Bollettino della Società Paleontologica Italiana	23 (2)	1984	240-258	5 pls.	Modena, Settembre 1985

Early Devonian (Lochkovian) conodonts from southwestern Sardinia

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KEY WORDS — Conodonts, Early Devonian, Sardinia, Systematics, Biostratigraphy.

ABSTRACT — Early Devonian conodonts are discussed and figured from nodular limestones outcrops near Fluminimaggiore in southwestern Sardinia.

By means of conodont study the occurrence of the Lochkovian age with the delta *Zone has been confirmed in the Fluminese area.*

The faunal association comprises diagnostic species as Ancyrodelloides kutscheri, Ancyrodelloides trigonicus, Ozarkodina transitans, Ozarkodina stygia, Ozarkodina steinhornensis telleri, Icriodus angustoides alcoleae *and* Ozarkodina fluminensis *n. sp.*

The species Ozarkodina fluminensis *is described as new taxon and discussed as probable stratigraphical marker of the* delta *Zone in Sardinia.*

A new apparatus (Apparatus A) is regarded as new but described with open nomenclature.

The species are described in terms of multielement taxonomy.

RIASSUNTO — [Conodonti del Devoniano inferiore (Lochkoviano) della Sardegna sud occidentale] — *Viene discussa e illustrata una associazione a conodonti del Devoniano inferiore proveniente dai calcari nodulari affioranti nei pressi di Fluminimaggiore nella Sardegna sud occidentale.*

Mediante l'esame dei conodonti è stata confermata la presenza del Lochkoviano, con il riconoscimento della Zona delta.

L'associazione comprende specie caratteristiche come: Ancyrodelloides kutscheri, Ancyrodelloides trigonicus, Ozarkodina transitans, Ozarkodina stygia, Ozarkodina steinhornensis telleri, Icriodus angustoides alcoleae *e* Ozarkodina fluminensis *n. sp.*

Quest'ultima specie viene descritta per la prima volta e discussa come probabile marker della Zona delta *in Sardegna.*

Viene descritto con l'uso della nomenclatura aperta un nuovo apparato (Apparato A).

Le specie sono state descritte con la tassonomia a più elementi.

INTRODUCTION

Devonian sediments are scarcely represented in southwestern Sardinia, particularly if one compares their spatial distribution with that of the Silurian sediments. Outcrops dated as Devonian are confined in a narrow belt that runs from Fluminese to southwestern Sulcis regions.

The main lithotypes are 1) calcareous shales and nodular limestones with tentaculites and crinoids of Early to Middle Devonian age, already attributed to the Upper Silurian by the old authors (Taricco 1921; Novarese & Taricco 1922), and 2) stratified limestones with crinoids and conodonts of Late Devonian age (Leone 1973; Olivieri 1985).

In the Fluminese area, the relationships between the Devonian sequence and underlying Silurian sediments are not clear because of the fragmentation of outcrops by later tectonic activity. No continuous sedimentary sequence straddling the two systems can be detected in the area.

Early Devonian sedimentary rocks were rarely mentioned from the Fluminese region. For a long time a clear paleontological evidence of this part of the Paleozoic sequence and specifically of Lochkovian (= Gedinnian *pars*) age was totally missing. Accor-

ding to the stratigraphic outline of the Lower Paleozoic of Sardinia compiled by Maxia and Pomesano Cherchi (1973, p. 87), the Devonian sequence in the Fluminese would begin with the calcareous shales of Late Siegenian-Emsian (=Pragian).

In fact, Alberti (1963) recognized in Fluminese region only the upper part of the Lower Devonian on the basis of one species of tentaculites (*Nowakia acuaria*). The occurrence of *Tentaculites (Nowakia) acuarius* associated with *Styliola laevis*, was already reported by Borneman (in Zoppi 1888, p. 43). Detailed stratigraphical and paleontological studies of Silurian to Devonian sections from southwestern Sardinia were carried out in the last few years. Conodonts were the fossils chiefly used to date such part of the Paleozoic sequence and allowed to recognize some biozones.

Recently a conodont fauna of the *woschmidti* Zone, close to Silurian-Devonian boundary, was found in both the Fluminese (Serpagli & Mastandrea 1980; Serpagli 1983) and the Sulcis (Olivieri, Mastandrea & Serpagli 1981). From the same areas a younger assemblage of Lochkovian age was reported by Serpagli *et al.* (1978) and Olivieri *et al.* (1981). Assemblages belonging to the *pireneae, dehiscens* and *laticostatus* Zones, indicating a Late Pragian to Dalejan age, were discovered in southern Sulcis by Olivieri *et al.* (1981). Moreover, the *pireneae* Zone together with the *eosteinhornensis* Zone (Pridolian) had been mentioned by Gnoli, Mastandrea & Olivieri (1981) in a short note. Further documentation of the Pragian age, also from the Fluminese region, was recently achieved by finding the *kindlei* and *pireneae* Zone (Mastandrea 1985).

Although the biostratigraphy of the Lower Devonian relied mainly upon its conodont faunas, other fossil groups from the Fluminese area were also studied such as orthocone cephalopods (Gnoli 1983), phyllocarids (Gnoli & Serpagli 1984), and foraminifera (Gnoli & Serpagli 1985).

Problems regarding the presence of possible hiatuses are still open.

The purpose of the present work is to improve our knowledge the conodont biostratigraphy of the Early Devonian from southwestern Sardinia.

This study is the continuation of the previous work on the conodont fauna of the Gedinnian age from Galemmu 1st section surveyed in the same area (Serpagli *et al.* 1978).

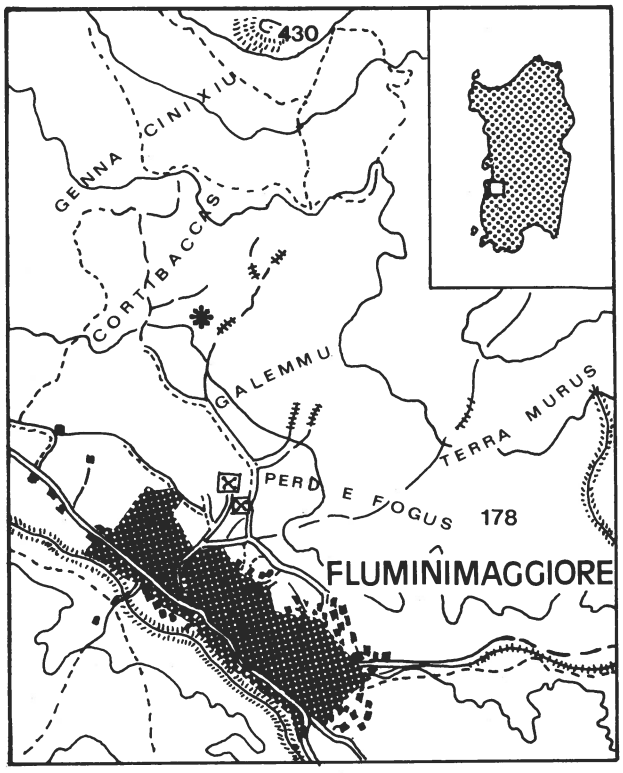
A new section, the Galemmu 2nd section was sampled in detail (section indicated by F. Leone, University of Cagliari, Italy) and a rich conodont fauna was recovered. This new finding allows us to study the affinity between this fauna with other similar faunas, and to establish whether Klapper's Western North America (1977) conodont zones could also apply to Sardinia faunas or not.

LITHOLOGICAL REMARKS

The studied section, named Galemmu 2nd, outcrops near the path to the cemetery of Fluminimaggiore in the Galemmu area, in southwestern Sardinia (Text-fig. 1).

The lithology of Galemmu 2nd section, 13.5 m. thick, consists of thick bedded grey tentaculite nodular limestones, subordinate dark grey fine micritic limestones alternating with thin layered black shales.

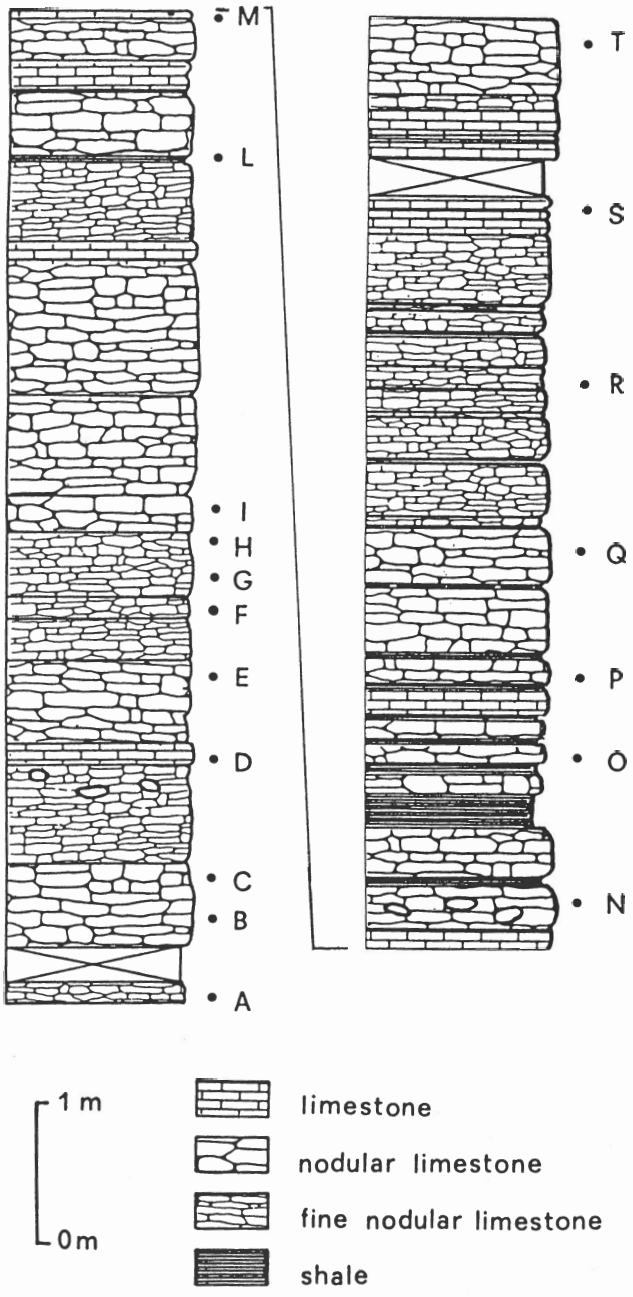
More detailed information on the vertical succession of the various lithologies are schematically shown in text-fig. 2. Concerning the depositional environment the limestone beds and related lithologies represent a pelagic deposit sedimented at slow rate possibly in a submarine rise setting (Gnoli 1985). Megafossils are rare except for some orthocone cephalopods and scattered disks of crinoid stems. In thin section, however, limestones are mostly biomicrites and fossiliferous micrites. Trilobites, brachiopods, crinoids and tentaculites, mainly dacryoconarids, have been recognized.



Text-fig. 1 - Location map of the Galemmu 2nd section. *

The insoluble residues of the processed samples, besides conodonts, yielded piritized tentaculites, mandibles of phyllocarids, inarticulate brachiopods, and few silicified ostracods.

A total amount of 95.7 kilograms of limestones was processed conodonts and the average yield was about 8 specimens per kilogram. Conodont specimens are well preserved, although broken elements are common. Their coloration falls mainly in the C.A.I. category 5 (Epstein *et al.*, 1977).



Text-fig. 2 - Stratigraphic section of the Galemmu 2nd showing lithologies and sampled intervals.

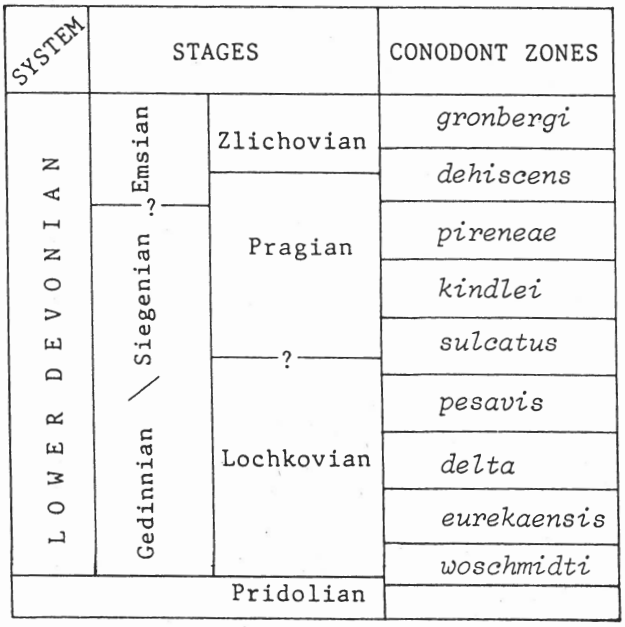
THE CONODONT ZONATION AND AGE OF THE FAUNA

The Lower Devonian conodont zonation was established by Klapper (1977) in central Nevada to replace the informal subdivision int Faunas 1 to 9 by Klapper, Sandberg and others (1971, p. 287-292). The zonation of the lower half of the Lower Devonian is based on the first occurrence of species belonging to several different lineages, because no single phyletic lineage widely ranged exists on which they could have been based. In the last years, several authors (Lane & Ormiston 1979; Klapper & Ziegler 1979; Klapper & Murphy 1980; Klapper & Johnson 1980; Johnson & Klapper 1981) have contributed in refining the zonal scheme.

The zonal scheme, compiled by Lane & Ormiston (1979, text-fig. 1), is adopted in the present paper.

The conodont fauna (tab. 1) occurring from sample D to T, at the top of the Galemmu 2nd section, belongs to the *delta* Zone. In conodont biostratigraphy it corresponds to the Lochkovian stage of Lower Devonian. The zonal assignment is supported by the presence of diagnostic species as *Ozarkodina transitans* α - δ morphotypes *sensu* Lane & Ormiston, *Ozarkodina stygia* β - γ morphotypes *sensu* Lane & Ormiston, *Ozarkodina remscheidensis repetitor* Carls & Gandl, *Ancyrodelloides kutscheri* Bischoff & Sannemann, *Ancyrodelloides trigonicus* Bischoff & Sannemann, *Icriodus angustoides alcoleae* Carls, and *Ozarkodina steinhornensis telleri* (Schulze). Many of them are listed by Klapper & Johnson (1980, table 2).

Although the nominal species *Ozarkodina delta,* described originally as *Ozarkodina* n. sp. D by Klapper (1977) from central Nevada, and two species *Amydrotaxis johnsoni* alpha morphotype *sensu* Klapper & Murphy (= *Ozarkodina* n. sp. C Klapper, 1977) and *Pedavis pesavis* n. subsp. A Klapper & Philip were not found, the *delta* Zone was recognized on the occurrence of the other characteristic species, among which the two species of *Ancyrodelloides* (see Lane & Ormiston 1979, p. 49 and Klapper & Johnson 1980, p. 408). In sample D, about 1.75 m above the base, makes its first occurrence *Ozarkodina transitans* Bischoff & Sannemann) associated with *Ozarkodina stygia* (Flajs) and *Ozarkodina remscheidensis repetitor* (Carls & Gandl). According to Klapper (1977, p. 40) and Lane & Ormiston (1979, tab. 1), *O. transitans* has its oldest stratigraphic occurrence in the *delta* Zone. Furthermore, about 3.5 m above the base of the section, in sample I occurs *Ozarkodina fluminensis* n. sp., a taxon very closely related to *Ozarkodina delta.* It is possible that the new species is confined to the *delta* Zone, and hence I regard the new



Text-fig. 3 - Correlation of Lower Devonian conodont zones with stages in Europe (from Lane & Ormiston 1979, fig. 5; Klapper & Johnson 1980, text-fig. 1).

taxon as diagnostic of that zone in Sardinia. However, its total range needs to be better known. Furthermore it is worth mentioning that *O. fluminensis* n. sp. is associated with *A. trigonicus* Bischoff & Sannemann and *A. kutscheri* Bischoff & Sannemann in all the investigated samples.

The lowermost samples A, B e C of Galemmu 2nd section yielded a fauna possibly belonging to the *eurekaensis* Zone, even an attribution to a lower *delta* Zone cannot be ruled out.

In these samples all the species characteristic of the *delta* Zone present in the overlying samples are missing. The fauna contains *Ozarkodina excavata excavata* (Branson & Mehl), *Ozarkodina remscheidensis remscheidensis* (Ziegler), *Ozarkodina stygia* (Flajs) and *Ozarkodina remscheidensis repetitor* (Carls & Gandl).

According to Carls & Gandl (1969) the lowest occurrence of *O. r. repetitor* is from d1cγ strata of the Luesma Formation in Aragon (Spain), with its range extended up into d2aα strata of the Nuogueras Formation. The latter strata are correlated with the *delta* Zone by Klapper in Klapper & Ziegler (1979, text-fig. 1). Furthermore Lane & Ormiston (1979) have noted that *O. stygia,* ranging from *delta* Zone to *pesavis* Zone, appears in Salmontrout River Area clearly below the *delta* Zone. Therefore a definitive assignment of the lowermost samples from Galemmu 2nd section to a specific zone at present is prevented.

SYSTEMATIC PALEONTOLOGY

The conodont fauna is described and illustrated following, where possible, the multielement taxonomy. Several common form species are also listed on tab. 1 (lower part) and figured on plate 5. The designation of the single elements within the platform multielement apparatuses follows Sweet & Schönlaub (1975) where it is possible. The terminology of Klapper & Philip

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EXPLANATION OF PLATE 1

All specimens from Galemmu 2nd section, Early Devonian.

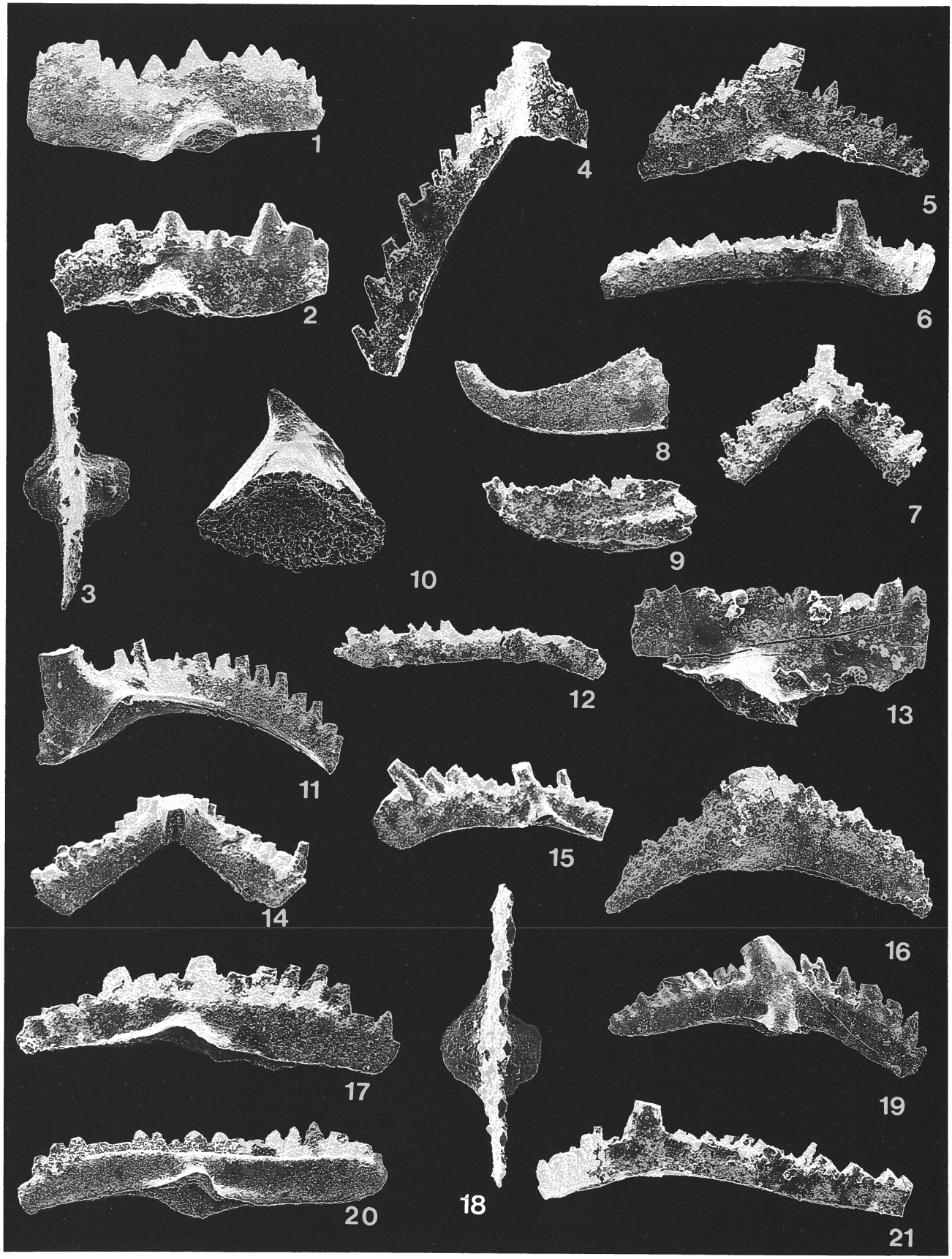
Figs. 1-7, 12 - *Ozarkodina remscheidensis remscheidensis* (Ziegler).
1, hypotype, n. 20909, lateral view of Pa element, sample A, x 45; 2, hypotype, n. 20910, lateral view of Pa element, sample B, x 95; 3, hypotype, n. 20911, upper view of Pa element, sample C, x 75; 4, hypotype, n. 20915, lateral view of M element, sample E, x 75; 5, hypotype, n. 20913, inner lateral view of Pb element, sample C, x 65; 6, hypotype, n. 20917, lateral view of Sc element, sample A, x 95; 7, hypotype, n. 20920. posterior view of Sa element, sample E, x 95; 12, hypotype, n. 20919, posterior view of Sb element, sample B, x 95.

Figs. 8-9 - *Belodella devonica* (Stauffer).
8, hypotype, n. 20860, lateral view, sample A, x 45; 9 hypotype, n. 20861, lateral view, sample P, x 95.

Fig. 10 - *Pseudooneotodus beckmani* (Bischoff & Sannemann).
Hypotype, n. 20985, lateral view, sample D, x 50.

Figs. 11, 14-15, 17, 19-21 - *Ozarkodina excavata excavata* (Branson & Mehl).
11, hypotype, n. 20885, lateral view of M element, sample G, x 45; 14, hypotype, n. 20900, posterior view of Sa element, sample C, x 95; 15, hypotype, n. 20889, posterior view of Sb element, sample C, x 75; 17, hypotype, n. 20880, lateral view of Pa element, sample A, x 70; 19, hypotype, n. 20883, inner lateral view of Pb element, sample D, x 45; 20, hypotype, n. 20881, lateral view of Pa element, sample T, x 50; 21, hypotype, n. 20887, lateral view of Sc element, sample G, x 50.

Figs. 13, 16, 18 - *Ozarkodina remscheidensis repetitor* (Carls & Gandl).
13, hypotype, n. 20922, lateral view of Pa element, sample N, x 90; 16, hypotype, n. 20925, inner lateral view of Pb element, sample D, x 45; 18, hypotype, n. 20923, upper view of Pa element, sample M, x 110.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(1971, 1972) is applied for the elements of the apparatus of *Icriodus*.

All the types and figured specimens are reposited at the Museum of the Institute of Paleontology. Modena University.

Genus ANCYRODELLOIDES Bischoff & Sannemann, 1958

Type species — *Ancyrodelloides trigonica* Bischoff & Sannemann, 1958.

ANCYRODELLOIDES KUTSCHERI Bischoff & Sannemann, 1958

Pl. 2, fig. 4

1978 *Ancyrodelloides kutscheri* Bischoff & Sannemann - SERPAGLI, GNOLI, MASTANDREA & OLIVIERI, p. 308, pl. 27, fig. 3.
1980 *Ancyrodelloides kutscheri* Bischoff & Sannemann - KLAPPER & JOHNSON, p. 447, tab. 2 (*cum. syn.*).

Remarks — Even though the two specimens studied have a broken blade, all the characters required to assign them definitively to *Ancyrodelloides kutscheri* are present. The specimen figured has a very large platform, in contrast with the holotype figured by Bischoff & Sannemann (1958, pl. 12, fig. 15).

Range — *delta* Zone (Klapper & Johnson 1980, tab. 2).

Material — 2 specimens.

Repository — Institute of Paleontology, Modena University, Micropaleontological Collection n. 20851 (figured hypotype), 20852 (hypotype not figured).

ANCYRODELLOIDES TRIGONICUS Bischoff & Sannemann, 1958

Pl. 2, figs. 7, 8, 11-13, 15

1978 *Ancyrodelloides trigonica* Bischoff & Sannemann - SERPAGLI, GNOLI, MASTANDREA & OLIVIERI, p. 301, pl. 27, figs. 4a, b.
1980 *Ancyrodelloides trigonicus* Bischoff & Sannemann - KLAPPER & JOHNSON, p. 447, tab. 2 (*cum. syn.*).

Remarks — Specimens with narrow platform and arrow-shape in upper view. These are characterized, inferiorly, by keels running medially along the blade and lateral processes. They converge onto a small, deep, basal cavity.

The majority of specimens examined correspond exactly to the type specimens from Frankenwald (Bischoff & Sannemann, 1958, p. 92, pl. 12, figs. 9, 12-14, 16). Nevertheless, some specimens differ from the latter chiefly in width of the platform and in having two or three higher denticles in the anterior third (pl. 2, fig. 13). The forms having a basal cavity intermediate between that of *A. trigonicus* and *O. transitans* are here considered to belong to *Ozarkodina transitans* δ morphotype *sensu* Lane & Ormiston (1979, p. 52).

A. trigonicus is morphologically close to *Ozarkodina asymmetrica* (Bischoff & Sannemann), especially in the outline of the platform and in the profile of the upper margin of the blade. They differ however, in having a basal cavity which occupies the entire area under lobes; the inner lobe is greatly reduced and does not carry denticles.

Range — *delta* Zone (Klapper & Johnson 1980, tab. 2).

EXPLANATION OF PLATE 2

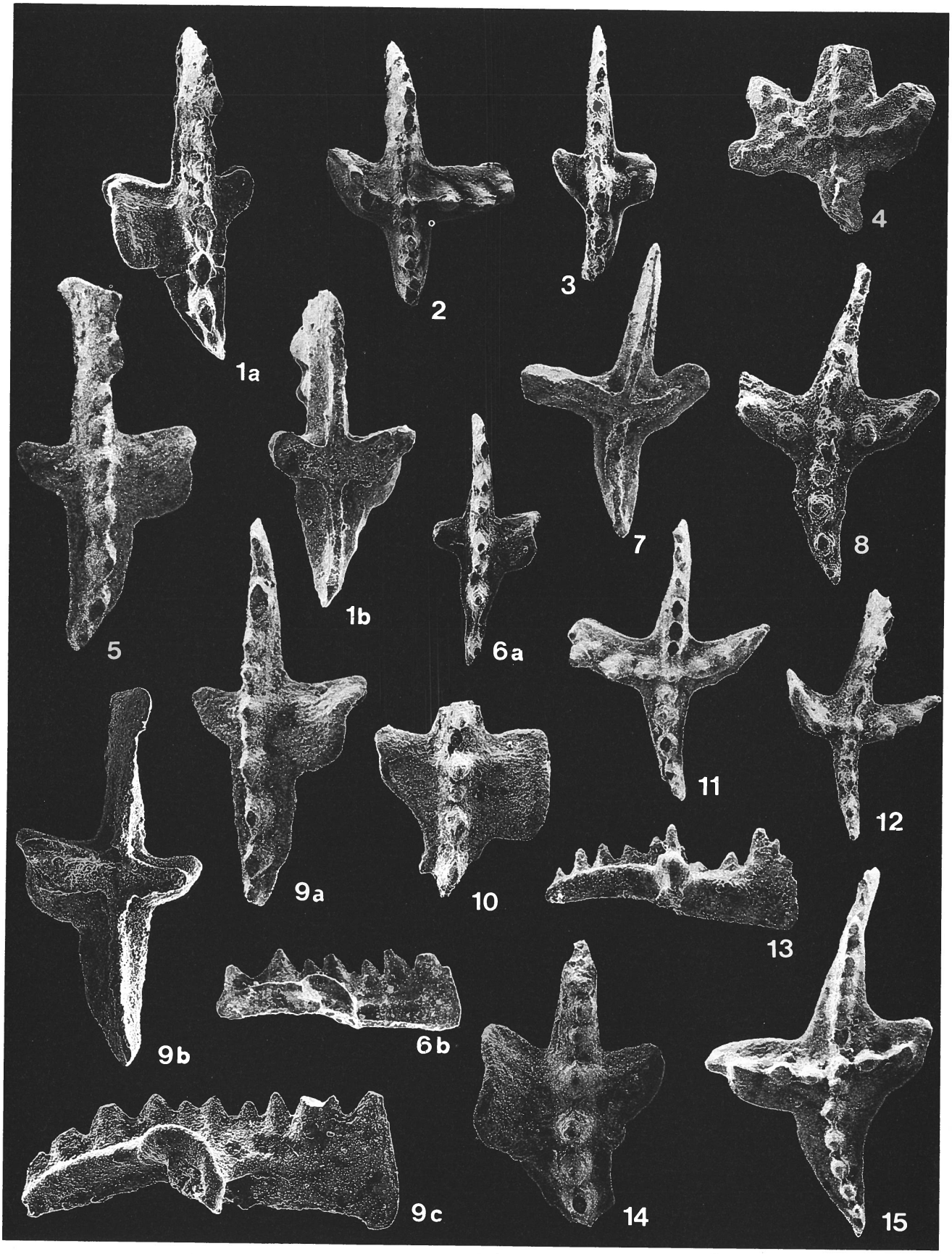
All specimens from Galemmu 2nd section, Early Devonian.

Figs. 1, 3, 5-6, 9-10, 14 - *Ozarkodina fluminensis* n. sp.
1a-b, paratype, n. 20902, lower and upper views of Pa element, sample P, x 75; 3, paratype, n. 20903, upper view of Pa element, sample Q, x 75; 5, paratype, n. 20904, upper view of Pa element, sample P, x 150; 6a-b, paratype, n. 20905, upper and lateral view of Pa element, sample P, x 75; 9a-c holotype, n. 20901, 9a, lower view, 9b, upper view, 9c lateral view of Pa element, sample P, x 150; 10, paratype, n. 20906, upper view of Pa element, sample P, x 75; 14, paratype, n. 20907, upper view of Pa element, sample P, x 75.

Fig. 2 - *Ozarkodina transitans* (Bischoff & Sannemann).
Hypotype, n. 20956, upper view of intermediate form, sample Q, x 38.

Figs. 7-8, 11-13, 15 - *Ancyrodelloides trigonicus* Bischoff & Sannemann.
7, hypotype, n. 20853, lower view of Pa element, sample Q, x 75; 8, hypotype, n. 20854, upper view of Pa element, sample G, x 75; 11, hypotype, n. 20855, upper view of Pa element, sample G, x 75; 12, hypotype, n. 20856, upper view of Pa element, sample I, x 75; 13, hypotype, n. 20857, lateral view of Pa element, sample Q, x 75; 15, hypotype, n. 20858, upper view of Pa element, sample Q, x 150.

Fig. 4 - *Ancyrodelloides kutscheri* Bischoff & Sannemann.
Hypotype, n. 20851, upper view of Pa element, sample R, x 38.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Material — 43 specimens.

Repository — Institute of Paleontology, Modena University, Micropaleontological Collection n. 20853 - 20858 (figured hypotypes), 20859 (hypotypes not figured).

Genus BELODELLA Ethington, 1959

Type species — *Belodus devonicus* Stauffer, 1940.

BELODELLA DEVONICA (Stauffer, 1940)
Pl. 1, figs. 8, 9

1974 *Belodella devonica* (Stauffer) - CHATTERTON, p. 1469, pl. 2, figs. 10-14 (*cum. syn.*).

Remarks — Chatterton (1974, p. 1469) observed that belodellan elements from the Middle Devonian of British Columbia varied in morphology and appeared to costitute a symmetry transition series that could belong to a single multielement apparatus not yet known. The end members of this series seem to be the form species *Belodella devonica* and *Belodella triangularis,* which he considers synonyms.

Serpagli (1967, p. 53) already cames to same conclusion and combines under *B. devonica* all post-ordovician species, independently of the shape in cross section, except for *B. erecta* (Rhodes & Dineley). Moreover, Lange (1968) described a coprolitic association of nine specimens of *Belodella* from the Upper Devonian in Germany. He assigned all the elements, even though they showed considerable variability, to *B. devonica* and concluded that it was a part of a multielement apparatus.

Also Telford (1975, p. 10) reported from Queensland the same distribution for both species *B. triangularis* and *B. devonica* and a third *B. resima* (Philip) which he considers a separate species. The same association was reported by Lane & Ormiston (1979, tables 1-2) from east-central Alaska.

The specimens collected from Sardinia include forms that show a tendency to intergrade and are thus all regarded under *B. devonica.*

Range — Middle-Upper Silurian (Serpagli & Greco, 1965) - Upper Devonian (Lange, 1968).

Material — 254 specimens.

Repository — Institute of Paleontology, Modena University, Micropaleontological Collection n. 20860-20861 (figured hypotypes), 20862 (hypotypes not figured).

Genus ICRIODUS Branson & Mehl, 1938

Type species — *Icriodus expansus* Branson & Mehl, 1938.

Remarks — The first interpretation of the multielement structure of *Icriodus* was given by Lange (1968) on material of probable coprolithic origin. Klapper & Philip (1971, 1972) described the apparatus of *Icriodus* as « Type 4 apparatuses » consisting of both icriodontan elements (I) and acodinan elements (S_2). This opinion was shared by the majority of the authors, with the exception of Bultynck (1972, p. 72) and later of Boogaard & Kuhry (1979, p. 15), who concluded that « it is extremely unlikely that these forms belonged to a common apparatus ».

An additional third element, M_2 element, similar to that of *Pelekysgnathus* has been suggested by Klapper & Ziegler (in Ziegler 1975, p. 67), Nicoll (1977, 1982) and Johnson & Klapper (1981) to belong to the *Icriodus* apparatus.

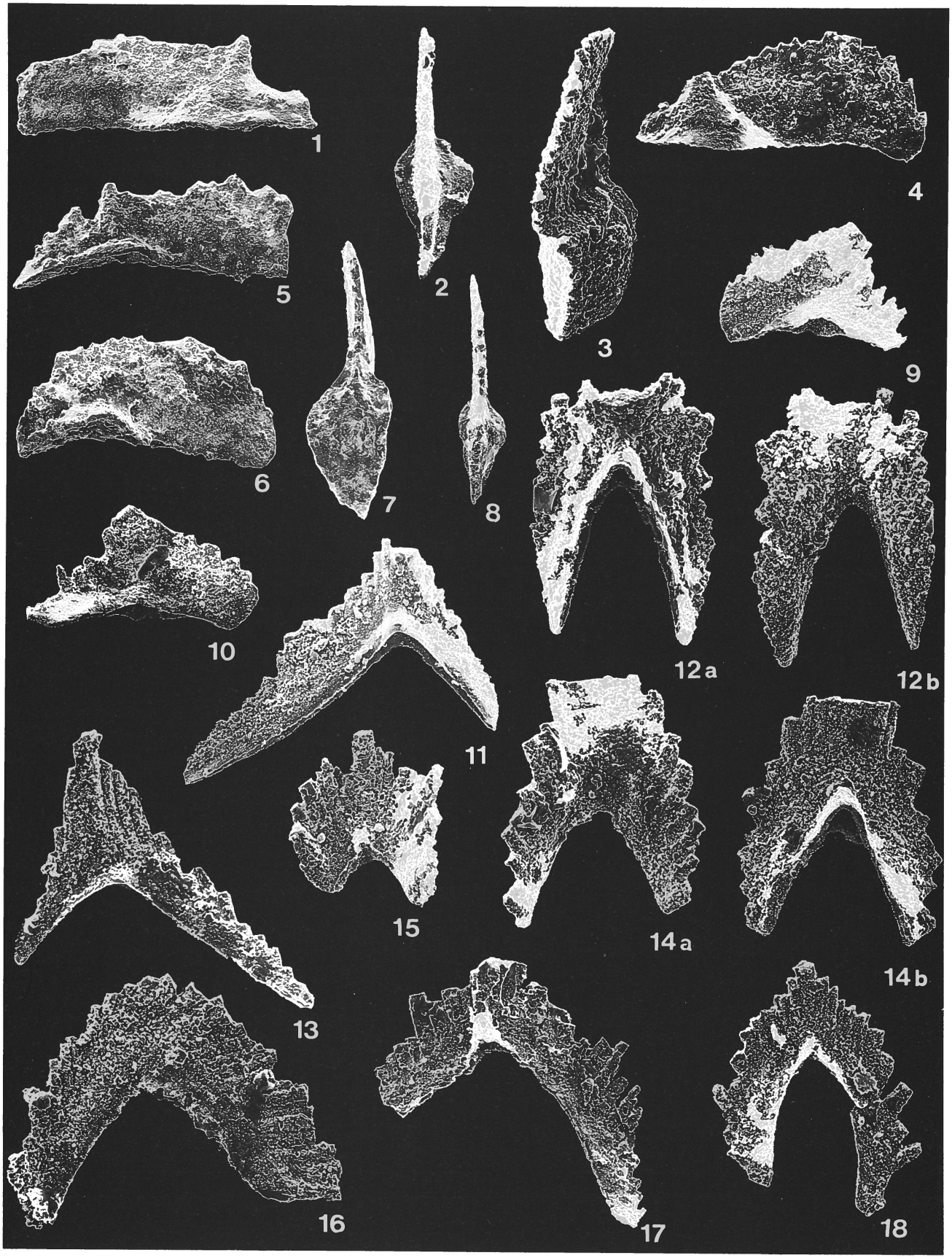
Recent studies further support the reconstruction of this apparatus as evidence as through natural associations. In fact, Uyeno (in Norris & Uyeno, 1981), recognized three acodinan elements (S_{2a}, S_{2b}, S_{2c}) as-

EXPLANATION OF PLATE 3

All specimens from Galemmu 2nd section, Early Devonian.

Figs. 1-10 - *Ozarkodina stygia* (Flajs).
1, hypotype, n. 20939, lateral view of Morphotype β Pa element, sample D, x 150; 2, hypotype, n. 20940, upper view of Morphotype β Pa element, sample C, x 95; 3, hypotype, n. 20941, upper view of Morphotype δ Pa element, sample S, x 95; 4, hypotype, n. 20942, lateral view of Morphotype δ Pa element, sample P, x 110; 5, hypotype, n. 20943, lateral view of Morphotype γ Pa element, sample G, x 95; 6, hypotype, n. 20944, lateral view of Morphotype γ Pa element, sample H, x 150; 7, hypotype, n. 20945, lower view of Morphotype β Pa element, sample D, x 95; 8, hypotype, n. 20946, upper view of Morphotype γ Pa element, sample G, x 95; 9, hypotype, n. 20948, inner lateral view of Pb element, sample D, x 95; 10, hypotype, n. 20949, inner lateral view of Pb element, sample A, x 95.

Figs. 11-18 - Apparatus A.
11, n. 20958, lateral view, sample C, x 95; 12a-b, n. 20959, inner and outer lateral views, sample H, x 150; 13, n. 20960, lateral view, sample F, x 120; 14a-b, n. 20961, inner and outer lateral views, sample E, x 150; 15, n. 20962, inner lateral view, sample E, x 100; 16, n. 20963, lateral view, sample E, x 100; 17, n. 20964, lateral view, sample E, x 100; 18, n. 20965, inner lateral view, sample E, x 100.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sociated with *Icriodus subterminus* Younquist. Two of these elements, S_{2b} and S_{2c}, correspond to the S_2 and M_2 elements, respectively.

Moreover, Johnson & Klapper (1981) statistically demonstrated the presence of both S_2 and M_2 elements associated with I elements of *Icriodus nevadensis* and *Icriodus trojani* in the upper part of the Lower Devonian. In a study based on a collection of fused clusters in a sample from the Upper Devonian, Nicoll (1982) recognized in the apparatus of *I. expansus* six types of cone elements (C elements). He suggested, furthermore, a new notational scheme that could be applied to the Icriodontidae. Serpagli (1983) described *Icriodus w. woschmidti* Ziegler apparatus consisting of six elements and not two as hitherto supposed, arranged into two transition series in accordance with the scheme proposed by Barnes *et al.* (1979).

Here the scheme proposed by Klapper and Philip (1971) is adopted. The icriodontan elements (I) at Galemmu were found in five samples. Only in one sample the M_2 element is missing, whereas all other samples contain the icriodontan elements (I) with simple cones (S_2 and M_2).

Icriodus angustoides alcoleae Carls, 1969

Pl. 4, figs. 7-20

1980 *Icriodus angustoides alcoleae* Carls - Klapper & Johnson, p. 447, tab. 2 (*cum. syn.*).

Description — I elements of *Icriodus a. alcoleae* are characterized by a narrow spindle and a cusp higher than other denticles. A distinct undenticolate costa is present in the position of the outer lateral or posterior process. It extends beyond the posterior margin of the basal cavity. The lateral-row round denticles are aligned with the middle-row denticles to which they are connected by thin transverse ridges. The basal cavity is narrow in the anterior half and expanded posteriorly.

In mature specimens the latter is broadly expanded posteriorly and bears a inner spur, moderately developed.

Acodinan (S_2) elements associated with *I. a. alcoleae* have a wide triangular base and developed anterior and posterior keels. Moreover, an outer lateral costa can be developed. Fine striations are present on the lateral surfaces of some elements (Pl. 4, figs. 8, 9).

The M_2 elements are represented by simple cones with an almost circular base; weak costae may be present in some specimens. The M_2 element is similar to that of *Pelekysgnathus* Thomas (Klapper & Philip 1972, p. 101, pl. 3, figs. 12, 13, 15).

Remarks — *Icriodus a. alcoleae* can be distinguished from *Icriodus angustoides angustoides* Carls & Gandl, which has a much higher cusp and many transverse ridges. The specimens from Galemmu are morphologically similar to those illustrated by Carls (1969, pl. 1, fig. 12; pl. 2, figs. 1-2), but they differ in having denticles less fused and longer in the outer lateral process.

I. a. alcoleae can be compared with the costate morphotype of *Icriodus trojani* Johnson & Klapper, which has a similar costa on the outer side, posteriorly. In the latter form the middle-row denticles of the spindle are well developed and the basal cavity is more restricted in posterior half.

I. a. alcoleae differs from *Icriodus nevadensis* Johnson & Klapper and from the other morphotype of *I. trojani* by lacking posterior process.

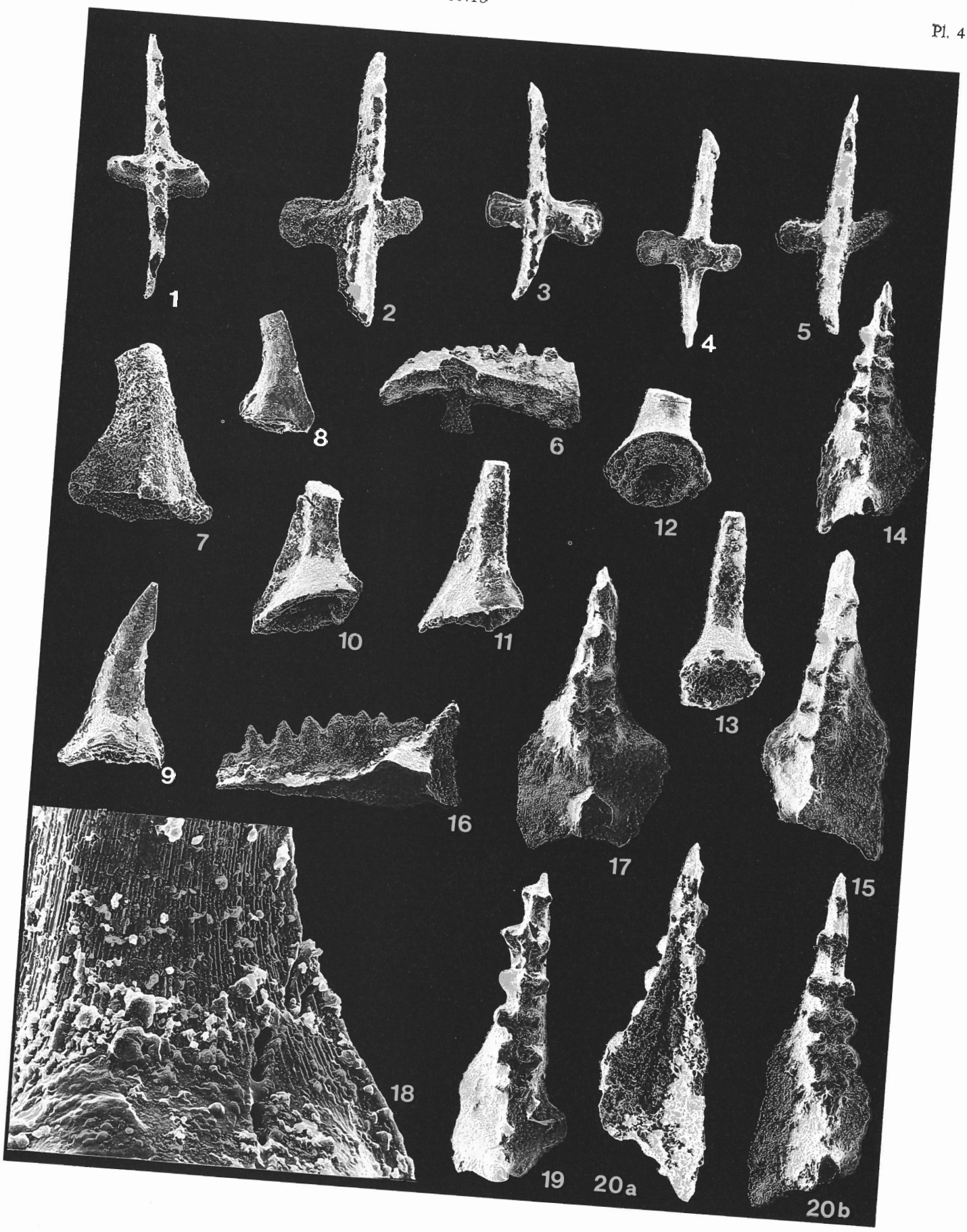
EXPLANATION OF PLATE 4

All specimens from Galemmu 2nd section, Early Devonian.

Fig. 1 - *Ozarkodina* sp. A.
Hypotype, n. 20931, upper view of Pa element, sample I, x 75.

Figs. 2-6 - *Ozarkodina steinhornensis telleri* (Schulze).
2, hypotype, n. 20933, upper view of Pa element, sample M, x 50; 3, hypotype, n. 20934, upper view of Pa element, sample N, x 75; 4, hypotype, n. 20935, lower view of Pa element, sample M, x 150; 5, hypotype, n. 20936, upper view of Pa element, sample I, x 75; 6, hypotype, n. 20937, lateral view of Pa element, sample M. x 150.

Figs. 7-20 - *Icriodus angustoides alcoleae* Carls & Gandl.
7, hypotype, n. 20871, outer lateral of S_2 element, sample Q, x 125; 8, hypotype, n. 20872, inner lateral view of S_2 element, sample N, x 125; 9, hypotype, n. 20873, inner lateral view of S_2 element, sample O, x 125; 10, hypotype, n. 20874, inner lateral view of S_2 element, sample N, x 125; 11, hypotype, n. 20875, inner lateral view of S_2 element, sample T, x 125; 12, hypotype, n. 20877, lateral view of M_2 element, sample N, x 125; 13, hypotype, n. 20878, lateral view of M_2 element, sample P, x 125; 14, hypotype, n. 20863, upper view of I element, sample R, x 60; 15, hypotype, n. 20865, upper view of I element, sample T, x 60; 16, hypotype, n. 20866, lateral view of I element, sample Q, x 45; 17, hypotype, n. 20867, upper view of I element, sample P, x 55; 18, detail of the fine striations on lateral view of S_2 element (fig. 9); 19, hypotype, n. 20868, upper view of I element, sample Q, x 60; 20a-b, hypotype, n. 20869, lower and upper views of I element, sample Q, x 75.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The only report of this species is from Guadarrama in central Spain.

Range — *eurekaensis* Zone — *delta* Zone (Klapper & Johnson 1980, tab. 2).

Material — 30 (I), 35 (S_2), 8 (M_2) elements.

Repository — Institute of Paleontology, Modena University, Micropaleontological Collection n. 20863-20869 (figured hypotypes of I elements), 20870 (hypotypes of I elements not figured), 20871-20875 (figured hypotypes of S_2 elements), 20876 (hypotypes of S_2 elements not figured), 20877-20878 (figured hypotypes of M_2 elements), 20879 (hypotypes of M_2 elements not figured).

Genus OZARKODINA Branson & Mehl, 1933a

Type species — *Ozarkodina confluens* (Branson & Mehl, 1933a) [=*Ozarkodina typica* Branson & Mehl, 1933a].

OZARKODINA EXCAVATA EXCAVATA (Branson & Mehl, 1933a)

Pl. 1, figs. 11, 14-15, 17, 19-21

1975 *Ozarkodina excavata excavata* (Branson & Mehl) - KLAPPER & MURPHY, p. 34, pl. 6, figs. 1-20 (*cum. syn.*).

Remarks — Klapper & Murphy (1975) provided a complete synonymy of this species, suggesting that the important character for determining the relationship between *Ozarkodina excavata excavata* and *Ozarkodina wurmi* (Bischoff & Sannemann) is to compare the shape of the basal cavity of Silurian Sa elements with that of the Devonian ones. The same authors, however, consider the Pa element of *O. e. excavata* synonym of that of *O. wurmi*. The Galemmu material contains only few poorly preserved Sa elements. No differences have been noted, thus I continue to consider the two species as synonyms.

Range — *patula* Zone (Walliser 1974, tab. 1) — *gronbergi* Zone (Klapper & Johnson 1980, tab. 1-5).

Material — 11 (Pa), 6 (Pb), 5 (M), 3 (Sc), 6 (Sb), 1 (Sa) elements.

Repository — Institute of Paleontology, Modena University, Micropaleontological Collection n. 20880-20881 (figured hypotypes of Pa elements), 20882 (hypotypes of Pa elements not figured), 20883 (figured hypotype of Pb element), 20884 (hypotypes of Pb elements not figured), 20885 (figured hypotype of M element), 20886 (hypotypes of M elements not figured), 20887 (figured hypotype of Sc element), 20888 (hypotypes of Sc elements not figured), 20889 (figured hypotype of Sb element), 20890 (hypotypes of Sb

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EXPLANATION OF PLATE 5

All specimens from Galemmu 2nd section, Early Devonian.

Fig. 1 - *Neoprioniodus multiformis* Walliser.
Hypotype, n. 20967, lateral view, sample M, x 45.

Figs. 2, 5 - Indet. Sb element.
2, n. 20968, lateral view, sample E, x 100; 5, n. 20969, lateral view, sample E, x 100.

Figs. 3, 6 - *Lonchodina greilingi* Walliser.
3, hypotype, n. 20970, posterior view, sample A, x 50; 6, hypotype, n. 20971, posterior view, sample A, x 50.

Fig. 4 - Indet. Sc element.
Hypotype, n. 20973, lateral view, sample L, x 45.

Fig. 7 - *Neoprioniodus excavatus* (Branson & Mehl).
Hypotype, n. 20974, lateral view, sample E, x 85.

Fig. 8 - *Trichonodella inconstans* Walliser.
Hypotype, n. 20975, posterior view, sample D, x 45.

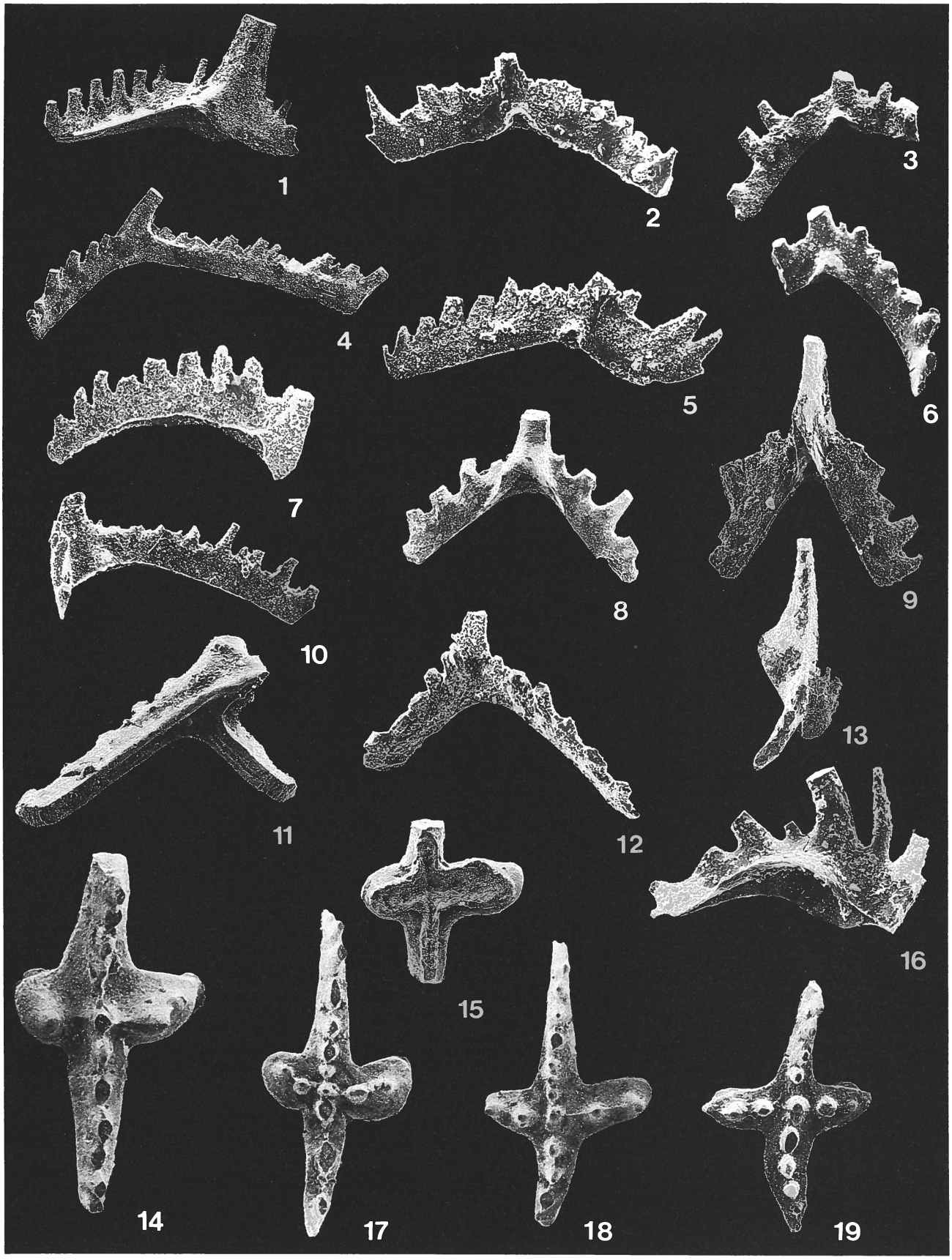
Figs. 9, 13 - *Trichonodella trichonodelloides* (Walliser).
9, n. 20977, posterior view, sample N, x 150; 13, n. 20978, lateral view, sample N, x 75.

Fig. 10 - *Ligonodina silurica* Branson & Mehl.
Hypotype, n. 20979, lateral view, sample P, x 55.

Figs. 11-12 - *Lonchodina detorta* Walliser.
11, n. 20981, inner lateral view, sample N, x 90; 12, n. 20982, outer lateral view, sample G, x 70.

Figs. 14-15 - *Ozarkodina transitans* (Bischoff & Sannemann).
17-19 14, hypotype, n. 20951, upper view of Morphotype α Pa element, sample L, x 38; 15, hypotype, n. 20952, lower view of Morphotype α Pa element, sample M, x 75; 17, hypotype, n. 20953, upper view of Morphotype γ Pa element, sample D, x 45; 18, hypotype, n. 20954, upper view of intermediate form, sample P, x 75; 19, hypotype, n. 20955, upper view of intermediate form, sample P, x 75.

Fig. 16 - *Lonchodina* cfr. *greilingi* Walliser.
Hypotype, n. 20984, posterior view, sample O, x 150.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elements not figured), 20900 (figured hypotype of Sa element).

Ozarkodina fluminensis n. sp.

Pl. 2, figs. 1-3, 5-6, 9-10, 14, text-fig. 4

Derivatio nominis — *flumen,* (latin) = river; after the origin of the name of Fluminimaggiore.

Holotype — Figured specimen in pl. 2, fig. 9a-c, n. 20901, Institute of Paleontology, Modena University.

Paratypes — Figured specimens in pl. 2, figs. 1-3, 5-6, 10, 14, n. 20902-20907, ibid. Specimens not figured n. 20908 ibid.

Locus typicus — Galemmu, 500 m NO of Fluminimaggiore (Iglesiente, Sardinia), F. 225, III NO.

Stratum typicum — Galemmu, sequence 2nd, layer P, *delta* Zone, Lochkovian.

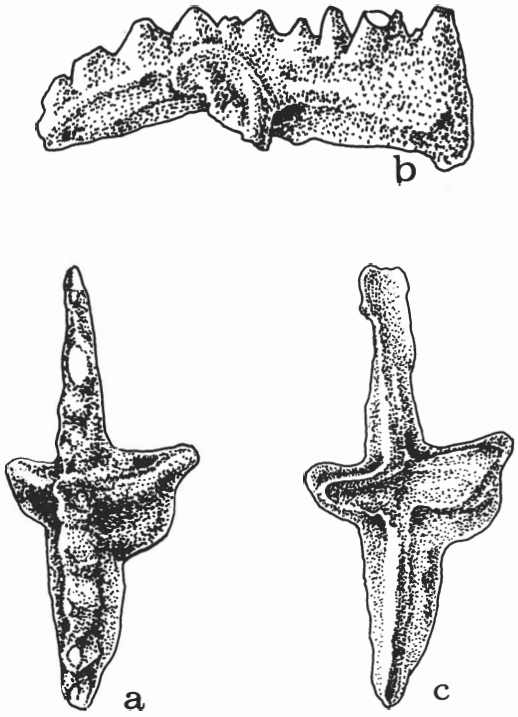
Diagnosis — A species of *Ozarkodina* whose Pa element is characterized by asymmetrical platform lobes at mid-length of the unit. The outer wider lobe has rounded upper margins, raised posterolaterally and bowed downward anteriorly. It has a depression in upper surface. The smaller inner lobe is crossed by a groove oblique to the blade. The basal cavity below the lobes is only slightly depressed.

Description — In upper view specimens show two lobes strongly asymmetric, located at mid-length. The wider lobe is on the outer side and delimited by a sinus in upper the margin: concave anterolaterally and slightly convex posterolaterally. The upper margin is rounded and raised posterolaterally, whereas it is strongly bowed downward anteriorly. A depression is present on the upper surface of the lobe. The smaller lobe is on the inner side and crossed by a low costa oriented at the angle to the blade. In some specimens the lower rim at the tip of the wider lobe extends farther laterally than the upper rim. The upper platform rim continues posteriorly until the end, but only for a short distance anteriorly.

The blade is high anteriorly and declines gradually to the posterior end. The denticles are uniformly high. They are conical and discrete.

The wide shallow basal cavity lies under the lobes but does not completely occupy all the lower surface. It extends as a very narrow groove along the anterior and posterior keels.

Remarks — *Ozarkodina fluminensis* n. sp. has an outline similar to *Ozarkodina delta* Klapper & Murphy. However, it can be distinguished from the latter species for the differently-shape lobes, the lacking of the depression that disects the wider lobe and the wider lobe being on the inner side. Furthermore, although the basal cavity under the lobes of the two species is similar excavated, the groove in the anterior and posterior keels is more evident in *O. delta*. *O. fluminensis* n. sp. differs also from *O. eleanorae* Lane & Ormiston in having the latter species lobes clearly subequal and rounded.



Text-fig. 4 - *Ozarkodina fluminensis* n. sp. a-c, upper, lateral and lower views of platform element (holotype). 20901, x 50.

It is possible that *O. fluminensis* n. sp. is confined to the *delta* Zone, and hence I regard the new taxon as diagnostic of that zone in Sardinia.

Material — 13 specimens.

Repository — Institute of Paleontology, Modena University, Micropaleontological Collection n. 20901 (holotype), 20902-20907 (figured paratypes), 20908 (paratypes not figured).

Ozarkodina remscheidensis remscheidensis (Ziegler, 1960)

Pl. 1, figs. 1-7, 12

1975 *Ozarkodina remscheidensis remscheidensis* (Ziegler) - Klapper & Murphy, p. 41, pl. 7, figs. 22, 25-30 (*cum. syn.*).

CONODONTS	LOWER DEVONIAN																	
	LOCHKOVIAN																	
	?			*delta* ZONE														
SPECIES \ SAMPLES	A	B	C	D	E	F	G	H	I	L	M	N	O	P	Q	R	S	T
Ozarkodina e. excavata (Pa)	1			2	2		3											3
Ozarkodina e. excavata (Pb)	1			1	1		1											2
Ozarkodina e. excavata (M)	1	1			2		1											
Ozarkodina e. excavata (Sc)					1		2											
Ozarkodina e. excavata (Sb)			1	1	2													2
Ozarkodina e. excavata (Sa)			1															
Ozarkodina r. remscheidensis (Pa)	8	6	9		1													
Ozarkodina r. remscheidensis (Pb)	9	1	3		2													
Ozarkodina r. remscheidensis (M)	1		1		1													
Ozarkodina r. remscheidensis (Sc)	1	2			1													
Ozarkodina r. remscheidensis (Sb)		1																
Ozarkodina r. remscheidensis (Sa)	1	2	1		1													
Ozarkodina stygia (Pa)	6		2	17	6		3	4		1			1					1
Ozarkodina stygia (Pb)				2	2		1	1										
Ozarkodina r. repetitor (Pa)			3	2			1				1	2						3
Ozarkodina r. repetitor (Pb)				2			2				1	5						1
Ozarkodina r. repetitor (M)				3														
Ozarkodina r. repetitor (Sc)			1				1											
Ozarkodina r. repetitor (Sb)			1	1														
Ozarkodina r. repetitor (Sa)				2								1						
Ozarkodina transitans				1		1	4			2	2	1		7				
Ancyrodelloides trigonicus					1	1	7	4	5					3	27	3	1	3
Ozarkodina s. telleri								2	7		1	4	5					
Ancyrodelloides kutscheri									1							1		
Ozarkodina fluminensis n. sp.									1			1		9	1			1
Icriodus a. alcoleae (I)												3		3	15	2		4
Icriodus a. alcoleae (S_2)												4	1	1	8	2		12
Icriodus a. alcoleae (M_2)												1		1	2			2
Apparatus A			2		6		4	1										
Ozarkodina sp. A				2	5					1			3	9	9			
Belodella devonica	23	4	17	26	2		18		26	1		15	5	62	17	1	10	25
Ligonodina silurica	1			1				1	1		1	2		3	2	1		
Ligonodina salopia				2			6	2	1	1			5	15	1			
Lonchodina detorta	1			1		1						1	2					
Lonchodina greilingi	3					1	3											
Lonchodina walliseri		1		3			3				3	4		8				
Neoprioniodus cf. *multiformis*	7			7	2		4		1	2		9		20	10			
Pseudooneotodus beckmanni				1							1			5	4		2	4
Trichonodella inconstans				1					1			1		2				
Trichonodella trichonodelloides				3			2				3	3		3				
Total number of specimens per sample	64	18	42	81	33	4	66	20	44	8	13	57	22	151	96	10	18	58
Weight (Kg)	9.4	2.7	2.2	2.8	3.0	3.0	4.0	2.8	9.0	2.6	2.8	7.4	1.9	15.1	8.0	2.0	6.3	10.7
Specimens per kilogram	7	7	19	29	11	1	16	7	5	3	5	8	12	10	12	5	3	5

CONODONTS	Total number of specimens
Ozarkodina e. excavata (Pa)	11
Ozarkodina e. excavata (Pb)	6
Ozarkodina e. excavata (M)	5
Ozarkodina e. excavata (Sc)	3
Ozarkodina e. excavata (Sb)	6
Ozarkodina e. excavata (Sa)	1
Ozarkodina r. remscheidensis (Pa)	24
Ozarkodina r. remscheidensis (Pb)	15
Ozarkodina r. remscheidensis (M)	3
Ozarkodina r. remscheidensis (Sc)	4
Ozarkodina r. remscheidensis (Sb)	1
Ozarkodina r. remscheidensis (Sa)	5
Ozarkodina stygia (Pa)	41
Ozarkodina stygia (Pb)	6
Ozarkodina r. repetitor (Pa)	12
Ozarkodina r. repetitor (Pb)	11
Ozarkodina r. repetitor (M)	3
Ozarkodina r. repetitor (Sc)	2
Ozarkodina r. repetitor (Sb)	2
Ozarkodina r. repetitor (Sa)	3
Ozarkodina transitans	18
Ancyrodelloides trigonicus	55
Ozarkodina s. telleri	19
Ancyrodelloides kutscheri	2
Ozarkodina fluminensis n. sp.	13
Icriodus a. alcoleae (I)	27
Icriodus a. alcoleae (S_2)	28
Icriodus a. alcoleae (M_2)	6
Apparatus A	13
Ozarkodina sp. A	29
Belodella devonica	252
Ligonodina silurica	13
Ligonodina salopia	33
Lonchodina detorta	6
Lonchodina greilingi	7
Lonchodina walliseri	22
Neoprioniodus cf. *multiformis*	62
Pseudooneotodus beckmanni	17
Trichonodella inconstans	5
Trichonodella trichonodelloides	14
Total number of specimens per sample	805
Weight (Kg)	——
Specimens per kilogram	——

Tab. 1 - Distribution of conodonts in the Galemmu 2nd section.

Remarks — A complete synonymy and exhaustive discussion of this subspecies are in Klapper & Murphy (1975).

In the Sardinian material all elements of the apparatus *O. r. remscheidensis* are present. This apparatus occurs in samples from the base of the section

In Carls & Gandl' material from Aragon *O. r. repetitor* (Carls & Gandl).

Range — *woschmidti* Zone (possibly extending downward into the uppermost Silurian; Klapper in Ziegler 1973, p. 242) — *delta* Zone (Klapper & Johnson 1980, tab. 2).

Material — 24 (Pa), 15 (Pb), 3 (M), 4 (Sc), 1 (Sb), 5 (Sa) elements.

Repository — Institute of Paleontology, Modena University, Micropaleontological Collection n. 20909-20911 (figured hypotypes of Pa elements), 20912 (hypotypes of Pa elements not figured), 20913 (figured hypotype of Pb element), 20914 (hypotypes of Pb elements not figured), 20915 (figured hypotype of M element), 20916 (hypotypes of M elements not figured), 20917 (figured hypotype of Sc element), 20918 (hypotypes of Sc elements not figured), 20919 (figured hypotype of Sb element), 20920 (figured hypotype of Sa element), 20921 (hypotype of Sa element not figured).

Ozarkodina remscheidensis repetitor (Carls & Gandl, 1969)

Pl. 1, figs. 13, 16, 18

1980 *Ozakodina remscheidensis repetitor* (Carls & Gandl) - Klapper & Johnson, p. 450, pl. 1, fig. 1, tabs. 2-3 (*cum. syn.*).

Remarks — The general aspect and the nearly uniform height of denticles of Pa element of *O. r. repetitor* resembles that of *O. r. eosteinhornensis* (Walliser), but it can be easily distinguished from it by a symmetrical narrow basal cavity at mid-length and a similar rising of both processes.

In Carls & Gandl' material from Aragon *O. r. repetitor* occurs in the 1dcγ strata of Luesma Formation associated with *O. r remscheidensis* (Ziegler), which latter subspecies differs, because of the markedly irregular height of denticles.

Some specimens from Galemmu show a short blade and a denticle above the basal cavity slightly higher than the others, they seem forms intermediate between *O. r. repetitor* and *O. r. remscheidensis*.

Range — ?*eurekaensis* Zone — *pesavis* Zone (Klapper & Johnson 1980, tabs. 2-3).

Material — 12 (Pa), 11 (Pb), 3 (M), 2 (Sc), 2 (Sb), 3 (Sa) elements.

Repository — Institute of Paleontology, Modena University, Micropaleontological Collection n. 20922-20923 (figured hypotypes of Pa elements), 20924 (hypotypes of Pa elements not figured), 20925 (figured hypotype of Pb element), 20926 (hypotypes of Pb elements not figured), 20927 (hypotypes of M elements not figured), 20928 (hypotypes of Sc elements not figured), 20929 (hypotypes of Sb elements not figured), 20930 (hypotypes of Sa elements not figured).

Ozarkodina steinhornensis telleri (Schulze, 1968)

Pl. 4, figs. 2-6

1968 *Spathognathodus steinhornensis telleri* Schulze, p. 229, pl. 17, figs. 18-19.

1978 *Spathognathodus steinhornensis telleri* Schulze - Serpagli, Gnoli, Mastandrea & Olivieri, p. 308, pl. 27, fig. 6.

Description — In upper view the blade is almost straight or slightly bowed posteriorly. Two rounded uneven lobes are located in the anterior third or, less commonly, just slightly posteriorly of that position. In some of the Galemmu specimens, the lobes are markedly asymmetrical, and the outer lobe is at least twice as wide as the inner lobe (Pl. 4, fig. 2). Most specimens however have lobes of nearly equal width.

The lobes are directed more or less at right angle to the blade, but can be also oblique to the blade. The denticles are of uniform height, closed one another but free near the pits, and they are compressed laterally.

In lateral view, the blade is high anteriorly and declines gradually to the posterior tip. The lower margin of the blade anteriorly at the basal cavity expansion is straight, while it makes a slightly concave arc posteriorly. The anterior end is at a level lower than that of the posterior end.

The abruptly expanded part of the basal cavity occupies the area under the two lobes and is moderately shallow. The basal cavity is continued anteriorly and posteriorly by a groove that extends along all the blade.

Remarks — The Galemmu material of *Ozarkodina s. telleri* agrees exactly with the type specimens from Karawanken Alps, Southern Austria (Schulze 1968, pl. 17, figs. 18-19).

They differ from the latter, however, in having much more variability in the angle formed by the axis of the lobes and the anterior two-thirds of the blade.

Furthermore, the denticles of the blade, in Galemmu specimens, are uniform and the lobes are markedly wider.

Only the Pa element of *O. s. telleri* is known with certainty.

In the sample where *O. s. telleri* is present, diplodellan elements (Sa) were not found; thus assignment to *Ozarkodina* is tentative.

Range — *delta* Zone (Klapper in Klapper & Ziegler 1979, p. 200).

Material — 19 (Pa) elements.

Repository — Institute of Paleontology, Modena University, Micropaleontological Collection n. 20933-20937 (figured hypotypes of Pa elements), 20938 (hypotypes of Pa elements not figured).

Ozarkodina stygia (Flajs, 1967)

Pl. 3, figs. 1-10

1978 *Spathognathodus stygius* Flajs - Serpagli, Gnoli, Mastandrea & Olivieri, p. 308, pl. 27, fig. 8.
1980 *Ozarkodina stygia* (Flajs) - Klapper & Johnson, p. 450, tabs. 2-3 (*cum. syn.*).

Diagnosis — Pa element is straight to strongly sigmoidal with a cusp above the large basal cavity. Pb element is a small edithaeform element with a posterior bar twisted inwardly.

Remarks — The Pa element is morphologically highly variable. In upper view the Pa element is straight, similar to Flajs' specimens, or strongly sigmoidal. A distinct high denticle is located above the basal cavity. Moreover, the upper margin of the free blade varies from straight to arched for the gradual increase in height of the denticles located anteriorly to the cusp.

In the Salmontrout River material, Lane & Ormiston (1979, p. 58) distinguished four morphotypes. Although the stratigraphic value of these morphotypes was not confirmed by a diagram, in the Galemmu material the specimens that occur from lower stratigraphic samples belong to the β morphotype, whereas γ and δ morphotypes occur in samples higher in the section.

Specimens belonging to the earliest form, α morphotype, are missing.

To date besides the Pa element of the apparatus of *O. stygia,* only the Pb element is known. As suggested by Lane & Ormiston (1979, p. 57), the Pb element is a small edithaeform element with a posterior bar twisted inward. The latter elements are also present in the Galemmu material.

Range — *eurekaensis* Zone — *pesavis* Zone (Klapper & Johnson 1980, tabs. 2-3).

Material — 50 (Pa), 6 (Pb) elements.

Repository — Institute of Paleontology, Modena University, Micropaleontological Collection n. 20939-20946 (figured hypotypes of Pa elements), 20947 (hypotypes of Pa elements not figured), 20948-20949 (figured hypotypes of Pb elements), 20950 (hypotypes of Pb elements not figured).

Ozarkodina transitans (Bischoff & Sannemann, 1958)

Pl. 2, fig. 2, pl. 5, figs. 14-15, 17-19

1969 *Spathognathodus transitans* Bischoff & Sannemann - Carls, p. 342, pl. 2, figs. 18-19 (*cum. syn.*).
1970 *Spathognathodus transitans* Bischoff & Sannemann - Seddon, p. 66, pl. 5, figs. 1-3.
1971 *Spathognathodus transitans* Bischoff & Sannemann - Bultynck, p. 34, pl. 1, figs. 3, 5-7.
1978 *Spathognathodus transitans* Bischoff & Sannemann - Serpagli, Gnoli, Mastandrea & Olivieri, p. 308, pl. 27. fig. 5.
1980 *Ozarkodina transitans* (Bischoff & Sannemann) - Klapper & Johnson, p. 450, tab. 2-3 (*cum. syn.*).

Remarks — The Galemmu specimens are very close to Bischoff & Sannemann's types of *O. transitans*. Platform elements of *O. transitans* have two unequal rounded lateral lobes or processes.

They are located at mid- length and bearing conical denticles.

A wide basal cavity occupies the area under the two lobes and it continue anteriorly and posteriorly by a narrow groove that extends along all the blade. In contrast, *Ancyrodelloides trigonicus* Bischoff & Sannemann has a small basal cavity.

Lane & Ormiston (1979, p. 58) recognized four morphotypes in the Salmontrout River material, which occur also in the Sardinia material. However, some specimens from Galemmu appear to possess a cavity intermediate between that of *O. transitans* δ morphotype *sensu* Lane & Ormiston and that of *A. trigonicus*.

Range — *delta* Zone — *pesavis* Zone (Klapper & Johnson 1980, tabs. 2-3).

Material — 19 specimens.

Repository — Institute of Paleontology, Modena University, Micropaleontological Collection n. 20951-20956 (figured hypotypes), 20957 (hypotypes not figured).

Apparatus A
Pl. 3, figs. 11-18

Remarks — Associated together in sample E, a series of elements morphologically similar were found that may be parts of a single apparatus. Moreover, some isolated elements also occur in samples C, G and H of the section. In apparatus A are included the elements with an apical denticle or cusp poorly differentiated from the others and with denticles of uniform width. The denticles are parallel to each other from base to top, though never fused and compressed laterally.

The basal cavity extends as narrow groove to the ends of the bars or processes. It may be extremely reduced at the point of greatest curvature as in some elements (pl. 3, fig. 13), or it shows a pronounced apical lip in others (pl. 3, figs. 12, 14).

The forms figured at pl. 3, figs. 11, 13 resemble to the Genus *Symprioniodina* Ulrich & Bassler, but they differs in lacking the prominent cusp.

These forms could probably be assigned to M elements as well as the specimen figured in pl. 3 fig. 18, they could be homologous of trichonodellan (Sa) element.

Material — 14 specimens.

Repository — Institute of Paleontology, Modena University, Micropaleontological Collection n. 20958-20965 (figured specimens), 20966 (specimens not figured).

ACKNOWLEDGEMENTS

I wish to thank to Prof. F. Russo, Modena University, who took scanning electron micrographs and assisted me in most of the photographic work; to the artist G. Leonardi, Modena University who re-drafted all the figures.

Thanks are due to Mr. G. Gentilini (technician at the Paleontological Institute, Modena University) for his help in processing materials.

This work was supported by grants of the Ministero della Pubblica Istruzione.

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(manuscript received April 13, 1985
accepted May 2, 1985)

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