1). In the latter, various tectonic units are recognized which can be grouped within four superimposed complexes, in ascending order: (1) Nevado-Filabride complex, (2) Ballabona-Cucharón complex, (3) Alpujarride complex, and (4) Malaguide complex (Egeler & Simon, 1969a, b). The Nevado-Filabride units show a medium-grade Alpine metamorphism, both the Ballabona-Cucharón and the Alpujarride units a low-grade metamorphism, whereas the Malaguide units are only locally influenced by Alpine metamorphism. The Triassic is the only period of which sediments are known from all units of the Betic Zone; consequently, for a reconstruction of the palaeogeography, one has no other choice than to concentrate on the Triassic sequences. When comparing these, the lack of precisely dated horizons forms a serious handicap. Until recently, dating was essentially based on lithostratigraphical correlation; obviously, the results were generally unreliable. Well-preserved macrofaunas have been reported from a few localities only (compare Simon, 1963). These faunas, however, have in most cases little stratigraphical value, since most species are of unknown stratigraphical range or have a range which is too long for exact correlation. In recent years, Triassic sequences from many parts of the world have been dated in detail with the aid of microfauna. A systematic program for dating of the Betic sequences with the aid of microfaunas has therefore been started; 250 samples of carbonate rocks – varying in weight from 0.3 to 15 kg – have been dissolved in diluted formic acid. Most residues were found to contain microfaunas. Some early results have been published by van den Boogaard in 1966 (see also Simon, 1966).

Acknowledgements

Thanks are due to Miss J. Bos, Miss A. M. C. Goedmakers, Mrs C. Mulder-Blanken, Mr G. Oreel and Miss B. Spiers for the preparation and sorting of the residues. Furthermore we want to express our gratitude to Mrs C. Mulder-Blanken, Mr C. Bakker and the Werkgroep Scanning Electronen Microscopie for taking the scanning electron micrographs. Thanks are also due to Mr T. Veldhuyzen and Mr J. Timmers for the light photographs, and to Mr F. H. Kievits and Mr J. Timmers for the drawings.

Geological setting of the conodont-bearing rocks

BETIC ZONE

Sierra de Carrascoy (area 1, A)

The conodont-bearing carbonate rocks belong to the Romero unit, the lowermost tectonic unit of the Ballabona-Cucharón complex in the Sierra de Carrascoy

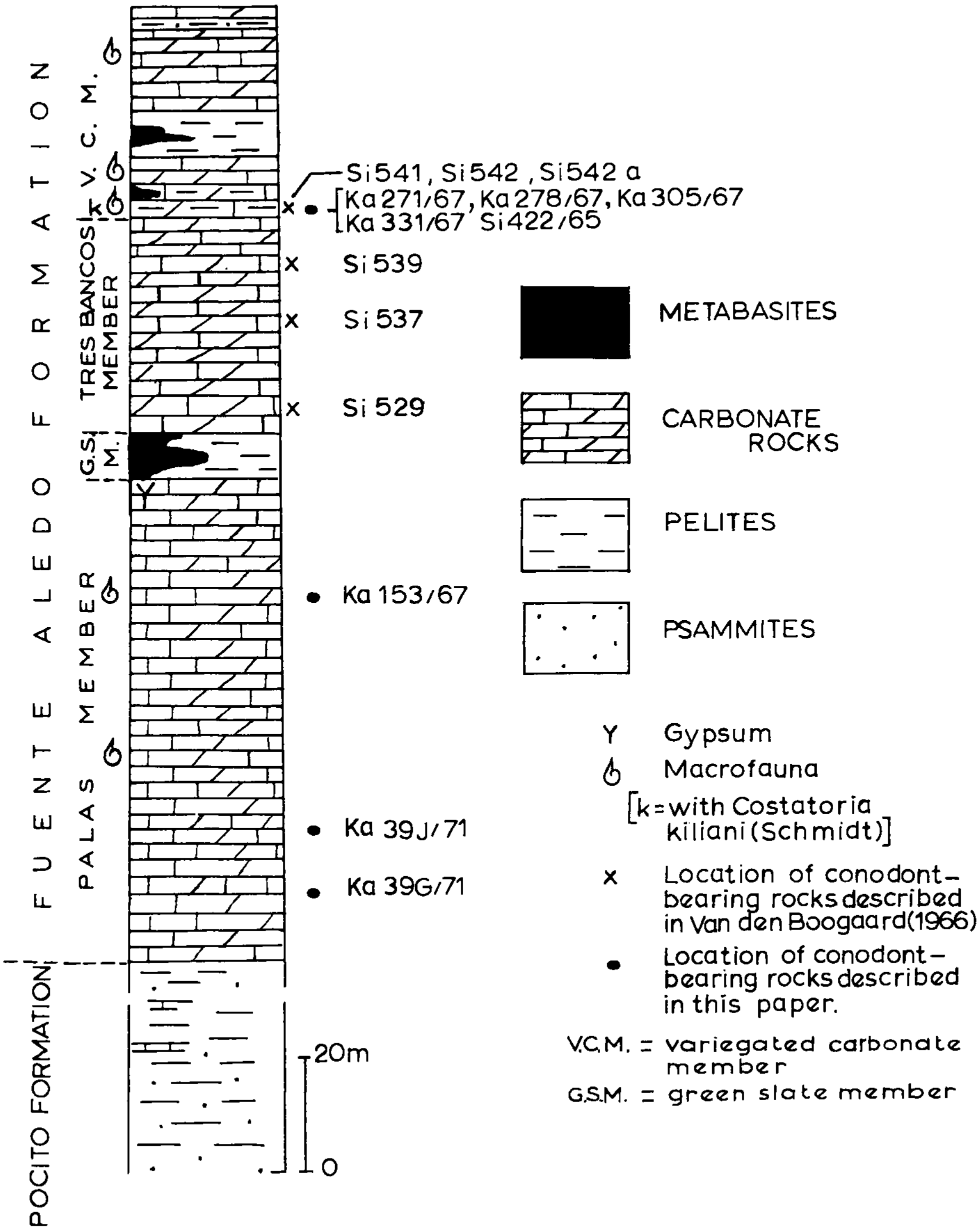

Fig. 2. Composite columnar section of the Romero unit, Sierra de Carrascoy (after Kampschuur, 1972).

(Kampschuur, 1972). A simplified columnar section of this unit indicating the stratigraphical position of the conodont-bearing samples is given in Figure 2. In the same beds from which samples Ka 271/67, Ka 278/67, Ka 305/67, Ka 331/67 and Si 422/65 have been taken, the following macrofossils have been found (Kampschuur, 1972): *Costatoria kiliani* (Schmidt), *Lyriomyophoria* cf. *sublaevis* (Schmidt) and *Gervilleia* cf. *joleaudi* Schmidt. In Schmidt's monograph (1935) on Triassic fossils from Spain similar fossils are described from Longobardic rock sequences outside the Betic Zone. Foucault (1970) mentions the presence of

Costatoria kiliani (Schmidt) and *Gervilleia* cf. *joleaudi* Schmidt in Longobardic rocks of the Prebetic Zone (see also p. 9). The chrono-stratigraphical correlation of the various members and formations of the Romero unit based on these macrofossils and the ostracodes of the Fuente Aledo formation (Kozur et al., in prep.) are given in Table 1.

Table 1. Chronostratigraphy of the Romero unit

Fuente Aledo formation	Ladinian-Carnian
variegated carbonate member	Ladinian-Carnian (Upper Longobard-Lower Cordevol)
tres bancos member	
green slate member	Ladinian
Palas member	Ladinian
Pocito formation	Ladinian and older?

The stratigraphical position of the conodont-bearing samples of area A described previously by van den Boogaard (1966; see also Simon, 1966) has been indicated in the columnar section of Figure 2.

Sierra del Puerto (area 2)

This mountain range forms the northeastern continuation of the Sierra de Carrascoy. The conodont-bearing samples (see Fig. 3) were taken from carbonate rocks of the Romero unit (Kozur et al., in prep.). In view of the strong tectonization, it was as yet impossible to establish the exact position of the conodont-bearing rocks in the stratigraphic column of the Romero unit. The samples have most probably been taken from the higher part of the variegated carbonate member, although the possibility that they belong either wholly or partly to a higher part of the Romero unit, not represented in the Sierra de Carrascoy, cannot be excluded. Holothurian sclerites point to a latest Longobardic to Cordevolic age for samples Kp 1 and Kp 2 and to a Cordevolic age for sample Kp 3 (Kozur & Simon, 1972). The ostracode-faunas from the samples Kp 1, Kp 2, Si 31/71, Si 36/71 and Si 37/71 indicate a Late Longobardic to Cordevolic age (Kozur et al., in prep.). In sample Si 36/71 the lamellibranch *Placunopsis flabellum* Schmidt has been found.

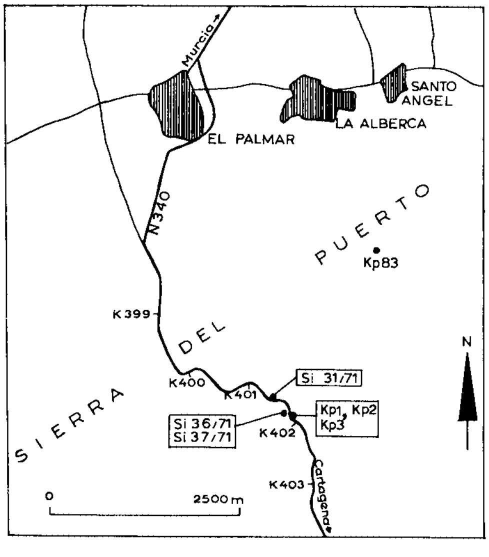

Fig. 3. Localities of the conodont-bearing rocks in the Sierra del Puerto, area 2 of Fig. 1.

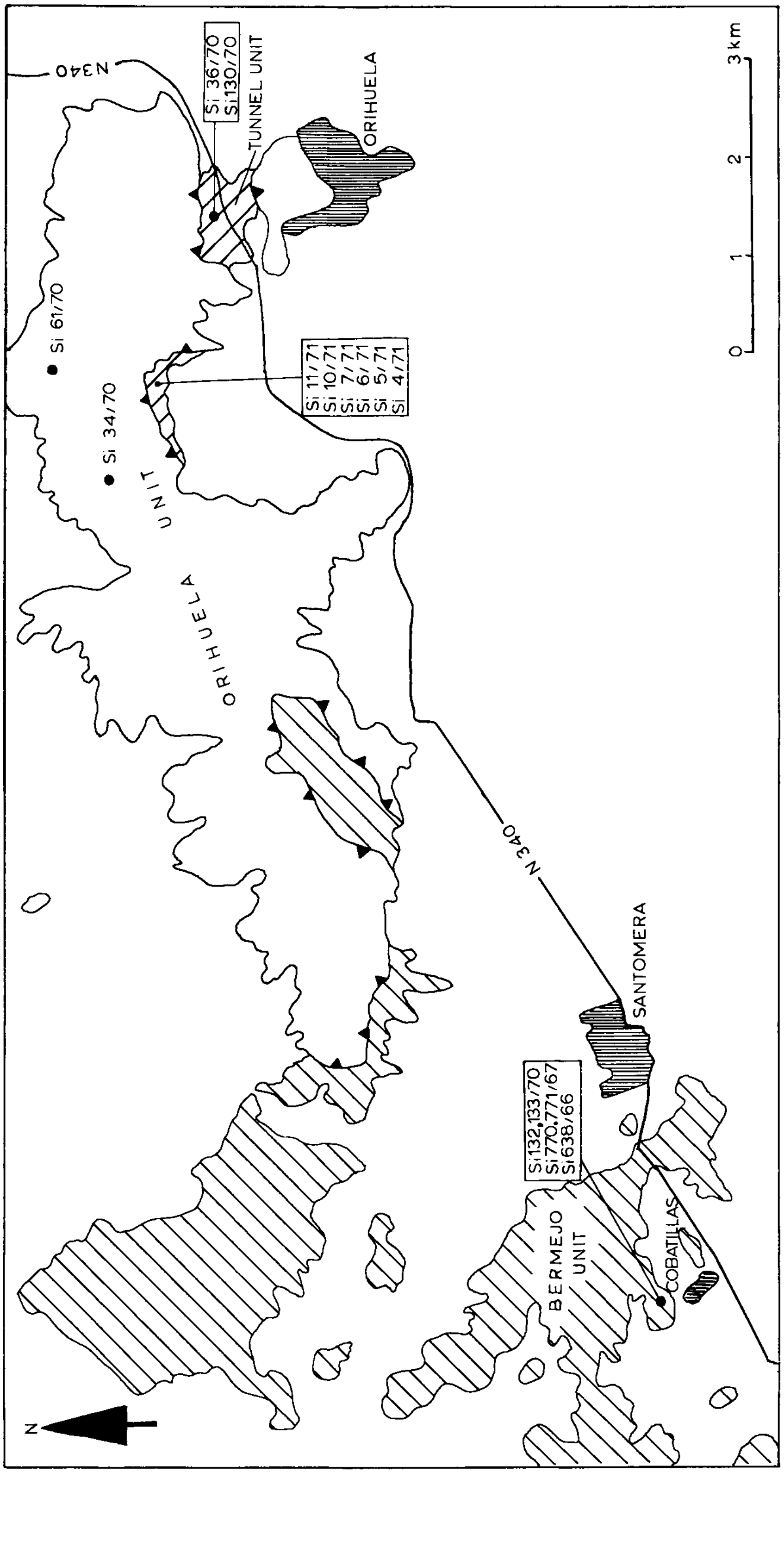

Fig. 4. Tectonic sketch-map of the Sierra de Orihuela and adjoining region to the west (areas 3 and 4 of Fig. 1) with the localities of the conodont-bearing rocks (after Egeler et al., in prep.).

Sierra de Orihuela (area 3)

In the Sierra de Orihuela several tectonic elements are recognized (Egeler et al., in prep.). The Orihuela unit, forming the backbone of the mountain range, represents the highest of these elements (Fig. 4). A schematic columnar section of this unit with the stratigraphic position of the conodont-bearing samples is given in Figure 5. On the basis of the ostracodes the rocks of the uppermost part of member C are tentatively dated as essentially Longobardic in age, and those of the higher part of member D as Longobardic to Cordevolic in age (Kozur et al., in prep.).

In the region north and northwest of the town of Orihuela, the Orihuela unit tectonically overlies the Tunnel unit (Egeler et al., in prep.). The maximum exposed thickness of the latter unit is approximately 110 m. Three members (a, b and c) can be distinguished in the Tunnel unit (see Table 2).

Table 2. Informal lithostratigraphical subdivision of the Tunnel unit (from top to bottom).

c. carbonates (partly rauhwackes), slates, quartzites and metabasites (max. thickness 90 m)
b. slates and quartzites (approx. 10 m)
a. carbonates, gypsum and metabasites (at least a tens of metres)

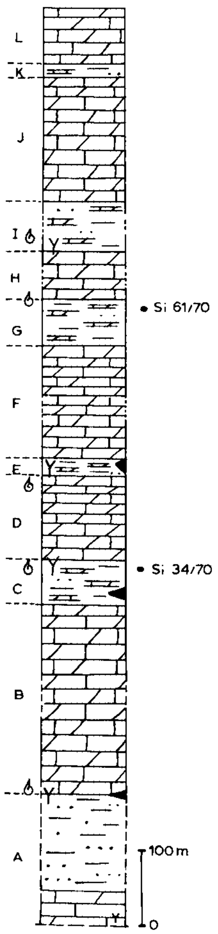

Fig. 5. Composite columnar section of the Orihuela unit, Sierra de Orihuela, with stratigraphical position of the conodont-bearing rocks (after Egeler et al., in prep.). For the legend see Fig. 2. A-L indicate the members of the Orihuela unit.

Approximately 30-35 m above the base of member c, carbonate rocks with *Costatoria kiliani* (Schmidt) and *Gervilleia* cf. *joleaudi* Schmidt have been found. From the same level, samples Si 36/70, Si 130/70 and Si 10/71 have been taken. The other conodont-bearing samples have been collected from the higher part of member c. The Tunnel unit has been correlated with the Romero unit on the basis of both the macro- and micro-faunas, and the lithostratigraphy (see Table 3).

Table 3. Correlation of the Tunnel unit with the Romero unit.

Tunnel unit, Sierra de Orihuela	Romero unit, Sierra de Carrascoy
member c	variegated carbonate member tres bancos member
member b	green slate member
member a	upper part of the Palas member

The possibility cannot be excluded that the higher part of member c contains rocks that are younger than those of the top of the variegated carbonate member of the Romero unit. Thus, it can be concluded that the conodont-bearing samples of the Tunnel unit have a Ladinian (Longobardic) to Carnian (Cordevolic) age.

Cobatillas region (area 4)

In the western Sierra de Orihuela, the Orihuela unit tectonically overlies a sequence which mainly consists of carbonate rocks, tentatively incorporated in the Bermejo unit. This unit has its greatest extension to the west and southwest of the Sierra de Orihuela (Fig. 4). The connection of the Bermejo unit with the Tunnel unit is uncertain. Lack of detailed maps and the strong tectonization make it impossible to give, at present, a detailed columnar section of the Bermejo unit. A tentative scheme is given in Table 4.

Table 4. Informal lithostratigraphical subdivision of the Bermejo unit (from top to bottom)

f. mainly carbonate rocks (at least some tens of metres)
e. slates, quartzites, carbonate rocks (partly rauhwackes), gypsum, and metabasites (10-20 m)
d. mainly carbonate rocks with intercalations of slates (60-80 m?)
c. (marly) carbonate rocks, slates, gypsum, and metabasites (15-20 m)
b. mainly carbonate rocks (10-20 m?)
a. slates and quartzites; in the uppermost part slates, rauhwackes, and metabasites (300-400 m)

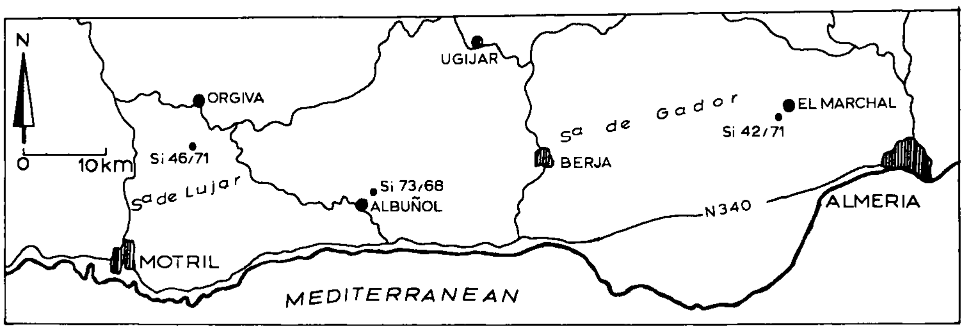

Fig. 6. Region between Motril and Almería, indicating the localities of the conodont-bearing rocks (areas 5, 6 and 7 of Fig. 1).

The conodont-bearing samples Si 638/66, Si 771/67, Si 770/67, Si 132/70, and Si 133/70 have been taken from carbonates most probably representing the basal part of member d. The age of the members of the Bermejo unit is not yet certain. A determinable macrofauna with *Placunopsis flabellum* Schmidt (det. Dr. F. Hirsch, Jerusalem) has so far been found exclusively in the conodont-bearing carbonates. As already mentioned, similar fossils have been described from Longobardic rock sequences outside the Betic Zone. In the Romero unit of the Sierra del Puerto *Placunopsis flabellum* occurs in rocks with a Late Longobardic to Cordevolic age (p. 4) and it has further been found in Cordevolic carbonate rocks from the western Sierra Alhamilla (see p. 10). It is therefore tentatively assumed that the conodont-bearing rocks from the Cobatillas region have a Longobardic to Cordevolic (Late Ladinian to Early Carnian) age.

Sierra de Lújar (area 5)

The Sierra de Lújar consists mainly of carbonate rocks but locally intercalations of slates, quartzites, gypsum, and metabasites occur (Boulin et al., 1966; Aldaya, 1968, 1969; Jacquin, 1970). The maximum estimated thickness of the sequence involved amounts to 1100 m. The age of the rock sequence has thus far been based on lithostratigraphical correlations (for a synopsis of the various views on the geology of the Sierra de Lújar see Jacquin, 1970). The conodont-bearing sample Si 46/71 has been taken approx. 300 m below the top of the sequence, about 4.5 km NNW of the highest point (1871 m) of the Sierra (Fig. 6). The sample contains also holothurian sclerites which indicate a Cordevolic age (Kozur & Simon, 1972). The rocks of the Sierra de Lújar have been incorporated in the Lújar unit (Van Bemmelen, 1927; Westerveld, 1929), considered by most authors (i.a. van Bemmelen, Westerveld, Boulin, Jacquin) to belong to the Alpujarride complex. Aldaya (1968) on the other hand, excludes the Lújar unit from the Alpujarride complex, and Egeler & Simon (1969 a, b) range this unit within the Ballabona-Cucharón complex.

Window of Albuñol (area 6)

The Lújar unit can be traced towards the east in the windows of Albuñol, Cerrón, and Calares de Turón (Westerveld, 1929; Aldaya, 1969; Jacquin, 1970; see also Fig. 1). In the Rambla de las Angosturas NE of the village of Albuñol (Fig. 6) sample Si 73/68 was taken from a carbonate rock. Besides conodonts these carbonates also contain foraminifera, fish remains and indeterminable lamellibranchs which give no specific age indication. Furthermore the carbonate rocks of the Albuñol window cannot be correlated with those of the Sierra de Lújar. Based on the lithology the rocks in question are referred by Aldaya (1969) to the Middle and Upper Triassic.

Sierra de Gador (area 7)

The conodont-bearing sample Si 42/71 has been taken from the Gador nappe of the Alpujarride complex. This nappe consists of a basement of Paleozoic mica-schists and a cover of Triassic and Permian rocks (Jacquin, 1970). Jacquin (1970) divided the succession of this cover into four parts (see Table 5).

Table 5. Informal lithostratigraphical subdivision of the sedimentary cover of the Gador nappe (from top to bottom).

t_3	mainly limestones and marls; some intercalations of dolomites, pelites, gypsum, and metabasites
t_{2b}	mainly dolomites and limestones
t_{2a}	mainly (marly) limestones
t_1	phyllites and quartzites

The thickness of the sequence of the Gador nappe varies strongly, the maximum thickness being 600-700 m (Jacquin, 1970, pl. 17, 18). The faunas found by Jacquin and other investigators indicate a Triassic age but the poor preservation prevents a more precise dating. On account of the lithology the phyllite-quartzite sequence (t_1) is referred to the Permo-Triassic (Jacquin, 1970). A conodont-bearing sample was collected from member t_{2b}, approx. 1050 m SE of El Marchal de Anton Lopez (Fig. 6). The remaining microfossils of this sample Si 42/71 provide no specific age indication. From the same locality a specimen of *Nautilus* has been reported (Jacquin, 1970, p. 182, figs. 76, 83, 84). The ostracodes from a sample of the higher part of member t_3 indicate a Longobardic to Cordevolic age (Kozur et al., in prep.).

Sierra de Almagro (area B)

The samples Simon 1679 and Simon 1866 (see van den Boogaard, 1966; Simon, 1966) belong to a tectonic unit which is the counterpart of the Romero unit of the Sierra de Carrascoy. Their stratigraphical position is the same as that of samples Ka 271/67, Ka 278/67, Ka 305/67, Ka 331/67 and Si 422/65 from the Romero unit of the Sierra de Carrascoy (Fig. 2). The beds from which they were taken contain *Costatoria kiliani* (Schmidt) and *Gervilleia* cf. *joleaudi* Schmidt.

Sierra Alhamilla (area C)

The conodont-bearing carbonates Ba 517 and Ba 518 previously described by van den Boogaard (1966; see also Simon, 1966) belong to an 'intermediate unit'. Some authors refer this unit and analogous ones to the Malaguide complex, others range them within the Alpujarride complex. The holothurian sclerites of sample Ba 518 indicate a Cordevolic age (Kozur & Simon, 1972). Among the macrofossils of sample Ba 518 *Placunopsis flabellum* Schmidt was identified by Dr F. Hirsch (Jerusalem).

SUBBETIC ZONE

Zarcilla de Ramos region (area 8; D)

In a previous paper by van den Boogaard (1966; see also Simon, 1966), conodont-bearing carbonate rocks (samples Rij 428 and Rij 46) have been described from this region. Samples Si 389/65 and Si 393/65 have been taken from the same localities as Rij 428 and Rij S 46, respectively. *Placunopsis* cf. *ostracina* von Schlotheim (det. Prof. H. Zapfe, Vienna) was found in carbonate rocks from which sample Si 393/65 derived. This species is known from Upper Ladinian (Longobardic) deposits in Spain (Schmidt, 1935) but its worldwide range is from Anisian to Carnian (see for example Kutassy, 1931).

Province of Cádiz (area 9)

Chauve (1967, p. 83) mentions a single conodont from Triassic carbonate rocks from the Subbetic Zone of the province of Cádiz (approx. 10 km NE of Alcala de los Gazules; see Fig. 1). Miss Mauvier identified the specimen as *Spathognathodus* sp., a species originally described by Diebel (1956) from the Upper Cretaceous of Cameroon. Van den Boogaard (1966) already stated that this form is conspecific with *Pseudofurnishius murcianus*. In view of the absence of determinable macrofossils the exact stratigraphical position of the conodont-bearing sample could not be established.

STRATIGRAPHICAL POSITION OF THE CONODONT FAUNAS

The samples which contain *Pseudofurnishius murcianus* as the only platform conodont (see Table 6) are all derived from strata of Late Ladinian-Early Carnian (Longobardic-Cordevolic) age. The faunas which contain *Pseudofurnishius huddlei* as the only platform conodont are derived from older strata (see Fig. 2), most probably of Late Ladinian (Longobardic) age. In Israel where both species occur together, the supposed age is Late Ladinian or Early Carnian (Huddle, 1970). The exact age of the sample with *Tardogondolella mungoensis mungoensis* and *Pseudofurnishius murcianus* is uncertain. Its stratigraphical position with regard to the two faunas mentioned above has not yet been established.

Palaeontology

FOSSIL CONTENT OF THE SAMPLES

The number of conodont specimens in most samples is small, generally less than 40 specimens per kilogram. The richest sample contained about 83 conodonts per kilogram, the poorest one per kilogram.

From Table 6 it appears that most samples contain *Pseudofurnihius murcianus* together with blade and bar conodonts. The samples Ka 153/67, Ka 39J/71, and Ka 39G/71 contain a different fauna consisting of *Pseudofurnishius huddlei* and some fragments of blade and bar conodonts. The sample Si 42/71 from the Sierra de Gador contains still another type of fauna which is characterized by the presence of *Tardogondolella mungoensis mungoensis* and *Pseudofurnishius murcianus* together with blade and bar conodonts. The sample from the Albuñol region, Si 73/68, contains one specimen of *Tardogondolella mungoensis mungoensis* and two indeterminable fragments.

As can be seen from Table 6 the number of specimens of *Pseudofurnishius* exceeds that of the blade and bar conodonts to a large extent in most of the samples. These blades and bars generally are fragmented and unrecognizable. Exceptionally they can be identified as *Lonchodina muelleri* Tatge, *Enantiognathus ziegleri* (Diebel), *Hibbardella magnidentata* (Tatge), or *Hindeodella* sp. These four species seem to accompany *Pseudofurnishius* in all faunas encountered in SE Spain (compare van den Boogaard, 1966). This could be an indication that these five species belong to the same conodont apparatus. However, the varying numbers in which they occur together, the lack of a constant proportion, do not warrant such an assumption.

Fish remains occur in most samples. Generally these remains are teeth or placoid scales of the same type as described by Huddle (1970) and they are also similar to the forms described under the names *Acodina* and *Nurrella* by Cherchi (1967).

The ostracodes which occur in many samples will be described in a forthcoming paper by Kozur, Kampschuur and Simon.

Table 6. Distribution and frequency of conodonts and relative quantities of other faunal elements; + = abundant, o = scarce, — = absent.

Area	Sample	Pseudofurnishius murcianus	Pseudofurnishius huddlei	Tardogondolella mungoensis mungoensis	Fragments of blade and bar conodonts	Foraminifera	Ostracoda	Holothuroidea	Fish remains	Gastropoda	Remains of crustaceans other than Ostracoda
Sierra de Carrascoy	Ka 331/67	4	-	-	2	o	o	-	o	o	-
	Ka 305/67	18	-	-	12	-	+	-	o	-	o
	Ka 278/67	11	-	-	20	o	+	-	o	o	+
	Ka 271/67	8	-	-	2	o	+	-	o	-	o
	Si 422/65	6	-	-	1	-	-	-	+	-	-
	Ka 153/67	-	8	-	10	+	+	-	+	o	o
	Ka 39J/71	-	1	-	-	+	+	-	o	-	-
	Ka 39G/71	-	22	-	1	-	+	-	+	-	-
Sierra del Puerto	Kp 3	11	-	-	3	-	-	-	-	o	+
	Kp 2	6	-	-	2	-	o	-	o	+	+
	Kp 1	10	-	-	5	-	o	-	+	-	+
	Kp 83	35	-	-	16	o	o	-	-	-	o
	Si 37/71	23	-	-	5	-	+	-	+	+	-
	Si 36/71	12	-	-	4	-	+	-	o	o	o
	Si 31/71	1	-	-	-	-	+	-	+	o	-
Sierra de Orihuela and adjoining region to the west	Si 61/70	41	-	-	18	o	-	-	o	o	-
	Si 34/70	1	-	-	9	+	+	-	o	-	-
	Si 11/71	48	-	-	12	o	o	-	o	-	o
	Si 10/71	12	-	-	3	-	o	-	o	-	o
	Si 7/71	2	-	-	2	-	+	-	o	-	-
	Si 6/71	57	-	-	24	-	-	-	o	-	-
	Si 5/71	88	-	-	25	-	o	-	+	-	+
	Si 4/71	1	-	-	-	-	+	-	o	-	o
	Si 36/70	65	-	-	36	-	-	-	o	-	-
	Si 130/70	54	-	-	8	-	-	-	o	o	-
	Si 133/70	276	-	-	79	o	-	-	+	-	o
	Si 132/70	280	-	-	59	+	-	-	+	-	+
	Si 771/67	502	-	-	68	-	-	-	-	-	-
	Si 770/67	19	-	-	8	-	-	-	o	-	o
	Si 638/66	113	-	-	20	-	-	-	o	-	o
Albuñol region	Si 73/68	-	-	1	2	-	-	-	o	-	-
Sierra de Lújar	Si 46/71	222	-	-	17	o	o	+	+	-	-
Sierra de Gador	Si 42/71	55	-	73	21	-	o	-	+	-	-
Zarcilla de Ramos region	Si 393-397	26	-	-	8	+	-	-	+	-	-
	Si 389/65	14	-	-	14	+	-	-	+	-	-

Holothuroid sclerites occur rather seldom. They have been described by Kozur and Simon (1972).

Remains of crustaceans other than ostracodes are abundant in a number of samples. Almost all specimens are slightly curved hollow cones, often with a broad base (see Pl. 2, fig. h, j). Some specimens show a crenulation on the concave side (Pl. 2, fig. e), others a slight convexity in the middle of the concave side (Pl. 2, fig. h). Many specimens have one rather flat lateral side. The basal opening is not round but more or less triangular or quadrangular. The length of the specimens varies between 0.8 and 2.4 mm. According to Mr W. Drucker, Geological Institute of the University of Amsterdam, the cones are composed of quartz and apatite. Their shape resembles much the shape of the movable finger of the chelae (claws) of some crustaceans. These fingers resist disintegration better than the other parts of the crustacean skeleton (Glaessner, 1969; Schäfer, 1962), and will fossilize relatively easily. Because of this and the great resemblance in form, we suppose to be dealing with remains of rather small crustaceans.

The letters RGM which preceed the registration-numbers in the following part mean that the material is stored in the Rijksmuseum van Geologie en Mineralogie, Leiden, The Netherlands.

SYSTEMATIC DESCRIPTIONS

Genus *Pseudofurnishius* van den Boogaard, 1966

1966 *Pseudofurnishius* n. gen. – van den Boogaard, p. 695.

Type species by original designation *Pseudofurnishius murcianus* van den Boogaard, 1966.

Remarks – Since the description of the genus, about 2 000 additional specimens have been found in samples collected in southern Spain by students of the University of Amsterdam. Huddle (1970) describes a fauna of about one hundred specimens, found in Israel, which contains forms of *Pseudofurnishius* showing an inner as well as an outer platform (Huddle, p. B129, fig. 2, m). We have found the same form in our samples Ka 153/67, Ka 39G/71 and Ka 39J/71. In these samples, all mature specimens do have a denticulated platform at the inner side and a denticulated platform or a relatively broad denticulated ledge at the outer side. In all other faunas, which were obtained from stratigraphically younger samples, not all forms of *Pseudofurnishius* have denticles at the outer side. In fact, only about 39% of the dextral specimens and about 7% of the sinistral specimens do have a narrow denticulated ledge at the outer side (see Fig. 7). The dextral and sinistral elements of the species apparently do not show a full mirror-image symmetry. We could not prove the existence or nonexistence of such a difference between dextral and sinistral forms in the biplatform specimens, because of the relatively small number available to the authors.

In the stratigraphically older faunas all mature specimens, dextral as well as sinistral, are of the biplatform type (generally two or more denticles on a platform or broad ledge at the outher side), whereas in the younger faunas the mature specimens often do not have denticles at the outer side or, if they have, generally not more than two denticles are present on a narrow ledge. These facts suggest that we are dealing with two species of *Pseudofurnishius*. The monoplatform type is the form originally described as *P. murcianus*. For the biplatform type we have chosen the name *Pseudofurnishius huddlei*. *P. murcianus* appears to have developed from *P. huddlei* by reduction of the number of denticles at the outer side, especially in the sinistral specimens.

Pseudofurnishius huddlei sp. nov.
Plate 1, fig. a, Plate 2, figs c, d, i.

E.P. 1970 *Pseudofurnishius murcianus* Boogaard – Huddle, p. B129, B130, fig. 2,m (non figs 2,i,j,k,l,n,o).

Derivation of name – the species is named in honour of Dr John W. Huddle.
Holotype – RGM 172 620, the specimen illustrated on Pl. 2, fig. i.
Type locality – Sierra de Carrascoy, Province of Murcia (Area A of Fig. 1).
Type stratum – Palas member of Fuente Aledo formation, 11-30 m above the base, sample number Ka 39G/71.

Diagnosis – a species of *Pseudofurnishius* with a platform on both sides of the posterior half of the blade.

number of denticles of the blade	sinistral specimens					dextral specimens				
	4	3	2	1	0	0	1	2	3	4
13						1	2			
12					1	1				
11		1	2		4	3	5		1	
10		1		5	22	26	11	8	3	1
9	1		1	3	66	64	40	17	2	1
8		2	1	5	122	87	44	8	3	
7			1	1	73	56	18	3		
6					27	29	5			
5					9	4	1			
4										

number of denticles at the outer side

Fig. 7. This diagram shows the numbers of complete sinistral and dextral specimens arranged according to the numbers of denticles of the blade and those at the outer side. All samples mentioned in Table 6 (this paper) and table 1 (van den Boogaard, 1966) have been used to construct this diagram.

If we restrict ourselves to the presence or absence of denticles at the outer side it becomes clear that no full mirror-image symmetry is present. The percentages of the totals of specimens with or without denticles at the outer side are respectively for sinistral specimens 6.9 and 93.1 and for dextral specimens 39 and 61.

Description – conodonts with an inner and outer platform which extend from about midlength of the blade towards the posterior tip which generally is not reached. Full-grown specimens may have some denticles in front of the platforms. Inner as well as outer platforms are variable in shape. This phenomenon is caused by the fact that they grow by addition of denticles in a somewhat irregular pattern. The specimens are therefore often asymmetrical. The outer platform may even be wider than the inner one (see Pl. 1, fig. a, Pl. 2, fig. i). The number of denticles on the inner platform more or less equals that of the outer platform (see Fig. 8B). The denticles of the blade are slightly laterally compressed and fused throughout half of their length. The posteriormost denticles of the blade stand upright or are somewhat inclined posteriorly. The other denticles are from the posterior end onwards successively more proclinate. The anteriormost denticle generally grows horizontally or may even point downwards. The blade is straight or very slightly curved inwards.

Remarks – *Pseudofurnishius huddlei* sp. nov. differs from *P. murcianus* in the fact that dextral as well as sinistral specimens have an outer platform, or at least a rather wide outer ledge, with two or more denticles. *P. huddlei* has a straighter blade and generally fewer denticles on its inner platform than *P. murcianus* (see Fig. 8), moreover the aboral side is somewhat more symmetrical.

Range – uncertain. *P. huddlei* occurs in Spain in the Ladinian, in Israel together with *P. murcianus* in the limestone-gypsum member of Sa'haronim Formation (Carnian?) (Huddle, 1970).

Material – figured specimens RGM 172 620 (holotype), RGM 172 698/1, RGM 172 698/2, RGM 172/700; further material RGM 172 617, 172 618 and 172-619.

A. Pseudofurnishius murcianus

number of denticles at the inner side \ number of denticles at the outer side	0	1	2	3	4	5	6	7
12	1							
11			1	1				
10	2	3		1				
9	9	3	4	2				
8	30	12	3	2	1			
7	48	15	8	3	2			
6	98	29	12	4	1			
5	150	37	11	1				
4	119	35	3					
3	84	10						
2	32							
1	19							

B. Pseudofurnishius huddlei

number of denticles at the inner side \ number of denticles at the outer side	0	1	2	3	4	5	6	7
6								1
5					1		1	
4			4	2	1			
3		1	1	6	2			
2		1	1					
1								

Fig. 8. These diagrams show the numbers of specimens of *Pseudofurnishius murcianus* and *P. huddlei* sp. nov. arranged according to the numbers of denticles at the inner side and those at the outer side. A. Data from the same samples used for the construction of Fig. 7. B. Data from the samples Ka 153/67, Ka 39G/71 and Ka 39J/71.

Note – after the scanning electron photographs were taken the specimens 172 698/1 (originally designated as holotype) and 172 698/2 were lost during transport. Therefore, a new specimen had to be designated as holotype. Since the faunas are rather small, we had little choice left. The specimen now designated as holotype has a platform like the original one but, unfortunately, the blade is broken off. To prevent accidents with this specimen during or after scanning and also considering the warnings given by Jenkins and Orr (1972) the holotype was pictured by light photography.

Pseudofurnishius murcianus van den Boogaard, 1966
Plate 1, figs b, d-f; Plate 2, figs f, g, k, l.

1956 *Spathognathodus* ? sp. – Diebel, p. 432-433, pl. 4, figs 6-7.
1966 *Pseudofurnishius murcianus* n. sp. – van den Bogaard, p. 696-697, pl. 1, figs 6-8; pl. 2, figs 1-5.
E.P. 1970 *Pseudofurnishius murcianus* Boogaard – Huddle, p. B129-B130, fig. 2, i,j,k,l,n,o (non fig. 2,m = *Pseudofurnishius huddlei* sp.n.).

Remarks – Huddle (1970) states that the size of the platforms is partly dependent on the growth stage, which was confirmed by the study of 780 complete specimens. When the blade consists of about 5 or 6 denticles the development of the platform at the inner side starts with the growth of one denticle (van den Boogaard, 1966, pl. 2, figs 3,5). From then on, the inner platform continues to grow by addition of denticles as shown in Figures 9 and 10. From these diagrams it appears that the average platform counts about 4 denticles when the blade has reached a number of 7. When the blade possesses about 9 denticles the platform generally has 5 to 6. In very mature specimens, the number of denticles of the platform may be as large as that of the blade or even exceed it (see Fig. 9). From the moment the blade has got about five denticles the development of blade and inner platform runs more or less parallel, be it not very regularly. Figures 9 and 10 also

sinistral specimens

number of denticles of the blade	12	11	10	9	8	7	6	5	4	3	2	1	0
14													
13													
12								1					
11				1	2	3							
10			1	1	8	4	6	5	3				
9	1			6	6	11	24	20	2	3			
8				1	6	6	30	51	20	15	1		
7					1	3	5	5	36	20	5		1
6							1	1	5	10	6	4	
5									1	4	2	2	

dextral specimens

number of denticles of the blade	0	1	2	3	4	5	6	7	8	9	10	11	12
14													
13							1	1		1			
12								1					
11				1		1	3		4		2		
10					1	7	16	14	7	2	1	2	
9			1	2	15	44	39	20	7	3	2		
8		1	1	11	37	48	24	10	8	3			
7		1	6	17	34	14	4	1					
6		9	10	9	3	3							
5		2	2	1									

number of denticles at the inner side

Fig. 9. This diagram shows the numbers of complete sinistral and dextral specimens of *Pseudofurnishius murcianus* arranged according to the numbers of denticles of the blade and those on the platform at the inner side. Data from the same samples as used for the construction of Fig. 7 (sample Si 771/67 inclusive).

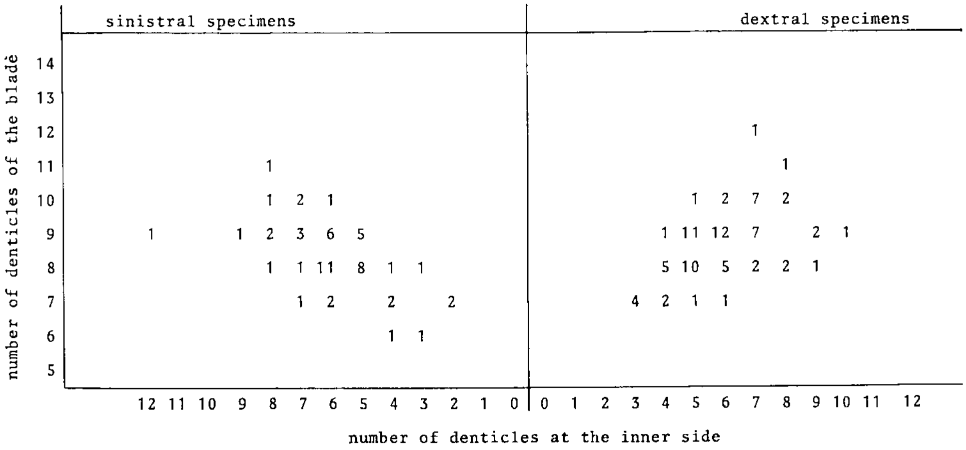

Fig. 10. This diagram shows the numbers of complete sinistral and dextral specimens of *Pseudofurnishius murcianus* arranged according to the numbers of denticles of the blade and those on the platform at the inner side. Data from sample Si 771/67.
Note: comparison of this figure with Fig. 9 shows that there is no difference in distribution pattern between the data obtained from one sample and those from the sum total of all samples with *Pseudofurnishius murcianus*.

show that no difference exists between dextral and sinistral specimens concerning the development of the inner platform. As already stated in the remarks upon the genus a difference between dextral and sinistral specimens does exist in the frequency of the occurrence of denticles at the outer side. Figure 7 shows that, when the blade has reached a growth stage of seven denticles, dextral specimens do have denticles at the outer side about ten times as often as sinistral specimens.

Material – figured specimens RGM 172 694, 172 697, 172 699, 172 702, 172 703; further material: RGM 172 604, 172 610, 172 612, 172 614, 172 615, 172 622, 172 624, 172 635, 172 637, 172 640 - 172-643, 172 645 - 172 657, 172 659 - 172 661, 172 663, 172 667 - 172 672, 172 676, 172 678 - 172 680, 172 684 - 172 687, 172 689 - 172 691, 172 693.

Tardogondolella mungoensis mungoensis (Diebel, 1956)
Pl. 1, fig. c; Pl. 2, figs a-b.

1956 *Polygnathus mungoensis* sp. n. – Diebel, p. 431-432, pl. 1, figs 1-20, pl. 2, figs 1-4, pl. 3, fig. 1, pl. 4, fig. 1.
1968 *Epigondolella mungoensis* (Diebel) – Mosher, p. 936-937, pl. 116, figs 16-19.
1970 *Epigondolella mungoensis* (Diebel) – Huddle, p. B127, figs 2 a-h.
1971 *Tardogondolella mungoensis mungoensis* (Diebel) – Kozur & Mostler, p. 16.

Remarks – the specimens are conspecific with those described by Diebel, Mosher and Huddle. The tendency to form a second posterior lobe as mentioned by Huddle seems to be rather pronounced in our material.

Material – figured specimens RGM 172 695; further material RGM 172 683, 172 688.

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Manuscript received 4 December 1972.

PLATE 1

All figures are scanning electron micrographs.

Pseudofurnishius huddlei sp. nov.

a. oral view of dextral specimen, 170 x. Specimen RGM 172 698/1 from sample Ka 39G/71.

Pseudofurnishius murcianus van den Boogaard,

b. oral view of sinistral specimen, 195 x. Specimen RGM 172 703/1 from sample Si 46/71.

d. oral view of dextral specimen, 165 x. Blade is broken off. Specimen RGM 172 703/2 from sample Si 46/71.

e. aboral view of dextral specimen, 195x. Specimen RGM 172 697 from sample Si 46/71.

f. oral view of dextral specimen, 200x. Specimen RGM 172 702 from sample Si 542a (see van den Boogaard, 1966).

Tardogondolella mungoensis mungoensis (Diebel)

c. oblique view of oral side, 115x. Specimen RGM 172 695/1 from sample Si 42/71.

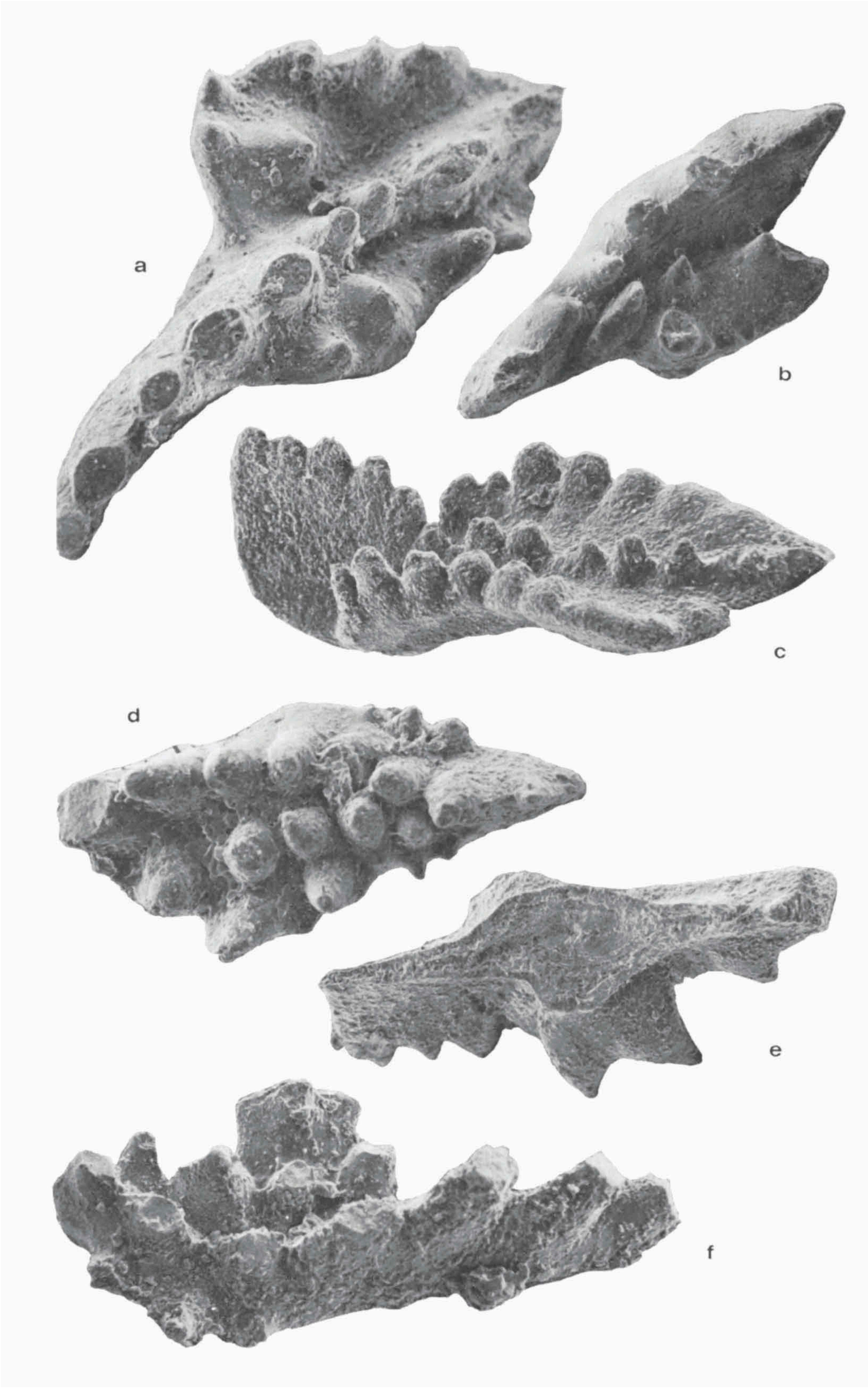

a
b
c
d
e
f

Plate 2

Figures a-d, f, g, k, l are scanning electron micrographs; figures e, h, i, j, are light micrographs.

Tardogondolella mungoensis mungoensis (Diebel),

a. oral view, 80x. Specimen RGM 172 695/2 from sample Si 42/71.

b. oblique view of oral side, 100x. Specimen RGM 172 695/3 from sample Si 42/71.

Pseudofurnishius huddlei sp. nov.

c. oblique view of aboral side, 100x. Specimen RGM 172 700 from sample Ka 39G/71.

d. oral view of sinistral specimen, 130x. Specimen RGM 172 698/2 from sample Ka 39G/71.

i. oral view of dextral specimen, holotype, 90 x Anterior part of blade is broken off. Specimen RGM 172 620 from sample Ka 39G/71.

Pseudofurnishius murcianus van den Boogaard

f. oblique view of inner side of dextral specimen, 115x. Specimen RGM 172 694/1 from sample Si 46/71.

g. oral view of dextral specimen, 140x. Specimen RGM 172 694/2 from sample Si 46/71.

k. oral view of sinistral specimen, 180x. Specimen RGM 172 699 from sample Si 542/65 (see van den Boogaard, 1966).

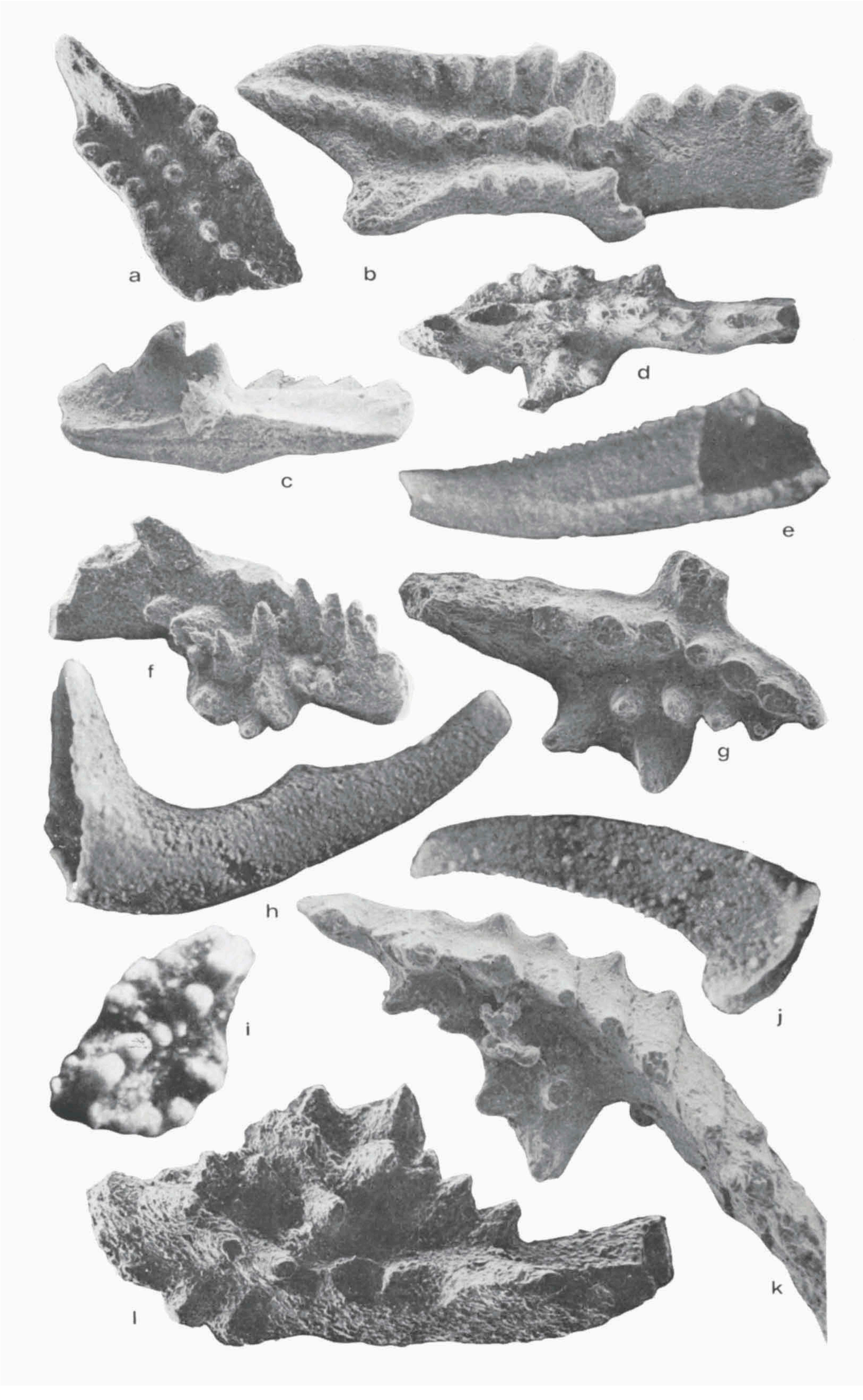
l. oral view of dextral specimen, 200x. Specimen RGM 172 694/3 from sample Si 46/71.

Remains of crustaceans

e. lateral view of broken specimen, 70x. Specimen RGM 172 634 from sample Kp 2.

h. lateral view, 35x. Specimen RGM 172 627 from sample Kp 2.

j. lateral view, 60x. Specimen RGM 172 630 from sample Kp 2.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Errata slip for Scripta Geologica 16, *Pseudofurnishius* (Conodonta) in the Triassic of the Betic Cordilleras, SE Spain. M. van den Boogaard and O. J. Simon.

page 14, 13 lines from top:

'*Type stratum* – Palas member of Fuente Aledo formation, 11-30 m above the base, sample' should read '*Type stratum* – Palas member of Fuente Aledo formation, 11,30 m above the base, sample'.

page 18:

Kozur, H., W. Kampschuur & O. J. Simon, in preparation. Contribution to the ostracode- of the Betic Zone (southern Spain.) – Rev. Española Micropaleontologia, Núm. should read

Kozur, H. & O. J. Simon, 1972. Contribution to the Triassic microfauna and stratigraphy of the Betic Zone (southern Spain). – Rev. Española Micropaleontologia, Núm.