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A new *Metapolygnathus* platform conodont species and its implications for Upper Carnian global correlations

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A rich conodont fauna from two Neotethyan sections, Pizzo Mondello (western Sicily, Italy) and Pignola 2 sections (southern Apennines, Italy) includes conodonts described herein as a new species. *Metapolygnathus praecommunisti* sp. nov. is transitional between *Paragondolella noah* and *Metapolygnathus communisti*. The genus *Metapolygnathus* (including *M. praecommunisti*) is now characterised by posterior prolongation of the keel termination, associated with a centrally located pit and with a weak ornamentation confined to the anterior part of the platform margins. The establishment of *M. praecommunisti* addresses the problems related to the origin and the peculiar, probably facies-controlled, distribution of its descendant species *M. communisti.* Since *M. praecommunisti* occurs in the entire Tethys and in North America, we propose the species as a good guide fossil for global correlations, characterised by a short temporal range limited to the uppermost Tuvalian (upper Carnian). The stratigraphic occurrence of the genus *Metapolygnathus* is restricted to the Tuvalian–Lacian (upper Carnian–lower Norian), excluding its presence in the Julian substage (lower Carnian).

Key words: Conodonta, *Metapolygnathus*, phylogeny, Carnian, Late Triassic.

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Introduction

Since the year of its establishment, *Metapolygnathus communisti* Hayashi, 1968 has been considered a problematic species due to its unclear origin and peculiar distribution in different provinces and it has been thus recently interpreted as a facies-controlled species (Kozur 2003). For these reasons *M. communisti* is one of the most problematic Upper Triassic conodont species. In North America, *M. communisti* occurs in the *M. communisti* Zone (Orchard 1991a, b). In the Neotethys it has been recovered in the *Metapolygnathus primitius* Zone (Kozur 2003), while in the northern Tethys it occurs in the *M. primitius* Zone and sometimes apparently also in the Upper Carnian *Carnepigondolella zoae* Zone (Kozur 2003; Channell et al. 2003; Noyan and Kozur 2007). In 2003, Kozur proposed a derivation of *M. communisti* from *Paragondolella noah*, and he observed that true *M. communisti* in North America is known only from the *M. primitius* Zone (Carter and Orchard 2000), where it occurs very sporadically. According to the same author, the specimens recovered from the *M. communisti* Zone are not referable to *M. communisti*, but represent some sort of transitional forms from *P. noah* to *M. communisti* itself. These transitional forms have also been recovered in the Neotethys from the *C. zoae* Zone and probably also from the *M. primitius* Zone, but they have not been described. Apparently, they have never been found in the northern Tethys, where *M. communisti* seems to appear suddenly and in advanced forms in a short range that begins before the First Appearance Datum (FAD) of *Norigondolella navicula* and ends before the *Epigondolella quadrata* Zone (Kozur 2003). This sudden appearance was explained by migrations from North America or the Neotethys. Furthermore, the distribution in space and time of *M. communisti* is complicated also by its competition with species belonging to the genera *Carnepigondolella* and *Epigondolella*. This competition was noticed by Kozur (2003) and corroborated by Mazza et al. (2010): in those strata where *Carnepigondolella* and *Epigondolella* are abundant, *Metapolygnathus* is rare. As a consequence, this competition resulted in gaps in the biostratigraphic distribution of species belonging to the genus *Metapolygnathus*, rendering the recognition of the complete phylogenetic lineage between *Paragondolella* and *Metapolygnathus* quite difficult.

In this study we investigated the upper Carnian (Tuvalian) to lower Norian (Lacian) stratigraphic interval in two Neotethyan sections, Pizzo Mondello (Sicani Mountains, western Sicily, Italy, GSSP candidate for the Norian [Nicora et al. 2007; Balini et al. 2008]) and Pignola 2 section (southern Apennines, Basilicata, Italy). The conodont elements are very numerous in samples collected from these sections. We recog-

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nised numerous specimens belonging to the genera *Paragondolella*, *Carnepigondolella*, *Epigondolella*, and *Metapolygnathus*. Due to the richness of the faunas in the samples collected and despite the hypothesised competition among genera (Mazza et al. 2010), it has been possible to identify a gradual transition between *Paragondolella noah* and *Metapolygnathus communisti* and to reconstruct the phylogenetic lineage between the two species.

For the first time we give a complete description of the transitional species between *P. noah* and *M. communisti*, here named *Metapolygnathus praecommunisti* sp. nov., and we demonstrate the derivation of *M. communisti* from *P. noah*. This species was informally presented, followed by a brief description, in Mazza et al. (2010), where the name *M. praecommunisti* was used as nomen nudum, according to arts. 16.4 and 72.3 of the International Code of Zoological Nomenclature. In this paper we officially institute this new species, by providing the holotype and its complete diagnosis. The proposal of the new species *M. praecommunisti* also gives the opportunity to propose a more precise diagnosis of the genus *Metapolygnathus* and solves some problems and apparent contradictions concerning the distribution of *M. communisti*. Furthermore, since the GSSP for the Norian has not been defined yet an accurate study of the *Paragondolella– Metapolygnathus* lineage around the Carnian/Norian boundary is fundamental because *M. communisti* is considered a possible marker species for the base of this stage (Krystyn et al. 2002).

Institutional abbreviation.—MPUM, Museo di Paleontologia, Università di Milano, Italy.

Other abbreviations.—CAI, Color Alteration Index; FAD, First Appearance Datum; FNP, Facies Nereo Preto; NA, Nicora Alda; P, Pignola; PM, Pizzo Mondello.

Stratigraphical and geological setting

The Upper Triassic succession of both Pizzo Mondello and Pignola 2 sections is represented by a hemipelagic to pelagic succession named "Calcari con Selce" (or "*Halobia* Limestone auctorum"; Cherty Limestone, Muttoni et al. 2001, 2004; Guaiumi et al. 2007), consisting of thin-bedded limestone with cherty beds and nodules and subordinate marl or marly limestone intercalations. The depositional basins of the two sections, the Sicano basin for the Pizzo Mondello section and the Lagonegro basin for the Pignola 2 section, were located in the southwestern branch of the Neotethyan realm, which constituted a deep gulf of the Tethys ocean developed along the equator and directly connected to open waters (Stampfly et al. 2003; Muttoni et al. 2004; Rigo et al. 2007 and references therein). The typical "Calcari con Selce" microfacies are mainly represented by mudstone and wackestone beds with thin-shelled bivalves, calcified radiolarians, ammonoids, foraminifers, and calcispheres (Scandone 1967; Di Stefano 1990). Scattered calcarenitic beds characterised by distal features (Tb and Tc of the Bouma sequence) have also been documented (e.g., Bertinelli et al. 2005; Guaiumi et al. 2007; Rigo et al. 2007). Coquina beds, very rich in bivalves belonging to the genus *Halobia*, occur in several stratigraphic intervals of the "Calcari con Selce" succession and they are particularly abundant in the Sicano basin. The cherty limestones of western Sicily are also rich in ammonoids, as testified by the large collection of Gemmellaro (1904), composed of about 4,000 well preserved specimens. Conodonts, radiolarians, ammonoids, and bivalves indicate an Upper Triassic correlation for this formation (e.g., Scandone 1967; De Capoa 1970, 1984; Gullo 1996; Muttoni et al. 2001, 2004; Bazzucchi et al. 2005; Bertinelli et al. 2005; Reggiani et al. 2005; Rigo et al. 2005, 2007; Guaiumi et al. 2007; Nicora et al. 2007; Giordano et al. 2010; Mazza et al. 2010; Rigo and Joachimski 2010).

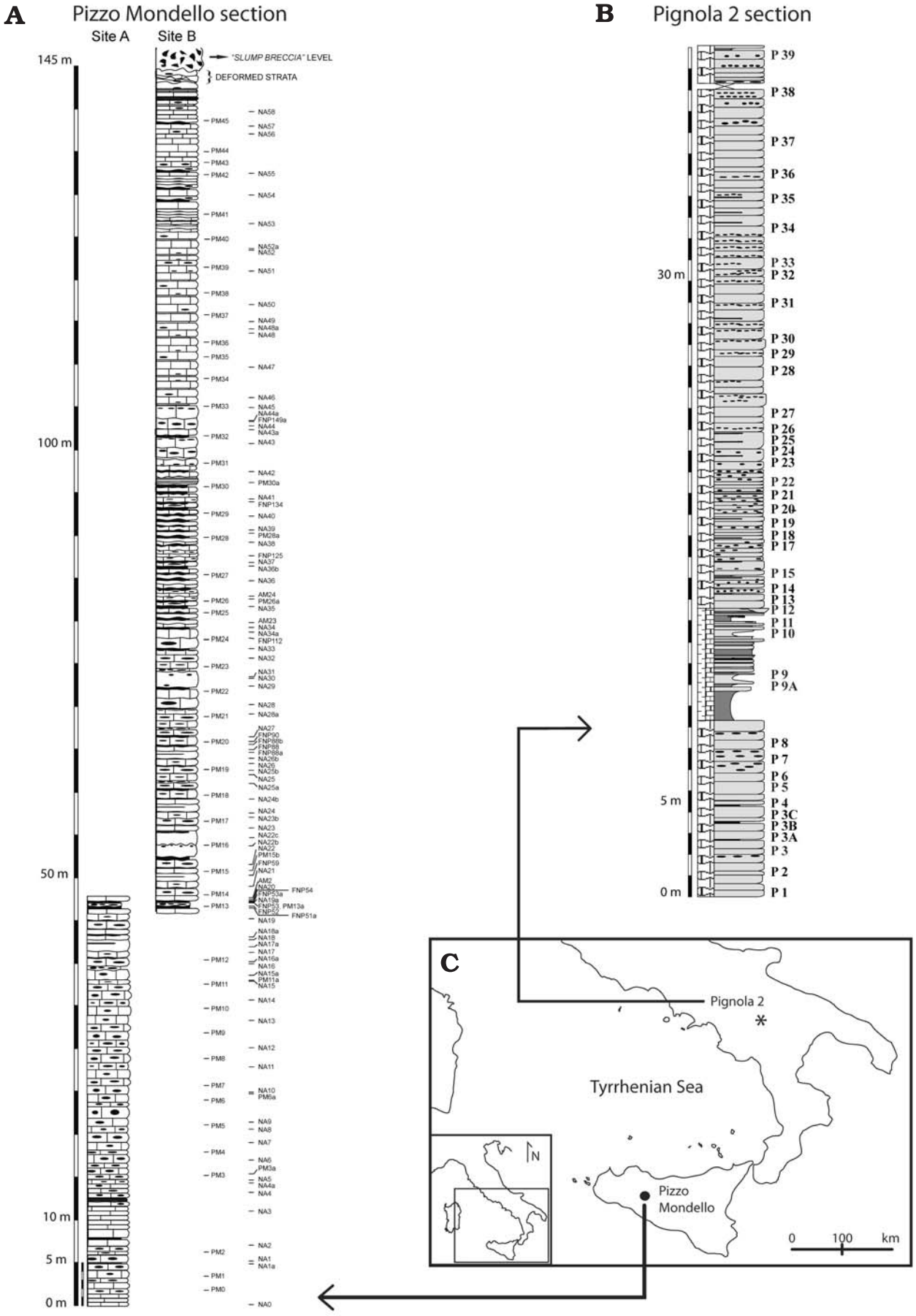
Material and methods

All the conodont samples studied in this work were collected from two sections belonging to the "Calcari con Selce", for a total stratigraphic interval that ranges from Upper Julian (Upper Carnian) to Lacian (Lower Norian): the Pignola 2 section of the Lagonegro Basin and the Pizzo Mondello section belonging to the Sicano Basin (Fig. 1). Details of stratigraphic/sedimentologic and biostratigraphic data are described in Rigo et al. (2007) and Mazza et al. (2010 and references therein) respectively.

The Pignola 2 section (southern Appenines, Basilicata, Italy) is a 40-m thick section with excellent exposure, representing a monotonous succession of cherty limestone, except for 6 m of shale, radiolarites, and cherts in its middle part. The conodonts recovered from the samples (~10 kg of rock per sample) indicate an age from Julian to Lacian. Considering the progress in studies of conodont taxonomy around the Carnian/ Norian boundary during the last few years, the conodont collection from Pignola 2 has been revised for this work. The conodont associations recognised and the two new conodont FADs proposed for the definition of the base of the Norian (Nicora et al. 2007; Orchard 2007b; Mazza et al. 2010), revealed that the Pignola 2 section is entirely Carnian in age, and it ranges from upper Julian to upper Tuvalian (see also Rigo and Joachimski 2010). The CAI of conodonts is 1.5.

The Pizzo Mondello section (Sicani Mountains, Sicily, Italy) is a 450 m thick continuous succession of cherty limestone ranging from upper Carnian to Rhaetian. The conodont samples (~10 kg of rock per sample) were collected from the first 143 metres of the succession, a stratigraphic interval that

Fig. 1. Location and stratigraphic logs of the two Neotethyan sections studied. **A**. Pizzo Mondello (Sicani mountains, western Sicily, Italy) (modified after Mazza et al. 2010). **B**. Pignola 2 (southern Apennines, Basilicata, Italy) (Rigo et al. 2007). **C**. Map of southern Italy withe the investigated sections indicated. →



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ranges from upper Tuvalian (upper Carnian) to Lacian (lower Norian). The age of the section is calibrated on the integrated biostratigraphy of a rich ammonoid, halobiid, radiolarian, and conodont record (see Nicora et al. 2007 and Balini et al. 2008 for details). All the conodonts are CAI 1.

Systematic palaeontology

Phylum Chordata Bateson, 1886

Subphylum Vertebrata Linnaeus, 1758

Class Conodonta Eichenberg, 1930

Order Ozarkodinida Dzik, 1976

Superfamily Gondolelloidea Lindström, 1970

Family Gondolellidae Lindström, 1970

Genus *Metapolygnathus* Hayashi, 1968

Type species: *Metapolygnathus communisti* Hayashi, 1968, from chert at the base of the Adoyama Formation within a mixed Middle–Upper Triassic fauna: Ashio Mountains, Central Japan.

Original diagnosis (from Hayashi 1968: 72).—"The present genus has intermediate biocharacters between the genera *Polygnathus, Gondolella*, and *Gladigondolella*. Platform shape square, growing short to long, posterior to anterior, the platform has subparallel lateral margins in the mature stage. Furrows lateral to carina are generally deep and well developed. Lower surface bears a stout, wide, flat and sharply edged keel, the posterior margin is always sharply squared and frequently forks off into two branches, groove narrow and striated extends along the length of unit, basal cavity located near the centre of the unit, more or less invisible or narrow and deep crack."

Emended diagnosis.—The genus is characterised on the lower side by a very narrow basal cavity, hardly visible, centrally located in primitive specimens and anteriorly shifted with respect to the middle of the platform in advanced forms. The keel shows a strong posterior prolongation behind the pit. The cusp is undistinguished in size and it is followed by two or more carinal nodes. The platform is robust but reduced and generally lacks ornamentation. In some species a few nodes may be present, but are always confined to the anterior platform margins or to the geniculation point. A distinct free blade is present, with highly fused denticles. The keel end is often, but not necessarily, bifurcated.

Remarks.—We believe that a new description of the genus is necessary, given the progress in the studies of the morphology and systematic of the Late Triassic conodonts achieved from the institution of the genus in 1968. In the original diagnosis of *Metapolygnathus* (Hayashi 1968), in fact, there are no remarks about a very diagnostic morphological feature that characterizes the type species of this genus: the presence of a pronounced posterior prolongation of the keel behind the pit. Remarks concerning the occurrence of some sort of ornamentation on the platform margins are also absent. The image of the holotype (Hayashi 1968: pl. 3: 11; the holotype is re-illustrated in Fig. 2B of the present paper), does not seem to show any kind of ornamentation on the platform margins. Nevertheless, analyses of rich populations of true *Metapolygnathus communisti* from the Pizzo Mondello section reveal the occurrence of 1–2 tiny nodes on the platform margins (see also Noyan and Kozur 2007). These nodes, however, are always confined to the geniculation point (see Sweet 1981 for morphological terminology). According to these observations and to the original diagnosis, we restrict the assignment of the genus *Metapolygnathus* only to those species that have the following combination of three characters: a well evident posterior prolongation of the keel end, a centrally located pit and the absence of ornamentation or, at least, the presence of tiny nodes but always confined to the anterior platform margins.

As a consequence, the stratigraphic distribution of the genus *Metapolygnathus* is here restricted to the Tuvalian (Carnian)–lower Lacian (Norian). In the stratigraphically older specimens of *Metapolygnathus* (Tuvalian), the pit may be located not exactly at the centre of the platform but slightly behind it, while in the more advanced (i.e., stratigraphically higher) specimens (Lacian) the pit may be still more anteriorly shifted with respect to the middle of the platform. Since the Julian and early Tuvalian metapolygnathids do not have the posterior keel prolongation and the centrally located pit, we assign them to other genera: *Paragondolella* and *Carnepigondolella*.

The genus *Paragondolella* is probably the direct forerunner of the genus *Metapolygnathus*, and it differs from the latter mainly in the subterminal position of the pit, the absence of the posterior prolongation of the keel, the long platform which covers almost the entire length of the element allowing the development of only a very short free blade, and the complete absence of nodes on the platform margins.

The genus *Carnepigondolella* is the forerunner of *Epigondolella* (Kozur 2003) and is characterised, on its lower side, by a pit which is placed behind the middle of the platform, but never centrally located as in *Metapolygnathus*, and slightly anteriorly shifted with respect to the keel end. Although in *Carnepigondolella* a forward shifting of the pit with respect to the keel end is recognizable, it is never so pronounced that it generates a posterior prolongation as in *Metapolygnathus*, which is set between 1/4 to half of the total keel length in the Lacian forms. Furthermore, the genus *Carnepigondolella* shows strong ornamentation on the platform margins, which is absent in *Metapolygnathus*. This ornamentation consists of large nodes or low denticles, which may occur also on the lateral margins of the platform and not only at the anterior margins or the geniculation point.

Metapolygnathus praecommunisti sp. nov.

Figs. 2C–J, 3.

1991 *Metapolygnathus communisti*; Orchard 1991a: 191: pl. 2: 18–20.
2007 *Metapolygnathus communisti*; Moix et al. 2007: 308: pl. 1: 11, 12.
2007 *Metapolygnathus* sp. nov. Y; Orchard 2007b: 141: pl. 2: 37–39.

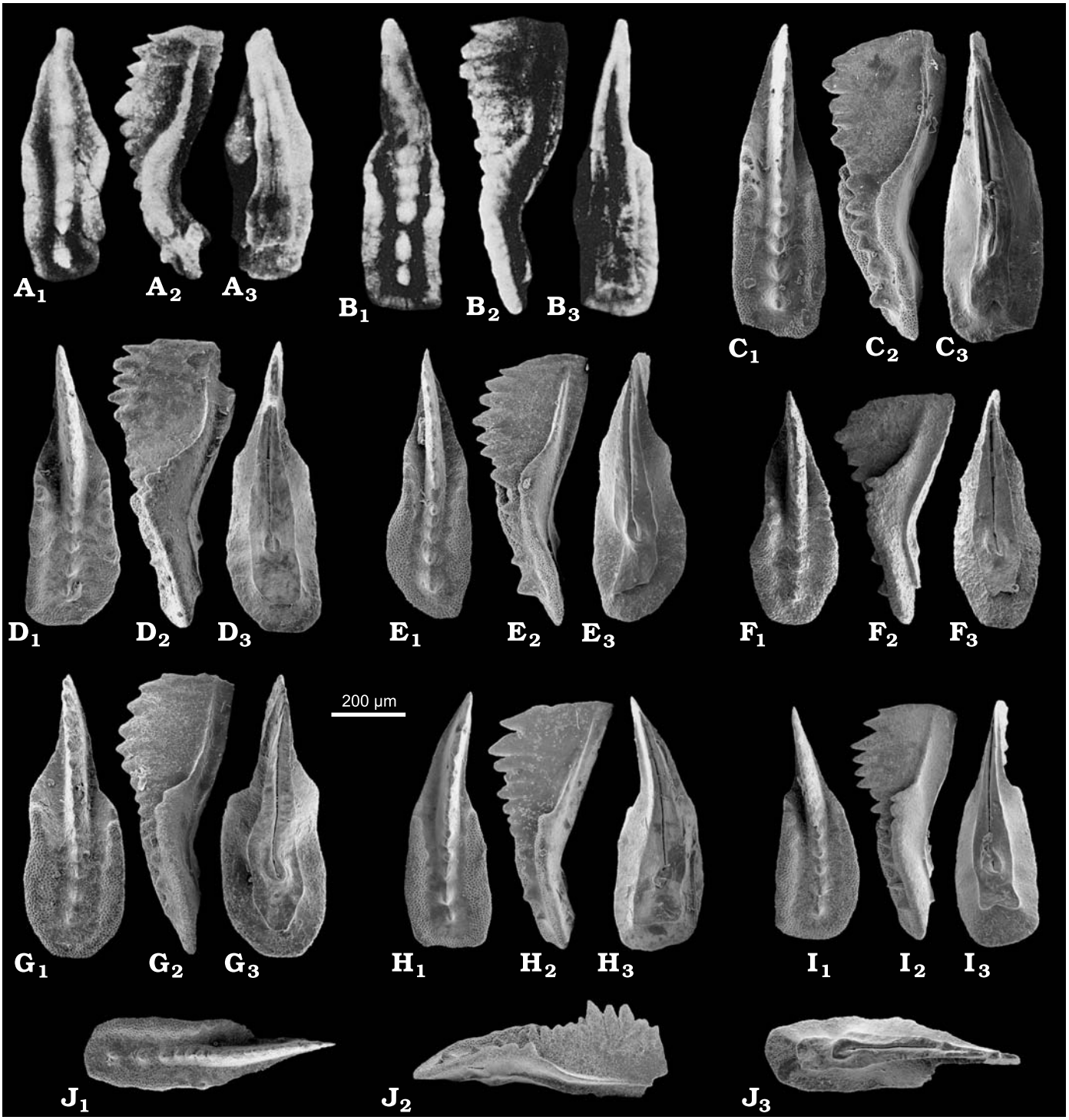

Fig. 2. SEM photographs of gondolellid conodonts. **A**. Holotype of *Paragondolella noah* (Hayashi, 1968). **B**. Holotype of *Metapolygnathus communisti* Hayashi, 1968 from the original plates of Hayashi (1968: 79, pl. 3). Both specimens are from chert at the base of the Adoyama Formation within a mixed Middle–Upper Triassic fauna (Ashio Mountains, Central Japan). **C**–**J**. *Metapolygnathus praecommunisti* sp. nov. from the Upper Triassic of "Calcari con Selce", Pizzo Mondello section (Sicani Mountains, Sicily). **C**. Holotype (sample NA12). **D**, **E**. Asymmetric morphotypes, samples NA14 and NA18 respectively. **F**, **G**. Rounded morphotypes, samples PM11A and NA19 respectively. **H**, **I**. More advanced forms with short platform (sample NA19). **J**. Advanced form, NA19 (from Mazza et al. 2010).

2007 *Metapolygnathus communisti*; Rigo et al. 2007: 195, fig. 5/4.

2010 *Metapolygnathus praecommunisti* nomen nudum sp.; Mazza et al. 2010: 133: pl. 1: 6.

Etymology: Forerunner of *Metapolygnathus communisti*.

Type material: Holotype: the platform specimen (MPUM 10103) illustrated in Fig. 2C. Morphotypes: specimens illustrated on Fig. 2D, E (asymmetric morphotype) and on Fig. 2F, G (rounded morphotype).

Type locality: Pizzo Mondello section (Monti Sicani, Western Sicily, It-

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aly), the abandoned quarry ("la Cava" locality) on the southwestern slope of Pizzo Mondello Mountain.

Type horizon: Bed NA12 of the Pizzo Mondello section, a white micritic calcilutite with black-brown cherty nodules and rich in halobiids, named as "Calcari con Selce" (i.e., cherty limestones) (upper Tuvalian [Carnian], Upper Triassic).

Material.—82 specimens from the Pizzo Mondello section and 29 from Pignola 2 section.

Diagnosis.—A primitive *Metapolygnathus* with a weakly to unornamented platform having subparallel margins, extended for two thirds of the entire element, and a wide anterior trough margin which leaves a short free blade of 1–2 denticles. The pit is centrally located or slightly posteriorly shifted with respect to the middle of the platform and it is anteriorly shifted with respect to the keel end, which is prolonged behind the pit and often irregular. The blade is composed of highly fused denticles, is very high and descends gradually into a low carina without steps. Behind the cusp, which is unremarkable in size from the other denticles, a carinal node larger than the others is always present, often in terminal position.

Description.—*Metapolygnathus praecommunisti* is characterised by a pit that is centrally located or slightly shifted posteriorly with respect to the entire length of the platform; the pit is narrow and surrounded by a prominent loop. Since *M. praecommunisti* is here defined as the transitional species between the genus *Paragondolella* and the *Metapolygnathus communisti* group (see "Remarks"), the species may show some intraspecific variation. In the stratigraphically lower specimens (the most primitive forms closer to the genus *Paragondolella*), the pit is slightly shifted posteriorly with respect to the centre of the platform and, thus, it is located in the posterior half. In the stratigraphically higher specimens (advanced forms), which are much closer to the genus *Metapolygnathus*, the pit is centrally located, following an evolutionary trend typical of the Upper Triassic pectiniform elements (see Mazza and Rigo 2008). A very important morphological character for the definition of this species is the prolongation of the keel behind the pit. We define the keel as posteriorly prolonged when that part is at least 1/4 of the entire length of the keel. This prolongation is less evident in the primitive specimens and longer in the advanced ones, but always present. The keel termination may be pointed, squared or rounded and it is often deformed, thus presenting a typical asymmetric shape.

The platform is relatively short (two thirds of the entire element length) and generally slender, with sub-parallel margins and a rounded posterior end.

The geniculation point is placed at two thirds of the platform length and it bears three low and separated nodes on the inner side and 1–2 nodes on the outer side. The number of nodes may be higher in advanced specimens, while they are absent in the most primitive and juvenile forms. At the geniculation point the platform margins decrease abruptly in a wide anterior trough margin, which leaves a real free blade of only 1–2 denticles. Platform margins are thick and both margins and nodes are covered by an intense microcrenulation. In specimens of late adult growth stages the platform is longer, the posterior end is blunter and the platform nodes coalesce (Fig. 3G, H). The blade is very high, typically truncated in its anterior part and composed of highly fused denticles. It descends gradually without steps in a low and long carina which reaches the posterior end of the platform. The cusp, which is the denticle exactly above the pit, is unremarkable in shape and dimension and it is followed by 2–3 accessory carinal nodes. Behind the cusp, in terminal or subterminal position, a larger carinal node is always present.

Two morphotypes are recorded from the type locality of *M. praecommunisti*, the Pizzo Mondello section. The first, very common, is characterised by a typical posterior asymmetry, due to the development of one posterior-lateral lobe (Fig. 2D, E); the second is identified by a slight enlargement in the posterior third of the platform, which gives the platform a more rounded shape (Fig. 2F, G).

Remarks.—*Metapolygnathus praecommunisti* was used as nomen nudum (according to arts. 16.4 and 72.3 of the International Code of Zoological Nomenclature) in Mazza et al. (2010), where this species was briefly introduced but not officially instituted. The holotype of this species is here illustrated and described for the first time. *Metapolygnathus praecommunisti* is here defined as the transitional species between *Paragondolella noah* and *M. communisti*. Primitive specimens of *M. praecommunisti*, in fact, are very close to *P. noah*. They are characterised by a similar platform shape, an abrupt step of the platform margins at the geniculation point and a large last node of the carina. As a difference, in *M. praecommunisti* the pit is more shifted to the anterior, a posterior prolongation of the keel is present, the platform is shorter and the step between blade and carina is lacking, resulting in a more continuous feature. The anterior platform margins do not bear any nodes, but only an internal crenulation on the lateral margins not visible in profile, which develops in nodes in the advanced forms (i.e., stratigraphically higher specimens).

Advanced specimens of *M. praecommunisti* present instead a central pit with respect to the platform and the keel is well prolonged behind the pit. Some nodes, as mentioned above, develop on the anterior platform margins, the abrupt step at the geniculation point decreases, the platform becomes shorter and the carina becomes longer.

In *M. communisti* the pit is strongly shifted to the anterior with respect to the centre of the platform and the posterior prolongation of the keel reaches almost half of the platform length. The platform is shorter than in *M. praecommunisti* and the last large denticle of the long carina disappears, but *M. communisti* retains the same blade profile, the shape of the platform and the anterior platform nodes of its forerunner, *M. praecommunisti*.

The forward shifting of the pit toward the centre of the element, the shortening of platform margins and the occurrence of nodes at the geniculation points are well-known evolutionary patterns of Late Triassic conodonts (Orchard 2007a, b; Mazza and Rigo 2008). Thus the morphological

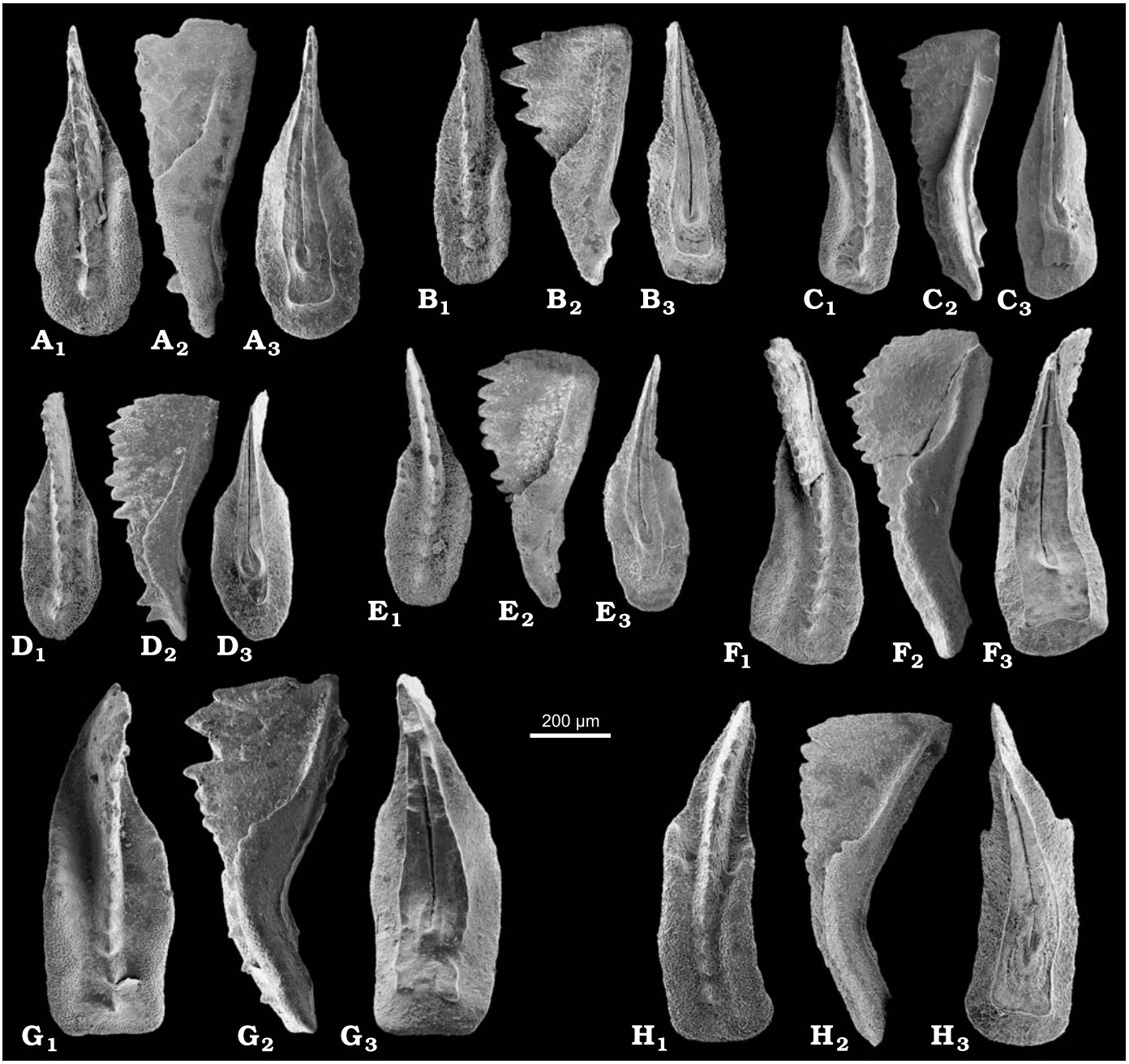

Fig. 3. SEM photographs of gondolellid conodonts *Metapolygnathus praecommunisti* sp. nov. from the *Calcari con Selce* of the Pizzo Mondello section (Sicani Mountains, Sicily) (A, C, D, F–H) and from the Upper Triassic of *Calcari con Selce* of the Pignola 2 section (southern Apennines, Basilicata) (B, E). **A**–**C**. Primitive forms, closer to *Paragondolella noah* (Hayashi, 1968), samples NA8, P25 and FNP53 respectively. **D**, **E**. Late juvenile growth stage, samples NA15A and P34 respectively. **F**. Advanced form, sample PM11A. **G**, **H**. Extremely mature stages, samples NA11 and PM11A.

variations here illustrated are clearly transitional to *M. communisti* and place *M. praecommunisti* as the transitional species between *P. noah* and *M. communisti* (Kozur 2003; Mazza and Rigo 2008; Mazza et al. 2010) (Fig. 4).

Metapolygnathus praecommunisti is similar to *Carnepigondolella nodosa*, but they differ because in *C. nodosa* the pit is more posteriorly shifted, the long posterior prolongation of the keel is lacking, the posterior platform is always symmetrical, the nodes on the platform are more numerous and they often reach the middle of the lateral margins.

Stratigraphic and geographic range.—The new species is common in the Neotethys of western Sicily and in the Lagonegro Basin (our data; Kozur 2003 and references therein), as in the whole Neotethyan province. *Metapolygnathus praecommunisti* is widespread also in the northern Tethys province, where specimens of *M. communisti* have been recovered in Carnian strata below the FAD of *Epigondolella quadrata*. These specimens do not belong to *M. communisti* in the strict sense, but to the new species *M. praecommunisti* as here defined (e.g., in the Carnian *Epigondolella orchardi* Zone of sec-

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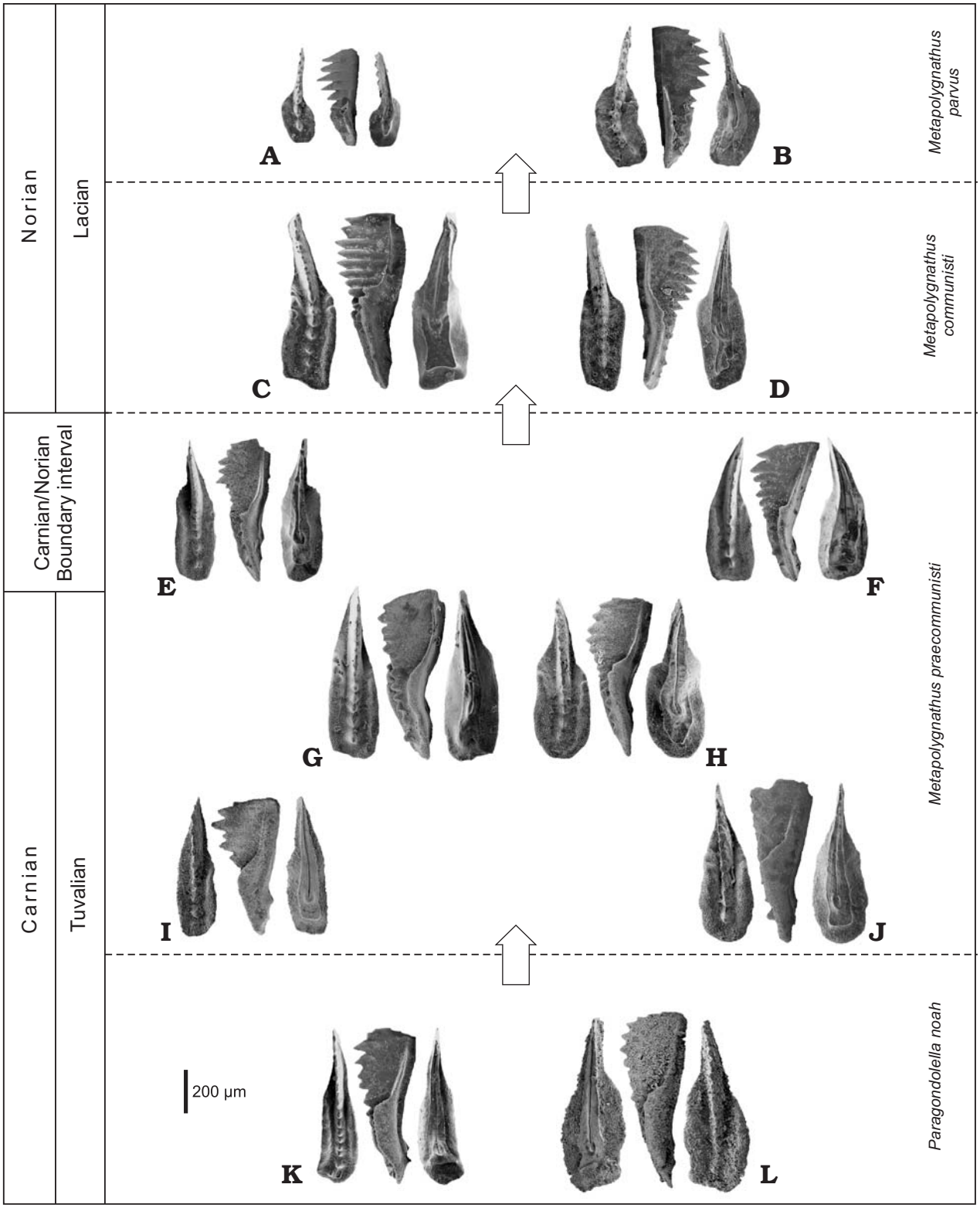

Fig. 4. A schematic figure illustrating the evolution of *Paragondolella noah* (Hayashi, 1968) into its descendant species. The main evolutionary trends from *P. noah* to the last representative of the lineage, *Metapolygnathus parvus* Kozur, 1972, are observable: the gradual shortening of the platform, the forward shifting of the pit, the posterior lengthening of the keel termination and the development of nodes at the geniculation point. In *M. parvus* the nodes disappear for the extreme reduction of the platform. **A**, **B**. *Metapolygnathus parvus* Kozur, 1972 (sample NA37, Lower Norian, PMs). **C**, **D**. *Metapolygnathus communisti* Hayashi, 1968 (samples NA39 and PM27 respectively, Lower Norian, PMs). *Metapolygnathus praecommunisti* sp. nov. from the Upper Carnian of the PMs and P2s: **E**, **F**. Very advanced specimens (samples NA22 and NA19 respectively, PMs). **G**, **H**. Intermediate specimens (samples NA12 and NA14 respectively, PMs). **I**, **J**. Primitive specimens (sample P25 of P2s and sample NA8 of PMs respectively). **K**, **L**. *Paragondolella noah* (sample NA2 of PMs and sample P21 of P2s respectively). Abbreviations: PMs, Pizzo Mondello section; P2s, Pignola 2 section.

tion C of the Kocatabur Block, Mersin Melange; see Moix et al. 2007). *M. praecommunisti* occurs also in North America (Black Bear Ridge section) in the *Metapolygnathus* sp. nov. Y Zone (upper Tuvalian), and it is probably a homeomorph of *Metapolygnathus* sp. nov. Y Orchard (Orchard 2007b: pl. 2: 28–30, 37–39). The *Metapolygnathus* sp. nov. Y Zone is in fact established on the previous *M. communisti* Zone and the new species that gives the name to the zone corresponds to the transitional metapolygnathids recognised by Kozur (2003). Furthermore, analysis of the published material and the original conodonts from the collection of the Black Bear Ridge section (through the kind permission of Michael J. Orchard) confirms that *Metapolygnathus* sp. nov. Y and *M. praecommunisti* are the same species.

Metapolygnathus praecommunisti ranges from the lower Tuvalian to the upper Tuvalian. In the lower Tuvalian the species is common in its primitive form, closer to *Paragondolella noah* and with rare or absent nodes on the platform margins. Advanced forms of this species occur in the upper Tuvalian.

Metapolygnathus praecommunisti was recovered at the Pizzo Mondello section in beds with *Halobia simplex*, *Halobia superba*, and with abundant *Halobia lenticularis* and *Halobia radiata*. The Carnian ammonoid *Dicotropites plinii* was also found 5 metres below the level from which the holotype of *M. praecommunisti* derives (NA12).

Discussion

Through the years, authors have given different interpretations about which species belong to the genus *Metapolygnathus*, disregarding sometimes the description of the type species of the genus, *Metapolygnathus communisti.* Orchard (1991a, b) included into *Metapolygnathus* all the Tuvalian conodonts, considering this genus as a polyphyletic group. He used the following criteria for the classification of the genus: the lower surface profile, the node height, the microcrenulation on the platform margins and the mode of growth. On the other hand, he disregarded the position of the pit as a diagnostic character, arguing that it is difficult to separate Carnian species only considering the position of the pit, because most of the Carnian conodont lineages show a forward progressive migration of the pit position (Orchard 2007a). Besides, he considered the node height but not their distribution on the platform margins. This sort of grouping led him to assign Carnian *Paragondolella* species (e.g., *Paragondolella polygnathiformis* group) and conodonts with a subterminal to a slightly anteriorly shifted pit to *Metapolygnathus* (Kozur 2003). As a consequence the stratigraphic distribution of the genus was extended downward and *Metapolygnathus* species ranged from Lower Carnian (Julian) to Lower Norian (Lacian).

Even if the forward shifting of the pit is actually a true evolutionary trend that is common to all the Carnian/Norian conodonts, as Orchard argued (Orchard 1991a, b; Kozur 2003; Mazza and Rigo 2008; Mazza et al. 2010), it remains useful for the recognition of the genus. In fact, we observed that the type species of *Metapolygnathus*, *M. communisti*, shows a centrally located pit with respect to the platform, which is also associated with a well developed posterior prolongation of the keel behind the pit. This combination of characters is absent in all the other conodont species of the Late Triassic, except for the genus *Orchardella* (sensu Kozur 2003). *Orchardella* is, however, easily distinguished from *Metapolygnathus*, because it is characterised by very different platform morphology and by the occurrence of high denticles on the platform margins, which are completely absent in *Metapolygnathus*. Thus, the combination of three characters: (i) the posterior prolongation of the keel; (ii) the anteriorly shifted pit; and(iii) the absence or a very weak ornamentation of the geniculation point, are key features for the identification of *Metapolygnathus*, as suggested also by Kozur (2003).

In fact, Kozur (1989, 2003) considered the genus *Metapolygnathus* to be a monophyletic group, the forerunner of which is *Paragondolella polygnathiformis noah.* Kozur (2003) recognised that most of the *M. communisti* specimens from the *M. communisti* Zone in North America illustrated by Orchard (1991a) were not true *M. communisti*, but possible transitional forms from *Paragondolella noah* to *M. communisti*. He observed that the position of the pit of those specimens was too posteriorly placed to be considered true *M. communisti*. These transitional forms have also been recognised in the same zone in the Neotethys (Kozur 2003) and we identified them in the two Neotethyan studied sections, Pignola 2 and Pizzo Mondello. We consider all these forms to belong to the same new species, here named *M. praecommunisti* sp. nov. This species is clearly transitional from *P. noah* to *M. communisti* (Fig. 4), as described in detail in the "Remarks" above. As a matter of fact, in the *M. communisti* Zones of North America and Neotethys, *M. communisti* is absent, while *M. praecommunisti* occurs abundantly. True *M. communisti* occurs only at higher stratigraphic levels. Representatives of this species, even if rare, have been recovered with *M. primitius* in North America, while abundant true *M. communisti* are common in a short interval before the occurrence of *Norigondolella navicula* in the Neotethys (according to Kozur 2003 and our data from the Pizzo Mondello section). *M. praecommunisti*, instead, seemed to be absent in northern Tethyan successions, where apparently only advanced individuals of *M. communisti* have been collected. Thus, Kozur (2003) interpreted the advanced *M. communisti* of the northern Tethys as generated by faunal invasions from North American and Neotethyan realms. Actually, *M. praecommunisti* is probably present also in the northern Tethys. In a recent paper by Moix et al. (2007: pl. 1: 11, 12), in fact, a *M. communisti* specimen is figured from the *E. orchardi* Zone (upper Carnian). This species has a centrally located pit and a short posterior keel prolongation, more typical of advanced forms of *M. praecommunisti,* which are very common in the same stratigraphic interval in the Pizzo Mondello section.

The occurrence of *M. praecommunisti* in North America, in the Neotethys and in northern Tethys allows us to consider

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the First Occurrence (FO) of *M. communisti* in these provinces as a real First Appearance Datum (FAD) and thus to correlate the bioevents as synchronous.

As recently hypothesised by Mazza et al. (2010), the occurrence of metapolygnathids (e.g., *M. communisti*, *M. parvus*, *M. mersinensis, M. moltinodosus*, *M. echinatus*) seems to depend also on the presence of the genera *Carnepigondolella* and *Epigondolella,* because the genus *Metapolygnathus* is believed to have suffered a strong competition with the species belonging to these genera. This could be another reason for the apparently different distribution of *M. communisti* in the various Late Triassic provinces, together with a taxonomic problem concerning *Epigondolella quadrata*. In the Tethys and in some sections of Neotethys (e.g., Silická Brezová), *M. communisti* seems to occur below the *E. quadrata* Zone (Krystyn and Gallet 2002; Noyan and Kozur 2007) while at the Pizzo Mondello section it occurs above the FAD of *E. quadrata*. The reason is probably that in the *E. quadrata* Zone, as presently recognised, only advanced species of *E. quadrata* occur, while the real FAD of the species is lower, coinciding with the FAD of primitive specimens of this species, which is still identified in other sections as *Carnepigondolella pseudodiebeli* (see Mazza et al. 2010 for more details), following an older taxonomy. Furthermore, as specified above, *M. praecommunisti* was probably confused in the past with true *M. communisti* (e.g., Krystyn 1980; Orchard 1991a; Channell et al. 2003; Moix et al. 2007; Nicora et al. 2007; Rigo et al. 2007), assigning the FAD of *M. communisti* to the Upper Carnian (Tuvalian) as a consequence, while it probably occurs only from the Lower Norian (Lacian).

Conclusions

Supported by rich conodont faunas collected in large samples from two Upper Triassic sections, Pignola 2 and Pizzo Mondello, the new Tuvalian species *Metapolygnathus praecommunisti* is here established.

- In accordance with well observable evolutionary trends of the Carnian/Norian conodont pectiniform elements, *Metapolygnathus praecommunisti* can be considered the transitional species between *Paragondolella noah* and *Metapolygnathus communisti*. This solves the problem of the previously unknown origin of *Metapolygnathus communisti*, interpreted now as a descendant of *Paragondolella noah*;
- *Metapolygnathus praecommunisti* is recorded in North America, northern Tethys and in the Neotethyan realm; because of this broad distribution it can be used as a guide taxon for global correlations;
- The assignment of the FAD of *Metapolygnathus communisti* to the Upper Carnian and, thus, the establishment of the *M. communisti* Zone in the Tuvalian, is due to the fact that *Metapolygnathus praecommunisti* was probably confused in the past with true *Metapolygnathus communisti*. *Metapolygnathus communisti* occurs everywhere later, surely in the Lower Norian in the Neotethys;
- The establishment of *Metapolygnathus praecommunisti* enables a revision of the genus *Metapolygnathus*, which is now restricted to those species that have a distinct posterior prolongation of the keel termination associated with a centrally located or slightly posteriorly shifted pit with respect to the centre of the platform, and a very weak ornamentation characterised by low nodes confined to the anterior part of the platform. As a consequence, we restrict the stratigraphic occurrence of *Metapolygnathus* to the Tuvalian/Lacian and we do not recognize it in the Julian.

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