A NEW COLOBODONT FISH FROM THE TRIAS OF SPAIN

by

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Summary

Andalusias ewerti a new genus and species of fish, based on teeth from Triassic carbonate rocks of the Betic Cordilleras, southern Spain, is described and its affinities discussed. The stratigraphic position, and associated fauna of the rock samples, are considered.

Introduction

Examination of Triassic rocks from southern Spain for their microfossil content has revealed a wide range of fish remains, details of which are being prepared for publication. A preliminary faunal list is given in Table 1, p. 68. A type of fish teeth, quite common in some samples, is considered to differ sufficiently widely from known genera to be allocated to a new genus, which forms the subject of the present paper. The specimens have been obtained from a number of horizons of carbonate rocks in the provinces of Jaén and Almeria.

Within the Betic Cordilleras, the Alpine Fold-Belt of southern Spain, two major tectonic zones can be distinguished: The External, and Internal or Betic, Zones (text-fig. 1). The former is made up of the Prebetic and Subbetic Zones, consisting of non-metamorphic rocks of Permo-Triassic and younger age. In the Betic Zone, four super-imposed tectonic complexes are recognised, which in ascending order are:

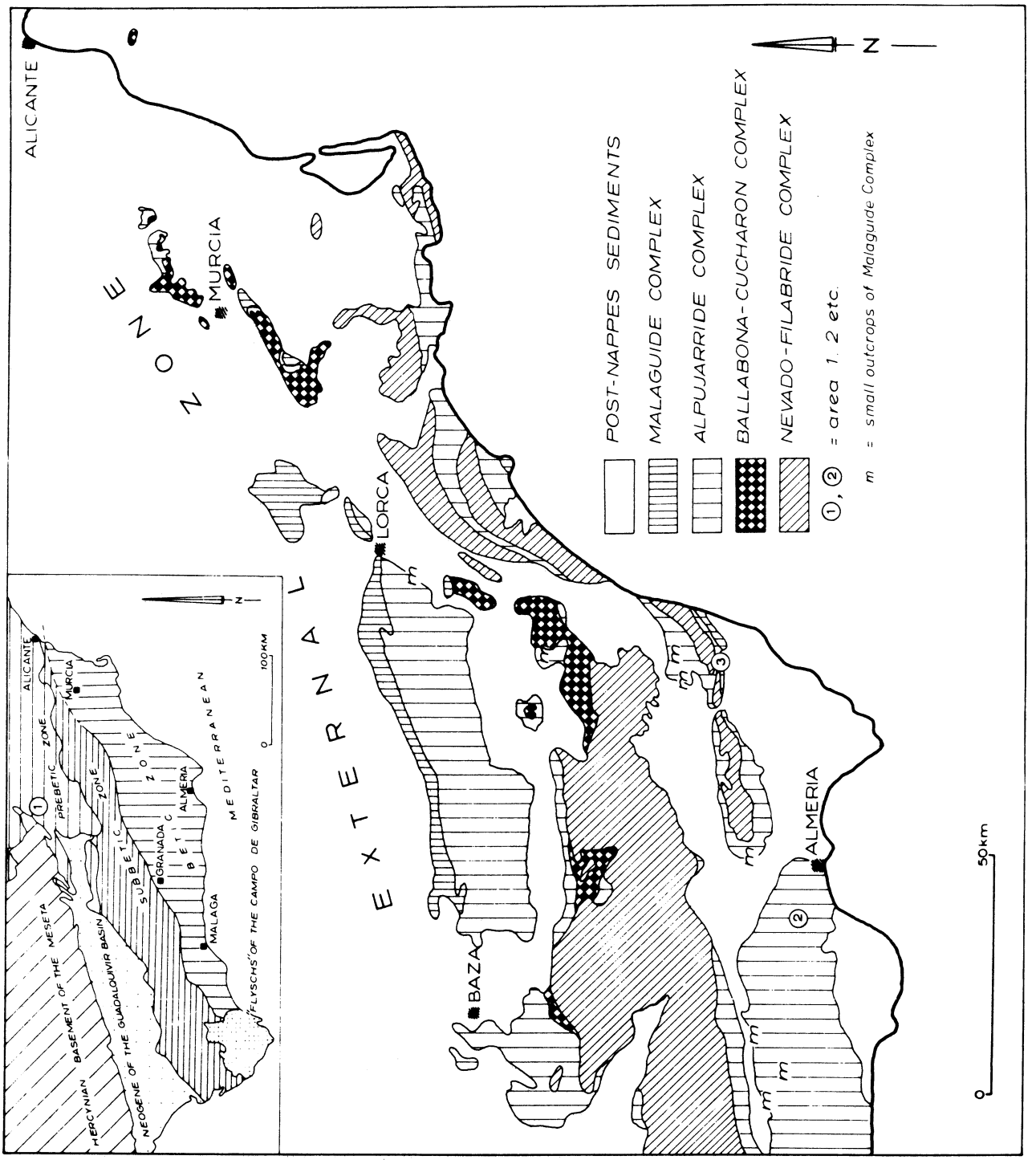
(4) Malaguide Complex
(3) Alpujarride Complex
(2) Ballabona-Cucharón Complex
(1) Nevado-Filabride Complex

after Egeler & Simon, (1969), Egeler & Fontboté, (1976).

The complexes listed above consist mainly of Triassic and older sediments, which generally show the effects of Alpine metamorphism. The Triassic is the only system with representative strata in all four complexes of the Betic Cordilleras. Consequently only Triassic rock sequences can be used for correlation between the various tectonic complexes and therefore are of essential importance for a reconstruction of the palaeogeography of the Betic Realm. Until recently dating was essentially based on lithological criteria and on some well preserved macrofaunas, but in the last few years also with the aid of microfossils. Early results using these fossils have been published by Van den Boogaard (1966), Simon (1966), Kozur & Simon (1972), Van den Boogaard & Simon (1973), Kozur *et al.* (1974) and Simon & Kozur (1977).

All the fish fragments are minute, almost entirely being less than 2 mm in size. The specimens were extracted by dissolving the carbonate rocks in dilute formic acid. This method of preparation along with the original metamorphism of the specimens from the Betic Zone (EW 76/007, Si 71/042 and 24-42/Ka/292), have combined to affect their state of preservation. Instead of the usual black and brownish colours of the phosphatic remains, they are nearly all white or yellowish-brown. Many are very fragile and appear to have a granular or corroded surface. Specimens from the External Zone (Si 77/016), which have not been metamorphosed, are better preserved.

Mercian Geol. Vol. 7, No. 1. 1979
pp. 65-74, 3 text-figs., Plate 11.



Text-fig. 1 - Tectonic sketch-map of the Betic Cordilleras.

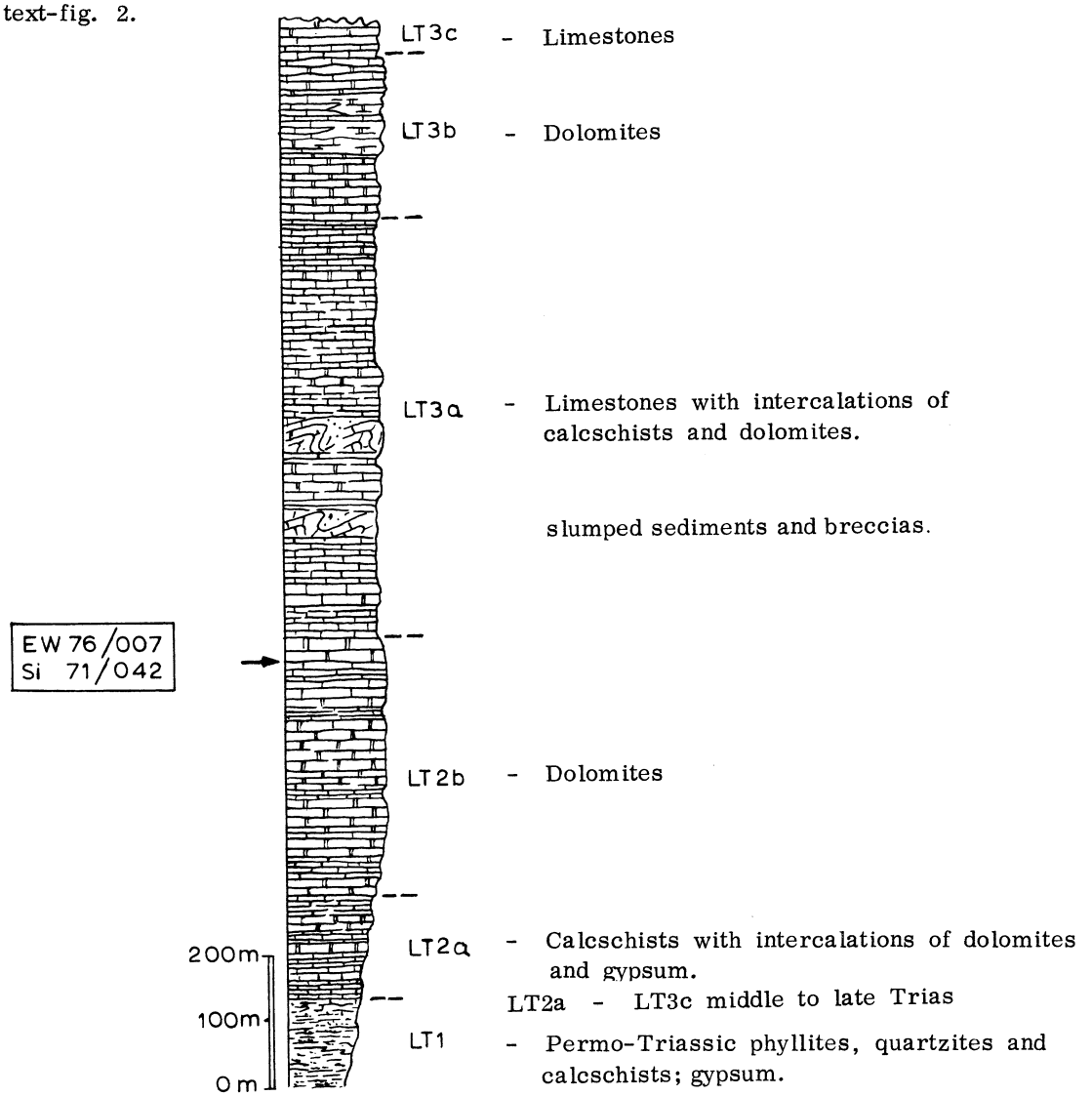
Prebetic Zone (area 1 of text-fig. 1.)

The holotype and paratypes, nos. 5, 6, and 7, have been obtained from sample Si 77/016, collected approximately 16 m above the base of a carbonate sequence in the 'Hornos-Siles Formation' (Lopez Garrido, 1971). From carbonate rocks in this Formation, bivalves and cephalopods have been reported by Schmidt (1935), Lopez Garrido (1971) and Hirsch (1977).

Micro-fossils from sample Si/77/016 comprise gastropod and echinoderm fragments with conodonts (*Pseudofurnishius murcianus* Van den Boogaard, 1966). Hirsch (1977) considers that the carbonate sequence of the 'Hornos-Siles Formation' can be correlated with the higher part of the Fuente-Aledo Formation of the Ballabona-Cucharón Complex (Betic Zone), as both have comparable bivalve and conodont faunas. He attributes a late Ladinian age to this part of the Fuente-Aledo Formation and to the carbonate sequence of the 'Hornos-Siles Formation'. Kozur *et al.* (1974) suggests a Cordevolian (early Carnian) age to the higher part of the Fuente-Aledo Formation on the evidence of ostracodes and holothurian sclerites. Preliminary determinations of the microflora indicate a late Ladinian to early Carnian age for the carbonate sequence of the 'Hornos-Siles Formation'.

Betic Zone (Alpujarride Complex, area 2 of text-fig. 1).

Paratypes nos. 1, 2, 4, and 8 from samples EW 76/007 and Si 71/042 come from the Alpujarride Lujar Unit (*sensu* Ewert, 1976) in the Sierra de Gador. A simplified vertical section of the Lujar Unit with the indicated stratigraphical position of the samples is given in text-fig. 2.



Text-fig. 2. Composite columnar section of the Lujar Unit, area 2 of text-fig. 1. after Ewert, 1976).

The macrofossil, *Nautilus* sp., has been described from the same bed as that from which sample Si 71/042 was taken (Jacquin, 1970). The microfauna contains conodonts and ostracodes. The conodonts, *Pseudofurnishius murcianus* Van den Boogaard 1966, and *Epigondolella mungoensis* (Diebel 1956), indicate a late Landinian age (Simon & Kozur, 1977; Hirsch, 1977), but a preliminary determination of the ostracodes from sample EW 76/007 suggest an early Carnian age. Samples from the lower part of sequence LT 3a (text-fig. 2) contain holothurian sclerites pertaining to the early Carnian. Approximately 150 m below samples EW 76/007 and Si 71/042 carbonate rocks occur which contain ostracodes indicating a late Ladinian age. Awaiting definite determinations of the ostracodes of sample EW 76/007, a late Ladinian to early Carnian age is tentatively assigned to samples EW 76/007 and Si 71/042.

Betic Zone (Alpujarride Complex, area 3 of text-fig. 1.)

Paratype 3 obtained from sample 24-42/Ka/292 was collected from the lower-most part of an Alpujarride carbonate sequence overlying a phyllite-quartzite sequence. The exact stratigraphical position of the sample in the sequence could not be established due to the fact that the contact between the two sequences at that place is of a tectonic nature. The macrofauna consists of indeterminate bivalves. The microfauna includes ostracodes, foraminifera and echinoid fragments. Preliminary dating of the ostracodes suggests a late Ladinian age.

Table 1 - Fossil frequency in relation to the Betic Zone Complexes and to the External Zone.

Fossils	Nevado-Filabride Complex	Ballabona-Cucharón Complex	Alpujarride Complex	Subbetic	Prebetic
Hybodus plicatilis		1	2		
Acrodus sp. 'A'			1		
Acrodus sp. 'B'		2			
Acrodus sp. 'C'		1			5
Indet. Dermal Denticles	3	2	164	1	164
Saurichthys longidens					17
Saurichthys apicalis		1	17		2
Birgeria mougeoti			3		1
Gyrolepis albertii			6		2
Gyrolepis sp.		1	52	18	302
Andalusias ewerti.		1	55	4	44
Indet. teeth 'A'		2	12		19
Indet. teeth 'B'			4		2
Indet. teeth 'C'	10				
Indet. scales			18		43
Indet. fish		1	9		10

All Specimens are deposited in the Geological Institute, University of Amsterdam.

Systematic Palaeontology

Outline classification based on Andrews *et al.* (1967).

Sub-class	Actinopterygii
Order	Perleidiformes
Family	Colobodontidae Stensiö 1916
Genus	*Andalusias* gen. nov.

Name:- derived from the area in which the specimens were found.

Diagnosis

Sub-circular and oval crushing teeth with multi-tuberculate caps which may or may not cover the upper surface of the pedicel. The caps are depressed and have major and minor tubercles. They vary between types which are flattened and seated horizontally on the pedicel and others which are inclined and rather spikey.

Type species, *Andalusias ewerti* sp. nov., pl. 11, figs. 1 - 9.

Name:- in honour of Mr. Klaus Ewert of Adra, Spain.

Diagnosis

Variable crushing teeth, oval and sub-circular in upper view with a barrel-shaped pedicel. Depressed tooth caps, seated horizontally on the pedicel, have one major and several minor tubercles peripherally on the upper face; these caps usually equal the pedicel in length and width. Teeth having a cap which is smaller in length and width than the pedicel, generally have fewer minor tubercles. Many of the caps are seated at an angle on the pedicel; the more steeply inclined the cap, the more significant is the major tubercle and the less significant are the minor tubercles. Teeth which are oval in upper view have a depressed cap with one major tubercle, one minor tubercle and, at times, minor tubercles on the upper face.

Holotype: Specimen no. K3337, sample Si 77/016, pl. 11, fig. 1.
Type locality: Siles, province of Jaen, Universal Transverse Mercator Coordinates (U. T. M. C.), 05.35.47/42.48.60, Prebetic Zone, Hornos-Siles Formation, late Ladinian - early Carnian.

Paratypes 1 and 4: P58853 and P59290, sample EW 76/007, pl. 11, figs. 2 and 5.
Type locality: Sierra de Gador, province of Almeria, U. T. M. C., 05.21.85/40.75.97., Alpujarride Complex, late Ladinian-early Carnian.

Paratypes 2 and 8: P58854 and P592294, sample Si 71/042, pl. 11, figs. 3 and 9.
Type locality: Sierra de Gador, province of Almeria, U. T. M. C. 05.32.82/40.82.20., Alpujarride Complex, late Ladinian - early Carnian.

Paratype 3: P58855, sample 24 - 42/Ka/292, pl. 11, fig. 4.
Type locality: Sierra Gabrera, province of Almeria, U. T. M. C., 05.92.10/40.99.52., Alpujarride Complex, late Ladinian.

Paratypes 5, 6, 7: P59291, P59292 and P59293, sample Si 77/016, pl. 11, figs. 6, 7, and 8.
Type Locality: Siles, province of Jaen, U. T. M. C., 05.35.47/42.48.60. Prebetic Zone, 'Hornos-Siles Formation', late Ladinian - early Carnian.

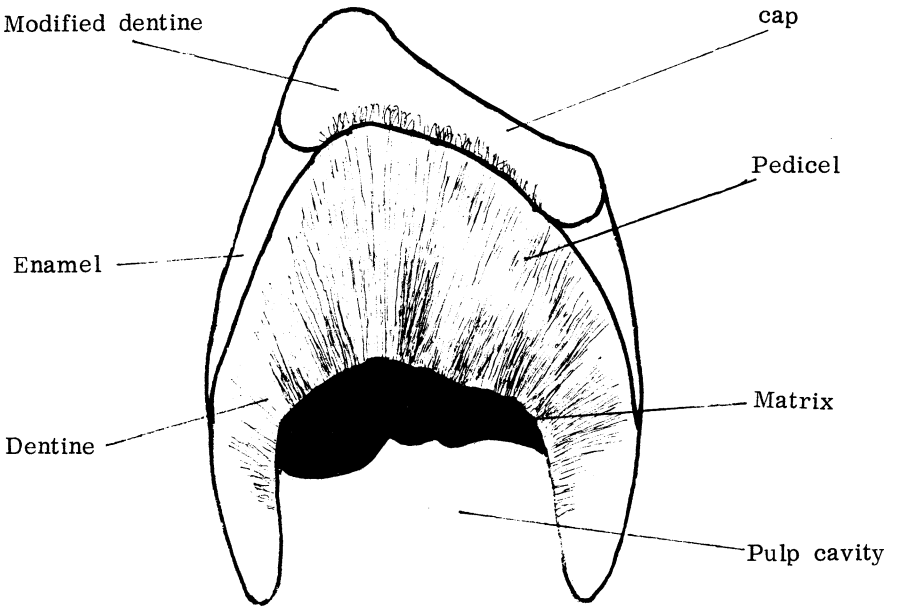
The holotype numbered K 3337 and the thin section, text-fig. 3, are deposited in the Geological Institute, University of Amsterdam; the paratypes, in the British Museum of Natural History, London.

Description of the teeth.

The isolated teeth consist of single crowns having a depressed cap on a short pedicel which has a pulp-cavity in the lower part. In well preserved specimens the pedicel is generally barrel-shaped, narrowing slightly at the top and down to the base. The pulp-cavity is wide making the walls of the pedicel thin, the lowest part of the pedicel being rarely preserved.

The teeth vary between types which are oval in upper view (pl. 11, fig. 8 & 9), and those which are sub-circular to slightly oval in upper view (pl. 11, figs 1 to 7). In the latter type, which are by far the most common, the tooth cap is depressed and has a series of tubercles on the upper surface (pl. 11, figs. 1 to 6). These consist of one major tubercle and up to twelve minor tubercles, arranged peripherally around the upper surface of the cap. Most of this type are found as isolated tooth caps (pl. 11, fig. 3). In some more complete specimens the cap is as wide and as long as the pedicel, covering the upper area of the tooth (pl. 11, fig. 2). In others the cap is less than the length and width of the pedicel (pl. 11, figs. 1, 4 & 5) and, generally, these have less minor tubercles. Most of the latter type have the cap seated at an angle on the pedicel. When the inclination is steep, minor tubercles are insignificant or absent and the major tubercles prominent and off-centre (pl. 11, figs. 6 & 7).

The type which is oval in upper view has a rather different cap; there are two dominant tubercles on the upper surface, one larger than the other (pl. 11, figs. 8 & 9). Nearly all the specimens of this type are found as isolated tooth caps, though, when found attached to the pedicel, they are seated horizontally. Only one oval specimen shows a tooth cap which is smaller in its width and length than the pedicel.



Text-fig. 3. Median, lateral section of tooth from sample Si 77/016, X 140.

In thin section (text-fig. 3) the teeth are shown to comprise of an independant cap of modified dentine seated on a pedicel made up of dentine with a surrounding layer of enamel. Radiating through the dentine there are very fine tubules which are dense in parts. They penetrate a short way into the cap at an angle which makes a dense tangled mat of tubules.

Discussion

The Families Colobodontidae and Lepidotidae Owen 1860, and the Order Pycnodontiformes have species which possess crushing teeth. These teeth are low, rounded and knob-like and are placed in rows or patches on the jaws and roof of the mouth. Each tooth has a cap of enamel or modified dentine on a stem-like pedicel which has a pulp-cavity in the lower part. The pedicel is usually short and is fixed at its base to the supporting bone. The new species is of this general morphological tooth type.

In the Family Colobodontidae there are four genera with fishes which have simple, tuberculate crushing teeth. The genus *Colobodus* Agassiz 1844, has several such species which, in general, have teeth with a centrally placed apical tubercle on a cap which is striate (Woodward, 1895; p. 68, Dames, 1888, pls. 2 & 3).

Nephrotus chorzowensis H. v. Meyer 1851, has some non-striate crushing teeth many of which have a simple, low, round tubercle on the upper face (Sykes, 1979, pl.13 fig. 7). Some have a more pointed, off-centre tubercle and there are much larger marginal teeth which are cylindrical in shape (Schmidt, 1928, p.36

The genus *Aetheodontus* Brough (Brough, 1939, p. 51) is described as having crushing dentition of cylindrical, blunt, teeth, varying in size and having a rounded crown with a small central pappilla. The species *Aetheodontus besanensis* Brough (Brough, 1939, p. 52) has short cylindrical teeth which have an off-centre tubercle on the apex; some of the teeth having a rather spikey appearance.

The genus *Perleidus* Stensiö 1932 has fishes with teeth similar to those in the genus *Aetheodontus*. *Perleidus stoschiensis* Stensiö (Stensiö, p. 218) has several rows of minute teeth some of which are oval and most of which are round in upper view. They have an apical tubercle which is either central or off-centre.

Teeth are one of the hard remains of fishes which are most likely to be preserved and become fossilised. Many species have been founded on isolated teeth and in considering their affinities both anatomical and stratigraphical considerations must be taken into account The Colobodonts are important and well known throughout the Trias and they have proved extremely useful in zoning the Triassic rocks of Bulgaria (Stefanov, 1977). Of the four genera mentioned *Colobodus* and *Nephrotus* range from the early to the late Triassic whilst *Aetheodontus* is Middle Triassic and *Perleidus* early Triassic.

Fish crushing teeth with tuberculate caps are quite common amongst the species of the Family Colobodontidae and there are several in which the apical tubercles are placed off-centre. The more spikey types of the Spanish specimens compare quite closely with many teeth of the fishes in the genera *Aetheodontus* and *Perleidus*. Species of the latter genus also show examples of a similar combination of both oval and rounded teeth. However, none of these species has teeth which compare with the multi-tuberculate nature of the Spanish specimens and so it is concluded that the new species should be placed in a new genus within the Family Colobodontidae.

In the Family Lepidotidae there are also fishes with small crushing teeth, though teeth from the Triassic Lepidotids are not very well known. One specimen from the Middle Triassic of Northern Italy (British Museum of Natural History No. P19355) has minute oval teeth with a small, rather pointed, off-centre, apical tubercle. The teeth vary in size but all have the same form.

Teeth of the genus *Lepidotes* Agassiz, 1833, are rare in the Triassic rocks and they generally have a smooth, round cap. Specimens of *Lepidotes* teeth from The Wealden (Patterson, 1966, p.258; Sykes, 1979, pl.12 fig. 9) have a single apical tubercle some of which are placed off-centre. Other exceptions being a small sample of specimens from the Rhaetic at Watchet (Woodward, 1895, p.122) which are tentatively placed in the genus *Lepidotes* and

some similar teeth from the Rhaetic at Barnstone (Sykes, 1979).

Although some of the Spanish specimens have features in common with Lepidotids there is not sufficient evidence to show that they belong to that family.

Many fossil fishes in the Order Pycnodontiformes have smooth, rounded, knob-like teeth many with an apical indentation. In the genus *Mesturus* Wagner, 1862, fish teeth have a crimped and indentented coronal apex.

One species from the Upper Jurassic *Mesturus leedsi* Woodward, 1895, has teeth which have varying patterns of minute tubercles on an indented upper surface (Lehman, 1966, fig. 166). A pycnodont from the Lower Jurassic, *Eomesodon liassicus* Edgerton has smooth teeth with a single apical tubercle but generally the pycnodont teeth are of a non-tuberculate form. *Eomesodon hoefori* from the late Triassic of Austria, is the only Triassic pycnodont species known and its teeth are not determined.

An approach to the depressed nature of the horizontally seated caps of the Spanish specimens is made in the pycnodont *Mesturus* though major and dominant, off-centre tubercles are not present in that genus. The stratigraphical horizon of *Andalusias ewerti* is considered to be of Ladinian-Carnian age, near the Middle and late Triassic boundary (Kozur, *et al.*, 1974). To consider the species as a pycnodont would extend the range of that Order on a species of isolated teeth that show affinities to a family which is much better known and more significant in the Trias.

Acknowledgements

The authors are greatly indebted to Dr. C. Patterson (British Museum Nat. Hist.) for his assistance with the palaeontology. Thanks are due to Mrs. C. Mulder-Blanken for taking the scanning electron micrographs, to Miss M. Rietveld, Mrs. C. Mulder-Blanken and Mr. J. Kaper for the preparation and sorting of the residues. Thanks are also due to Mr. Klaus Ewert for information on the geology of the Sierra de Gador, to Dr. H. Visscher and Mr. R. Besems for information on the geology of the Siles region and for their help during the collection of the samples. One of the authors (O.J. Simon) wishes to thank the Netherlands Organisation for the Advancement of Pure Research (Z.W.O.) for financial support.

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References

ANDREWS, S.M. *et al.* 1967. Pisces. In: HARLAND, W.B. *et al.* *The Fossil Record*, pp. 637 - 683, London.

BOOGAARD, M. van den 1966. Post-Carboniferous conodonts from south-eastern Spain. *Proc. Kon. Ned. Akad. Wetensch.*, vol. 69, pp. 691 - 698.

BOOGAARD, M. van den and SIMON, O.J. 1973. *Pseudofurnishius murcianus* (Conodonta) in the Triassic of the Betic Cordilleras, S.E. Spain. *Scripta Geol.* vol. 16, pp. 1 - 18.

BROUGH, J. 1939. *The Triassic fishes of Besano, Lombardy.* Brit. Mus. (Nat. Hist.), 177 pp.

DAMES, W. 1888. Die Ganoiden des deutschen Muschelkalks. *Palaeont, Abh.*, vol. 4, pp. 133 - 179.

EGELER, C.G. and SIMON, O.J. 1969. Sur la tectonique de la Zone Bétique, (Cordillères Bétiques, Espagne). *Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk.* vol. 25, 90 pp.

EGELER, C.G. and FONTBOTE, J.M. 1976. Aperçu géologique sur les parties centrale et orientale des Cordilléres Bétiques. *Bull. Soc. géol. France*, (7), vol. 18, pp. 571 - 582.

EWERT, K. 1976. Estratigrafía, Litologia y Mineralizaciones del. Manto de Lujar (Zona Bética). *Studia Geologica*, vol. 11, pp. 109 - 120.

HIRSCH, F. 1977. Essai de corrélation biostratigraphique des niveaux méso- et néotriasiques de faciès 'Muschelkalk' du domaine sépharde. *Cuad. Geol. Iberica*, vol. 4, pp. 511 - 526.

JACQUIN, J.P. 1970. *Contribution à l'étude géologique et minière de la Sierra de Gador (Almeria, Espagne)* Thesis, University of Nantes, 501 pp.

KOZUR, H. and SIMON, O.J. 1972. Contribution to the Triassic microfauna and stratigraphy of the Betic Zone (southern Spain), *Rev. Esp. Micropal.*, Numero Extraordinario XXX, Aniversario E.N. Adaro, pp. 143 - 158.

KOZUR, H., KAMPSCHUUR, W., MULDER-BLANKEN, C.W. and SIMON, O.J. 1974. Contribution to the Triassic ostracode faunas of the Betic Zone (southern Spain), *Scripta Geologica* Vol. 23, pp. 1 - 56.

LEHMAN, J.P. 1966. *Actinopterygii*, pp. 1 - 242, In : *Traité de Paléontologie*, ed. J. Piveteau, t. 4, vol. 3, 442pp.

LOPEZ GARRIDO, A.C. 1971. *Geologiá de la zona Prebetica al NE de la provincia de Jaén.* Thesis, University of Granada, 317pp.

PATTERSON, C. 1966. British Wealden Sharks. *Bull. Brit. Mus. Nat. Hist.* vol. 11, pp. 281 - 350.

SCHMIDT, M. 1928. *Die Lebewelt unserer Trias.* Hohenlohe'sche Buchhandlung Ferdinand Rau, Öhzingen, 461 pp., 1220 text figs.

SCHMIDT, M. 1935 Fossilien der spanischen Trias. *Abh. Heidelb. Akad. Wiss., Math.—Naturwiss. Kl.* vol. 22, pp. 1 - 140.

SIMON, O.J. 1966. The age of the conodont-bearing rocks from the Sierras de Carrascoy, de Almagro and Alhamilla and from the Zarcilla de Ramos region, S.E. Spain. *Proc. Kon. Ned. Akad. Wetensch.*, vol. 69, pp. 699 - 709.

SIMON, O.J. and KOZUR, H. 1977. New data on the (Permo-) Triassic of the Betic Zone (southern Spain). *Cuad. Geol. Ibérica*, vol. 4, pp. 307 - 322.

STEFANOV, S.A. 1977. Biostratigraphy of the Balkanide Carbonate Triassic on the Basis of Conodonts and Fish Remains. *Geol. Balcanica* vol. 7, pp. 65 - 84.

STENSIO, E.H. 1932. Triassic fishes from East Greenland. *Medd. on Grønland*, vol. 83, no. 3, 305 pp.

SYKES, J.H. *Lepidotes sp.* Rhaetian Fish Teeth from Barnstone, Nottinghamshire. *Mercian Geol.*, vol. 7, no. 2, 1979 (in press.)

WOODWARD, A.S. 1895. *Catalogue of Fishes in the British Museum.* Brit. Mus. (Nat. Hist.), pt. 3, 504 pp.

EXPLANATION FOR PLATE 11

Fig. 1. Tooth with inclined tuberculate cap, holotype, oblique lateral view. No. K 3337.

Fig. 2. Tooth with horizontal tuberculate cap (detached from pedicel in transit), Paratype no. 1, oblique upper view, no. P58853.

Fig. 3. Detached tooth cap, paratype no. 2 upper view, no. P58854.

Fig. 4. Tooth with broken pedicel, paratype no. 3, lateral view, no. P58855.

Fig. 5. Tooth with slightly inclined, tuberculate cap, paratype no. 4 oblique, lateral view, no. P59290.

Fig. 6. Worn tooth with inclined tuberculate cap, paratype no. 5, oblique lateral view no. P59291.

Fig. 7. Tooth with steeply inclined cap, paratype no. 6, lateral view, no. P59292.

Fig. 8. Oval tooth with major tubercles, paratype no. 7, oblique upper view, no. P592293.

Fig. 9. Oval tooth with major and minor tubercles, paratype no. 8, transverse, oblique, upper view, no. P59294.

P numbers refer to specimens in the British Museum (Nat. Hist.)

Dimensions (in mm)

Fig. no.	Length	Depth	Height
1	0.4	0.4	0.7
2	0.3	0.3	0.4
3	0.6	0.7	0.3
4	0.4	0.5	0.4
5	0.4	0.4	0.7
6	0.3	0.3	0.4
7	0.3	0.3	0.6
8	0.3	0.4	0.5
9	0.5	0.7	0.3

Plate 11