ISSN (print): 1698-6180. ISSN (online): 1886-7995
www.ucm.es/info/estratig/journal.htm

Journal of Iberian Geology 33 (2) 2007: 163-172

Journal of Iberian Geology
AN INTERNATIONAL PUBLICATION OF EARTH SCIENCES

Sephardiellinae, a new Middle Triassic conodont subfamily

Sephardiellinae, una nueva subfamilia de conodontos del Triásico Medio

P. Plasencia[1], F. Hirsch[2], A. Márquez- Aliaga[1]

[1]Instituto Cavanilles de Biodiversidad y Biología Evolutiva and Departamento de Geología.
Universidad de Valencia, Dr. Moliner 50, 46100 Burjassot, Spain.
Pablo.Plasencia@uv.es, Ana.Marquez@uv.es
[2]Naruto University of Education, Naruto, Tokushima, Japan.
francis-hirsch@mrj.biglobe.ne.jp

Received: 26/02/06 / Accepted: 09/10/06

Abstract

Sephardiellinae (nov. subfam.) encompasses a Middle Triassic Gondolleloid lineage that originated in the Sephardic realm, westernmost shallow Neotethys, from where, in the course of the Ladinian and earliest Carnian, some of its species spread to the world oceans, before extinction as a result of the Carnian salinity crisis. It is composed of two genera, *Sephardiella* and *Pseudofurnishius.* Differential criteria in its septimembrate apparatus are the basal cavity structure of P1 element and morphological variations in the P2 and S3 elements.

Keywords: Conodonts, Middle Triassic, Sephardiellinae, Sephardic Realm, Neotethys.

Resumen

La nueva subfamilia Sephardiellinae está comprendida dentro del linaje de Gondolellidae del Triásico Medio y se originó en el Dominio Sefardí, la parte más occidental del Neotetis. Durante el Ladiniense-Carniense Inferior, algunas de sus especies irradian y se distribuyen por todos los océanos. Su extinción está relacionada con la crisis de salinidad que tuvo lugar en el Carniense. La nueva subfamilia está constituida por dos géneros, Sephardiella y Pseudofurnishius las diferencias morfológicas de su aparato septimembrado, como son la estructura de la cavidad basal del elemento P1 y las variaciones morfológicas de los elementos P2 y S3, constituyen el criterio utilizado.

Palabras clave: Conodontos, Triásico Medio, Sephardiellinae, Dominio Sefardí, Neotetis.

1. Introduction

Lindström (1970) established the Triassic family Gondolellidae with a septimembrate apparatus, while Sweet, in Clark *et al.* (1981) established the seximembrate Xaniognathidae, annotated Pa, Pb, M, Sa, Sb, Sc elements. Hirsch (1981), after adding the missing P element in the later, discarded it as a family and distinguished two different stocks in Gondolellidae: a “xaniognathid-neogondolellid stock”, which included encompassing the genera *Neospathodus, Neogondolella, Pseudofurnishius, Carinella* and *Epigondolella,* and a “xaniognathid- gladigondolellid stock" for the apparatus genus *Gladigondolella*, making both septimembrate apparatuses. Hirsch (1994) subsequently has subdivided Gondolellidae in the subfamilies Neogondolellinae and Gladigondolellinae, and included *Pseudofurnishius* and *Sephardiella* genus in Neogondolellinae. In this work we propose the new subfamily Sephardillinae, encompassing this two genera and this will be based in the reconstruction of their apparatus.

Dealing with the reconstruction of multi-elements and clusters of *Pseudofurnishius* and *Sephardiella*, Ramovs (1977), Mietto (1982), Bagnoli *et al*. (1985) and Dzik (1991) created notations based on the form-taxonomic names for the elements of their apparatuses, described as pentamembrate or septimembrate types. Orchard and Rieber (1999), reassembled several loose form-taxonomic fragments into new multi-element units and set the base for the octomembrate apparatus of most subfamilies established by Orchard (2005) in Gondolelloidea. The question remains whether the reassignments of form-taxonomic fragments within the elements of an octomembrate apparatus are all justified. Related with *Pseudofurnishius,* Orchard (2005, p. 92-93) states that Ramovs (1977) has not differentiated any S_2 element and that his "Chi" element almost certainly represents a distal hindeodellid fragment (S_3-S_4), similar to element "Hi" in Ramovs' stunning good material to justify a octomembrate apparatus in this genus. It can be said that the "de-jure" form-taxonomy, enables identification of the elements of the apparatus in the "de-facto" multi-element taxonomy; in other words, the correlation of apparatus elements to their original form-taxonomic name enables to keep track within the different multi-element notations proposed by authors (Fig. 1).

To propose Sephardiellinae we have studied the materials described by several authors from Jordan, Italy (Sicily), Israel and Spain, doing a re-interpretation of the observations carried out by Benjamini and Chepstow-Lusty (1986), Gullo and Kozur (1989, 1991), Sadeddin (1990), Sadeddin and Kozur (1992), March (1991), Hirsch (1966, 1994) and Márquez-Aliaga *et al*. (1996). On the other hand, we have studied new material from different outcrops, sited in Spain in the Catalonian Coastal Range (Colldejou and Benifallet-Rasquera) (Calvet and Marzo, 1994), the Iberian Range (Calanda, Libros and Henarejos) (López-Gómez *et al*., 1987; Márquez-Aliaga *et al*., 1989; Márquez-Aliaga *et al.* 1994), and the Betic Range (Espejeras and Cabo Cope) (López-Gómez *et al*., 1994; Pérez-López *et al*., 2003) (Fig. 2a) and of Israel, Negev (Makhtesh Ramon) (Benjamini and Chepstow-Lusty, 1986) (Fig. 2b).

2. Systematic Paleontology Discussion

The Spanish material is hosted in the "Museu de Geologia de la Universitat de Valencia", sited in the Department of Geology. The Israeli material is hosted in the Department of Earth Sciences, Ben Gurion University of the Negev, Beersheba, Israel. We follow the element notation proposed by Purnell *et al.* (2000).

Order OZARKODINIDA Dzik, 1976
Superfamily Gondolellacea (Lindström, 1970)
Family Gondolellidae (Lindström, 1970)

Sephardiellinae nov. subfam.

Synonymy: Pseudofurnishiidae Ramovs 1977
Novispathodinae Orchard 2005 *pro parte*

Type genus: *Sephardiella* March, Budurov, Hirsch and Márquez-Aliaga (1988) **(**=*Budurovignathus* Kozur, 1988)

FORM-TAXON	Hirsch (1994)	Orchard & Rieber (1999) *	Orchard (2005) **	Ramovs (1977)	Dzik (1991)
Platform-element	**P**	**Pa**	**P_1**	**P**	**sp**
Ozarkodina tortilis	**Pa**	**Pb**	**P_2**	**Po** (pollognathiform)	**oz**
Enanthiognathus ziegleri	**Pb**	**Sb_1**	**S_1**	**En** (enantiognathiform)	**lo**
Roundya magnidentata	**M**	**Sa**	**So** (hibbardellid)	**Hib** (hibbardelliform)	**tr**
Prioniodina muelleri	**Sa**	**M**	**M**	**Pr** (prioniodiniform)	**ne**
Lonchodina latidentata	**Sb**	**Sc_2**	**S_4** (hindeodellid)		
Hindeodella triassica	**Sc**			**Hi** (hindeodelliform)	**hi**
Metalonchodina ?		**Sb_2**	**S_2**		**pl**
Chirodella sp. indet.				**Chi**	
Diplododella sp.indet.		**Sc1**	**S_3** (hindeodellid)		

Fig. 1.- Element notations used for the apparatuses of Gondolellidae: * after Von Bitter and Merrill (1998) ** after Purnell *et al*. (2000).
Fig. 1.- Denominación de los elementos utilizada para el aparato de Gondolellidae: *según Von Bitter y Merrill (1998); **según Purnell *et al.* (2000).

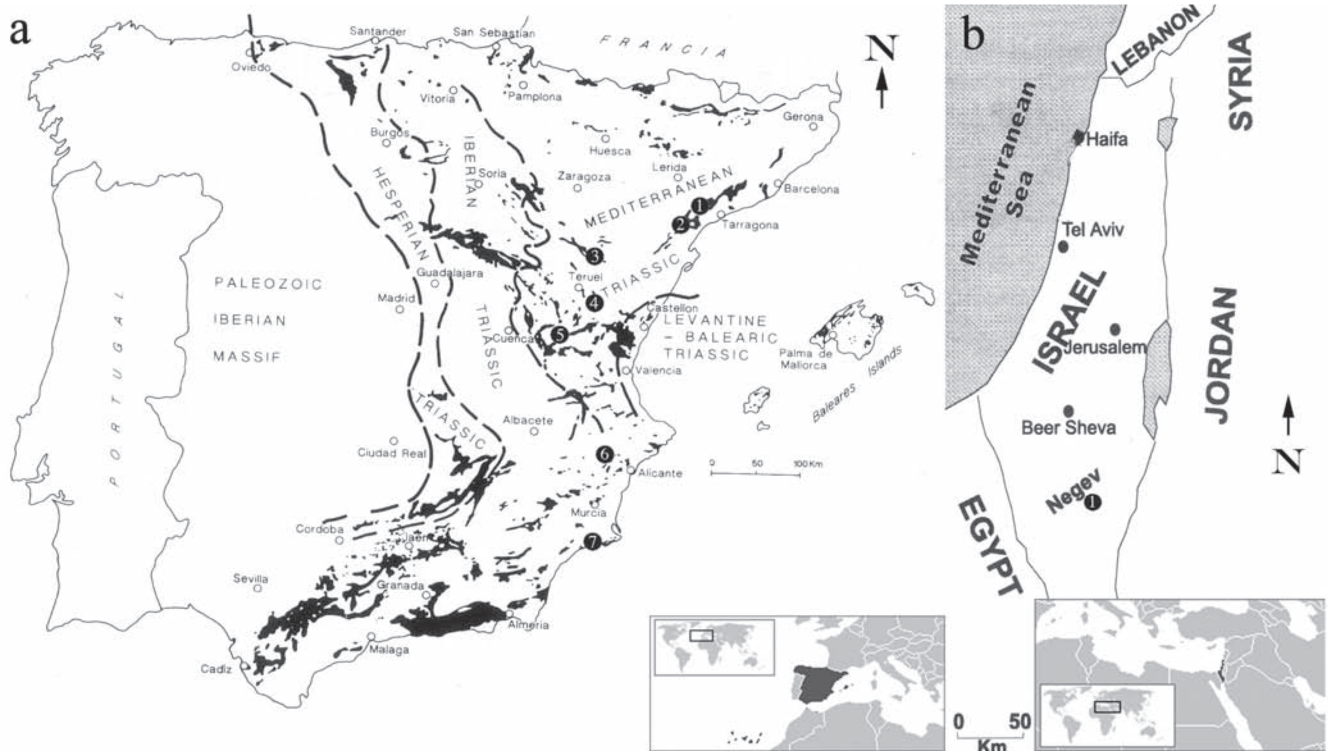

Fig. 2.- a) Iberian Peninsula outcrops situation: 1.- Colldejou; 2.- Benifallet-Rasquera; 3.- Calanda; 4.- Libros; 5- Henarejos; 6-. Espejeras; 7-. Cabo Cope. Modified from López-Gómez *et al.* (2000). b) Israel outcrop situation: 1.- Negev. Modified from Benjamini *et al.* (2005).

Fig. 2.- a) Situación de las secciones en la Península Ibérica: 1.- Colldejou; 2.- Benifallet-Rasquera; 3.- Calanda; 4.- Libros; 5- Henarejos; 6-. Espejeras; 7-. Cabo Cope. Modificado de López-Gómez *et al.* (2000). b) Situación de la sección en Israel: 1.- Negev. Modificado de Benjamín *et al.* (2005).

Derivation of the name: after the Sephardic realm (Hirsch, 1972).

Diagnose: Differential criteria of the sephardiellin septimembrate apparatus are the structure of the basal cavity in the P_1 element, the variable morphology of the P_2 (ozarkodiniform) element, and the simple S_3 (hindeodellid) element, devoid of a diplodellid bifid anterior process.

Description: Septimembrate apparatus composed of a pair of P_1, P_2, M, S_1, S_2 and S_3 elements, and a single S_0 element. The P_1 element develops several kinds of platforms in the course of its phylogeny; amygdaloid basal cavity, with tendency of the basal pit to shift towards the posterior end of the unit in the course of advanced phylogeny; early platform naked, but ornamented by several kinds of denticles, that accuse the generic differences between *Pseudofurnishius* and *Sephardiella*. P_2 element is ozarkodiniform, with "pollognathid" variations in *Pseudofurnishius;* S_3 element is devoid of diplodellid bifid anterior process.

Lineage: The earliest taxon of this subfamily known is *Neospathodus shagami* Benjamini and Chepstow-Lust (1986), which was originally described from the *Gevanites inflatus* beds that crosses the Illyrian - Fassanian boundary in Makhtesh Ramon (Israel) and in a correspondent level [Ab8] at Wadi Naur (Jordan). Its first biochronological appearance is, however, mentioned in an early Upper Anisian (Pelsonian) *Trigonodus* bed [TJ17] at Wadi Siyala, Jordan (Sadeddin, 1990; Sadeddin and Kozur, 1992). The P_1 element of this taxon shows a typical sephardiellin basal cavity, and the slight curvature of the unit shows affinity to that of *Pseudofurnishius,* justifying eventually our new assignment to that genus (Fig. 3). Junior synonyms of *P. shagami* include *Pseudofurnishius siyalaensis* Sadeddin and Kozur (1992) (which appears together with *P. shagami* in Wadi Siyala) and the slightly different morphotype *Pseudofurnishius priscus* Sadeddin (1990). *Pseudofurnishius shagami* strongly resembles *Pseudofurnishius sosioensis* Gullo and Kozur (1989) and may possibly directly precede the earliest Fassanian (Ladinian) *Pseudofurnishius murcianus* Boogaard (1966), in the section of Ramon (Israel). In the sierra de Carrascoy (Murcia, Southern Spain), type locality of *P. murcianus*, this taxon is preceded by *Pseudofurnishius huddlei* Boogaard & Simon (1973), a taxon that may represent the transition between *P. shagami* and *P. murcianus*. The linage of *Pseudofurnishius* ranges from Upper Anisian to Early Carnian.

In strata of similar age of *P. huddlei* (Fassanian) in Northern Spain, Sardinia and Provence (Southern France), *Sephardiella truempyi* (Hirsch, 1971) occurs, this is the earliest taxon of the genus *Sephardiella*. The lineage of *Sephardiella* also includes, *Sephardiella mungoensis* (Diebel, 1956), *Sephardiella hungarica* (Kozur and Vegh, 1972), *Sephardiella japonica* (Hayashi, 1968) and *Sephardiella diebeli* (Kozur and Mostler, 1970), ranging from Early Ladinian to Early Carnian.

All these forms, originally described either as *Neospathodus, Pseudofurnishius*, *Polygnathus, Gondolella, Metapolygnathus, Epigondolella, Tardogondonella, Carinella, Sephardiella* and *Budurovignathus*, belong into the new subfamily Sephardiellinae. All species of the lineage display an almost identical amygdaloid basal cavity in P_1 element. During ontogeny, more advanced forms of *Sephardiella mungoensis* (Diebel, 1956) may display an inclination that suggests a tendency towards the formation of a bifid posterior end of the basal cavity.

Discussion: According to Orchard (2005), Novispathodinae developed from Neogondolellinae through loss of bifurcation in the S_4 and growth of the anterior edge of S_2, while S_3 is non-bifid. However, it is necessary to consider the fundamental differences of the P_1 and P_2 elements in Early Triassic and Early Anisian forms of this subfamily. Therefore Sephardiellinae (n. subfam.) is erected to distinguish a group of Late Anisian to earliest Carnian forms that share very particular features of the P_1 element, while their P_2 element is clearly distinct from other Novispathodinae taxa. The inclusion of *Mosherella newspasensis* (Mosher, 1968) as a taxon apparently derived from *Pseudofurnishius*, is, at this stage, not sufficiently substantiated.

Genus ***Pseudofurnishius*** Van den Boogaard, 1966
Figure 4

Type Species**:** *Pseudofurnishius murcianus* Van den Boogaard, 1966.

The genus *Pseudofurnishius* was established by Boogaard (1966), and its apparatus has subsequently been well described by Ramovs (1977). Benjamini and Cheptow-Lusty (1986) have also illustrated elements of the apparatus of *P. shagami* in which the element P_1, S_3 (hindeodelliform) and S_2/M (cypridodelliform) elements can be identified. March (1991) described for *Pseudofurnishius murcianus* an apparatus composition that we re-interpreted in this work as follows: P_1 element, P_2

Fig. 3.- P_1 elements from *Pseudofurnishius shagami* (Benjamini and Chepstow-Lusty). Bar = 50 μ. 1.- Right element, inner view. Sh01c. 2.- Right element, inner view. Sh02c; 3.- Right element, aboral view. Sh01a; 4.- Right element, aboral view. Sh03c. Har Gevanim section, Saharonim formation, Negev, Israel (Anisian – Ladinian)

Fig. 3.- Elementos P_1 de *Pseudofurnishius shagami* (Benjamini & Chepstow-Lusty). Barra = 50 μ. 1.- Elemento derecho, vista interna. Sh01c; 2.- Elemento derecho, vista interna. Sh02c; 3.- Elemento derecho, vista inferior. Sh01c; 4.- Elemento derecho, vista inferior. Sh03c. Sección Har Gevanim, formación Saharonim, Negev, Israel (Anisiense – Ladininese).

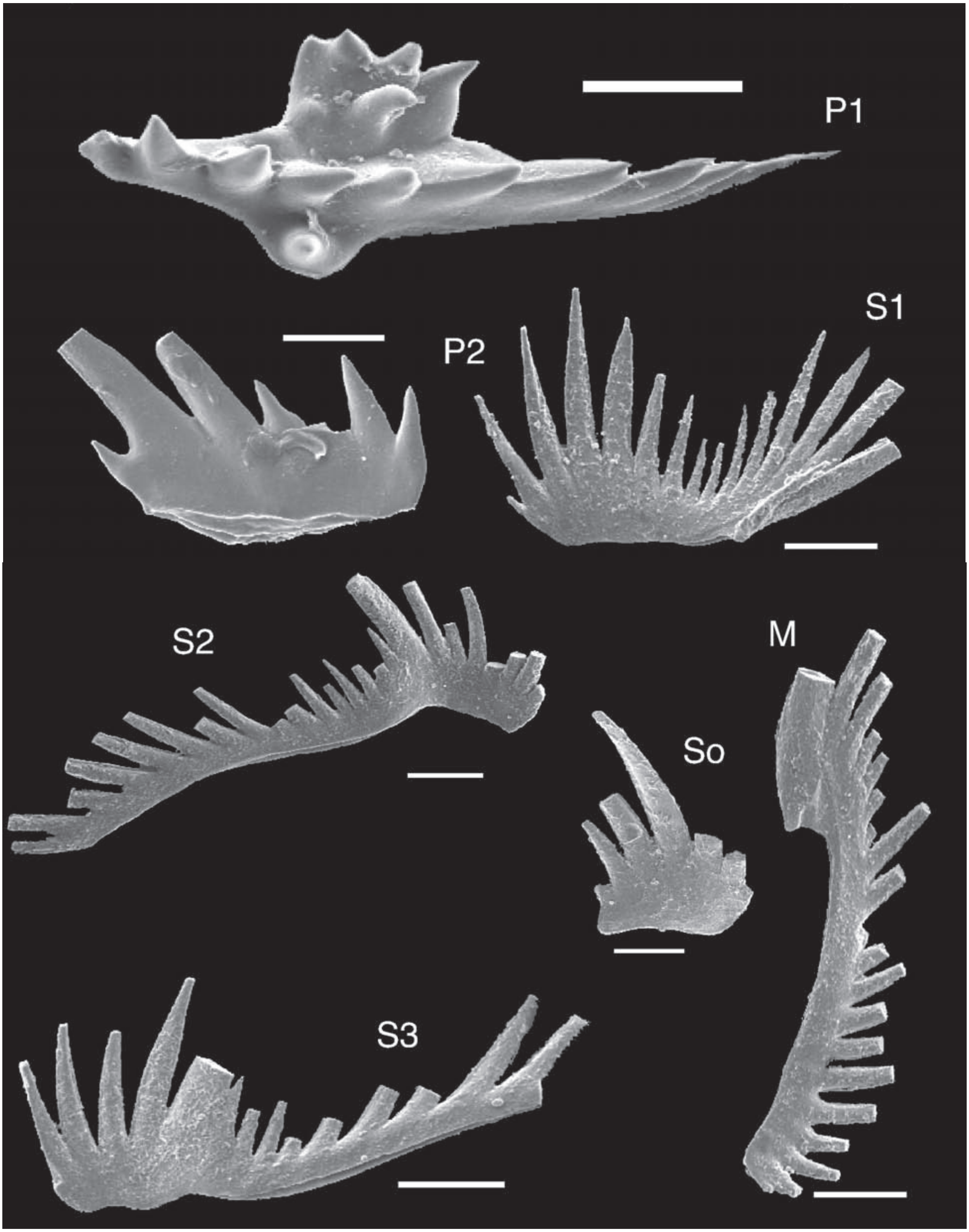

Fig. 4.- Apparatus of *Pseudofurnishius murcianus* (van den Boogaard). Bar = 50 µ. P_1. Right element, upper view. CLD2703, Calanda; P_2. Left Element, inner view. HE1802P2, Henarejos; S_0. Left element, inner view. LI801, Libros; S_1. Left element, inner view. ESP3104S, Espejeras; S_2. Left element, inner view. ESP3102S; S_3. Right element, inner view. ESP3106S, Espejeras; M. Right element, inner view. ESP3105S, Espejeras. Ladinian.

Fig. 4.- Aparato de *Pseudofurnishius murcianus* (van den Boogaard). Barra = 50 µ. P_1. Elemento derecho, vista superior. CLD2703, Calanda; P_2. Elemento izquierdo, vista interior. HE1802P2, Henarejos; S_0. Elemento izquierdo, vista interior. LIE801, Libros; S_1. Elemento izquierdo, vista interior. ESP3104S, Espejeras; S_2. Elemento izquierdo, vista interior. ESP3102S, Espejeras; S_3. Elemento derecho, vista interior. ESP3106S, Espejeras; M. Elemento derecho, vista interior. ESP3105S, Espejeras. Ladiniense.

(*Ozarkodina tortilis),* M *(Prioniodina muelleri),* S_0 *(Diplododella magnidentata),* S_1 *(Enanthiognathus ziegleri),* S_2 (*Prioniodina muelleri* var or *Cypridodella mediocris*) and S_3 *(Hindeodella suevica + Hindeodella triassica + Lonchodina latidentata).* Re-evaluation of March's illustrations and additional element study of new collections allow us to do the following re-assessment of the *Pseudofurnishius* apparatus (Fig. 4).

Range: Upper Anisian – Early Carnian.

Genus ***Sephardiella*** March, Budurov, Hirsch and Márquez-Aliaga, 1988

Figure 5, 6

Type Species: *Sephardiella mungoensis (*Diebel, 1956*)*

Diagnosis: as for *Sephardiella* (March *et al*., 1990) including all stages from juvenile to fully mature development.

Description: The multi-element reconstruction of *S. truempyi* (Hirsch, 1971) has been depicted by Bagnoli *et al.* (1985, Plate 1, p. 314; figure 5), and we considered

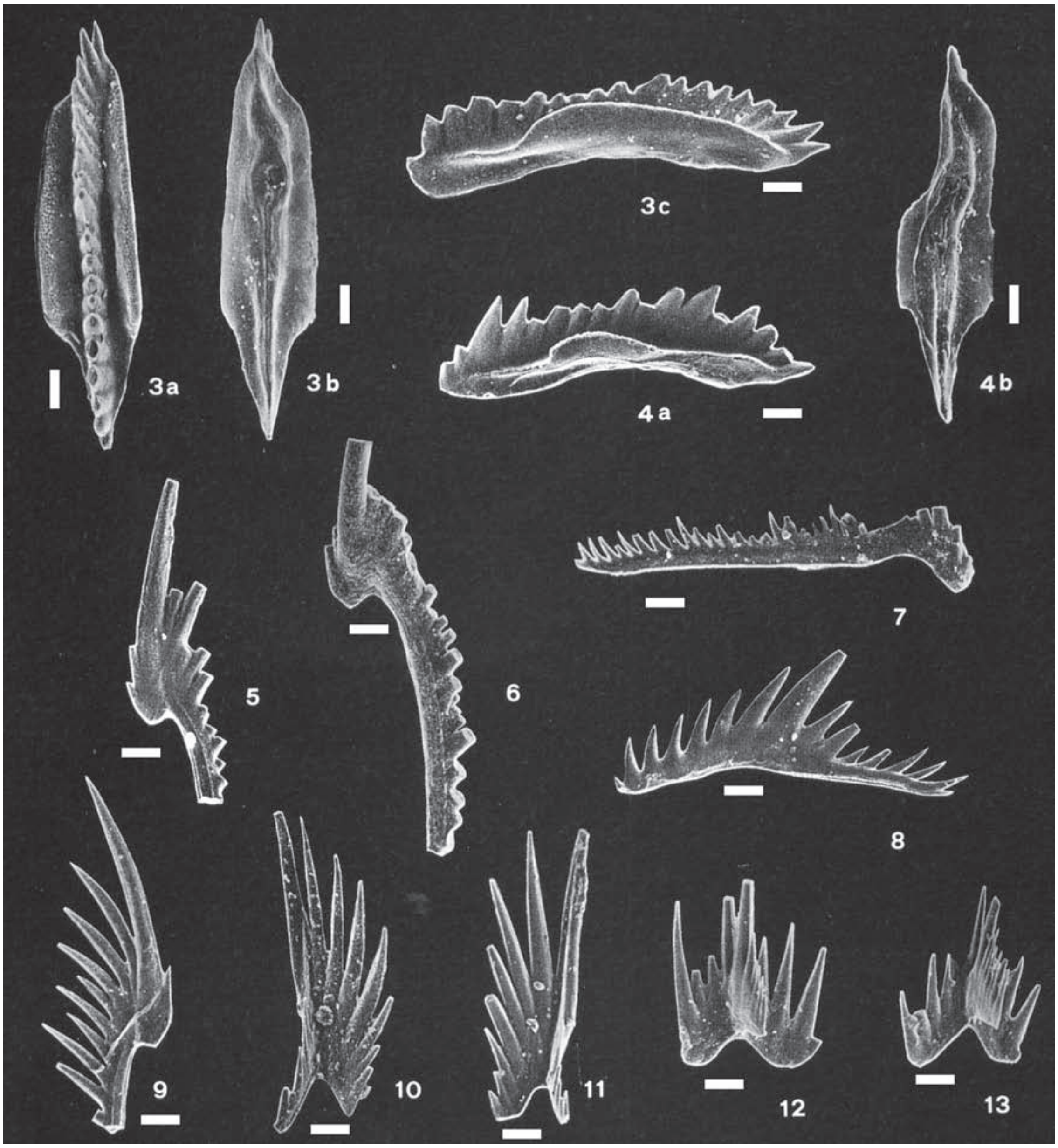

Fig. 5.- Apparatus of *Sephardiella truempyi* (Hirsch) elements, reproduced of Bagnoli *et al*. (1985). Bar = 50 µ. 3a-c, 4a-b: P_1; 5, 6: M (prioniodiniform); 7: S_3-$_4$ (hindeodelliform); 8: P_2 (ozarkodiniform); 9: S_2 (cypridodelliform); 10, 11: S_1 (enantiognathiform); 12, 13: S_0 (diplodelliform).

Fig. 5 -Aparato de *Sephardiella truempyi* (Hirsch) reproducido de Bagnoli *et al*., (1985). Barra = 50 µ. 3a-c, 4a,b: P_1 plataforma; 5, 6: M (prioniodiniforme); 7: S_3-$_4$ (hindeodelliforme); 8: P_2 (ozarkodiniforme); 9 S_2 (cypridodelliforme); 10, 11: S_1 (enantiognathiforme); 12, 13: S_0 (diplodelliforme).

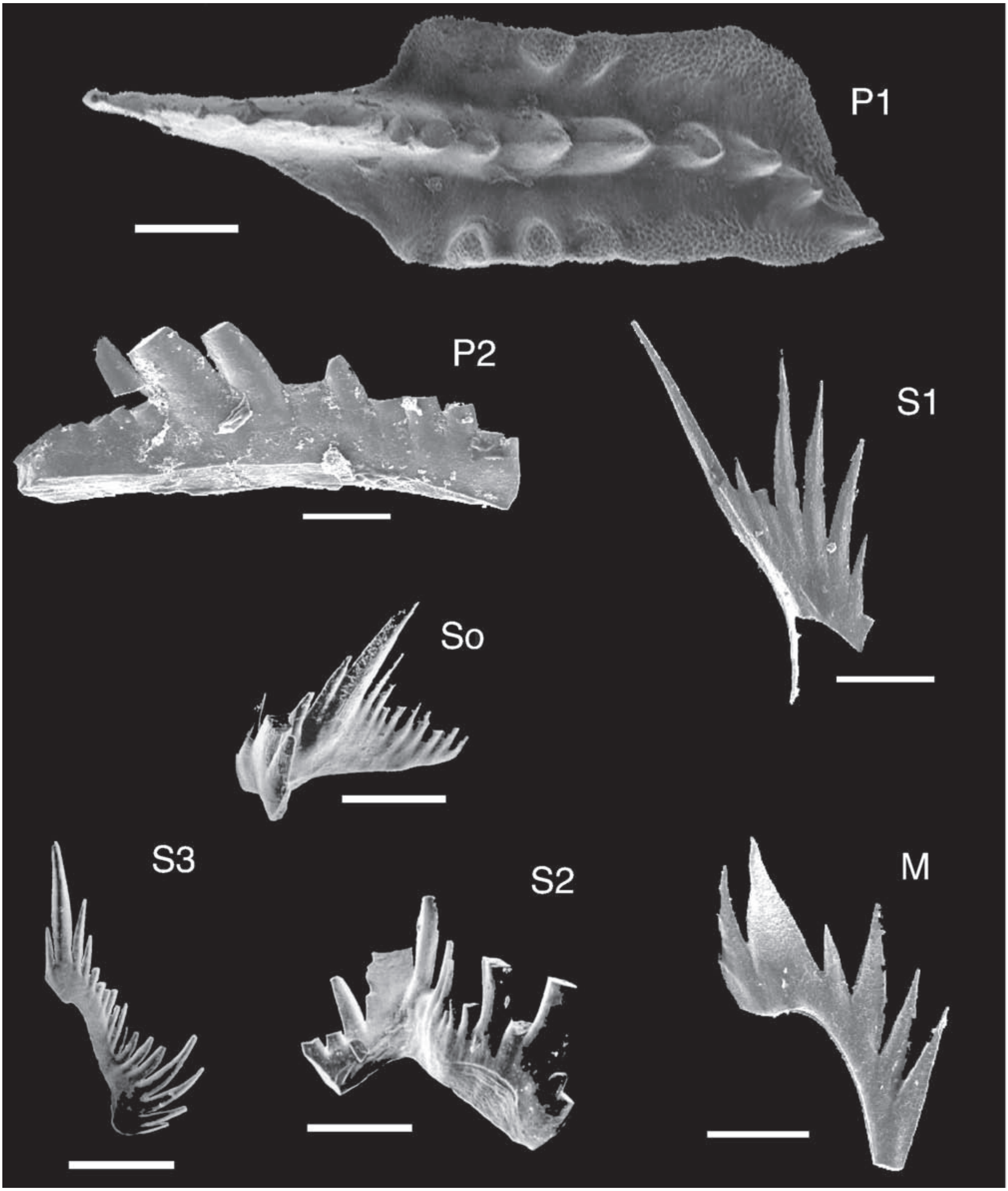

Fig. 6.- Apparatus of *Sephardiella mungoensis* (Diebel). Elements P_1, P_2, S_1, M, bar = 50 μ. Elements S_0, S_2, S_3, reproduced of March (1991), bar = 100 μ. P_1. Left element, upper view. 963401A, Cabo Cope; P_2. Right? element, inner view. CRB104M, Benifallet-Rasquera; S_0. Insolated element, inner view. CCO-13, Colldejou; S_1. Right? element, inner view. CRB101M, Benifallet-Rasquera; S_2. left element, inner view. CCO-13, Colldejou; S_3. Right element, inner view. CCO-13, Colldejou; M. Right element, inner view. CRB103M, Benifallet-Rasquera. Ladinian.

Fig 6. Aparato de *Sephardiella mungoensis* (Diebel). Elementos P_1, P_2, S_1, M, barra = 50 μ. Elementos S_0, S_2, S_3 reproducidas de March (1991), barra = 100 μ. P_1. Elemento izquierdo, vista superior. 963401A, Cabo Cope; P_2. Elemento derecho?, vista interior. CRB104M, Benifallet-Rasquera; S_0. Elemento único, vista interior. CCO-13, Colldejou; S_1. Elemento derecho?, vista interior. CRB101M, Benifallet-Rasquera; S_2. Elemento izquierdo, vista interior, CCO-13, Colldejou; S_3. Elemento derecho, vista interior, Colldejou; M. Elemento derecho, vista interior. CRB103M, Benifallet-Rasquera. Ladiniense.

Bagnoli *et al.* 1985	**Ramovs 1977**
P_1 *"Epigondolella" truempyi*	**P_1** *Pseudofurnishius murcianus*
P_2 (ozarkodiniform)	**P_2 (**pollognathiform)
S_1 (enantiognathiform)	**S_1** (enantiognathiform)
S_0 (diplododelliform)	**S_0** (hibbardelliform)
M (prioniodiniform)	**M** (prioniodiniform)
S_2 (cypridodelliform)	
S_3 (hindeodelliform)	**S_3** (hindeodelliform)

Fig. 7.- Elements identified by Bagnoli *et al.* (1985) as *"Epigondolella" truempyi* and Ramovs (1977) as *Pseudofurnishius murcianus*.
Fig. 7.- Elementos identificados por Bagnoli *et al.* (1985) como *"Epigondolella" truempyi* y Ramovs (1977) como *Pseudofurnishius murcianus*.

this specie as an early taxon of the *Sephardiella* genus. March (1991) has emphasized that the apparatus of *Sephardiella* and *Pseudofurnishius* are widely identical but we have noted differences at the level of the P_2 element (figures 4 and 6). Besides this point, the *Sephardiella* apparatus composition follows the same element position of *Pseudofurnishius.* That could mean strong phylogenetic links that connect *Sephardiella* to *Pseudofurnishius*. One aspect in discussion, however, is that while *Cypridodella* (*Metalonchodina*) *mediocris* Tatge (1956) was included in the variability of *P. muelleri* by Kozur and Mostler (1972), it became restored by Orchard and Rieber (1999) as their element S_2. We cannot currently decide which is correct and we can only express the discrepancy in the table of the elements recognized by Bagnoli *et al*. (1985) and by Ramovs (1977) (Fig. 7).

Range: Early Ladinian to Early Carnian

Remarks: Notwithstanding the oral statement of Dr. Heinz Kozur to Dr. Kyril Budurov and Dr. Francis Hirsch (ECOS V-Meeting, Frankfurt/Main 1988) that he would acknowledge the generic name *Sephardiella,* the name *Budurovignathus* Kozur was maintained in ECOS V Proceedings Volume I (Kozur, 1989) on the base of page priority in the 1988 ECOS V-symposium abstract volume (Kozur, pages 244-245; March *et al.*, page 247) while the ECOS V Proceedings Volume II that contains the contribution of March *et al*. appeared a year later (1990).

However, Sudar (1989) has made clear that *Sephardiella* should be chosen as generic name instead of *Budurovignathus* in accordance with (ICZN) International Code of Zoological Nomenclature (1961), paragraph 24 (a) 'Names published simultaneously'. Although the name published by Kozur (1989) is in accordance with ICZN paragraph 13 (a)(iii), it is in disagreement with ICZN 'Code of Ethics', appendix A, paragraph 3 as well as with the ICZN 'General recommendations', appendix E, paragraph 23. It may also be reminded that ICZN of 1947 (in Keen and Muller, 1948), in case of homonymy, the 'Code of Ethics' states that the proper action, from a standpoint of professional etiquette, is to notify an author of the facts of a case, and to give said author ample opportunity to propose a substitute name.

3. Conclusions

The Triassic radiation of Gondolellacea has followed the ups and downs of global sea-level changes that happened during this time (Hirsch *et al.,* 1987; Hirsch and Márquez-Aliaga, 1988; Hirsch, 1994). From Early Triassic, the step by step rising relative eustatic sea level (Haq *et al*., 1987) resulted in the appearance of new environmental niches, creating breathing grounds for speciation and radiation of new taxa, and among them, Sephardiellinae (nov. subfam.) species, that range from Late Anisian to Early Carnian when extreme low stand and a substantial salinity crisis brought its extinction.

In Upper Anisian and Early Ladinian, Sephardiellinae is restricted to the Sephardic Realm. During the Ladinian, *Pseudofurnishius* is mono-specifically confined to shallower or slightly hypersaline intervals of the Sephardic realm and the Southern Alps, and *Sephardiella* has a worldwide distribution in more open marine environments (Hirsch *et al.,* 1987; Budurov *et al.,* 1993). Thus, the hypothesis may be advanced that not only their spatial distribution but also the morphological variability within their apparatus may depend of facial conditions, like depth, salinity, trophic resources and possibly variations of the calcium-phosphate levels in the water.

Differential criteria in its septimembrate apparatus, the basal cavity structure of P_1 element and morphological variations in the P_2 and S_3 elements defined the Sephardiellinae (nov. subfam.), which encompass a Middle Triassic Gondolelloid lineage that originated in the Sephardic realm, westernmost shallow Neotethys, from where, in the course of the Ladinian and earliest Carnian, some of its species spread to the world oceans, before extinction as a result of the Carnian salinity crisis.

Acknowledgments

This paper does homage to Professor Carmina Virgili for the outstanding role she has played for half a century in the service of scientific research. Without her discovery of Middle Triassic (early Ladinian) red beds, straightening out the Triassic stratigraphy of the Iberian Peninsula, it would have taken long to unravel the superposition of Anisian and Ladinian carbonate sequences. It is thanks to this pioneering work that one of the authors of this paper was able to correctly sample in stratigraphic sequence the materials in which the first conodonts in the NE part of the Iberian Peninsula were found (Hirsch, 1966).

The authors thank Ali Murat Kiliç (Sivas, Turkey), Prof. Keisuke Ishida (Tokushima, Japan) and José Ignacio Valenzuela-Ríos for discussions on conodont revision as well as Prof. Alberto Pérez-López and Dr. Fernando Pérez-Varela (Granada, Spain) for their help in the field. The project was funded by PROYECTO CGL2005-01520/BTE and represents a contribution to the IGCP 467 and 506.

References

Bagnoli, G., Perri, M. C., Gandin, A. (1985): Ladinian conodont apparatuses from northwestern Sardinia, Italy. *Bollettino della Società Paleontologica Italiana*, 23: 311–323.

Benjamini, C., Chepstow-Lusty, A. (1986): *Neospathodus* and other conodonts from the Saharonim Formation (Anisian-Ladinian) at Makhtesh Ramon, Negev, southern Israel. *Journal of Micropalaeontology*, 5: 67-75.

Benjamini, C., Hirsch, F., Eshet, Y. (2005): The Triassic of Israel. In: J.K. Hall, V.A. Krasheninnikov, F. Hirsch, C. Benjamini, A. Flexer (eds.): *Geological Framework of the Levant Volume II: The Levantine Basin and Israel.* Historical Productions Hall, 331-360.

Boogaard, M. van den (1966): Post-Carboniferous conodonts from south-eastern Spain. *Proceedings of the Koninklijke, Nederlandse Akademie Van Wetenschappen, Series B*. 69 (5): 1–19.

Boogaard, M. van den., Simon, O.J. (1973): *Pseudofurnishius* (Conodonta) in the Triassic of the Betic Cordilleras SE Spain. *Scripta Geologica*, 16: 1-23.

Budurov, K., Calvet, F., Goy, A., Márquez-Aliaga, A., Márquez, L., Trifonova, E., Arche, A. 1993. Middle Triassic Stratigraphy and Correlatión in parts of the Tethys Realm (Bulgaria and Spain). In: *Muschelkalk Schöntaler Symposium 1991.* H. Hagdorm, J. Seilacher (eds.): *Sonderbände der Gesellschaft für Naturkunde in Wüttemberg* 2, Stuttgart, Korb (Goldschneck), 157-164.

Calvet, F., Marzo, M. (1994): El Triásico de las cordilleras costero catalanas: estratigrafía, sedimentología, y análisis secuencial. Guía de Campo. In: A. Arche (ed.): *Resúmenes del III. Coloquio de Estratigrafía y Paleogeografía del Pérmico y Triásico de España, Cuenca*, 1-53.

Clark, D. L., Sweet, W. C., Bergström, S. M., Klapper, G., Austin, R. L., Rhodes, F. H. T., Müller, K. J., Ziegler, W., Lindström, M., Miller, J. F., Harris, A. G. (1981): *Treatise on invertebrate paleontology. Part W Miscellanea, Supplement 2, Conodonta*. Geological Society of America, Boulder, and University of Kansas Press, Lawrence, 202 pp.

Diebel, K. (1956): Conodonten in der Oberkreide von Kamerun. *Geologie*, 5: 424–450.

Dzik, J. (1991): Evolution of oral apparatuses in the conodont chordates. *Acta Palaeontologica Polonica*, 36: 265-323.

Gullo M., Kozur H. (1989): *Pseudofurnishius sosioensis* n.sp. A new conodont species from the Late Ladinian of Sosio Valley, Western Sicily (Italy). *Geologisch-Palaeontologische Mitteilungen Innsbruck*, 16: 207-211.

Gullo M., Kozur H. (1991): Taxonomy, Stratigraphic and Paleogeographic significance of the Late Ladinian – Early Carnian Conodont genus *Pseudofurnishius. Palaeontographica Abteilung A.,* 218: 69-86.

Haq, B.U., Hardenbol, J., Vail, P. R. (1987): Chronology of fluctuating sea levels since the Triassic. *Science,* 235: 1156-1167.

Hayashi, S. (1968): The Permian conodonts in chert of the Adoyama Formation, Ashio Mountains, central Japan. *Earth Science*, 22: 63-77.

Hirsch, F. (1966): Sobre la presencia de conodontos en el Muschelkalk superior de los Catalánides. *Notas y Comunicaciones del Instituto Geológico y Minero de España*, 90: 85-92.

Hirsch, F. (1971): Conodontes nouvelles du Trias mediterraneen. *Compte Rendu des Seances de la Société de Physique et d' Historie Naturelle de Genève*, 6: 65-69.

Hirsch, F. (1972): Middle Triassic conodonts from Israel, southern France and Spain. *Mitteilungen der Gesellschaft der Geologie- und Bergbaustudenten*, 21: 811-828.

Hirsch, F. (1981): Some Late Eo- and Mesotriassic conodont multielements; notes on their taxonomy, phylogeny and distribution. *Archives des Sciences Physiques et Naturelle. Genève,* 34 (2): 201-210.

Hirsch, F. (1994): Triassic conodonts as ecological and eustatic sensors. In: A.F. Embry, B. Beauchamp, D.J. Glass (eds.): *Pangea: global environments and resources. Memoir of the Canadian Society of Petroleum Geologist*s, 17: 949-959.

Hirsch, F., Márquez-Aliaga, A. (1988): Triassic circummediterranean Bivalve facies, cycles and Global sea level changes. In: *Resúmes del II Congreso Geológico de España*. *Paleontología*, 1: 342-344.

Hirsch, F., Márquez-Aliaga, A., Santisteban, C. (1987): Distribución de moluscos y conodontos del Tramo Superior del Muschelkalk en el sector occidental de la Provincia Sefardí. *Cuadernos de Geología Ibérica*, 11: 799-815.

Keen, A. M., Müller, S. W. (1948): *Procedure in Taxonomy*. (Revised Edition of Schenk E.T. and McMasters J.H., 1936). Standford University Press, California. 93 pp.

Kozur, H. (1988): Division of the gondolellid platform conodonts. In: Proceedings of the Fifth European Conodont Symposium, Frankfut, Contributions 1. *Courier Forchungsinstitut Senckenberg*, 102: 244–245.

Kozur, H. (1989): The taxonomy of the gondolellid conodonts in the Permian and Triassic. *Courier Forschungsinstitut Senckenberg*, 117: 409–469.

Kozur, H., Mostler, H. (1970): Neue Conodonten aus der Trias. *Berichte des Naturwissenschaftlich-medizinischen Vereins in Innsbruck*, 58: 429-464.

Kozur, H., Mostler, H. (1972): Die Conodonten der Trias und ihr stratigraphisher Wert: I. Die "Zahnreihen-Conodonten" der Mittel und Obertrias. *Abhandlungen der Geologischen Bundesanstalt*, 28(1): 1-36.

Lindström, M. (1970): A suprageneric taxonomy of the conodonts. *Lethaia*, 3: 427-445.

López-Gómez, J., Arche, A., Calvet, F., Goy, A. (2000): Epicontinental marine carbonate sediments of the Middle and Upper Triassic in the westernmost part of the Tethys Sea, Iberian Peninsula. In: G.H. Bachmann, I. Lerche (eds.): *Epicontinental Triassic*. E. Schweizerbartsche Verlagsbuchhandlung (Nägele u. Obermiller) Stuttgart. *Zentralblatt für Geologie und Paläontologie*, 2 (9-10): 1033-1084.

López-Gómez, J., Márquez-Aliaga, A., Arche, A., Goy, A. (1987): Las facies Muschelkalk de Henarejos (Cuenca): sedimentología y fauna del tramo superior. *Cuadernos de Geología Ibérica*, 11: 665-676.

López-Gómez, J., Márquez-Aliaga, A., Calvet, F., Márquez, L., Arche, A. (1994): Aportaciones a la estratigrafía y paleontología del Triásico Medio de los alrededores de Agost, Alicante. *Boletín de la Real Sociedad española de Historia Natural (Sección Geológica)*, 89 (1-4): 109-120.

March, M. (1991): *Los conodontos del Triásico Medio (Facies Muschelkalk) del Noreste de la Península Ibérica y de Menorca*. Tesis Doctoral, Universitat de València 394 p. (Unpublished).

March, M., Budurov, K., Hirsch, F., Márquez-Aliaga, A. (1988): *Sephardiella* nov. gen.(Conodonta), Emendation of *Carinella* (Budurov, 1973), Ladinian (Middle Triassic). IN: Proceedings of the Fifth European Conodont Symposium, Frankfurt, Contributions 1. *Courier Forchungsinstitut Senckenberg*, 102: 247.

March, M., Budurov, K., Hirsch, F., Márquez-Aliaga, A. (1990): *Sephardiella* nov. gen.(Conodonta), Emendation of *Carinella* (Budurov, 1973), Ladinian (Middle Triassic) Type Area in Catalonia (N.E. Spain), Sephardic Province. *Courier Forchungsinstitut Senckenberg,* 118: 197-201.

Márquez-Aliaga, A., López Gómez, J. (1989): Paleontología y ambientes sedimentarios del Triásico Medio, Muschelkalk, de la cordillera Ibérica I: Cuenca y Valencia, España. *Estudios Geológicos,* 45: 387-398.

Márquez- Aliaga, A., Arche, A., Brito, J.M., Calvet, F., Goy, A., López-Gómez, J., Márquez, L. (1994): El Muschelkalk en el Anticlinal de Calanda (Teruel, España): Estratigrafía y contenido paleontológico. *Boletín de la Real Sociedad española de Historia Natural (Sección Geológica)*, 89 (1-4): 145-166.

Márquez- Aliaga, A., Budurov, K., Martínez, V. (1996): Registro de conodontos del Triásico Medio en un nautiloideo de Espejeras (Alicante, España). *Coloquios de Paleontología*, 48: 76-83.

Mietto, P. (1982): A Ladinian conodont-cluster of *Metapolygnathus mungoensis* (Diebel) from Trento area (NE Italy). *Neues Jahrbuch für Geologie und Palaöntologie, Monatshefte,* 1982: 600-606.

Mosher, L. C. (1968): Triassic conodonts from western North America and Europe and their correlation. *Journal of Paleontology*, 42: 895-946.

Orchard, M. J. (2005): Multielement Conodont apparatuses of Triassic Gondolelloidea. *Special Papers in Paleontology*, 73: 73-101.

Orchard, M. J., Rieber, H. (1999): Multielement *Neogondolella* (Conodonta, Upper Permian–Middle Triassic). In: E. Serpagli (ed.): *Studies on conodonts. Proceedings of the Seventh European Conodont Symposium,* Bologna-Modena, Italy, June 1998. *Bollettino della Società Palaeontologica Italiana*, 37: 475-488.

Pérez-López, A., López-Garrido, A., Márquez-Aliaga, A., Sanz de Galdeano, C., García-Tortosa, F. J. (2003): Ladinian carbonate of the Cabo Cope unit (Betic Cordillera, SE Spain): A Tethys - Malaguide palaeogeographic Gateway. *Facies*, 48:1-8.

Purnell, M. A., Donoghue, P. C. J., Aldridge, R. J. (2000): Orientation and anatomical notation in conodonts. *Journal of Paleontology*, 74: 113–122.

Ramovs, A. (1977): Skelettapparat von *Pseudofurnishius murcianus* (Conodontophorida) im Mitteltrias (NW Jugoslawien). *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen,* 153: 361–399.

Sadeddin, W. (1990): *Pseudofurnishius priscus* n. sp. (condonta) and its stratigraphic significance for the Ladinian (Middle Triassic) in Jordan. *Neues Jahrbuch für Geologie und Paläontologie. Abhandlungen*, 178: 369-382.

Sadeddin, W., Kozur, H. (1992): *Pseudofurnishius siyalaensis* n. sp. (Condonta) from the Lower Ladinian of Wadi Siyala (Jordan). *Neues Jahrbuch für Geologie und Paläontologie. Monatshefte*. 1992: 459-368.

Sudar, M. N. (1989): Revision of conodont genera *Sephardiella* March, Budurov, Hirsch and Marquez-Aliaga, 1988 and *Budurovignathus* Kozur, 1988. *Geologica Balcanica*, 9: 8.

Tatge, U. (1956): Conodonten aus dem germanischen Muschelkalk. *Palaöntologische Zeitschrift*, 30: 108–127, 129–147.

Von Bitter, P. H., Merrill G. K. (1998): Apparatus composition and structure of the Pennsylvanian conodont genus *Gondolella* based on assemblages from the Desmoinesian of northwestern Illinois, U.S.A. *Journal of Paleontology*, 72: 112–132.