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PERMIAN–TRIASSIC BOUNDARY AND EARLY TRIASSIC CONODONTS FROM THE SOUTHERN ALPS, ITALY

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In memory of our friend Giulio Pisa (1936–1976)

Key–words: Conodonta, Taxonomy, Biostratigraphy, Permian/Triassic, Southern Alps, Italy.

Riassunto. Sono stati studiati i conodonti provenienti da dieci sezioni stratigrafiche misurate nella Formazione a Bellerophon (Permiano Superiore) e nella Formazione di Werfen (Triassico Inferiore) delle Alpi Carniche e delle Dolomiti. Il materiale è stato classificato per apparati.

La Formazione a Bellerophon ha dato alcuni elementi di *Hindeodus typicalis, Ellisonia agordina, Ellisonia* sp. La Formazione di Werfen, dove la fauna è risultata più abbondante, ha fornito elementi di *Hindeodus typicalis, Ellisonia agordina, E. triassica, Hadrodontina anceps, Xaniognathus gradatus, Isarcicella isarcica, Pachycladina obliqua, Ellisonia delicatula, Neospathodus triangularis.*

Ellisonia agordina n. sp. è stata trovata al tetto della Formazione a Bellerophon e nella parte basale della Formazione di Werfen (dal Membro di Tesero a quello di Siusi), cioè al limite Permiano – Triassico e nel Triassico Inferiore.

Hindeodus typicalis, già nota nel Sudalpino nella Formazione di Werfen, è stata reperita anche nella parte superiore della Formazione a Bellerophon. La distribuzione della specie viene così estesa al Permiano Superiore. Le distribuzioni delle specie nel Sudalpino rientrano in quelle già note a livello mondiale.

Sulla base unicamente della fauna a conodonti non è possibile al momento stabilire una più esatta posizione del limite tra i due sistemi nelle successioni Bellerophon/Werfen delle Alpi Meridionali. Risulta comunque evidente che il ritrovamento di *Isarcicella isarcica* permette la sicura identificazione del Triassico.

Abstract. The Bellerophon (Late Permian) and Werfen (Lower Triassic) Formations were investigated on the basis of conodonts. Fifteen sections were sampled from Carnic Alps and Dolomites area in the Southern Alps. Ten were productive.

The Bellerophon Formation yielded a few specimens of *Hindeodus typicalis, Ellisonia agordina* and *Ellisonia* sp.

In the Werfen Formation were collected *Hindeodus typicalis, Ellisonia agordina, E. triassica, Hadrodontina anceps, Xaniognathus gradatus, Isarcicella isarcica, Pachycladina obliqua, Ellisonia delicatula, Neospathodus triangularis.*

In describing the conodont fauna, multielement taxonomy is applied.

Ellisonia agordina is a new species found at the top of the Bellerophon Formation and from the Tesero to the Siusi Members of the Werfen Formation, i. e. at the Permian – Triassic boundary and in the Lower Triassic. The apparatus of this new species is described. In the Southern Alps the range of *Hindeodus typicalis*, previously known in the Werfen Formation, extends down into the uppermost Bellerophon Formation. All species confirm the ranges found elsewhere in the world.

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On the basis of only the conodont fauna, it is not possible as yet to recognize the position of the Permian – Triassic boundary more precisely in the Bellerophon/Werfen Formations in the Southern Alps. It is obvious, however, that the recovery of *Isarcicella isarcica* allows the certain identification of the Triassic.

Introduction.

The international activity to define the Permian–Triassic boundary has brought out a careful study of the validity and the possibility to apply the conodont biostratigraphy (Sweet et al., 1971; Sweet & Bergstrom, 1986). This has shown itself very useful to clarify the relations among the other fossil groups (Newell, 1978; Altiner et al., 1980; Bando et al., 1980) mainly in areas, such as the Southern Alps of Northern Italy, where only shallow water sediments occur. These lack pelagic fossils like ammonoids and mainly contain benthic, environmentally dependent biota of minor importance for correlation purposes.

The conodonts, whose biostratigraphy is increasingly correlated with that of the ammonoid, are present in the area although as scarce specimens. The uppermost Permian and lowermost Triassic of the Southern Alps corresponding to the Bellerophon and Werfen Formations, have been investigated by stratigraphical, sedimentological and paleontological analyses (Bosellini, 1964; Bosellini & Hardie, 1973; Assereto et al., 1973; De Zanche & Farabegoli, 1981; Farabegoli & Viel, 1981, 1982a, b; Broglio Loriga et al., 1980, 1986; Broglio Loriga et al., 1979, 1983; Pasini, 1985). In previous conodont studies Huckriede (1958) first found conodonts in the Southern Alps (Pufelsbach = Bulla in Gardena Valley)

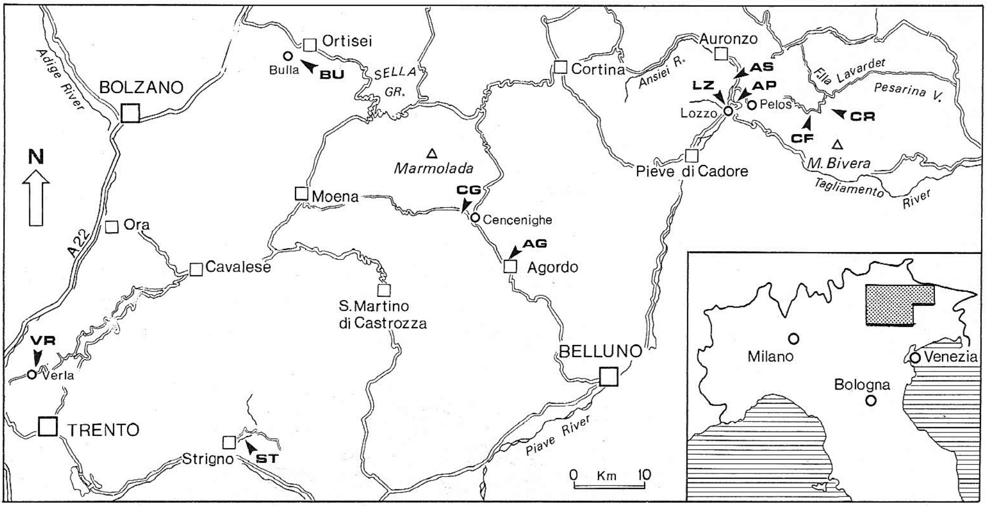


Fig. 1 – Index map of Carnic Alps and Dolomites (Southern Alps, Italy) showing the location of the conodont yielding sections. CF) Casera Federata; CR) Col di Rioda; LZ) Lozzo; AS) Ansiei; AP) Auronzo Pelos; AG) Agordo; CG) Cencenighe Galleria; BU) Bulla; ST) Strigno; VR) Verla.

1 Kozur & Mostler, 1982	2 Sweet et al., 1971	3 Sweet & Bergstrom, 1986
Foliella gardenae – Z.	13 *Neospathodus timorensis*	*Timorensis*
Pachycladina lata – Ass.–Z.	12 *Neogondolella jubata*	*Jubata*
Eurignathodus costatus – Z.	11	*Collinsoni*
E. paracostatus – Z.	10 *Platyvillosus*	*Triangularis*
Ellisonia aequabilis – Ass.–Z.	9 *Neogondolella milleri*	*Milleri*
Hindeodus n. sp. – Ass. – Z.	8 *Neospathodus conservativus*	*Waageni*
Isarcicella isarcicus – Z.	7 *Parachirognathus – Furnischius*	*Pakistanensis*
Hindeodus parvus – Ass.–Z.	6 *Neospathodus pakistanensis*	*Kummeli – cristagalli*
	5 *Neospathodus cristagalli*	*Isarcica*
	4 *Neospathodus dieneri*	*Typicalis* – – –traditional base of Triassic
	3 *Neospathodus kummeli*	
	2 *Neogondolella carinata*	
	1 *Anchignathodus typicalis*	

Tab. 1 – Conodont zonations.
1) Local zonation for the Southern Alps by Kozur & Mostler (1982). 2) Lower Triassic conodont zones proposed by Sweet et al. (1971) on the base of the world –wide ranges. 3) Zones proposed by Sweet & Bergstrom (1986) inferred from the composite section of the Lower Triassic created by grafic correlation of sections in Kashmir, Pakistan, Utah, northern Italy and Primor'ye.
Zonations 2 and 3 are the ones preferred in this report. No correlations are proposed.

describing five form species (*Spathognathodus isarcica* n. sp., *S.* cf. *minutus* (Ellison), *S.* n. sp. *A, Hindeodella* sp. *A, Lonchodina* n. sp. *A*) from the Seiser Schichten corresponding to the lower part of the Werfen Formation. Staesche (1964) studied the conodont associations, with 15 form species diagnosed (*Spathognathodus isarcicus* Huckriede, *Hadrodontina aequabilis* n. sp., *H. anceps* n. sp., *H.* sp. *A, H. adunca* n.sp., *H. biserialis* n.sp., *Eurygnathodus costatus* n. sp., *Pachycladina inclinata* n. sp., *P. lata* n. sp., *P. longispinosa* n. sp., *P. obliqua* n. sp., *P. symmetrica* n. sp., *P. tricuspidata* n. sp., *Polygnathus gardenae* n. sp., *Parachirognathus geiseri* Clark) from the Werfen Formation from the Alto Adige area. Assereto et al. (1973) first extracted conodonts (a single specifically

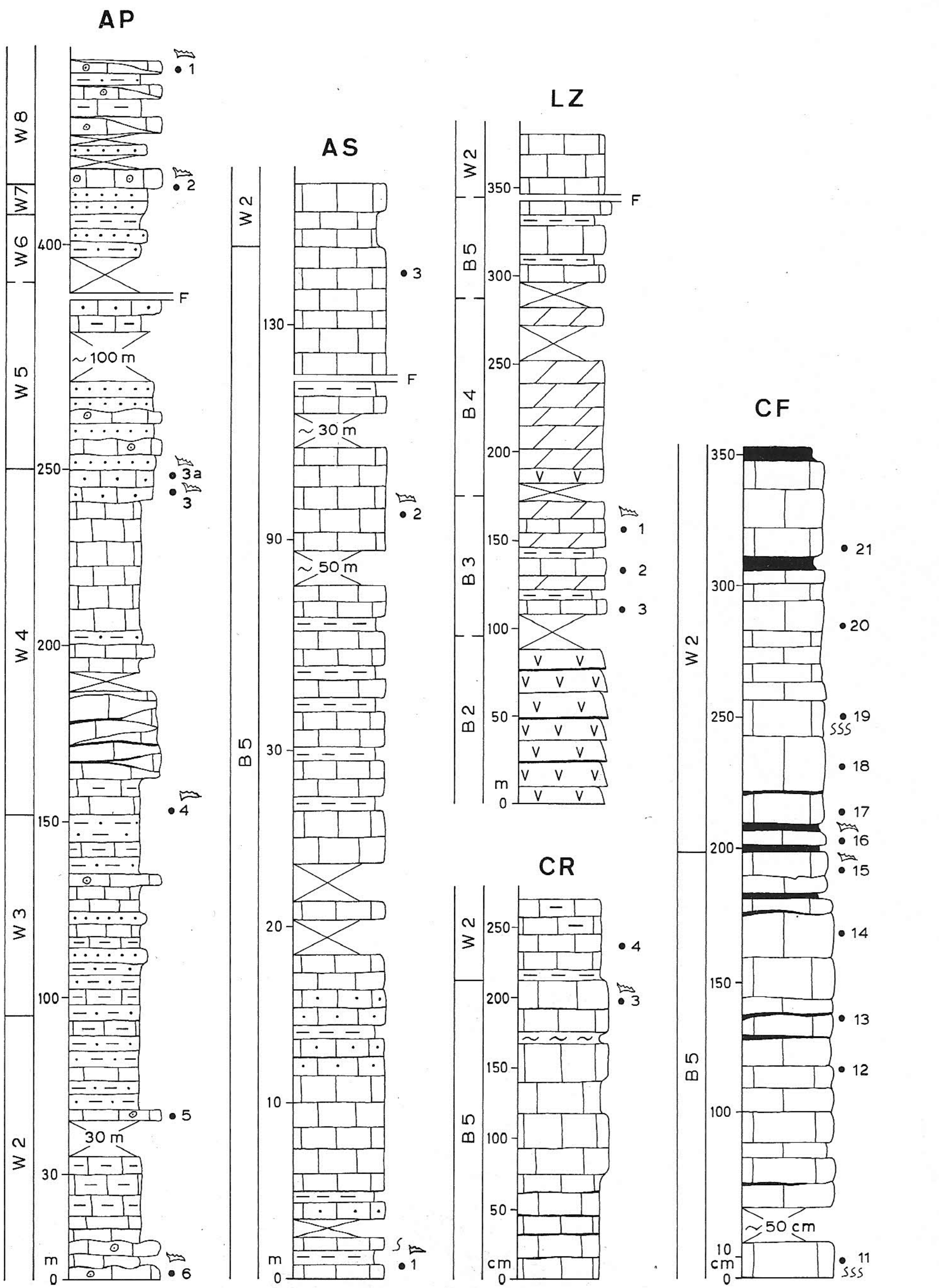
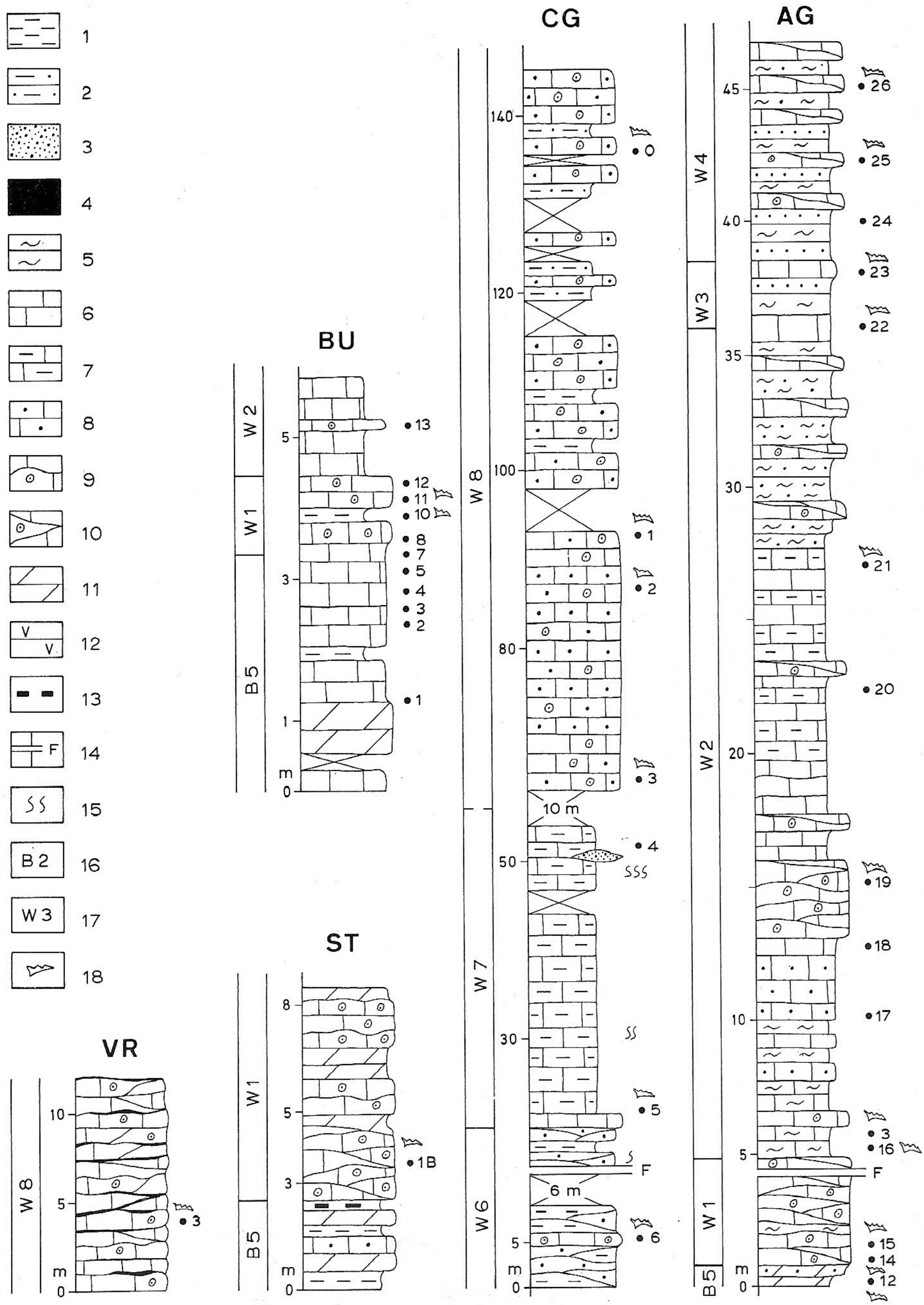


Fig. 2 – Stratigraphic columns of Casera Federata (CF), Col di Rioda (CR), Lozzo (LZ), Ansiei (AS), Auronzo Pelos (AP), Agordo (AG), Cencenighe Galleria (CG), Bulla (BU), Strigno (ST), Verla (VR) sections showing only the intervals yielding conodonts. 1) Siltstone; 2) silty sandstone; 3) sandstone; 4) marl, claymarl; 5) marl; 6) mudstone, wackestone; 7) silty mudstone and wackestone; 8) packstone, grainstone; 9) nodular oolitic limestone; 10) hummocky bedding oolitic limestone;



11) dolostone; 12) clastic gypsum; 13) carbonaceous bed; 14) fault; 15) bioturbations; 16) Bellerophon Formation members: B2) Lozzo Member, B3) Rioda Mb., B4) Barbide Mb., B5) Casera Razzo Mb.; 17) Werfen Formation members: W1) Tesero Mb., W2) Mazzin Mb., W3) Andraz Horizon, W4) Siusi Mb., W5) Gastropod Oolite Mb., W6) Campil Mb., W7) Val Badia Mb., W8) Cencenighe Mb.; 18) conodonts.

indeterminate specimen of *Anchignathodus* and fragmentary specimens of *Ellisonia*) from the Bellerophon Formation. Moreover, in the Mazzin and Siusi Members of the Werfen Formation they found specimens referred to the species *Anchignathodus typicalis* Sweet, *A. isarcicus* (Huckriede) and *Ellisonia* sp. Kozur & Mostler (1982) suggested a local biozonation inferred from the conodont ranges in the section along the road to Bulla Village (Tab. 1).

The purpose of the present study is the investigation of conodont biostratigraphy of the whole Bellerophon and Werfen Formations and especially the Permian–Triassic boundary in a wide area of the Southern Alps.

Stratigraphy.

Fifteen sections have been sampled in an area from the Western Carnic Alps to the Dolomites. Ten of these (Casera Federata, Col di Rioda, Lozzo, Ansiei, Auronzo Pelos, Agordo, Cencenighe Galleria, Bulla, Strigno, Verla) yielded conodonts (Fig. 1, 2).

The Bellerophon Formation usually occurs with modest thickness (a few meters); only in two continuous sections (Lavardet Rioda, lacking in conodonts, and Lozzo) it is about three hundred meters thick. The Bellerophon Formation overlies the Val Gardena Sandstone (Permian: Upper Capitanian–Dorashamian) characterized by red, grey and greenish sandstones, conglomerates and pelites. Locally the two formations interfinger (Assereto et al., 1973; Farabegoli & Viel, 1982b; Farabegoli et al., 1986) (Fig. 3). The Bellerophon Formation is characterized by two interfingering main lithofacies:

1) dark grey fossiliferous, calcareous packstone and wackestone, with 5–40 cm thick layers, rich in ostracods, bivalves, radiolarians, calcareous red algae, dasycladaceans and calcareous sponges, with subordinate pelites. Wave ripples and hummocky bedding are frequent;

2) prevalent light grey clastic gypsum alternating with pelites, micro and meso cristalline dolomite and vuggy dolomite with nodular and «chicken–wire» gypsum.

Alternations of these two lithofacies can be utilized to subdivide the Formation into five subunits. Recently Farabegoli et al. (1986, fig. 30, 31) have proposed an informal denomination for these *litosomata* (Fig. 3). From the base: B1 – Casera Federata Member (lithofacies 1); B2 – Lozzo Mb. (lith. 2); B3 – Rioda Mb. (lith. 1); B4 – Rio Barbide Mb. (lith. 2); B5 – Casera Razzo Mb. (lith. 1).

The depositional environment is considered to be a shallow water high energy marine area sometimes evolving into lagoonal peritidal conditions experiencing gypsum deposition by evaporation phases.

The Werfen Formation paraconformably overlies the Bellerophon Formation (Assereto et al., 1973; Bosellini & Hardie, 1973; Farabegoli et al., 1986). The Werfen Formation is subdivided from the base to the top into the following subunits:

W1 – Tesero Mb. Oolite limestones and dolomites alternating with marly micrite. The thickness is 0 to 11 m. This subunit interfingers with the overlying Mazzin Mb. in the Dolomites and it does not occur in the Cadore–Carnia area.

W2 – Mazzin Mb. Grey micrite marly or silty, sometimes nodular, and mudstone alternating with grey pelites. Bioturbated layers. The thickness is 30–60 m.

W3 – Andraz Horizon. Yellow and red laminated marly–silty dolomites and dolomicrite with rare interbedded gypsum layers. Mudcracks are present. Thickness is 10–30 m.

W4 – Siusi Mb. Grey limestones and micritic marly–silty limestones with storm layers. Grey and reddish siltstones, marls and clays with wave ripples. Moderate bioturbation. The thickness is about 50 to 100 m.

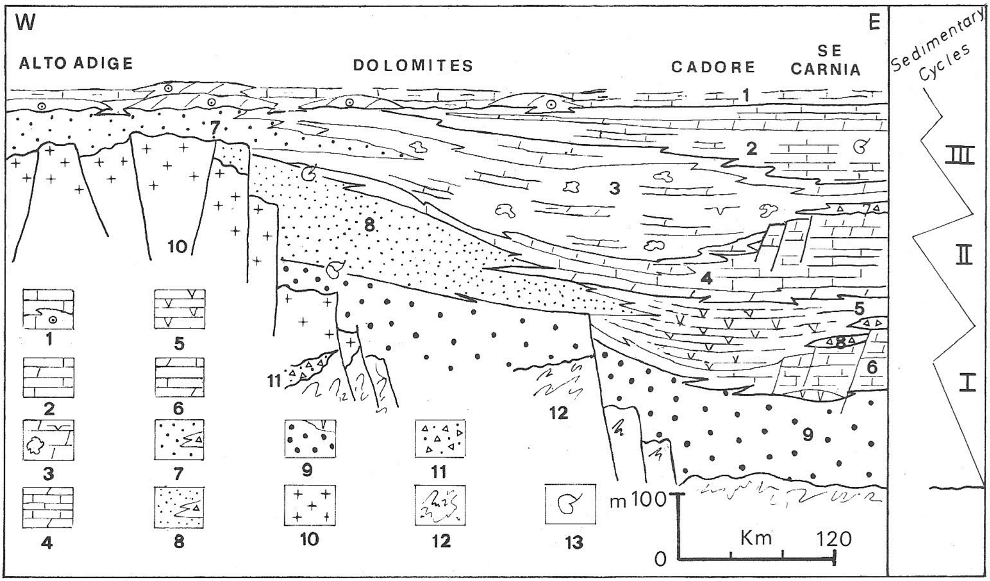


Fig. 3 – Stratigraphic–paleostructural relationships between the Permian–Lower Scythian units in Dolomites and Southwestern Carnia (after Farabegoli & Viel, 1982b, modified in Farabegoli et al., 1986).
Werfen Formation: 1) Tesero and Mazzin Members. Bellerophon Formation: 2) limestones of upper Bellerophon Formation (Casera Razzo Member); 3) gypsum –dolomite cycles of upper Bellerophon Fm. (Rio Barbide Member); 4) limestones of middle Bellerophon Fm. (Rioda Member); 5) clastic, laminated gypsum of middle Bellerophon Fm. (Lozzo Member); 6) limestones of lower Bellerophon Fm. (Lavardet Mb.). Val Gardena Sandstone: 7) sandstone and breccias of upper Val Gardena Sandstone (Rio Bavaro Member); 8) sandstone and breccias of middle V. Gardena Sandstone (Butterloch Member); 9) sandstones, conglomerates, pelites and gypsum of lower V. Gardena Sandstone (Ora Member). 10) Volcanic Complex; 11) Basal Conglomerate; 12) Metamorphic basement; 13) nautiloids.
The lithostratigraphic informal nomenclature of the Bellerophon–Val Gardena Sandstone Formations is from Farabegoli & Viel (in preparation).

W5 – Gastropod Oolite Mb. Yellowish and reddish fossiliferous oolitic packstones and wackestones. Hummocky bedding frequent. Grey, greenish fine sandstones alternating to grey–greenish pelites. The Gastropod Oolite crops out only in two of the investigated sections (Auronzo Pelos, Agordo). Maximum measurable thickness is 8 m.

W6 – Campil Mb. Red quartzose–micaceous siltstones and fine sandstones with frequent ripple marks, hummocky bedding, mudcracks and load casts. This subunit is often covered and faulted. Maximum measurable thickness is 15 m.

W7 – Val Badia Mb. Grey silty–marly limestones and subordinate siltstones. The thickness is 8 to 30 m.

W8 – Cencenighe Mb. Red, violet and yellow oolitic wackestones, packstones, oolitic dolomites, pelites, siltstones and sandstones. Frequent hummocky bedding. The thickness is 30 to more than 100 m.

The depositional environment of the Werfen Formation can be referred to a shallow epicontinental sea (Assereto et al., 1973).

Therefore, the shallow marine sedimentation was periodically interrupted by supra–subtidal episodes, indicating a sequence of sedimentary transgressive –regressive cycles controlled by eustatic and tectonic phases (De Zanche & Farabegoli, 1981; Farabegoli & Viel, 1982a).

The conodont fauna.

The following conodont fauna has been recovered in the two investigated formations (Tab. 2): *Ellisonia agordina* n. sp., *E. delicatula* Sweet, 1970, *E. triassica* Müller, 1956, *Hadrodontina anceps* Staesche, 1964, *Hindeodus typicalis* Sweet, 1970, *Isarcicella isarcica* (Huckriede, 1958), *Neospathodus triangularis* (Bender, 1970), *Pachycladina obliqua* Staesche, 1964, *Xaniognathus gradatus* (Sweet, 1970).

The sampled carbonate lithofacies of the Bellerophon Formation yielded in the Rioda Member (Lozzo section) only fragmentary specimens of *Ellisonia*, in the Casera Razzo Mb. (Casera Federata, Col di Rioda, Ansiei sections) a few specimens of *Hindeodus typicalis*, sometimes in association with elements of *Ellisonia*, and in the uppermost part of the same member (Agordo section) *Ellisonia agordina* (Fig. 2, 4, 5). *Hindeodus typicalis* ranges into the Werfen Formation where it is present in the Mazzin Mb. (Casera Federata section) and in the Tesero Mb. (Bulla and Strigno sections). *Isarcicella isarcica* was found in the Mazzin Mb. (Auronzo Pelos section). The lower part of the Werfen Formation (Tesero–Siusi Members) contains also *Ellisonia agordina, E. triassica, Hadrodontina anceps, Xaniognathus gradatus.*

Ellisonia triassica, Hadrodontina anceps and *Xaniognathus gradatus* range from the lower into the upper part of the Werfen Formation (Campil–Cencenighe Members). *Pachycladina obliqua* starts in the Campil Mb. and ranges up to the Cencenighe Mb. (Cencenighe Galleria section). The first appearances of *Neospathodus triangularis* and *Ellisonia delicatula* are in the Val Badia Mb.

		VR	ST	BU		CG						AG											AP						AS		LZ	CR	CF	
		W8	W1	W1		W6	W7	W8				B5	W1			W2			W3		W4		W2	W4			W8		B5		B3	B5	B5	W2
		3	1B	10	11	6	5	3	2	1	0	12	14	15	16	3	19	21	22	23	25	26	6	4	3	3a	2	1	1	2	1	3	15	16
Ellisonia sp.	Sa																												1					
	Sc			5																											2	1		
Hindeodus typicalis	Pa		3	9	1																									1		4		2
	Pb																															1		
	Sa																															1		
	Sb		1																													1		
	Sc																															3	1	1
Ellisonia agordina	Pa												2			1	1			1	1	1												
	Pb											1	2		2	1	3			3	1	1												
	M												1			1	2			10		1												
	Sa															1	3	1		10														
	Sb												4	1	1		1	1		2														
	Sc											3	4		2	4	10			23	2	4												
Ellisonia triassica	Pa									1?																								
	Pb						1?																											
	M						1?																2				1							
	Sa						1																1?				1							
	Sb						1?																											
	Sc						2			1			2		3	8	1	3					2	1	2	1	8	1						
Hadrodontina anceps	Pa					11																												
	Pb	2				15			1		2																							
	M	1				22		1	1?		7		1		2	1		1									1							
	Sa					16					1																							
	Sb	1				10			1		3																							
	Sc					7			4			3																						
Xaniognathus gradatus	Pb													1					1															
	M																										1							
	Sa																		2								1							
	Sb																										1	1						
	Sc																										1							
Isarcicella isarcica	Pa																						2											
Pachycladina obliqua	Pa					68		1																										
	Pb					108																												
	M					68		1																										
	Sa					62					2																							
	Sb					76			1		1																							
	Sc					31					2																							
Ellisonia delicatula	Pb						1																											
	M						1?																											
	Sb						1																											
	Sc									4																		3						
Neospathodus triangularis	Pa						35																				1							

Tab. 2 – Distribution of conodonts in samples from the studied sections. (See Fig. 2).

and they range up into the Cencenighe Mb. (Auronzo Pelos and Cencenighe Galleria sections).

Summarizing these data (Fig. 5):

a) *Hindeodus typicalis* ranges from the uppermost Bellerophon Formation

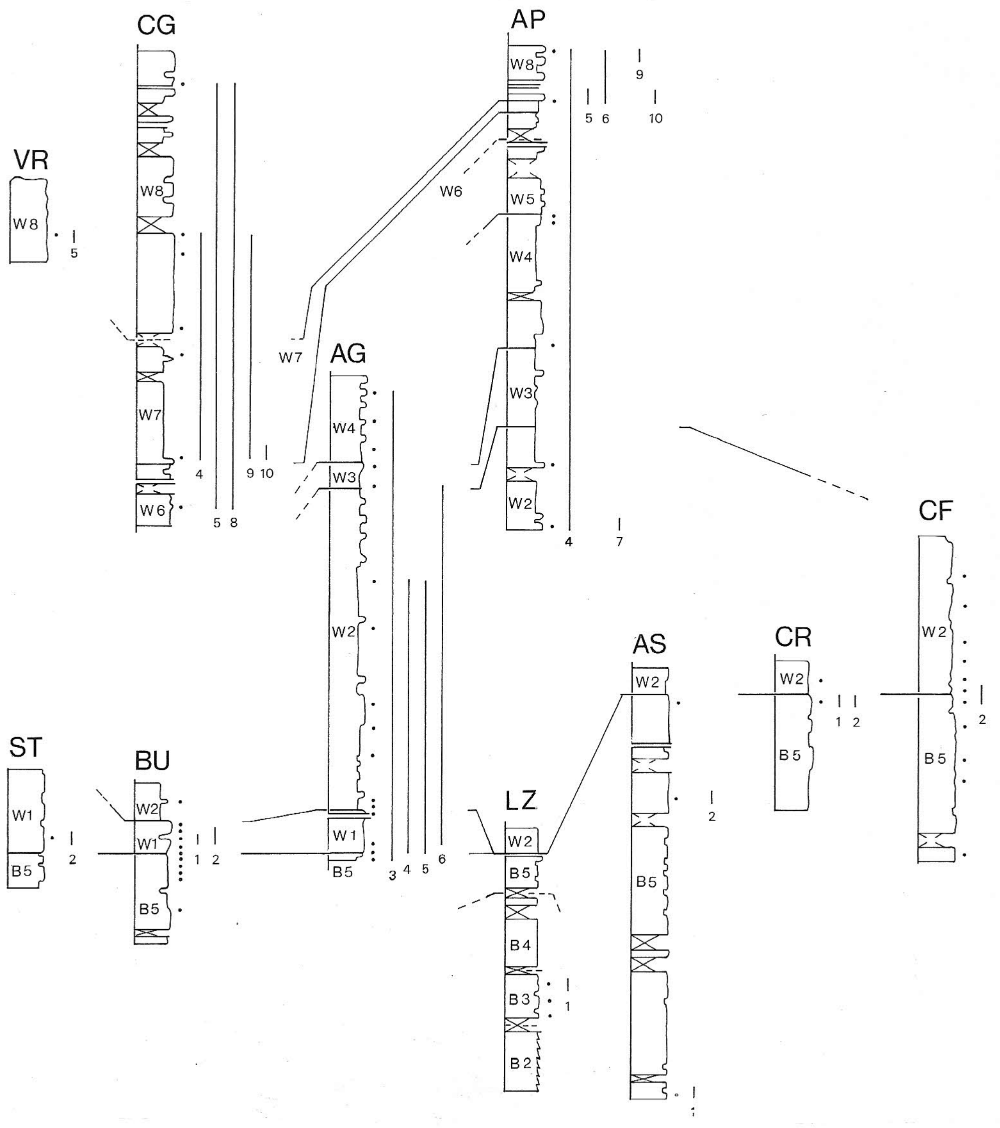


Fig. 4 – Lithostratigraphic correlation of the examined sections with conodont ranges. 1) *Ellisonia* sp.; 2) *Hindeodus typicalis*; 3) *Ellisonia agordina*; 4) *E. triassica*; 5) *Hadrodontina anceps*; 6) *Xaniognathus gradatus*; 7) *Isarcicella isarcica*; 8) *Pachycladina obliqua*; 9) *Ellisonia delicatula*; 10) *Neospathodus triangularis*. (For the scales of the stratigraphic columns see Fig. 2).

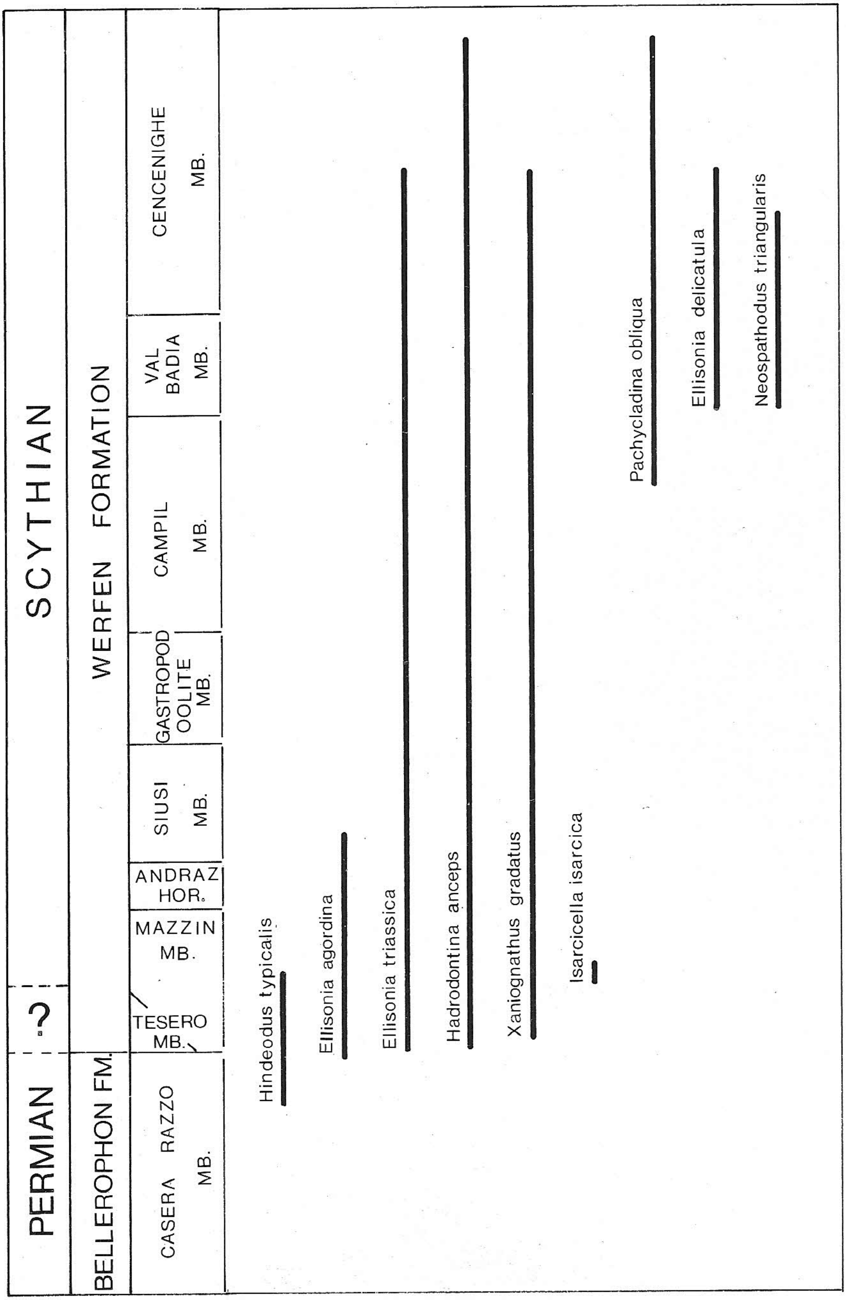


Fig. 5 – Composite conodont ranges in the standard sequence of the uppermost Bellerophon and Werfen Formations in the investigated area. ?) Interval in which the position of the Permian/Triassic boundary more precisely could be recognized.

into the lowermost Werfen Formation. b) *Ellisonia agordina* starts in the uppermost Bellerophon (70 cm below the formational boundary) and continues in the Tesero–Siusi Members. c) *Ellisonia triassica* and *Hadrodontina anceps* were recovered throughout the whole Werfen Formation. d) *Xaniognathus gradatus* was found only in the lower part and in the uppermost part of the Werfen Formation. e) *Isarcicella isarcica* is present in the Mazzin Mb. f) *Pachycladina obliqua* occurs from the Campil to the Cencenighe Mb. g) *Neospathodus triangularis* and *Ellisonia delicatula* range in the Val Badia and Cencenighe Members.

Biostratigraphy and chronostratigraphy.

Sweet et al. (1971) defined the *typicalis* Zone. These authors located the traditional Permian–Triassic boundary within this zone. Sweet & Bergstrom (1986) have the same point of view.

In the Southern Alps, Assereto et al. (1973) found *H. typicalis* in the Mazzin Mb. from the basal bed of the unit, in association with *Lingula. H. typicalis* has been found by us in samples from the base of the Werfen Formation and from the uppermost Bellerophon Formation.

In the Southern Alps Staesche (1964), Assereto et al. (1973) and we, in this work, found *Isarcicella isarcica* some 15–25 m above the base of the Werfen Formation. Sweet (1973, 1979) judges that *I. isarcica* is the lowermost Triassic species occurring together with the Triassic ammonoids *Ophiceras* and *Glyptophiceras* in Kashmir, West Pakistan and Iran. Assereto et al. (1973), on the basis of the occurrence of *I. isarcica*, suggest a Lower, but not basal, Griesbachian age for the Mazzin Mb.

Sweet & Bergstrom (1986) proposed the *isarcica* Zone above the *typicalis* Zone.

On the basis of only the conodont fauna it is not possible as yet to locate the position of the Permian–Triassic boundary more precisely in the Bellerophon/Werfen stratigraphic successions in the Southern Alps. However, it is obvious that the recovery of *Isarcicella isarcica* permits the certain identification of the Triassic.

The occurrence of *Pachycladina obliqua* (Fig. 5) corresponds to the one reported by Staesche (1964). The Campil, Val Badia and Cencenighe Members of the Werfen Formation yielding *P. obliqua* were referred to upper Nammalian–Spathian age on the basis of benthic macrofossils by Broglio Loriga et al. (1983) and Broglio Loriga et al. (1986). The wide geographic distribution (N. America, Europe, Middle East, Asia) and the range restricted to the Upper Scythian suggest an important stratigraphic use for *P. obliqua*.

The range of *Neospathodus triangularis* confirms the Spathian age suggested by Perri (1986) in the Southern Alps.

The ranges of *Ellisonia delicatula, E. triassica* and *Xaniognathus gradatus* fall within the ranges given by Sweet (1970 b) and confirm a Lower Triassic age and in particular *E. delicatula* indicates the Upper Lower Triassic.

The new species *Ellisonia agordina* found in association with long–ranging species such as *E. triassica* and *Hadrodontina anceps*, may be of local biostratigraphic utility for the lower Scythian.

Therefore, on the basis of the collected faunas, only the Zone 1 (= *Anchygnathodus typicalis* Zone) of the standard conodont biostratigraphic zonation (Sweet et al., 1971) is recognizable (Tab. 1). According to the biozones proposed by Sweet & Bergstrom (1986) (Tab. 1), the *typicalis, isarcica* and *triangularis* Zones are identifiable in the Southern Alps. The other ones are not identified because of the absence of the diagnostic species.

Systematic paleontology

In describing the conodont fauna, multielement taxonomy is applied. We have followed the locational notation scheme used in Robison (Ed.) (1981). Here the Color Alteration Index (CAI) as proposed by Epstein et al. (1977) for conodont elements is utilized.

The complete synonymy is given only for the discussed species.

All studied and figured specimens are registered in the conodont inventory (IC) and deposited at the Museo «G. Capellini» of the Dipartimento di Scienze Geologiche of the University of Bologna.

SUPERFAMILY	FAMILY	GENUS	SPECIES
Gondolellacea	*Ellisoniidae*	*Ellisonia*	*agordina* *delicatula* *triassica*
		Hadrodontina	*anceps*
		Pachycladina	*obliqua*
	Xaniognathidae	*Neospathodus*	*triangularis*
		Xaniognathus	*gradatus*
Polygnathacea	*Anchignathodontidae*	*Hindeodus*	*typicalis*
		Isarcicella	*isarcica*

Genus *Ellisonia* Müller, 1956

Type species *Ellisonia triassica* Müller, 1956

Ellisonia agordina n. sp.

Pl. 30, fig. 1–7

Derivatio nominis. From the name of the village near the *Locus typicus.*

Holotype. Sa element, IC 1353 (Pl. 30, fig. 5).

Paratypes. Pa element, IC 1349 (Pl. 30, fig. 1a, b); Pb element, IC 1350 (Pl. 30, fig. 2a, b); M element, IC 1351 (Pl. 30, fig. 3a, b); Sa element, IC 1352 (Pl. 30, fig. 4); Sb element, IC 1354 (Pl. 30, fig. 6a, b); Sc element, IC 1355 (Pl. 30, fig. 7a, b).

Locus typicus. Section cropping out along the road S.S. N. 347 at SW of Agordo (Belluno).

Stratum typicum. Agordo section, samples AG 23, at 39,65 m from the base of the Werfen Formation in the Andraz Horizon.

Age. Lower Triassic (Griesbachian).

Material. 49 specimens.

Repository. Museo «G. Capellini», Dipartimento di Scienze Geologiche, Bologna.

Diagnosis. Species with a seximembrate apparatus characterized by an inflated rib at midheight of the elements.

Description. Apparatus seximembrate with Pa element carminate, Pb digyrate and bowed out, M digyrate, Sa alate with posterior process, Sb digyrate, Sc bipennate with long posterior process and shorter laterally deflected anterior process.

The species is characterized by an inflated rib at midheight of the elements. This characteristic is located on the outer side in the Pa, Sc–position elements and on the anterior side in the Pb, M, Sa, Sb–position elements. Robust elements bearing big laterally compressed denticles discrete in late stage of growth, with little needle–shaped denticles between two big ones in the early stage of growth.

Wide lower side, flattened to reversed, with basal pit extending in a basal groove and broadly expanded zones of recessive basal margin. Well visible growth strips.

Pa element. Carminate element faintly bent with five subequal denticles bowed toward the posterior end.

Pb element. Digyrate with one process longer than the other and outwardly bowed. 5 to 7 denticles. Cusp bent toward the shorter process.

M element. Digyrate element with processes of unequal length. Wide variability in the shape of the lower side depending on the size of the element.

Sa element. Alate with long arched denticulate posterior process. The last denticle of this process is very thick. The two antero–lateral processes with fused denticles are very short and form an angle of 180° degrees. The inflated rib at midheight on the anterior surface of the two antero–lateral processes is well developed in the elements representing late growth stage. The big cusp bows toward the posterior process. Lower side wide and flattened.

Sb element. Digyrate with the two processes different in length. The shorter process bears 3 denticles, the longer 5. The large cusp bends towards the longer lateral process. Inflated rib at midheight distinctly visible.

Sc element. Bipennate element. The shorter anterior process, bearing two denticles, laterally deflected, the longer posterior process with very discrete big denticles. Inflated rib well marked at midheight on the outer side.

Remarks. Abundant specimens, well preserved in every stage of growth, with CAI of 3. No species known in literature shows affinities.

Occurrence. Agordo section, Bellerophon Formation: samples AG 12 (Casera Razzo Member); Werfen Formation: AG 14, 15, 16 (Tesero Mb.); AG 3, 19, 21 (Mazzin Mb.); AG 23 (Andraz Hor.); AG 25, 26 (Siusi Mb.).

Age. Upper Permian (Upper Dorashamian) – Lower Triassic (Griesbachian).

Ellisonia delicatula Sweet, 1970

Multielement

1970b *Ellisonia delicatula* Sweet, p. 226, pl. 4, fig. 9–14.

Remarks. According to Sweet (1981), apparatus seximembrate. Some elements representing the Pb (digyrate), M (digyrate), Sb (digyrate) and Sc (bipennate) positions of the apparatus of *Ellisonia delicatula* are present. Rare specimens with CAI of 3 close to those figured by Sweet (1970b).

Occurrence. Auronzo Pelos section, Werfen Formation: sample AP 1 (Cencenighe Member). Cencenighe Galleria section, Werfen Formation: sample CG 5 (Val Badia Mb.); CG 1 (Cencenighe Mb.).

Age. Lower Triassic (Spathian).

Material. 10 specimens.

Ellisonia triassica Müller, 1956

Multielement

1970b *Ellisonia triassica* – Sweet, p. 235, pl. 5, fig. 9, 13–15, 17, 18, 20–22 (*cum syn*).
1981 *Ellisonia triassica* – Sweet, p. W152, fig. 101 *Ellisoniidae*, 3 a–f.

Remarks. According to Sweet (1981) apparatus seximembrate. The specimens found may be referred to the Pa, Pb, M, Sa, Sc positions of the apparatus corresponding to the original diagnosis. The material is scant and fragmentary of CAI 3.

Occurrence. Auronzo Pelos section, Werfen Formation: samples AP 6 (Mazzin Member); AP 4, 3, 3a (Siusi Mb.); AP 2 (Cencenighe Mb.). Agordo section, Werfen Formation: samples AG 14, 16 (Tesero Mb.); AG 3, 19, 21 (Mazzin Mb.). Cencenighe Galleria section, Werfen Formation: samples CG 5 (Val Badia Mb.); CG 1 (Cencenighe Mb.).

Age. Lower Triassic (Griesbachian–Spathian).

Material. 44 specimens.

Ellisonia sp.

Remarks. Few specimens in Sa (alate with posterior process) and Sc (bipennate) positions with broad basal cavity extending in a basal groove; characters common in elements of Permian species of the genus *Ellisonia.*

Occurrence. Col di Rioda section, Bellerophon Formation: sample CR 1 (Casera Razzo Member). Lozzo section, Bellerophon Formation: sample LZ 1 (Rioda Mb.). Ansiei section, Bellerophon Formation: sample AS 1 (Casera Razzo Mb.). Bulla section, Werfen Formation: sample BU 10 (Tesero Mb.).

Age. Upper Permian (Dorashamian) – Lower Triassic (Griesbachian).

Material. 9 specimens.

Genus *Hadrodontina* Staesche, 1964

Type species *Hadrodontina anceps* Staesche, 1964

Hadrodontina anceps Staesche, 1964

Pl. 31, fig. 1–6

Pa element

1964 *Hadrodontina biserialis* Staesche, p. 274, fig. 7, 24, 42; pl. 28, fig. 11; pl. 32, fig. 2.
1973 *Hadrodontina biserialis* – Budurov & Pantic, p. 55, pl. 1, fig. 27–29.

Pb element

1986 *Hadrodontina* n. sp. Perri, pl. 1, fig. 3.

M element

1964 *Hadrodontina anceps* Staesche, p. 272, fig. 40, pl. 28, fig. 7, 8; pl. 32, fig. 5.
1973 *Ellisonia anceps* – Budurov & Pantic, p. 50, pl. 2, fig. 7–13.
1979 *Hadrodontina subsymmetrica* – Buryi, p. 31, pl. 3, fig. 1–4, 6.
1986 *Hadrodontina anceps* – Perri, pl. 1, fig. 2.

Sa element
Sb element

1964 *Hadrodontina adunca* Staesche, p. 273, fig. 10, 26, 41; pl. 28, fig. 9, 10.
1979 *Hadrodontina adunca* – Buryi, p. 32, pl. 4, fig. 1, 2, 4.

Sc element

1964 *Hadrodontina* n. gen. Staesche, pl. 28, fig. 12.
1986 *Hadrodontina* n. sp. *A* –Perri, pl. 1, fig. 4.

Multielement

1981 *Hadrodontina anceps* – Sweet, p. W 153, fig. 101 *Ellisoniidae*, 1a–e.

Description. Apparatus seximembrate with Pa element angulate, Pb digyrate, M digyrate, Sa alate, Sb digyrate, Sc bipennate.

Big elements bearing peg like denticles with a possible secondary row of denticles on the outer side parallel to main denticle series. Wide asymmetrical lower surface with inner (Pa, Pb, Sc) or posterior (M, Sa, Sb) side more expanded and flattened than outer or anterior one, showing a characteristic rounded surface. Midlateral ribs and growth stripes. Basal margin sharp. A small basal cavity or a only pit is always present.

The Pb, Sa and Sc elements are described here for the first time.

Pa element. Angulate element with inner side more flattened than outer one inflated and rounded. Main denticle row with 11 to 14 subequal, radial denticles and bowed inwardly. All specimens bear a secondary denticle row with 3 to 6 discrete, small or node–like denticles.

Pb element. Digyrate element bowed outwardly, with unequal processes forming an angle of variable width. Subequal, 9 to 11 denticles in the main row, bowed laterally and posteriorly. In larger size specimens, on the anterior side corresponding to the curvature, 2 or 3 denticles are present at the base of the larger ones of the main denticle row.

M element. Digyrate element with processes subequal to different in length with 7–9 posteriorly bowed denticles and a large cusp. At the base of the cusp, on the posterior side, there is a prominence, probably an incipient of a posterior process.

Sa element. Alate element with no posterior process. 7–13 denticles that are radial, and slightly bowed posteriorly. A discrete, straight slightly posterior bowed cusp longer than any denticle. In major size specimens above the midlateral rib of the anterior side may bear one or more denticles like a secondary denticle row.

Sb element. Digyrate slightly asymmetrical element with two lateral processes of different length. The longer process about at half length develops a strong curvature and has 7 to 13 denticles. The large cusp is slightly bowed laterally and posteriorly.

Sc element. Bipennate element with a small incurved anterior process bearing 1 or 2 denticles and a long sinuous posterior process with 3 to 4 posteriorly curved denticles. Also, the large cusp curves posteriorly. Lower surface wide especially on inner side. Lower margin sharp.

Remarks. Many well preserved specimens, in every stage of growth, with CAI of 3. The apparatus herein reconstructed has some elements very close to specimens referred to form species of *Hadrodontina* figured by Staesche (1964) and to the *Hadrodontina anceps* seximembrate apparatus by Sweet (1981).

In the lower part of the Werfen Formation only M elements are present

(Tab. 2). These are very close to the M element with a wide basal cavity figured by Sweet (1981, fig. 101 *Ellisoniidae*, 1 c). In contrast, in the upper part of the Werfen Formation the whole apparatus has been found with the M element closely similar to the form species *Hadrodontina anceps* figured by Staesche (1964, pl. 28, fig. 7, 8; pl. 32, fig. 5). Thus, the apparatus shows close affinities in the Pa and M elements with the apparatus described but not figured by Hirsch (1981, p. 203).

Occurrence. Cencenighe Galleria section, Werfen Formation: samples CG 6 (Campil Member); CG 3, 2, 0 (Cencenighe Mb.). Auronzo Pelos section, Werfen Formation: sample AP 2 (Cencenighe Mb.). Agordo section, Werfen Formation: samples AG 14, 16 (Tesero Mb.); AG 3, 21 (Mazzin Mb.). Verla section, Werfen Formation: sample VR 3 (Cencenighe Mb.).

Age. Lower Triassic (Griesbachian–Spathian).

Material. 115 specimens.

Repository. Hypotypes: IC 1356 – IC 1361.

Genus *Hindeodus* Rexroad & Furnish, 1964

Type species *Trichonodella imperfecta* Rexroad, 1957
(= *Spathognathodus cristulus* Youngquist & Miller, 1949)

Hindeodus typicalis (Sweet, 1970)

Pl. 32, fig. 1–5

Pa element

1970a *Anchignathodus typicalis* Sweet, p. 7, pl. 1, fig. 13, 22.
1970b *Anchignathodus typicalis* – Sweet, pp. 222–223, pl. 1, fig. 13, 20.

Multielement

1970b *Ellisonia teicherti* Sweet, p. 232, pl. 4, fig. 20–28.
1977 *Hindeodus typicalis* – Sweet, p. 223, *Hindeodus* – pl. 2, fig. 1–6.

Remarks. Apparatus seximembrate with Pa element carminiscaphate, Pb element angulate, M element dolobrate or digyrate with one lateral process adenticulate, Sa element alate with no posterior process, Sb element digyrate and Sc bipennate.

Few specimens have been found in this study, some are well preserved and show a CAI of 1. Pa elements are more abundant than the ramiform ones. The Pa elements fall within the intraspecific variability of the form species *Anchignathodus typicalis* established by Sweet (1970a,b) on Kashmir and West Pakistan specimens. All the apparatus elements are very close to ones of *Hindeodus* *typicalis* figured in Sweet (1977, *Hindeodus* – pl. 2, fig. 1–6). The species *H. typicalis* (Sweet, 1970) and *H. minutus* (Ellison, 1941) have been separated herein because they have distinctly different Pa elements.

In agreement with Sweet (1977) and Clark & Carr (1982), it is necessary to study *Hindeodus* not only by analyzing the Pa elements but also by study of the whole apparatus.

Moreover, following the opinions of Sweet (1977) and Clark & Carr (1982), *Hindeodus*, ranging from the Pennsylvanian to Scythian, probably includes more than the known species.

Occurrence. Casera Federata section, Bellerophon Formation: sample CF 15 (Casera Razzo Member); Werfen Formation: CF 16 (Mazzin Mb.). Col di Rioda section, Bellerophon Formation: sample CR 3 (Casera Razzo Mb.). Ansiei section, Bellerophon Formation: sample AS 2 (Casera Razzo Mb.). Auronzo Pelos section, Werfen Formation: sample AP 6 (Mazzin Mb.). Bulla section, Werfen Formation: sample BU 10 (Tesero Mb.). Strigno section, Bellerophon Formation: sample ST 1b (Casera Razzo Mb.).

Age. Upper Permian (Dorashamian) – Lower Triassic (Griesbachian).

Material. 29 specimens.

Repository. Hypotypes: IC 1362 – IC 1366.

Genus *Isarcicella* Kozur, 1975

Type species *Spathognathodus isarcicus* Huckriede, 1958

Isarcicella isarcica (Huckriede, 1958)

Pl. 32, fig. 6, 7

Pa element

1958 *Spathognathodus isarcica* Huckriede, pp. 162, 167, pl. 10, fig. 6, 7a-c.
1958 *Spathognathodus* cf. *minutus* (Ellison) – Huckriede, pp. 162, 167, pl. 10, fig. 8.
1964 *Spathognathodus isarcicus* – Staesche, pp. 288–289, fig. 6, 60–64.
1970b *Anchignathodus isarcicus* – Sweet, pp. 223–224, pl. 1, fig. 18, 19.
1973 *Spathognathodus isarcicus* – Hirsch & Süssli, p. 528, pl. 1, fig. 1, 2.
1973 *Anchignathodus isarcicus* – Sweet, pp. 13–14, *Anchignathodus* – pl. 1, fig. 1a-c.
1975 *Anchignathodus parvus* Kozur & Pjatakova, in Kozur, pp. 7–9, pl. 1, fig. 17, 19, 20, 22.
1975 *Isarcicella isarcicus* – Kozur, p. 11, pl. 1, fig. 18.
1975 *Anchignathodus parvus* – Kozur, Mostler & Rahimi–Yazd, p. 4, pl. 1, fig. 12–15; pl. 7, fig. 7–9.
1975 *Isarcicella isarcicus* – Kozur, Mostler & Rahimi–Yazd, p. 6, pl. 7, fig. 3–6, 8.
1977 *Isarcicella isarcica* – Sweet, pp. 229–230, text–fig. «Terminology of *Isarcicella* Kozur, 1975», p. 225.
1980 *Anchignathodus parvus* – Bando et al., pl. 9, fig. 12.
1980 *Isarcicella isarcica* – Bando et al., pl. 9, fig. 11.
1981 *Hindeodus parvus* – Matsuda, pp. 91–93, pl. 5, fig. 1–3.

1981 *Isarcicella isarcica* – Matsuda, pp. 93–94, pl. 5, fig. 4–7.
1981 *Isarcicella isarcica* – Sweet & Clark, pp. W167 – W168, fig. 114/2.
1982 *Isarcicella isarcica* – Paull, fig. 5/14, 16–19.

Remarks. Apparatus unimembrate with variable Pa element. That is scaphate, posteriorly truncate with smooth, laterally expanded basal cavity. A few specimens are present in this study that probably represent an early growth stage. CAI 2.

The problem of the specific attribution of these laterally adenticulate elements is still open. According to some authors these elements show morphological characters close to the form species *Spathodus minutus* Ellison, 1941 or *Anchignathodus typicalis* Sweet, 1970, for other authors to the form species *Spathognathodus isarcicus* Huckriede, 1958.

Huckriede (1958, pl. 10, fig. 8) referred the smooth elements to *Spathognathodus* cf. *S. minutus* (Ellison).

Staesche (1964) included Huckriede's Tyrolean specimens and others from his own collection from the South Tyrol, northern Italy, in *S. isarcicus* (Huckriede).

Kozur & Pjatakova (in Kozur, 1975) described these laterally adenticulate elements as a new species, *Anchignathodus parvus*, characteristic of the *Ophiceras commune* Zone.

According to Kozur (1975), *Isarcicella isarcica* (Huckriede), agrees in size, cusp and denticle row with *A. parvus*. The two species are slightly different in the denticulate (= *isarcica*) or adenticulate (= *parvus*) laterally expansed basal cavity.

Sweet (1977), in agreement with Staesche (1964), included the smooth form in *Isarcicella isarcica* (Huckriede), as one of the three morphotypes of the species. According to Sweet (1977), in the Werfen Formation the stratigraphic range of these adenticulate specimens is the same as the laterally denticulate Pa elements on which *I. isarcica* was based.

Additionally, Paull (1982) collected in a section of the Terrace Mountains, northwestern Utah, the three morphotypes of *I. isarcica*. The few specimens found herein are closely similar to one figured by Paull (fig. 5/18).

Matsuda (1981) referred these laterally adenticulate elements to *Hindeodus parvus* (Kozur & Pjatakova) because the «*H. parvus* Pa element is very close to *H. minutus* Pa element and is regarded to be derived from *H. minutus* Pa element through a transitional form. The morphological characters of *Isarcicella* genus elements, are different from *H. minutus* and *H. parvus* Pa elements». So Matsuda has not included *A. parvus* in the genus *Isarcicella* but rather in *Hindeodus*, even though the ramiform elements characteristic of that genus have not been found in his study of the Kashmir samples. According to Sweet (1981), the laterally adenticulate elements were found in samples lacking ramiform components of *Hindeodus*, and are thus included in *Isarcicella*. The ramiform elements of *Isarcicella isarcica* are still unknown (Sweet, 1977), so the apparatus is problably unimembrate with a variable single element (Sweet & Clark, 1981).

In our opinion, the morphological characters close to those of the form species *isarcica*, and the absence of ramiform elements characteristic of *Hindeodus* in association in the same sample, indicates that the laterally smooth specimens should be included in *Isarcicella*.

Occurrence. Auronzo Pelos section, Werfen Formation: sample AP 6 (Mazzin Member).

Age. Lower Triassic (Griesbachian).

Material. 2 specimens.

Repository. Hypotypes: IC 1367 – IC 1368.

Genus *Neospathodus* Mosher, 1968

Types species *Spathognathodus cristagalli* Huckriede, 1958

Neospathodus triangularis (Bender, 1970)

Pl. 33, fig. 1–5

Pa element

1963 *Spathognathodus triangularis* – Bender & Kockel, pl. 54.
1964 *Spathognathodus* n. sp. *A* Staesche, p. 289, pl. 31, fig. 1.
1968 *Neospathodus cristagalli* – Mosher (part), p. 930, pl. 115, fig. 2.
1970 *Spathognathodus triangularis* Bender, p. 530, pl. 5, fig. 22a, b, 23.
1970b *Neospathodus triangularis* – Sweet, p. 253, pl. 1, fig. 7, 8.
1986 *Neospathodus triangularis* – Perri, p. 25, pl. 1, fig. 1.

Remarks. Unimembrate apparatus composed of segminate, straight or slightly curved Pa elements. The species is characterized by a short and high blade and a basal cavity with a triangular or heart–like outline.

Abundant well preserved specimens in every stage of growth with CAI of 2.

The specimen figured by Staesche (1964, pl. 31, fig. 1) could be referred to *N. triangularis* because of the short blade and the heart–like basal cavity. This specimen is closely similar to those found herein and to those previously collected in the Southern Alps by Perri (1986).

Occurrence. Auronzo Pelos section, Werfen Formation: sample AP 2 (Cencenighe Member). Cencenighe Galleria section, Werfen Formation: sample CG 5 (Val Badia Mb.).

Age. Lower Triassic (Spathian).

Material. 36 specimens.

Repository. Hypotypes: IC 1369 – IC 1373.

Genus *Pachycladina* Staesche, 1964

Type species *Pachycladina obliqua* Staesche, 1964

Pachycladina obliqua Staesche, 1964

Pl. 34, fig. 1–7

Pa element

1964 *Pachycladina lata* Staesche, p. 284, fig. 18, 55.
1973 *Parachirognathus lata* – Budurov & Pantic, p. 59, pl. 1, fig. 21–23.
1974 *Hadrodontina* cf. *H. adunca* – Hirsch & Gerry, pl. 1, fig. 7.

Pb element

1964 *Pachycladina inclinata* Staesche, p. 282, fig. 17, 23, 33, 53, 54; pl. 29, fig. 5, 6.
1973 *Parachirognathus ethingtoni* – Budurov & Pantic, p. 57, pl. 2, fig. 1, 2, 5, 6.
1974 *Pachycladina inclinata* – Hirsch & Gerry, pl. 1, fig. 4.

M element

1964 *Pachycladina obliqua* Staesche, p. 279, fig. 14, 21, 31, 46, 47; pl. 29, fig. 2–4.
1973 *Parachirognathus obliqua* – Budurov & Pantic, p. 58, pl. 4, fig. 5, 6.
1974 *Pachycladina obliqua* – Hirsch & Gerry, pl. 1, fig. 10.

Sa element

1964 *Pachycladina symmetrica* Staesche, p. 280, fig. 19, 20, 30, 35, 48–51; pl. 29, fig. 1; pl. 31, fig. 4; pl. 32, fig. 1.
1973 *Parachirognathus obliqua* – Budurov & Pantic, p. 58, pl. 4, fig. 1, 2, 4.
1979 *Parachirognathus symmetrica* – Buryi, p. 28, pl. 1, fig. 1, 2.
1981 *Pachycladina symmetrica* – Wang & Cao, p. 369, pl. 3, fig. 7, 8.
1981 *Pachycladina tridentata* – Wang & Cao, p. 369, pl. 3, fig. 12, 13.

Sb element

1964 *Pachycladina tricuspidata* Staesche, p. 281, fig. 16, 34, 52.
1973 *Parachirognathus obliqua* – Budurov & Pantic, p. 58, pl. 4, fig. 3.
1974 *Pachycladina symmetrica* – Hirsch & Gerry, pl. 1, fig. 9.
1974 *Pachycladina tricuspidata* – Hirsch & Gerry, pl. 1, fig. 11.
1979 *Hadrodontina symmetrica* – Buryi, p. 33, pl. 2, fig. 1, 2.
1981 *Pachycladina tricuspidata* – Wang & Cao, p. 369, pl. 3, fig. 17, 18.
1981 *Pachycladina trigona* – Wang & Cao, p. 370, pl. 3, fig. 10.
1981 *Pachycladina tridentata* – Wang & Cao, p. 369, pl. 3, fig. 14.

Sc element

1964 *Pachycladina longispinosa* Staesche, p. 285, fig. 15, 22, 32, 56–58; pl. 30, fig. 2; pl. 31, fig. 2.
1973 *Parachirognathus longispinosa* – Budurov & Pantic, p. 58, pl. 3, fig. 15, 16, 18, 20.
1974 *Pachycladina longispinosa* – Hirsch & Gerry, pl. 1, fig. 5.

Multielement

1981 *Pachycladina obliqua* – Sweet, p. W154, fig. 102 *Ellisoniidae*, 4a-e.

Remarks. According to Sweet (1981), the apparatus is seximembrate with Pa element carminate to planate, Pb digyrate, M digyrate, Sa alate, Sb digyrate, Sc bipennate.

Robust elements bear large denticles that are generally laterally compressed, a wide lower surface that is cuneiform with midlateral ribs corresponding to the upper margins of the lower surface. Growth stripes visible on two thirds of the lower surface. Very small or quite invisible basal pit.

Pa element. Very wide, straight carminate to planate element. The midlateral ribs are laterally developed like a platform. 4 to 7, bowed denticles posteriorly. The cusp can be the same or up to double the height of the other denticles.

Pb element. Slightly asymmetrical digyrate element, midlateral ribs not expanded as in the Pa element. The element bears 5 to 9 radial, laterally and posteriorly bowed discrete denticles. Cusp up to three times as high as the other denticles.

M element. Digyrate with processes of unequal length, ratio is 1/1,5 to 1/2,5.5 to 9 denticles radial or laterally and posteriorly bowed. Large cusp two or up to two and half times as high as the other denticles, bowed toward the shorter process and sometimes posteriorly.

Sa element. Alate without posterior process, with 3–11 denticles straight to slightly curved in opposite directions. The cusp is straight, sometimes posteriorly bowed, with height up to twice that of the other denticles. On the outer side of the lower surface the midlateral rib shows a wide variability in the outline, from W–shaped to a wide continuous lip. These stages were distinguished by Staesche (1964) as variant A and B of the form species *P. symmetrica.*

Sb element. Slightly asymmetrical digyrate element, without posterior process. 4 to 10 denticles and cusp, two or three times higher, postero–laterally curved. The anterior midlateral rib shows two prominences, that more pronounced is on the shorter process and corresponds to the curvature of the element.

Sc element. Bipennate with incurved anterior process and long posterior process with a ratio of 1/2 to 1/3. Denticles (5 to 9) and a large cusp curved inwardly.

Many massive specimens, of large size, well preserved, in every stage of growth, with CAI of 3.

Occurrence. Cencenighe Galleria section, Werfen Formation: sample CG 6 (Campil Member); CG 3, 2, 0 (Cencenighe Mb.).

Age. Lower Triassic (Upper Nammalian–Spathian).

Material. 421 specimens.

Repository. Hypotypes: IC 1374 – IC 1380.

Genus *Xaniognathus* Sweet, 1970

Type species *Xaniognathus curvatus* Sweet, 1970

Xaniognathus gradatus (Sweet, 1970)

Multielement

1970a *Ellisonia gradata* Sweet, p. 8, pl. 1, fig. 1, 5, 6, 9, (*cum syn.*).
1970b *Ellisonia gradata* – Sweet, p. 229, pl. 4, fig. 1–8.

Remarks. According to Sweet (1981) apparatus seximembrate with Pa element carminate or angulate, Pb digyrate, M digyrate, Sa alate with long posterior process, Sb digyrate, Sc bipennate.

The studied specimens may be referred to the Pb, M, Sa, Sb, Sc elements of the apparatus of *X. gradatus*. Scant and fragmentary material, with CAI of 3. The elements show morphological characters close to those of *Ellisonia gradata* figured by Sweet (1970b).

Occurrence. Auronzo Pelos section, Werfen Formation: samples AP 2, 1 (Cencenighe Member). Agordo section, Werfen Formation: sample AG 15 (Tesero Mb.); AG 22 (Andraz Hor.).

Age. Lower Triassic (Griesbachian–Spathian).

Material. 9 specimens.

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PLATE 30

Ellisonia agordina n. sp.

Fig. 1 a, b – Pa element. a) Inner view; b) outer view. Paratype, IC 1349.

Fig. 2 a, b – Pb element. a) Anterior view; b) posterior view. Paratype, IC 1350.

Fig. 3 a, b – M element. a) Posterior view; b) anterior view. Paratype, IC 1351.

Fig. 4 – Sa element, antero–lateral view. Paratype, IC 1352.

Fig. 5 – Sa element, lateral view. Holotype, IC 1353.

Fig. 6 a, b – Sb element. a) Anterior view; b) posterior view. Paratype, IC 1354.

Fig. 7 a, b – Sc element. a) Inner view; b) outer view. Paratype. IC 1355.

Agordo section, sample AG 23, Andraz Horizon, Werfen Formation.
All magnifications x 75.

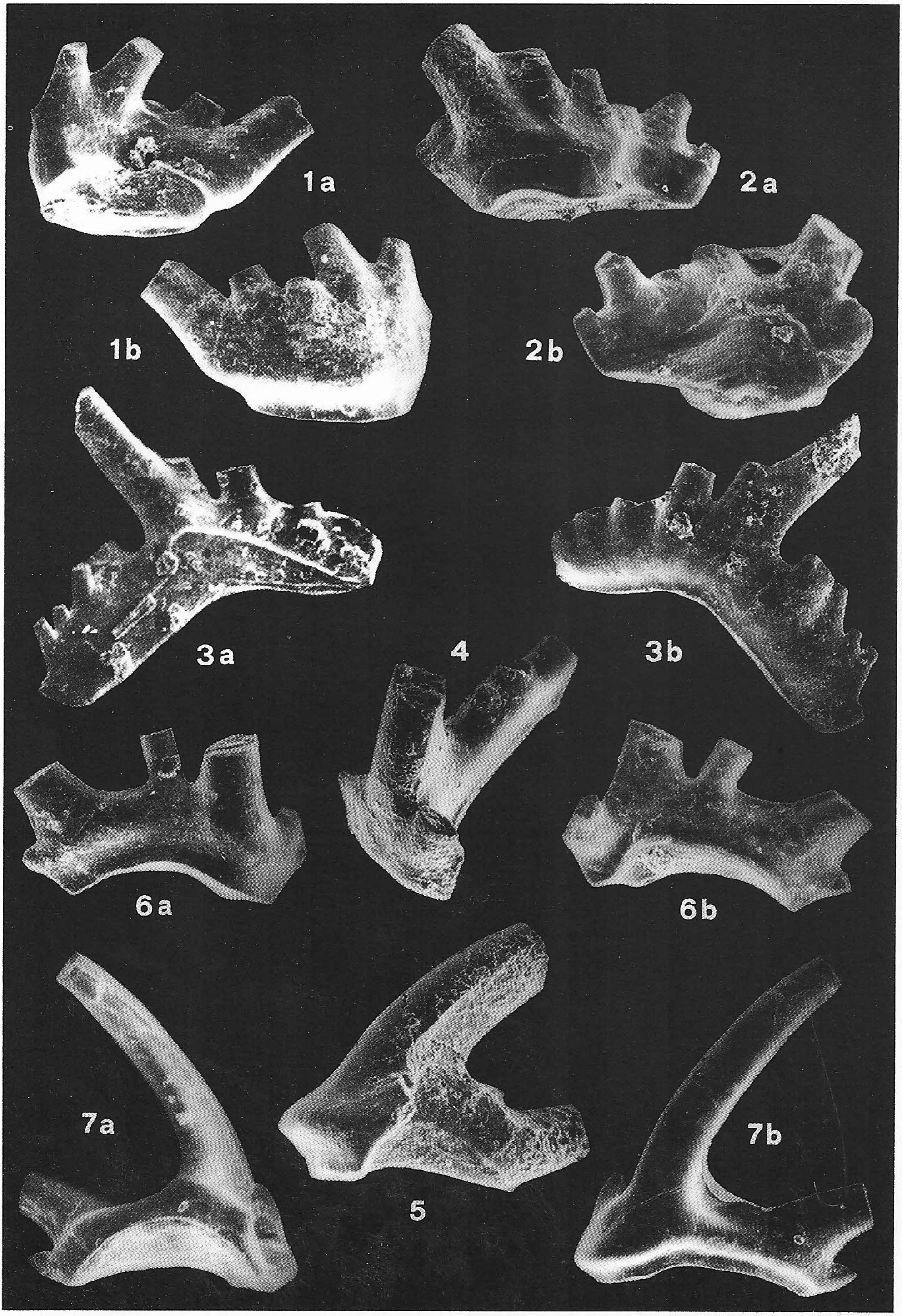

1a
2a
1b
2b
3a
4
3b
6a
6b
7a
7b
5

PLATE 31

Hadrodontina anceps Staesche, 1964.

Fig. 1 a, b – Pa element. a) Outer view; b) inner view. IC 1356.

Fig. 2 a, b – Pb element. a) Anterior view; b) posterior view. IC 1357.

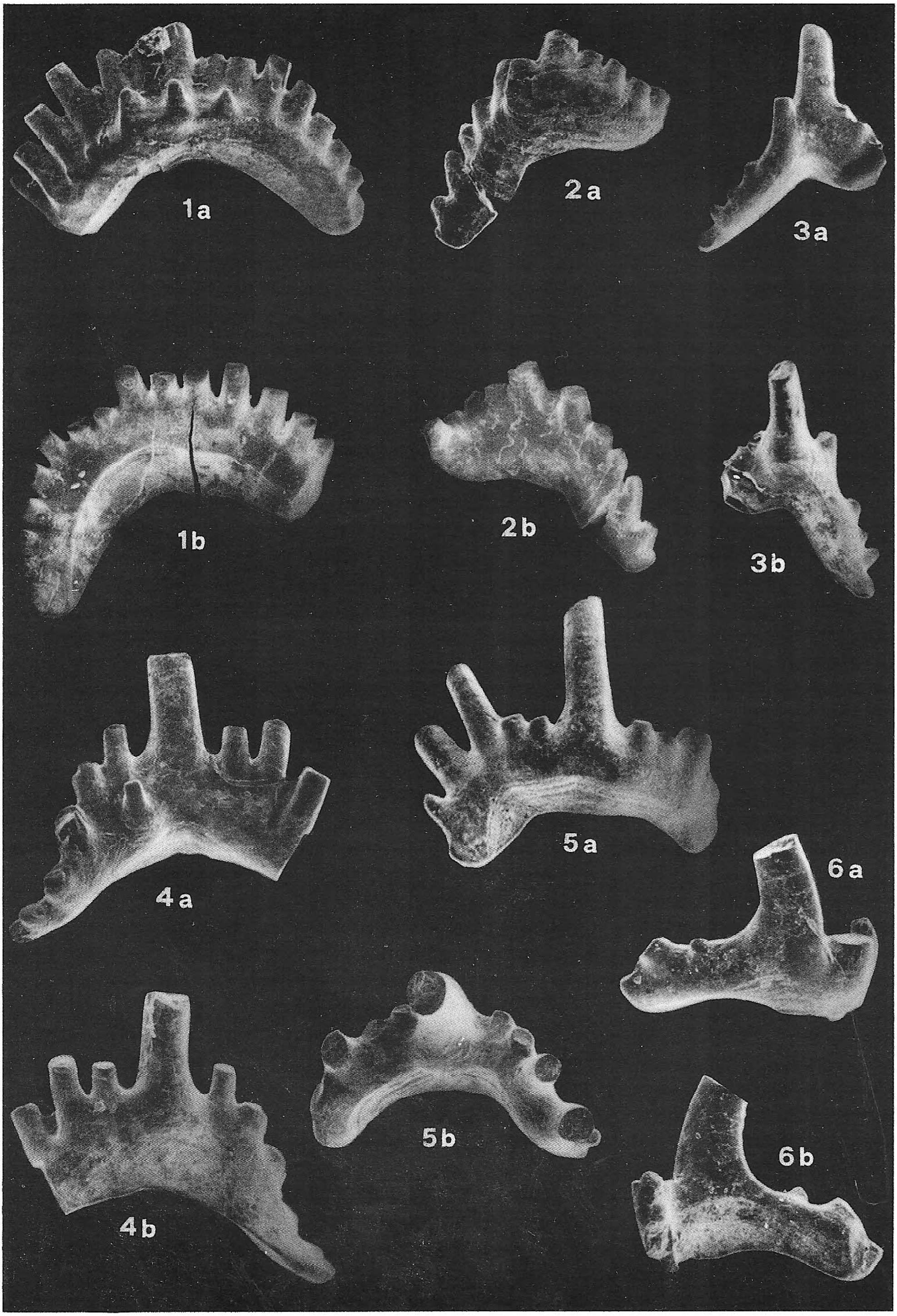
Fig. 3 a, b – M element. a) Anterior view; b) posterior view. IC 1358.

Fig. 4 a, b – Sa element. a) Anterior view; b) posterior view. IC 1359.

Fig. 5 a, b – Sb element. a) Anterior view; b) posterior view. IC 1360.

Fig. 6 a, b – Sc element. a) Outer view; b) inner view. IC 1361.

Cencenighe Galleria section, sample CG 6, Campil Member, Werfen Formation.
All magnifications x 33.


1a
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1b
2b
3b
4a
5a
6a
4b
5b
6b

PLATE 32

Hindeodus typicalis (Sweet, 1970).

Fig. 1 a - c — Pa element. a) Upper view; b) lateral view; c) lower view. IC 1362. Strigno section, sample 1B, Tesero Member, Werfen Formation; x 66.

Fig. 2 a, b — Pa element. a) Upper view; b) lateral view. IC 1363. Bulla section, sample 10, Tesero Mb., Werfen Fm.; x 100.

Fig. 3 — Pa element. Lateral view. IC 1364. Bulla section, sample 10, Tesero Mb., Werfen Fm.; x 100.

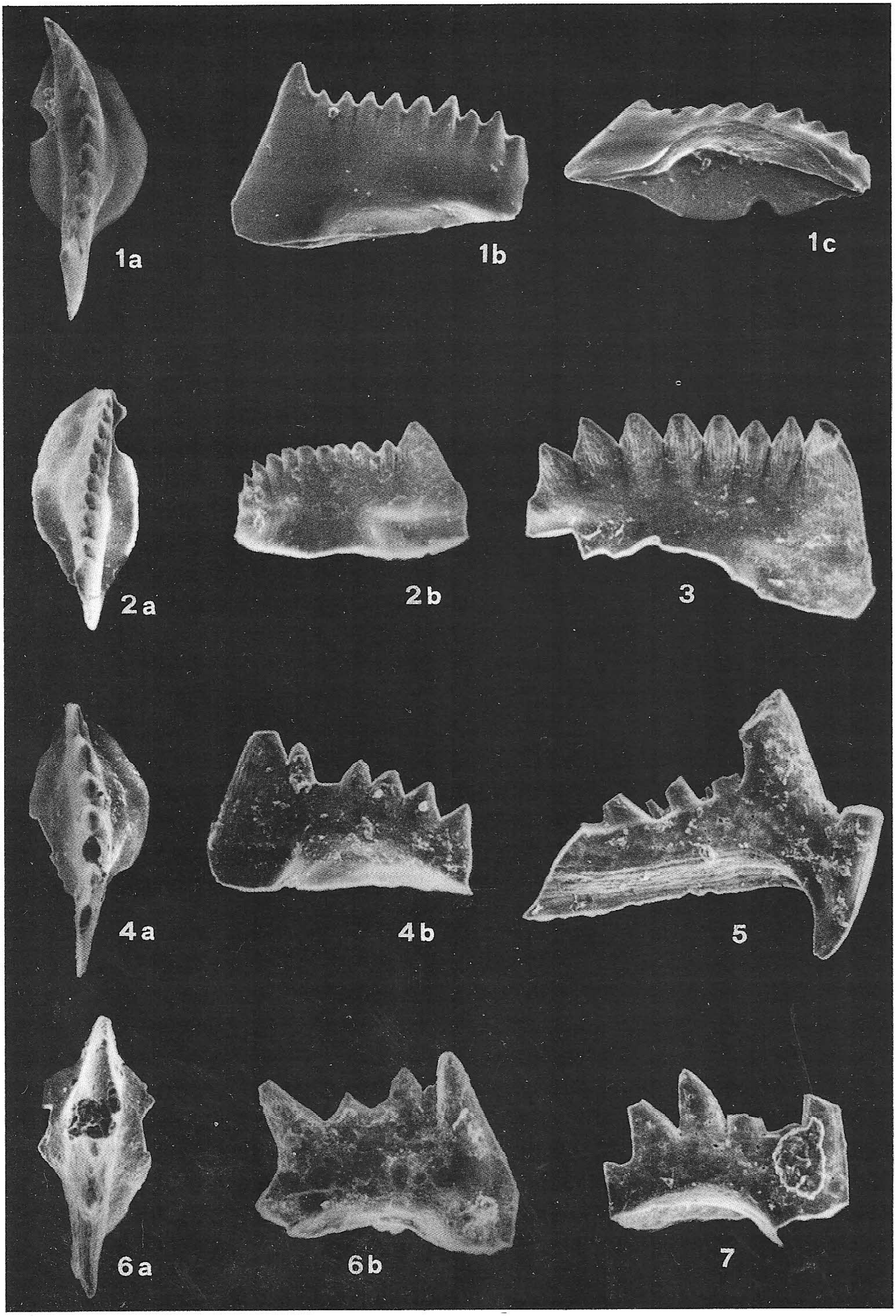
Fig. 4 a, b — Pa element. a) Upper view; b) lateral view. IC 1365. Col di Rioda section, sample CR 3, Casera Razzo Mb., Bellerophon Fm.; x 100.

Fig. 5 — Sc element. In lateral view. IC 1366. Col di Rioda section, sample CR 3, Casera Razzo Mb., Bellerophon Fm.; x 100.

Isarcicella isarcica (Huckriede, 1958).

Fig. 6 a, b — Pa element. a) Upper view; b) lateral view. IC 1367. Auronzo Pelos section, sample AP 6, Mazzin Mb., Werfen Fm.; x 100.

Fig. 7 — Pa element. Lateral view. IC 1368. Auronzo Pelos section, sample AP6, Mazzin Mb., Werfen Fm.; x 100.


1a
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1c
2a
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3
4a
4b
5
6a
6b
7

PLATE 33

Neospathodus triangularis (Bender, 1970).

Fig. 1 a - c — Pa element. a) Lower view; b) lateral view; c) upper view. IC 1369.

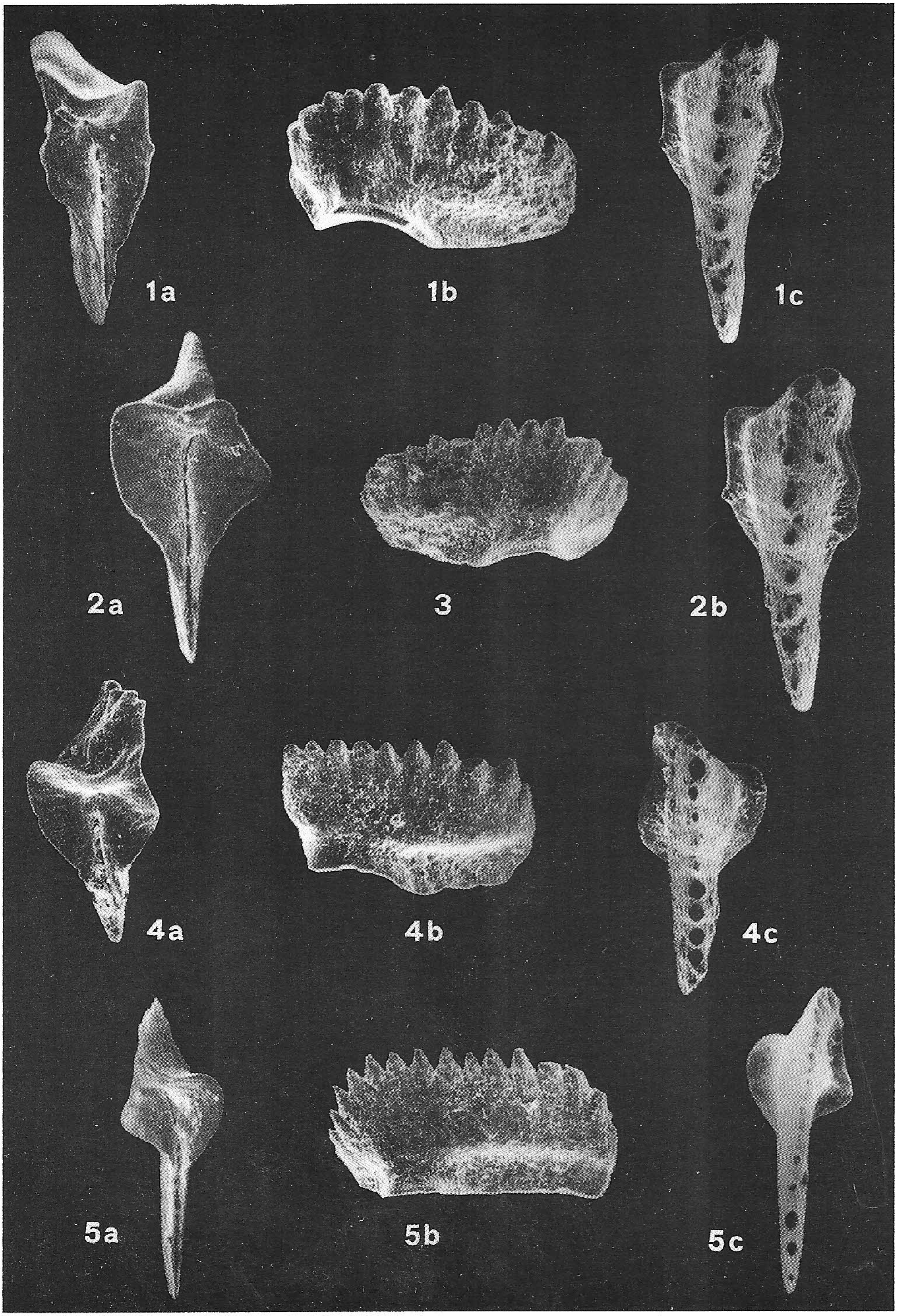
Fig. 2 a, b — Pa element. a) Lower view; b) upper view. IC 1370.

Fig. 3 — Pa element. Lateral view. IC 1371.

Fig. 4 a - c — Pa element. a) Lower view; b) lateral view; c) upper view. IC 1372.

Fig. 5 a - c — Pa element. a) Lower view; b) lateral view; c) upper view. IC 1373.

Cencenighe Galleria section, sample CG 5, Val Badia Member, Werfen Formation.
All magnifications x 75.


1a
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4b
4c
5a
5b
5c

PLATE 34

Pachycladina obliqua Staesche, 1964.

Fig. 1 a, b – Pa element. a, b) Lateral views. IC 1374.

Fig. 2 a, b – Pb element. a) Upper view; b) lateral view. IC 1375.

Fig. 3 a, b – M element. a) Anterior view; b) posterior view. IC 1376.

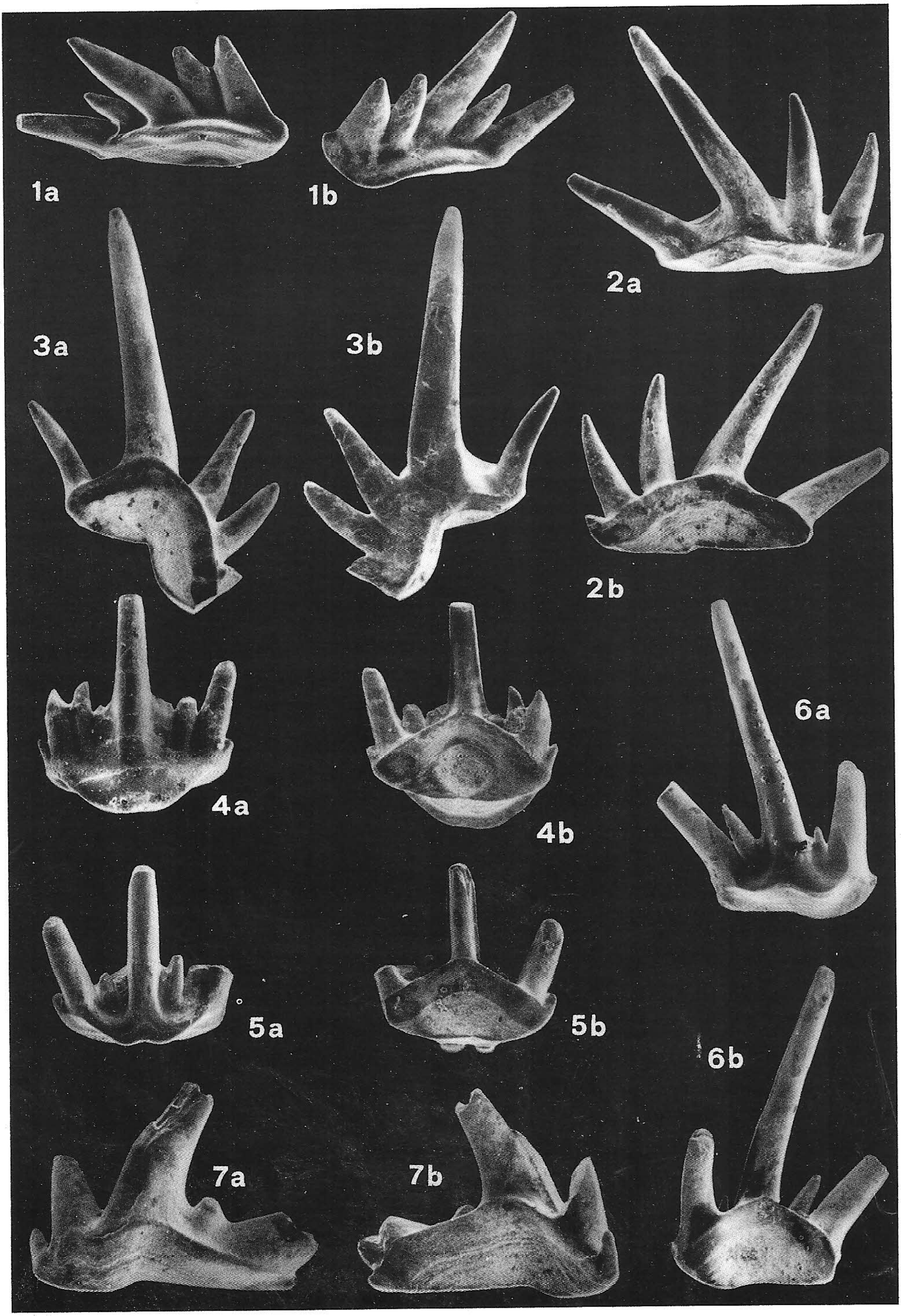
Fig. 4 a, b – Sa element. a) Anterior view; b) posterior view. IC 1377.

Fig. 5 a, b – Sa element. a) Anterior view; b) posterior view. IC 1378.

Fig. 6 a, b – Sb element. a) Anterior view; b) posterior view. IC 1379.

Fig. 7 a, b – Sc element. a) Out–lateral view; b) in–lateral view. IC 1380.

Cencenighe Galleria section, sample CG 6, Campil Member, Werfen Formation.
All magnifications x 33.


1a
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