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Alessandro Garassino (*), Giorgio Teruzzi (*) & Fabio Marco Dalla Vecchia (**)

# The macruran decapod crustaceans of the Dolomia di Forni (Norian, Upper Triassic) of Carnia (Udine, NE Italy)

**Abstract** - This work describes the macruran decapod crustaceans of the Dolomia di Forni (Norian, Upper Triassic) of Carnia (Udine, NE Italy). It is an important fauna of the alpine Upper Triassic sharing some species with the Norian faunae known so far in the Calcare di Zorzino of Cene (Seriana Valley, Bergamo - N Italy) and Prati di Rest (Valvestino, Brescia - N Italy), thus pointing out a relative affinity of the crustacean faunae of Northern Italy during Norian age. At the same time, the fauna here described includes the species *Pseudocoleia mazzolenii* Garassino & Teruzzi, 1993 known to date only in the more recent fauna (Sevatian, Upper Norian or Lower Rhaetian, according to the authors) of Ponte Giurino (Imagna Valley, Bergamo - N Italy). In the studied fauna the following decapod groups are represented: infraorder Penaeidea de Haan, 1849 (family Penaeidae Rafinesque, 1815) including the genera *Dusa* Münster, 1839 with the species *D. longipes* (Pinna, 1974) and *Antrimpos* Münster, 1839 with the species *A. noricus* Pinna, 1974; infraorder Caridea Dana, 1852 with the species *Acanthinopus gibbosus* Pinna, 1974 (indeterminate family); the infraorder Astacidea Latreille, 1803 (family Platychelidae Glaessner, 1931) is represented by the genus *Glaessnericaris* Garassino & Teruzzi, 1993 with *Glaessnericaris* sp. the infraorder Palinura Latreille, 1803 includes four genera: *Archaeopalinurus* Pinna, 1974 with the species *A. levis* Pinna, 1974 (family Palinuridae Latreille, 1802), *Glyphea* von Meyer, 1835 with *Glyphea* sp. (family Glypheidae Zittel, 1885), *Pseudocoleia* Garassino & Teruzzi, 1993 with the species *P. mazzolenii* Garassino & Teruzzi, 1993 (family Coleiidae Van Straelen, 1924) and *Rosenfeldia* n.gen. with the species *R. triasica* n.gen.n.sp. (family Eryonidae de Haan, 1841). The family Eryonidae de Haan, 1841 is reported for the first time in the Triassic.

The study of the macruran decapod crustaceans of the Dolomia di Forni increases not only the knowledge on the evolutionary history of decapods in the final stages of Triassic, but also allows to enrich the palaeoenvironmental picture on decapod crustacean faunae in the carbonatic platforms of Southern Alps. The higher local diversification of reptant forms compared to the natantian forms is a feature shared by the faunae of Carnia and Ponte Giurino and the younger faunae of the Lower Jurassic, like as Osteno (Lugano Lake, N Italy), Lyme Regis (West Country, England) and Holzmaden (Baden-Württemberg, Germany). Moreover the presence of the genera *Glyphea* von Meyer, 1835, *Pseudocoleia* Garassino & Teruzzi, 1993 and *Rosenfeldia* n.gen. plays a particularly important role by differentiating the studied fauna from the Lombardy Norian faunae of the Calcare di Zorzino.

**Riassunto** - I crostacei decapodi macruri della Dolomia di Forni (Norico, Triassico superiore) della Carnia (Udine, NE Italia).

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(*) Museo Civico di Storia Naturale, C.so Venezia 55 - 20121 Milano
(**) Dip. di Geologia, Paleontologia e Geofisica, Università di Padova, Via Giotto, 1, 35137 Padova, Italy and Museo Friulano di Storia Naturale, Via Grazzano 1, I-33100 Udine

Vengono descritti i crostacei decapodi della Dolomia di Forni (Norico, Triassico superiore) della Carnia (Udine, NE Italia). Si tratta di un'importante fauna del Triassico superiore alpino che presenta alcune specie in comune con le faune noriche finora conosciute nel Calcare di Zorzino di Cene (Val Seriana, Bergamo - N. Italia) e Prati di Rest (Valvestino, Brescia - N. Italia), evidenziando così una certa affinità tra le faune a crostacei dell'Italia settentrionale durante il Norico. Allo stesso tempo, nella fauna friulana è stata segnalata la specie *Pseudocoleia mazzolenii* Garassino & Teruzzi, 1993 conosciuta finora solo nella fauna più recente (Sevatico, Norico superiore o Retico inferiore a seconda degli autori) di Ponte Giurino (Val Imagna, Bergamo - N. Italia). Nella fauna esaminata sono rappresentati i seguenti gruppi di decapodi: infraordine Penaeidea de Haan, 1849 (famiglia Penaeidae Rafinesque, 1815) che comprende i generi *Dusa* Münster, 1839 con la specie *D. longipes* (Pinna, 1974) e *Antrimpos* Münster, 1839 con la specie *A. noricus* Pinna, 1974; l'infraordine Caridea Dana, 1852 con la specie *Acanthinopus gibbosus* Pinna, 1974 (famiglia indeterminata); l'infraordine Astacidea Latreille, 1803 (famiglia Platychelidae Glaessner, 1931) è rappresentata dal genere *Glaessnericaris* Garassino & Teruzzi, 1993 con *Glaessnericaris* sp.; l'infraordine Palinura Latreille, 1803 comprende quattro generi: *Archaeopalinurus* Pinna, 1974 con la specie *A. levis* Pinna, 1974 (famiglia Palinuridae Latreille, 1802), *Glyphea* von Meyer, 1835 con *Glyphea* sp. (famiglia Glypheidae Zittel, 1885), *Pseudocoleia* Garassino & Teruzzi, 1993 con la specie *P. mazzolenii* Garassino & Teruzzi, 1993 (famiglia Coleiidae Van Straelen, 1924) e *Rosenfeldia* n.gen. con la specie *R. triasica* n.gen.n.sp. (famiglia Eryonidae de Haan, 1841). La famiglia Eryonidae de Haan, 1841 viene segnalata per la prima volta nei terreni triassici.

Lo studio dei crostacei decapodi macruri della Dolomia di Forni incrementa non solo le conoscenze sulla storia evolutiva dei decapodi nelle fasi terminali del Triassico, ma permette di arricchire il quadro paleoambientale delle faune a crostacei decapodi delle piattaforme carbonatiche del Sudalpino. La maggiore diversificazione locale delle forme reptanti rispetto a quelle natanti è una caratteristica che accomuna la fauna della Dolomia di Forni a quella di Ponte Giurino e alle successive faune del Giurassico inferiore, quali Osteno (Lago di Lugano, N. Italia), Lyme Regis (West Country, Inghilterra) e Holzmaden (Baden-Württemberg, Germania). Inoltre, il rinvenimento dei generi *Glyphea* von Meyer, 1835, *Pseudocoleia* Garassino & Teruzzi, 1993 e *Rosenfeldia* n.gen. riveste una particolare importanza in quanto distingue la fauna esaminata dalle faune noriche lombarde del Calcare di Zorzino.

**Key words:** Crustacea, Decapoda, Upper Triassic, Norian, Carnic Prealps, Friuli, North-Eastern Italy

## Introduction

Since the beginning of the 80s, the Dolomia di Forni (Norian, Upper Triassic), previously unfossiliferous, began to supply several organisms such as reptiles, fishes, macruran decapods, misidaceans and thylacocephalans that can be preserved only under particular environmental conditions.

Due to the palaeontological interest of these specimens, the Museo Friulano di Storia Naturale organized a series of excavations between 1987 and 1991; several specimens were also gathered by some collaborators of the Museum, among which C. Rosenfeld, S. Spizzamiglio and one of the authors (Fabio M. Dalla Vecchia). Such discoveries contributed to increase the collection of fossils from the Dolomia di Forni kept in the Museo Friulano di Storia Naturale, presently consisting of several hundreds specimens.

The research programme, started for the study of these fossils, brought to the description of various taxa.

Reptiles, which remains are very rare, include *Megalancosaurus preonensis*, a possible arboreal archosauromorph (Calzavara et al., 1980; Renesto, 1994); a prolacertid reptile similar to *Macrocnemus*; *Preondactylus buffarinii*, a pterosaur (Wild, 1984; Dalla Vecchia & Muscio, 1989; Dalla Vecchia, 1994). The most frequent vertebrates in the Dolomia di Forni are bony fishes (actinopterygians and sarcopterygians), also the subjects of many works. They include small pholidophorids (Zambelli, 1990), durophagous forms (*Sargodon tomicus*, ?*Paralepidotus ornatus* and ?*Gibbodon* sp.), flying fishes (*Thoracopterus martinisi*), large predators (*Birgeria* sp. and *Saurichthys* sp.), and coelacants (Muscio, 1988; Dalla Vecchia & Muscio, 1991; Dalla Vecchia, Muscio & Tintori, 1990; Tintori & Sassi, 1992).

But the most abundant fossils in the outcrops of the Dolomia di Forni are constituted by crustacean remains: among them there are rare and not yet described misidaceans; thylacocephalans are relatively more abundant (Dalla Vecchia & Muscio, 1990; Arduini, 1992). Macruran decapod crustaceans are, on the contrary, quite common.

## Geology and age of the Dolomia di Forni

The Dolomia di Forni (Mattavelli & Rizzini, 1974) is a lithostratigraphic unit outcropping in Carnia (Friuli-Venezia Giulia, NE Italy) along the upper valley of the Tagliamento river between the towns of Tolmezzo and Forni di Sotto (Fig. 1 A-B). It is indicated as T5 in the sheets 4c-13 Mount Cavallino-Ampezzo of the Italian Geological Map, and is also known as Calcari di Caprizzi (Ferasin et al., 1969). The name Dolomia di Forni is to be preferred to the priority-name Calcare di Caprizzi, since the lithology is mainly dolomitic.

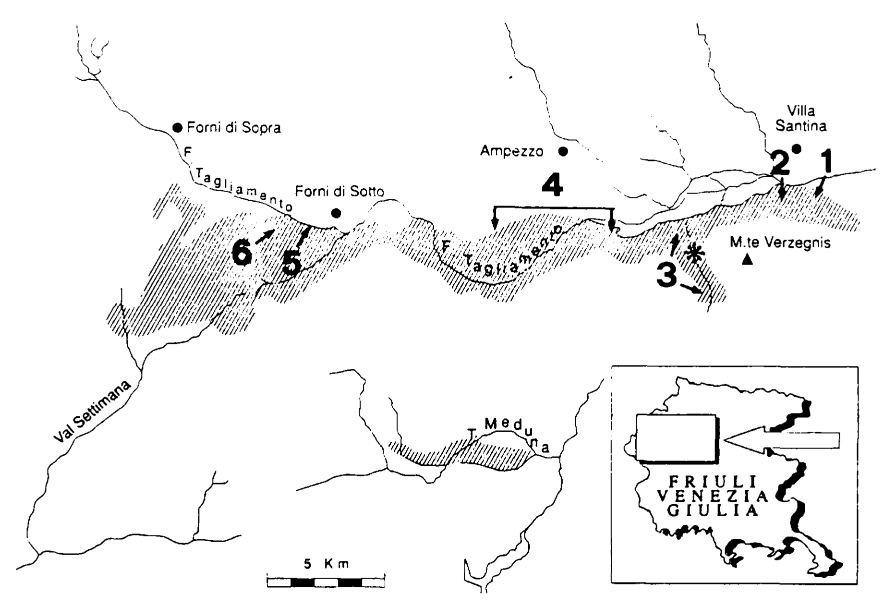


Fig. 1 – A) Localisation of outcrops (the numbers correspond to those appearing in Table I).

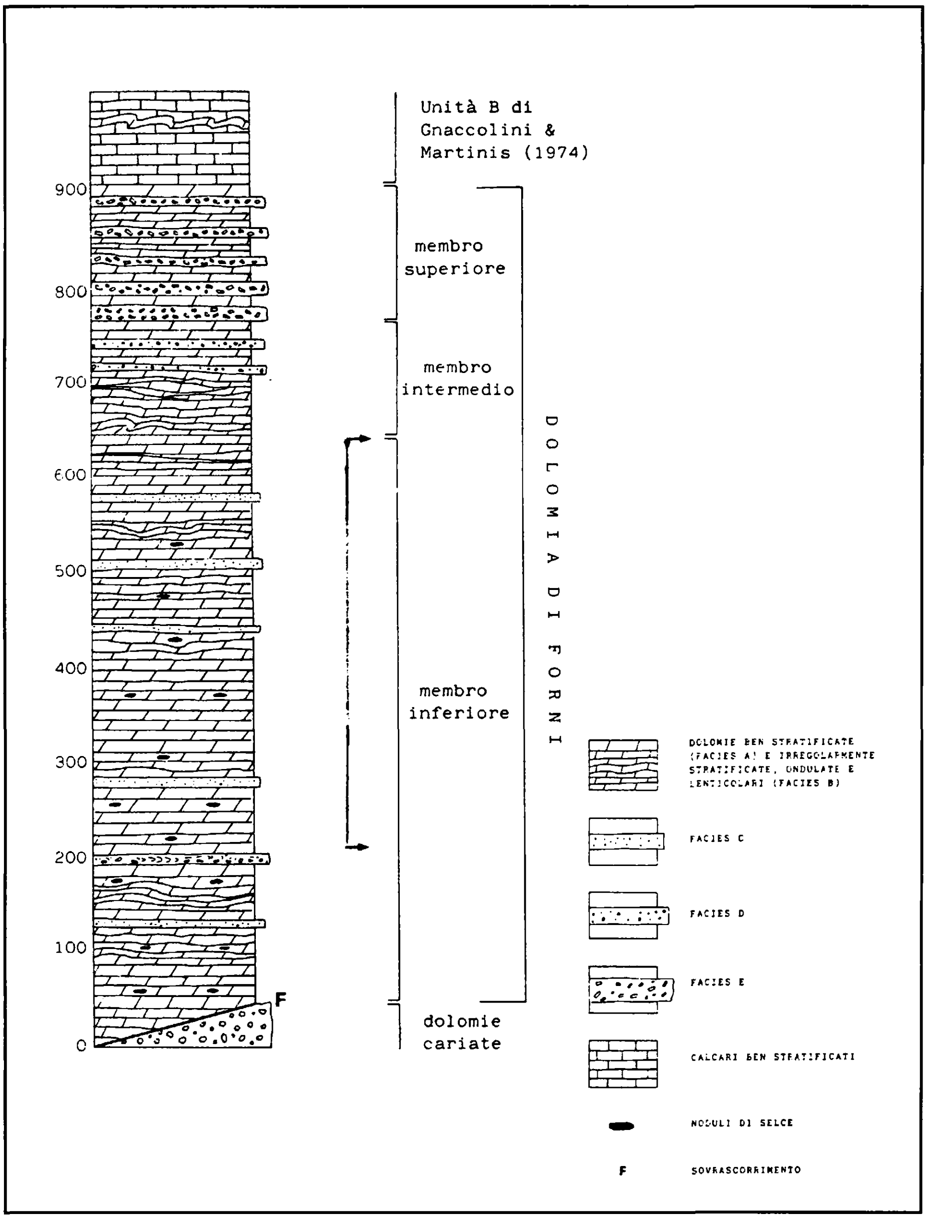


Fig. 1 – B) Stratigraphyc section of the Rio Seazza valley, with location of the columnar sections, 1, 2 and 3 and the main fossiliferous autcrops.

Even though it outcrops from east to west for over 30 km, most of the studies - both palaeontological and geological - was focused in the Rio Seazza Valley (incorrectly known also as Preone Valley) transversally cutting the eastern outcropping portion of the unit. Here the Dolomia di Forni has been informally subdivided into three members by Dalla Vecchia (1991): lower, middle and upper, respectively about 600, 150 and 150 m thick. At the bottom it is in tectonic contact with the "Dolomie cariate", while at the top it reaches the limestone of "Unità B" of Gnaccolini and Martinis (1974).

The deposition environment of the Dolomia di Forni is considered a small euxinic basin bordered by shallow lagoons and by the tidal flats of the carbonate platform where the Dolomia Principale deposited (Dalla Vecchia, 1991).

It was recently possible to date some outcrops of the examined unit on a biostratigraphic basis (conodonts) (Roghi et al., in press). The lower member in the Rio Seazza Valley - the most fossiliferous interval - is of Alaunian age (Middle or Late Norian, depending if the following Sevatian stage is considered part of the Norian or of the Rhaetian) (Dalla Vecchia, 1994; Roghi et al., in press). Also for more western outcrops (Rio Poschiadea and Rio Rovadia), the first biostratigraphic data indicate a similar age (Dalla Vecchia, 1994; Roghi et al., in press).

## Stratigraphic and geographic distribution of macruran decapod crustaceans in the Dolomia di Forni

The macruran decapod crustaceans housed in the Museo Friulano di Storia Naturale of Udine were gathered in outcrops stratigraphically located at different levels of the Dolomia di Forni, mainly in the lower member. Most of the specimens was gathered in the Rio Seazza Valley near the town of Preone, but particularly important levels, rich in specimens, can also be found in the northern side of Auda Mount, near the town of Caprizzi.

The different taxa show a particular stratigraphic and geographic distribution. Such distribution is reliable and was not carried out at random, since the whole outcropping area of the Dolomia di Forni has been intensely surveyed in the last 15 years by the Museo Friulano di Storia Naturale and its collaborators.

*Dusa longipes* (Pinna, 1974) is the most common fossil in the lower member of the Rio Seazza Valley (where it represents the majority of macruran decapod crustaceans) and in the most eastern outcropping area of the Dolomia di Forni (Rio Forchiar, Rio Secco) (Tab. I, II).

It is almost completely lacking in the middle member: a few very small specimens (for example MFSN 16079) were found in a not very thick interval near the waterworks in the Rio Seazza Valley. The upper member only supplied a few macruran decapod crustaceans, among which only one specimen (MFSN 16024) of *Dusa longipes* (Pinna, 1974). *Dusa longipes* (Pinna, 1974) is also almost entirely absent in the West of the Rio Seazza Valley; only a few small-sized specimens were gathered in the Rio di Donna (MFSN: 16168, 16169) and near Forni di Sopra (MFSN: 16107, 16167). The specimens gathered in the Rio Seazza Valley come from several levels located in a 300 m thick section: they are therefore specimens belonging to different populations, that lived in a relatively wide time range (cfr. Roghi et al., in press).

Tab. I - Frequency of macruran decapod crustaceans of the Dolomia di Forni housed in the collection of Museo Friulano di Storia Naturale according to the site of finding. The number indicated corresponds to the specimens. (*) About thousand chelae, tail fans, isolated pereiopods and antennae are not included. From east to west: 1) Rio Secco and Rio Plera; 2) Rio Forchiar; 3) Rio Seazza; 4) northern side of Auda Mount, Borta landslide, Rio di Donne and corresponding stretch of the Tagliamento river near Caprizzi (Socchieve); 5) Rio dai Clas and Forni di Sotto environs; 6) Rio Rovadia and Forni di Sopra environs. The eastern and western areas are identified with reference to the Rio Seazza Valley (Fig. 1)

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| *Dusa longipes* | *1 | *10 | *~310 | 2 | | 3 |
| *Antrimpos noricus* | | | 9 | 1 | | 1 |
| indet. little natantians | 1 | 3 | ~170 | 7 | | |
| *Acanthinopus gibbosus* | | | 2 | | | |
| indet. caridean | | | | 1 | | |
| *Rosenfeldia triasica* | | | | 31 | | 1 |
| *Pseudocoleia mazzolenii* | | | | 6 | | |
| *Archaeopalinurus levis* | | | 1 | 123 | 1 | 1 |
| *Glyphea* sp. | | | 1 | 4 | | |
| *Glaessnericaris* sp. | | | 1 | | | |
| ? Platichelidae | | | | 2 | | |
| indet. big reptantians | | | | 2 | | |

Tab. II - Frequency of macruran decapod crustaceans of the Dolomia di Forni in the Rio Seazza Valley (Preone). (*) About thousand chelae, tail fans, isolated pereiopods and antennae are not included.

| | lower mb. | medium mb. | upper mb. |
|---|---|---|---|
| *Dusa longipes* | *~300 | 10 | 1? |
| *Antrimpos noricus* | 8 | | 1 |
| indet. little natantians | ~150 | 17 | 1 |
| *Acanthinoupus gibbosus* | 2 | | |
| *Archaeopalinurus levis* | | 1 | |
| *Glyphea* sp. | | 1 | |

In the northern side of Auda Mount and around Caprizzi, *Dusa longipes* (Pinna, 1974) is absent, while small natantian decapods and particularly reptant decapods are present: large-sized palinurids(?), *Archaeopalinurus levis* Pinna, 1974, *Rosenfeldia triasica* n.gen.n.sp., *Glaessnericaris* sp., *Pseudocoleia mazzolenii* Garassino & Teruzzi, 1993 and *Glyphea* sp.. Most of the specimens of *Rosenfeldia triasica* n.gen.n.sp. comes from a single layer, forming the totality of decapod crustaceans of such layer. Most of the specimens of *Archaeopalinurus levis* Pinna, 1974 comes from a less than one metre thick interval, and they constitute the only macruran decapod crustaceans of such interval. However, both these benthonic forms are present in different layers and are therefore relatively widespread in this area.

In the West of the Rio Poschiadea, the gathered specimens are quite scarce and differentiated (rare and small specimens of *Dusa longipes* (Pinna, 1974), *Antrimpos noricus* Pinna, 1974 *Archaeopalinurus levis* Pinna, 1974, and *Rosenfeldia triasica* n.gen.n.sp.), apparently without the prevalence of a single taxon.

Such a peculiar distribution of the different taxa, with a dominance of reptant decapods west of the Rio Seazza Valley (Tab. I), also in concomitance with a partially different fish association showing in the western area a certain frequency of forms like *Paralepidotus* - lacking in the eastern area - (Dalla Vecchia et al., 1990), probably indicates a different position of the two areas of the basin if compared to the margin of the platform, with the western area nearest to it and, therefore, with a higher quantity of remains of reptant decapod crustaceans. Such assumption seems to be confirmed also by the geological data and by the first attempts to carry out a palinspastic reconstruction of the deposition basin of the Dolomia di Forni (Ponton, com. pers.; Ponton & Podda, 1995).

A marked change in the macruran decapod crustacean association, as mentioned above, can be noticed also in the area of the Rio Seazza Valley (Tab. II). The lower member shows a prevalence of *Dusa longipes* (Pinna, 1974) and, subordinately to it, small undetermined natantians and *Antrimpos noricus* Pinna, 1974. *Dusa longipes* (Pinna, 1974) almost disappears in the intermediate member (only few small-sized specimens can be found), and the reptants *Glyphea* sp. and *Archaeopalinurus levis* Pinna, 1974 (MFSN 15743) are found. Fossils are rare in the upper member: *Antrimpos noricus* Pinna, 1974 is present, together with a specimen of *Dusa longipes* (Pinna, 1974), that seems to be morphologically different from the other specimens of the same species. We would like to point out that, by moving from the lower member to the upper member, not only we move toward stratigraphically more recent levels, but also toward the margin of the platform (Dalla Vecchia, 1991). The faunistic changes can therefore be due to the different position of the deposition area, compared to the margin of the carbonate platform, and therefore to ecological reasons. By moving along the sides of the basin toward the margin of the platform we reached more oxygen-rich environments, probably from an anaerobic sea-bottom to a normally oxygenated one, through a disaerobic zone. The benthonic forms could not live or spread in anoxic sea-bottom waters. By moving toward the margin of the platform we get closer to normally oxygenated sea-bottoms, that had to be populated by benthonic crustaceans; therefore the remains of such crustaceans should become more frequent. Natantian decapods, which can freely swim and live in the normally oxygenated water mass standing above the anoxic sea-bottom, could more easily end up in the sea-bottoms - also far from the margins of the platform - simply because of post-mortem fallout. However the causes of the different arrangements and frequencies of the individual taxa are probably to be searched in their ecological needs, that cannot be identified on the basis of the geological record only.

## Previous knowledge of coeval faunae

The Dolomia di Forni is almost coeval and similar from a palaeoenvironmental point of view, to the Calcare di Zorzino, a basinal Formation outcropping in Lombardy (for a more extended description cfr. Jadoul, 1986; Jadoul, Berra & Frisia, 1992; Stefani et al., 1992). Many of the fossiliferous outcrops of the Calcare di Zorzino contain macruran decapod crustaceans remains. Two faunae have been described so far by literature: those of Cene (Seriana Valley, province of Bergamo - N Italy) (Pinna, 1974), and Prati di Rest (Valvestino, province of Brescia - N Italy) (Pinna, 1976).

## Preservation modalities

Macruran decapod crustaceans, preserved only in the thickly laminate levels, are flattened parallel to the stratification plane. The preparation work is made difficult by the strong consistency of the dolomitic rock. Some levels, rich in *Dusa longipes* (Pinna, 1974) remains, especially in the F1 outcrop by Dalla Vecchia (1991), show a few complete specimens and a high quantity of chelae, isolated dactylus and index, pereiopods II-III, isolated tail fans and tail fans with the last abdominal somites. Complete abdomens and isolated carapaces are completely lacking. This particular association of fragments is certainly due to contingent factors linked to the deposition environment and to life modalities of this species. At present it is very difficult to identify such factors. This accumulation can probably be linked to the phenomenon of ecdysis or to decomposition, dismemberment and selective transfer of the different parts of the body.

The specimens of *Dusa longipes* (Pinna, 1974) are found mostly complete in the other fossiliferous levels - the specimens never lack pereiopods I-III, long and delicate - associated to isolated dactylus and index of the same pair of pereiopods. The very good preservation and articulation of the specimens indicate a limited post-mortem transfer: currents, swell or turbulence of the water masses would rapidly disarticulate, or at least divide, the specimens along the line joining the carapace to the abdomen. What observed can be explained by two different assumptions:

1 - macruran decapod crustaceans lived on the sea-bottom close to the burial area.

2 - macruran decapod crustaceans lived in the above-standing water mass and were subject only to a vertical post-mortem transfer.

The second assumption seems to be the most probable, because of the unfavourable conditions that the sea-bottom offered to life (Dalla Vecchia, 1990, 1991). The environment of deposition was in fact oxygen-depleted and acid. Such factors prevented necrophagous organisms (including bacteria) from living on the sea-bottom: these organisms would have caused the dismemberment and destruction of all the organic remains.

Most of the remains of *Archaeopalinurus levis* Pinna, 1974, found in the fossiliferous interval of Auda Mount (less than 1 m thick), is represented only by pereiopods (pereiopods II-V are usually preserved) and antennae. The carapace is never preserved and only a few specimens still present the abdomen and the tail fan. This type of preservation, together with the concentration of organic remains, could be linked to the ecdysis process (therefore they would be exuvie) and to the selective transfer by currents.

The specimens of *Rosenfeldia triasica* n.gen.n.sp. are generally complete, even though in many cases the carapace is not well preserved. The specimens are mainly in ventral view.

The large-sized specimens (e.g. *Glyphea* sp.) are mostly fragmentary, due to fracturing of the layers containing them and to the difficulty in extracting and finding slabs large enough to contain them completely.

Since the examined sample is represented by strongly compressed specimens, the reconstruction of the details of the external morphology of the different species has not always been easy, because the different parts of the exoskeleton are often overlapping. Aside from the flattening of the examined specimens, the perfect state of preservation allowed in certain taxa a satisfactory reconstruction of many details of the external morphology.

## Material

The collections of the Museo Friulano di Storia Naturale di Udine contain more than 1500 specimens of macruran decapod crustaceans in different states of preservation. The preliminary analysis of this material allowed us to select a sample of 196 specimens, subject of this work. Most of the specimens excluded from this study consisted of scattered remains (about a thousand chelae, tail fans, isolated pereiopods and antennae) of the penaeid *Dusa longipes* (Pinna, 1974), the most frequent species in the Dolomia di Forni. We also excluded about 150 specimens of small-sized natantian decapod crustaceans (10 to 45 mm in length) from the Rio Seazza Valley, since their state of preservation did not allow to detect the presence of morphological features leading to a certain ascription.

The study of the macruran decapod crustaceans of Norian age of Carnia is one of purposes set by the Museo Friulano di Storia Naturale di Udine in programming the excavations carried out between 1987 and 1991, and it is part of a research programme on Mesozoic macruran decapod crustaceans that the Museo di Storia Naturale di Milano has been carrying out for many years on materials from its own and other Museums' collections. Up to now this programme brought to the description of important Italian and foreign faunistic associations, such as the Triassic associations of the Ambilobè region (NW Madagascar) (Garassino & Teruzzi, 1995), of Cene (Seriana Valley, Bergamo - N Italy) (Pinna, 1974), of Prati di Rest (Valvestino, Brescia - N Italy) (Pinna, 1976) and Ponte Giurino (Imagna Valley, Bergamo - N Italy) (Garassino & Teruzzi, 1993); the Jurassic fauna of Osteno (Lugano Lake, Como - N Italy) (Pinna, 1968, 1969; Garassino & Teruzzi, 1990; Teruzzi, 1990 and Garassino, in press) and the Cretaceous assemblages of Trebiciano (Trieste, NE Italy) (Garassino & Ferrari, 1992), of the Lebanese outcrops (Garassino, 1994) and of Vernasso (Udine, NE Italy) (Garassino & Teruzzi, in press).

Acronyms. MFSN: Museo Friulano di Storia Naturale; MSNS: Museo di Scienze Naturali di Bergamo; MSNM: Museo di Storia Naturale di Milano

Abbreviations
R - rostrum
E - eye
t - telson
Pt - protopodite
En - endopodite
C - carina
Ex - exopodite
di - diaeresis
P - propodus
D - dactylus
I - index

## Systematics

Infraorder Penaeidea de Haan, 1849
Superfamily Penaeoidea Rafinesque, 1815
Family Penaeidae Rafinesque, 1815
Genus *Dusa* Münster, 1839

*Dusa longipes* (Pinna, 1974)
Figs. 2, 3, 4, 5, 11, 12, 13, 14, 15

1974 - *Palaeodusa longipes* - Pinna, p. 21, Figs. 9,10, Tab. I (Fig. 5), Tab. XIII (Figs. 1-3)
1976 - *Palaeodusa longipes* - Pinna, p. 36, Fig. 1, Tab. II (Figs. 1-2)
1990 - *Dusa denticulata* Münster - Dalla Vecchia, p. 122, Fig. 21 photos 31-35
1991 - *Dusa denticulata* Münster - Dalla Vecchia, p. 22, Figs. 15,16,17
1993 - *Palaeodusa longipes* Pinna - Garassino & Teruzzi, p. 11, Fig. 16
1993 - *Dusa* sp. - Dalla Vecchia, p. 62, Figs. 3,4

Diagnosis: subrectangular carapace; short rostrum with eight suprarostral teeth; rostral carina with 4-5 anteriorly projecting teeth; pereiopods I-III chelate with thin and elongate merus and carpus; pereiopod III with marked elongation of the propodus of the chela; somite VI subrectangular; exopodite with diaeresis.

Material: to the collection of the Museo Friulano di Storia Naturale belong about 300 more or less complete specimens and several hundreds isolate pereiopods, chelae and tail fans; 58 among complete and fragmentary specimens in a generally good state of preservation have been analyzed in detail to deepen the analysis of this species, adding further data to the original description by Pinna (1974), based on a sample of 43 specimens, mostly incomplete. Most of the specimens is preserved in lateral view, and only two in dorsal view. Almost all the examined sample (48) was gathered in the Rio Seazza (Preone), while a small part is from Rio Forchiar (Enemonzo) (5), Forni di Sopra (2), Rio di Donna (Socchieve) (2) and Rio Secco (Villa Santina) (1).

MFSN: 992, 1416, 1417, 1418, 1420, 1427, 1431, 1433, 1434, 1439, 1442, 1446, 1449, 1461, 1469, 1474, 1475, 1491, 1493, 1494, 1509, 1554, 1588, 1590, 1592, 1604, 1680, 1688, 1697, 1698, 1703, 1715, 1730, 1893, 1895, 1951, 6441, 13717, 13722, 13725, 13804, 13808, 13809, 15381, 16094, 16097, 16098, 16099, 16100, 16103, 16105, 16106, 16107, 16167, 16168, 16169, 16385, 18455

The new description of the species is mainly based on the following specimens: MSFN 1417, 1433, 1439, 1474, 1475, 1590, 1592, 1697, 1698, 1703, 1951, 6441, 13725, 15381, 16098, 16100, 16105, 18455

Description. A large-sized penaeid, with thin and completely smooth exoskeleton, with a total length reaching 9.5 cm, while the smallest specimens are 2.5 cm long. The average length of the specimens is 6.5 cm.

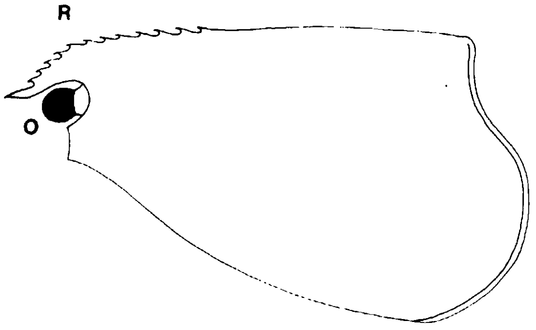


Fig. 2 – *Dusa longipes* (Pinna, 1974), reconstruction of the carapace, line drawing

Carapace. The carapace (Fig. 2), in lateral view, has a subrectangular shape and gets slightly narrow toward the anterior margin for the slight curvature of the ventral margin. The dorsal margin is straight, while the posterior margin is straight in the upper part and slightly convex in the median and lower portions, covering part of somite I. The posterior margin is strengthened by a thin marginal carina. The ventral margin has a curvilinear trend. The dorsal margin extends into a short rostrum, slightly upward bent, with pointed distal extremity and bearing eight anteriorly projecting suprarostral teeth. The subrostral teeth are lacking. The rostral carina has four or five identical and anteriorly projecting teeth. The ocular incision is narrow and shallow. The antennal and pterygostomial angles are not very pronounced. No traces of grooves, carinae and spines can be observed on the surface of the carapace, even though Pinna (1976) pointed out the presence of the hepatic groove while re-describing this species on three specimens from Prati di Rest.

Abdomen. The somites have a subrectangular shape and a uniform length from I to V. Somite VI has a subrectangular shape and is longer than the previous ones. The lower margin of all somites is strengthened by a thin marginal carina. The posterior margin of somites I-III is straight, while in somites IV-V it is posteriorly projecting. The triangular telson is strongly elongate and does not show any particular ornamentation. The endopodite is smooth, while the exopodite shows a thickened external margin, with a small spine near the diaeresis: the latter has a semicircular shape with an anteriorly directed convexity (Fig. 3). The exopodite, longer than the endopodite, is about 1/3 longer than the telson.

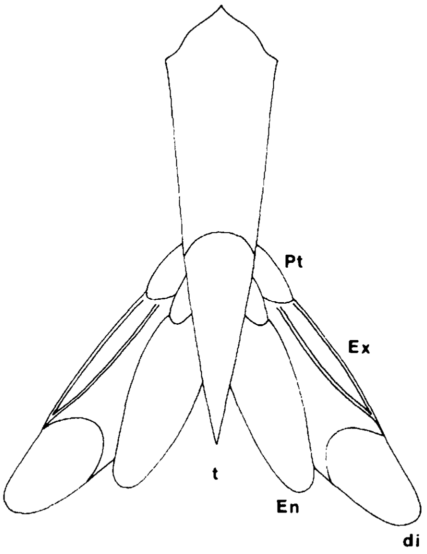


Fig. 3 – *Dusa longipes* (Pinna, 1974), reconstruction of the tail fan, line drawing

Cephalic appendages. Badly preserved in all specimens. The eye is supported by a short eye-stalk. Only the flagella of the antennulae can be observed, while the antennae preserve the spatula-shaped well developed scaphocerite and the elongate carpocerite, joint to a flagellum as long as the body.

Thoracic appendages. Well preserved in all specimens. The 3rd maxilliped, well preserved in specimen MFSN 18455, consists of four elements getting slightly narrower toward the distal extremity, bearing a row of strong spines. Pereiopods I-III are characterised by extremely thin and elongate merus and carpus. The carpus broadens at the distal extremity and is joint to the proximal portion of the propodus. If compared to pereiopods II-III with thin and elongate propodus of the chela, pereiopod I has a short and stocky propodus. Pereiopod III is extremely elongate, to the point that in big-sized specimens, such as MFSN 1697, the merus and the carpus can be 6 cm long. We observed that in most specimens the chela of pereiopods I-III is about 1/3 shorter than the other articula. If we therefore consider the length of each articulum, we can state that in large-sized specimens pereiopod III can reach an overall length that is almost twice as the total length of the body. Only specimen MFSN 16094, found in the upper member, seems to be different from the other specimens of the same species, since it has not a particularly elongate chela of pereiopod III; the propodus of the chela is in fact shorter, stocky and swollen. Lacking a numerically more significant sample of specimens from the upper member of the Dolomia di Forni, it is difficult to qualitatively evaluate these morphological differences.

The abundant sample of *D. longipes* (Pinna, 1974) allowed to observe that, on the basis of the relative proportions of the elements of the chelae of pereiopods I-III, it is possible to locate two groups: one group where dactylus and index have the same length, and another one where the dactylus is much longer than the index (Fig. 4). An analogous dimorphism was noticed by re-examining the specimens from the Cene outcrop, while it is particularly marked in the specimens from Prati di Rest (Fig. 15). Pereiopods IV-V have a terminal dactylus and are shorter than the other pairs.

Abdominal appendages. Well preserved in a few specimens. The pleopods consist of a well developed subrectangular sympodite, to which two extremely elongate multiarticulated flagella are joint. In six specimens (MFSN 1439, 1474, 1951, 15381, 16105, 16385) the petasma can be observed: it is not easy to reconstruct due to the flattening and twisting it was subject during fossilisation.

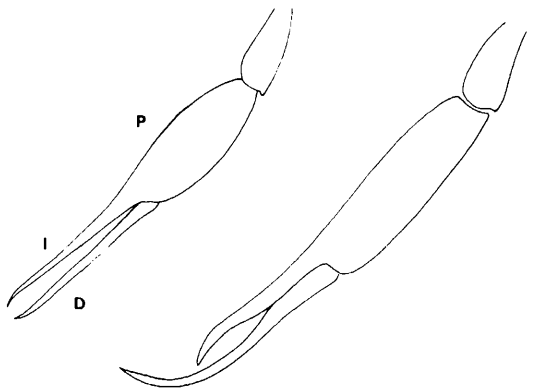


Fig. 4 – *Dusa longipes* (Pinna, 1974), chelae of the pereiopod III, line drawing

## Possible sexual dimorphism in Dusa longipes (Pinna, 1974)

As already seen, the species *D. longipes* (Pinna, 1974) of the Dolomia di Forni can be distinguished into two groups, on the basis of the different morphology of the chelae of pereiopods I-III: the dactylus and the index of the former have the same length, while a second group has chelae with a dactylus longer than the index. There are basically four preliminary assumptions aimed at explaining such a difference:

a) the possibility that the differences observed were to be ascribed to a certain degree of intraspecific variability
b) the possibility that the specimens could represent different ontogenetic stages, during which a progressive modification of the chela took place
c) the possibility that two different species were present in the examined sample
d) the possibility that the differences found were to be ascribed to a sexual dimorphism

The last assumption seems the most probable. In fact all specimens supplied with petasma bear chelae with dactylus as long as the index while, where the state of preservation allowed it, the presence of the petasma has never been observed in individuals with dactylus longer than the index (Fig. 5).

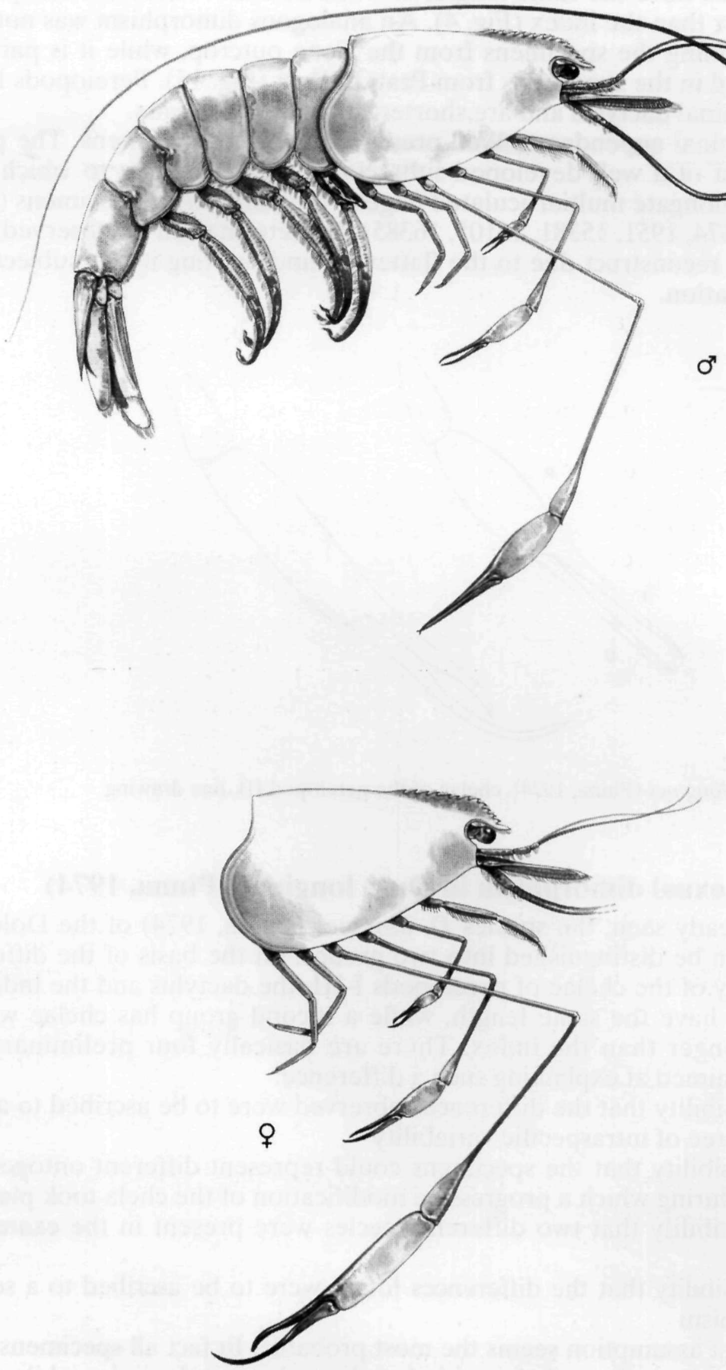


Fig. 5 – *Dusa longipes* (Pinna, 1974), reconstruction

Recently a specimen (MSNM i13394) of *D. longipes* (Pinna, 1974) supplied with petasma has been found in Valvestino, which would thus confirm this hypothesis: also this specimen, as those from Friuli, has pereiopods I-III bearing chelae with the dactylus as long as the index.

**Observations**

The species *Dusa longipes* was erected by Pinna (1974) on a sample of 43 specimens, found at Cene.

The study of a particularly interesting faunistic association discovered near Prati di Rest and described by Pinna (1976) highlighted the presence of the same species, thus pointing out the tight correlation between the Norian faunae of Bergamo and Brescia Prealps. This species has been recently found in the Argillite di Riva di Solto (Sevatian, Upper Norian or Lower Rhaetian, according to the authors; see the conclusions of this work) near Ponte Giurino (Garassino & Teruzzi, 1993). Recently Dalla Vecchia (1993) reported the presence of this genus in the Unità Fonte Santa (Upper Triassic) near the town of Filettino (Lazio, Central Italy). This discovery is particularly interesting, since in the case of Italy it is the first report about Triassic macruran decapod crustaceans outside the Alps.

Before proceeding to the comparison with the specimens from Friuli, we re-examined the sample of Cene. In the 43 specimens described Pinna did not find the presence of the rostrum and of the suprarostral teeth, nor differences in the structure of the chela of pereiopods I-III. On the contrary the analysis of the holotype (MSNB 3422) and of other specimens (MSNB: 3101, 3125b, 3195, 3417) highlighted in the chela of pereiopods I-III a minimum elongation of the dactylus if compared to the index. Even though the dactylus is longer than the index, it is interesting to observe that such elongation is less marked than that observed in the specimens from Prati di Rest and Carnia. The structure of the chela is also different: if in the specimens from Cene the dactylus and the index are thin, elongate and straight, those from Prati di Rest and Carnia have a strong and elongate dactylus and index, in most cases with a sinuous trend.

Moreover it was possible to observe in a specimen (MSNB 3105), after a careful preparation work, the short rostrum with pointed distal extremity and at least five anteriorly projecting and identical suprarostral teeth.

The examined specimens, from different outcrops in the Dolomia di Forni, especially in the Rio Seazza section, have been ascribed to the species *Palaeodusa longipes* Pinna, 1974 on the basis of certain features, such as the short rostrum with pointed distal extremity, the presence of an analogous number of suprarostral teeth, the extreme elongation of pereiopod III, the structure of the chela of pereiopods I-III and the pleopods with strongly elongate multiarticulate flagella.

The re-examination of the sample from Cene, together with the study of the specimens from Carnia and of about 60 specimens gathered in the last few years in Valvestino (Schiavone, 1992) (in particular the following specimens have been examined, MSNM: i13191, i13205, i13391, i13392, i13394), highlighted a few features, such as the subrectangular carapace, the rostrum with many suprarostral teeth and the shape of abdominal somites. In our opinion all these features are enough to raise doubts on the systematic validity of the genus *Palaeodusa* Pinna, 1974.

From the one side Pinna (1974) erected this genus in order to point out the morphological affinities, and on the other side to remark the differences in age compared to the genus *Dusa* Münster, 1839.

If nonetheless we compare the main features of the genus *Dusa* Münster, 1839, such as the subrectangular carapace, the structure of the rostrum with many suprarostral teeth, pereiopods I-III with strongly elongate merus and carpus and the subrectangular shape of the abdominal somites, to the features found in the examined specimens, no substantial morphological difference can be found. We therefore believe that the specimens found at Cene, Prati di Rest, Ponte Giurino and Carnia must be ascribed to the genus *Dusa* Münster, 1839.

At the same time we believe that the species *D. longipes* (Pinna, 1974) shows certain features distinguishing it from the species known to date: *D. monocera* Münster, 1839 and *D. denticulata* Münster, 1839 of the Tithonian of Solnhofen (Münster, 1839, p. 71, 72, Tab. XX (Figs. 3,4); Oppel, 1862, p. 107, 108, Tab. 32 (Figs. 1,2)). In fact *D. longipes* (Pinna, 1974) is different from *D. monocera* Münster, 1839 because of the elongation of the merus and carpus of pereiopods I-III, more marked than the elongation that can be observed in the German species, and because of the propodus of the chela, more elongate than the stockier and more swollen one of the Münster's species. The structure of the rostrum is similar, with many suprarostral teeth. On the contrary *D. longipes* (Pinna, 1974) differs from *D. denticulata* Münster, 1839 in the structure of the rostrum, with eight suprarostral teeth compared to the German species, showing a short rostrum with only 4-5 suprarostral teeth. The structure of pereiopods I-III is similar in both species, characterised by the strong elongation of the merus and carpus.

On the basis of this comparison, we believe that the presence of the genus *Dusa* Münster, 1839 with the species *D. longipes* (Pinna, 1974) in the lagerstätten of the alpine Upper Triassic points out the extremely conservative aspect of this genus, known in the past only in the Tithonian of Solnhofen (Upper Jurassic).

An interesting aspect that emerged from the study of the specimens from Carnia is that of bigger body size compared to that of the specimens found in the Lombardy outcrops. In fact if the biggest specimens of *D. longipes* (Pinna, 1974) found at Cene and Prati di Rest have 7 cm in length, the biggest specimens found in Carnia reach 9.5 cm in length. The increase in body size is not limited to this species, since the same phenomenon can be observed also in the species *A. noricus* Pinna, 1974, still found in Carnia.

### Genus *Antrimpos* Münster, 1839

### *A. noricus* Pinna, 1974

1974 - *Antrimpos noricus* - Pinna, p. 14, Figs. 4-8, Tab. II-XI
1976 - *Antrimpos noricus* - Pinna, p. 34, Tab. I (Figs. 1,2), Tab. III (Fig. 2)
1990 - *Antrimpos* sp. - Dalla Vecchia, p. 131, photo 37
1991 - *Antrimpos* sp. - Dalla Vecchia, p. 26

Material: 11 specimens in fair state of preservation, 3.5 to 8 cm in length. Nine of the examined specimens are from Rio Seazza (Preone), while two respectively from Caprizzi (Socchieve) and Forni di Sopra.

MFSN: 1421, 1536 b-c, 1655, 1722a-b, 1731, 13720, 16096, 16101, 16109, 16142 a-b, 16166

The state of preservation of the examined specimens does not allow to add further data to the description of the species previously supplied by Pinna (1974) on a sample of 149 specimens found at Cene. Even though the available sample is limited, it was possible to highlight three features that allowed to ascribe the examined specimens to the species *A. noricus* Pinna, 1974: the slightly upward pointing rostrum with two supṛarostral teeth, the 3rd maxilliped with two rows of spines and the pleopods with extremely elongate multiarticulate flagella.

Nevertheless four specimens preserve certain features that cannot be observed in the Cene specimens. Two specimens (MFSN: 1536 b-c, 16096) in fact have small spines on pereiopods I-III and the diaeresis on the exopodite, while other two specimens (MFSN: 1421, 16142 a-b) show the epigastric tooth in the anterior third of the dorsal margin of the carapace. Probably this last feature was not pointed out by Pinna, because the rostral region of most of the specimens he examined was fractured and twisted, making reconstruction very difficult.

Also the study of certain specimens (MSNM: i13365, i13397, i13398, i13399) gathered during the last few years at Prati di Rest (Schiavone, 1992) highlighted the presence of features that cannot be found in the specimens from Cene: the rostrum has not only the two strong suprarostral basal teeth, but also 3-4 smaller suprarostral teeth in the proximal third and a subrostral median tooth; the posterior margin of the carapace is strongly posteriorly projecting in the inferior third, covering part of somite I; the telson shows slightly toothed lateral margins; finally the exopodite, longer than the endopodite, has a strong spine near the inferior third of the lateral margin and a rounded diaeresis.

Also Pinna (1976) noticed in the 34 specimens he examined the presence of the same features observed in the specimens recently gathered at Prati di Rest. Despite these differences, the author still ascribed the specimens to the species *A. noricus* Pinna, 1974.

We believe that the morphological differences of the Valvestino specimens compared to the Cene specimens could be essentially interpreted in two different ways:

a) the diversity falls within a certain intraspecific variability.
b) the features of the Valvestino specimens are such as to consider them a new specific or sub-specific entity.

Despite the above-stated assumptions, the differences found in the specimens from the different sites could also be due to the different quality of preservation; in this case we therefore prefer to include specimens both from Lombardy and Friuli in the single species *A. noricus* Pinna, 1974.

### Infraorder Caridea Dana, 1852
### Indet. Family
### Genus *Acanthinopus* Pinna, 1974

### *Acanthinopus gibbosus* Pinna, 1974

1974 - *Acanthinopus gibbosus* Pinna, p. 23, Tab. XII (Fig. 3), Tab. XIII (Fig. 5)

Material: 2 specimens, one of which is complete and in fair state of preservation, while the other is incomplete. The specimens are from Rio Seazza (Preone).

MFSN: 18454 a-b, 16104 a-b

The species *A. gibbosus* Pinna, 1974 has been erected by Pinna (1974) on one single badly preserved specimen, found at Cene. This species has been recently reported also in the Calcare di Zorzino at Prati di Rest (Schiavone, 1992). Also in this case it is one single specimen (MSNM i13400) which, unlike the holotype, has pereiopods I-V well preserved, characterized by a double row of spines and by the lack of chelae in all pereiopods. The state of preservation of the examined specimens is such that it does not allow to add any further data to the species description previously supplied by the author. Like the holotype, the total length of the body of the complete specimen is 2.5 cm, and the presence of the double row of spines on pereiopods I-V on both specimens is the only feature allowing to ascribe them to the species *A. gibbosus* Pinna, 1974.

Even though the genus *Acanthinopus* Pinna, 1974 has well defined peculiar features, these are not enough to ascribe it with certainty to any known fossil or living family.

### Caridean gen. et sp. indet.
Fig. 16

Material: 1 complete specimen in fair state of preservation. The specimen is from the environs of Caprizzi (Socchieve).

MFSN: 16140

Description. A small-sized caridean, with thin and completely smooth exoskeleton, 3.5 cm in length.

Carapace. The carapace, in lateral view, has a subrectangular shape and gets slightly narrow toward the anterior margin for the slight curvature of the ventral margin. The dorsal margin is straight, while the posterior margin is straight in the upper and median portions, forming a slight convexity in the lower third, covering part of somite I. The ventral margin is curvilinear. The dorsal margin extends into a short rostrum, lacking supra- and subrostral teeth, with a pointed distal extremity. No antennal and pterygostomial angles are visible. No grooves, carinae and spines can be observed on the surface of the carapace.

Abdomen. The somites have a subrectangular shape and a uniform length. Somite II has a subround pleura partly covering that of somites I and III. The posterior margin of somites I and III is straight, while in somites IV-V it is posteriorly projecting. The telson has a triangular shape, with a pointed distal extremity. The badly preserved uropods are about 1/3 longer than the telson. The exopodite has no diaeresis.

Cephalic appendages. Only the flagella of the antennulae and antennae can be observed.

Thoracic appendages. It is not possible to establish if pereiopods I-II have a terminal dactylus or chelae.

Abdominal appendages. Only a short flagellum can be observed near somite III.

**Observations**

Carideans are extremely rare in the palaeontological record and not much known in their anatomical details, because of their poor state of preservation.

Only three genera are known to date in the Triassic. The most ancient genera, *Acanthinopus* Pinna, 1974 and *Leiothorax* Pinna, 1974, were found in the Calcare di Zorzino of Bergamo Prealps (Pinna, 1974). The genus *Acanthinopus* was also reported at Prati di Rest (Schiavone, 1992). A new form, *Pinnacaris* Garassino & Teruzzi, 1993, has been recently described in the Argillite di Riva di Solto near Ponte Giurino (Garassino & Teruzzi, 1993).

We believe that the features observed in the examined specimen are enough to consider the existence of a new caridean form. In fact the short rostrum lacking supra- and subrostral teeth, the lack of grooves and carinae on the carapace and the spineless pereiopods are enough to distinguish this form from the genera stated above.

However the poor material and the state of preservation do not allow to carry out a more detailed description of the specimen, and therefore the istitution of a new genus and a new species.

Infraorder Palinura Latreille, 1803
Superfamily Eryonoidea de Haan, 1841
Family Eryonidae de Haan, 1841

Genus *Rosenfeldia* nov.

Diagnosis: subround carapace, with longitudinal median carina originating from the posterior margin; two thin carinae run parallel to the median carina; two parallel rows of tubercles are located in the median portion of the cephalic region; chela of pereiopod I with the dactylus longer than the index and bent at the distal extremity; subrectangular telson; exopodite without diaeresis.

*Derivatio nominis*: dedicated to Corrado Rosenfeld, who found and donated the specimens on which the study on this genus is based.

Type species: *Rosenfeldia triasica* n.sp..

Description: as for the type species.

*Rosenfeldia triasica* n.sp.
Figs. 6,7,8,9,10,17,18,19,20

*Derivatio nominis*: it refers to the period it belongs to
Holotype: MFSN 16178
Paratypes: MFSN 16173, 16176, 16179
Type locality: Northern Flank of Auda Mount (Socchieve, Udine)
Geological age: Alaunian, Norian (Late Triassic)
Diagnosis: as for the genus

Material: 32 specimens in fair state of preservation, 31 of which from Auda Mount and 1 from Forni di Sopra (MFSN 16110). Most of the specimens (29) is in ventral view and only three in dorsal view.

MFSN: 1955, 16110, 16122, 16139, 16141 a-b, 16152, 16155 a-b, 16171, 16172, 16173, 16174 a-b, 16176, 16177, 16178, 16179, 16180, 16181, 16183, 16185, 16186, 16187, 16188, 16189, 16190, 16191, 16192, 16193, 16194, 16195, 16196, 16198, 19197

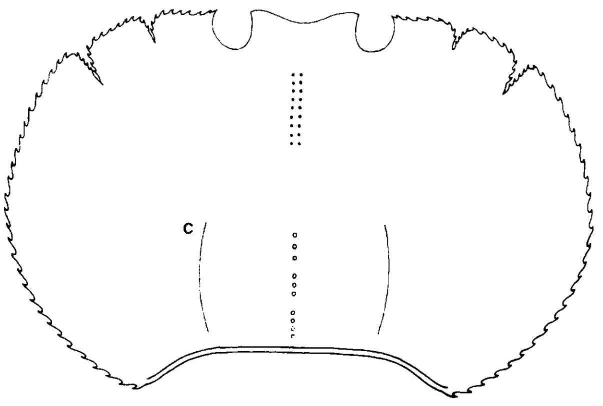


Fig. 6 – *Rosenfeldia triasica* n.gen.n.sp., reconstruction of the carapace, line drawing

Description. Short and stocky eryonoid, with a strongly tuberculate body surface, 2 to 4 cm in length. However, considering a fragmentary remain (MFSN 16110), the size of the species should be bigger. In 10 examined specimens (MFSN: 16110, 16152, 16155 a-b, 16171, 16172, 16173, 16177, 16178, 16179, 16189) we verified that the carapace/abdomen ratio is about 1/1. Concerning this, by examining specimen 16110 - which carapace is 2.5 cm long - we believe that the total length of the body should be 5 cm.

Carapace. The carapace (Fig 6), in dorsal view only in three specimens, has a subround shape and shows two deep incisions near the superior third of the lateral margins. The anterior margin is almost straight and the ocular incisions are shallow. The lateral margins are extremely rounded and bearing a row of small and strong spines running along its whole length. The posterior margin, slightly anteriorly arcuate, is strengthened by a thin marginal carina. On the surface of the carapace (Fig. 6) the following elements can be observed: a tuberculate longitudinal median carina originating from the posterior margin of the carapace and running along half the length of the carapace; two thin carinae with no tubercles running parallel to the median carina; finally two parallel rows of small tubercles running along the median part of the cephalic region. The portion of carapace located between the median carina and the lateral carinae is slightly depressed. The cervical and branchiocardiac grooves are lacking. In certain specimens in ventral view it is possible to observe the tuberculate ventral margin.

Abdomen. Well preserved in most specimens, it is as long as the carapace. The subrectangular somites are anteriorly wider and get progressively narrower toward the caudal extremity. All somites have a small and slightly marked central carina. The pleural margins are strong and pointed and bear a row of small and strong spines delimiting its outline. The tail fan is well preserved (Fig. 7). The telson is subrectangular and its lateral and distal margins are strengthened by a row of small spines. The uropods, rounded at the distal extremity, are not longer than the telson. The exopodite has no diaeresis and the endopodite does not show a particular ornamentation. The lateral margins of the exopodite and endopodite bear smaller spines than those on the telson. The surface of the telson and the uropods is tuberculate.

Cephalic appendages. Badly preserved in all specimens. The antennulae are not preserved. In certain specimens (MFSN: 16178, 16189) the petaloid-shaped scaphocerite can be observed, rounded at the distal extremity and bearing a row of small spines along the external margin.

Thoracic appendages. Well preserved in most specimens. In some specimens (MFSN: 16139, 16171, 16172, 16174 a-b, 16176, 16183, 16194, 16196) in ventral view it is possible to observe the well developed tuberculate 3rd maxilliped with the external margin bearing a row of small spines and with the slightly saw-toothed internal margins (Fig. 8 A-B). Out of the 32 examined specimens, only 17 have pereiopod I well preserved. The merus is elongate, while the subrectangular carpus is short and stocky. The chela, with strong and elongate propodus, has a dactylus longer than the index and bent at the distal extremity. Only in the case of the holotype (MFSN 16178) the elongation of the dactylus is particularly marked. Pereiopods II-IV are supplied with small chelae with dactylus and index bent at the distal extremity. Pereiopod V has a terminal dactylus. All the articula of pereiopods I-V are tuberculate, except the dactylus and the index. Finally, the lateral margins of pereiopods I-IV bear a row of small spines.

Abdominal appendages. Not preserved.

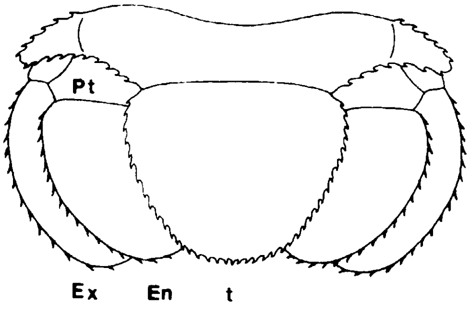
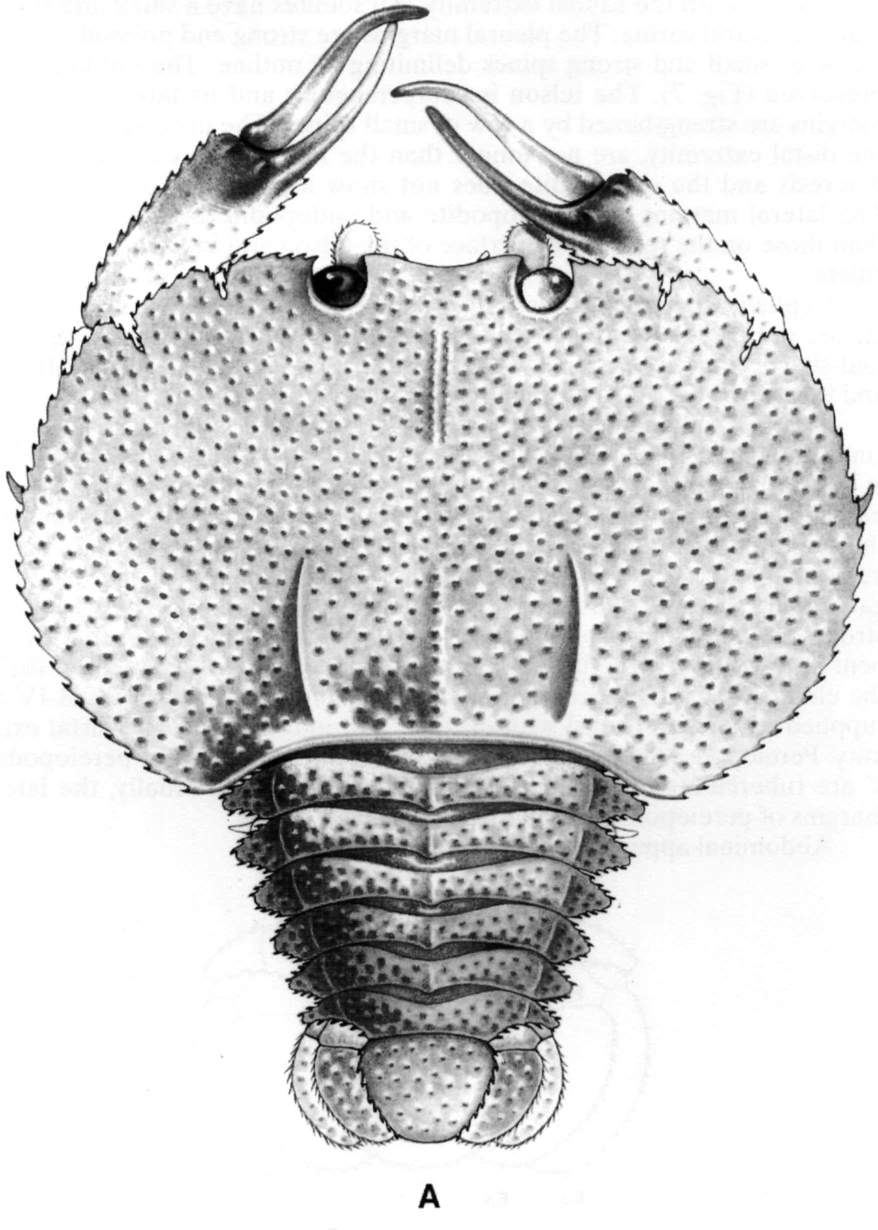


Fig. 7 – *Rosenfeldia triasica* n.gen.n.sp., reconstruction of the tail fan, line drawing

## Observations

The study of the genus *Rosenfeldia* n.gen. pointed out the presence of morphological features shared by the four families belonging to the superfamily Eryonoidea de Haan, 1841: Tetrachelidae Beurlen, 1930, Coleiidae Van Straelen, 1924, Polychelidae Wood-Mason, 1847 and Eryonidae de Haan, 1841.



A

Fig. 8A – *Rosenfeldia triasica* n.gen.n.sp., reconstruction in dorsal view

The family Tetrachelidae Beurlen, 1930 includes only the genus *Tetrachela* Reuss, 1858 which, with the species *T. raiblana* (Bronn, 1858), is known in Upper Triassic (Carnian) of Raibl (today Cave del Predil, Udine) in the Julian Alps. The genus *Tetrachela* Reuss, 1858 represents the most ancient eryonoid known to date. Glaessner (1930) revised this genus on a sample of 90 specimens - of which only 4 with a complete carapace - by

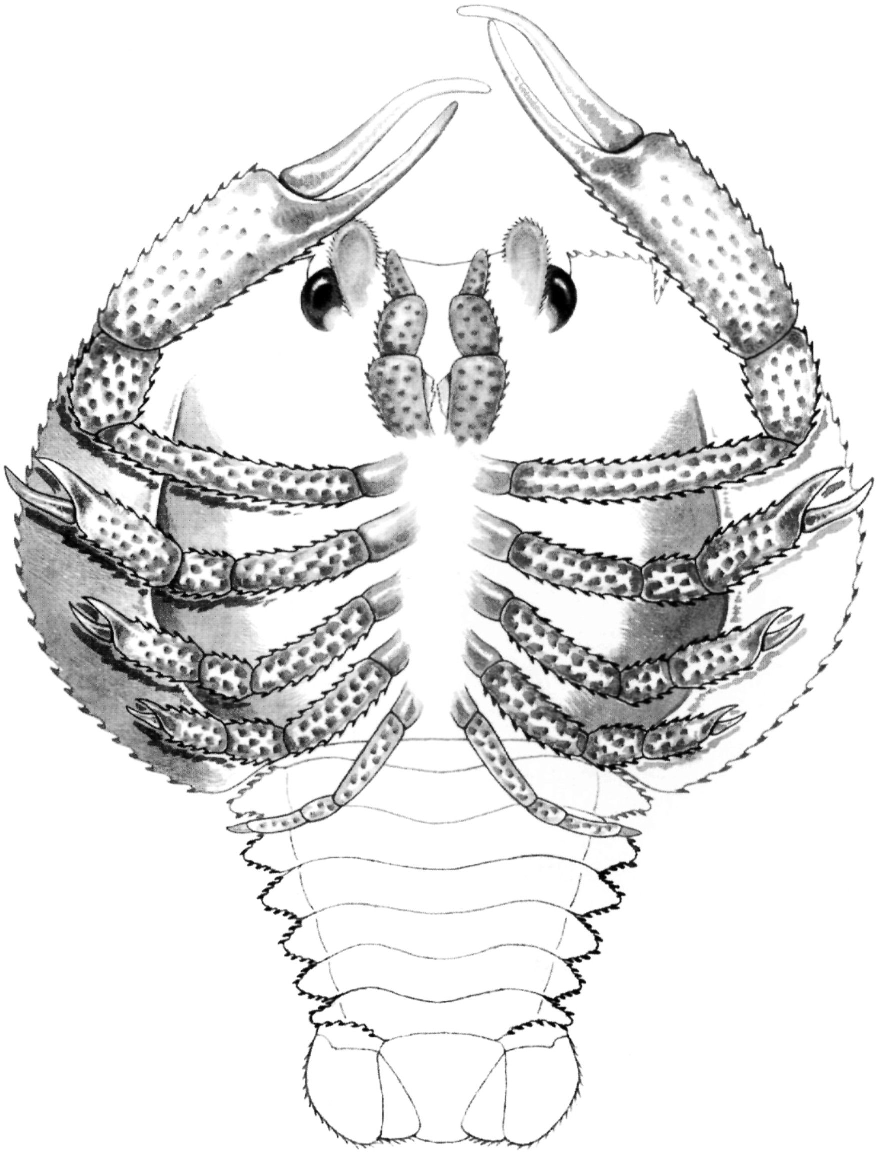


Fig. 8B – *Rosenfeldia triasica* n.gen.n.sp., reconstruction in ventral view stressing the following features: more or less quadrangular carapace, strongly marked cervical and branchiocardiac grooves, postcervical groove joining the cervical and the branchiocardiac grooves, subrectangular telson with rounded distal extremity and exopodite with diaeresis.

It was not possible to examine Glaessner's original sample, probably destroyed during the II World War. However the analysis of 27 specimens, 20 of which are housed in the Naturhistorisches Museum of Vienna, 4 in the Museo Paleontologico Cittadino di Monfalcone (2508-2509, 2512, 2514, 2517) and 3 in the Museo Friulano di Storia Naturale (MFSN 15538, 15539, 15540), allowed to detect the morphological features observed by Glaessner.

One single specimen, housed in the Museum of Vienna (1922 - N° 12), preserves the subquadrate carapace with the cervical, postcervical and branchiocardiac grooves and the complex system of carinae (Fig. 9). In another specimen, still housed in the Museum of Vienna and lacking any catalogue number, it is possible to observe the subrectangular telson and the exopodite with diaeresis. In all specimens pereiopod I has a short and stocky propodus, with dactylus as long as the index, both slightly bent at the distal extremity.

With the exception of the few features noticed, the overall preservation of the examined specimens is bad enough to make difficult the detailed description of other features. Only a sufficiently wide sample will allow a more detailed description and review of this genus.

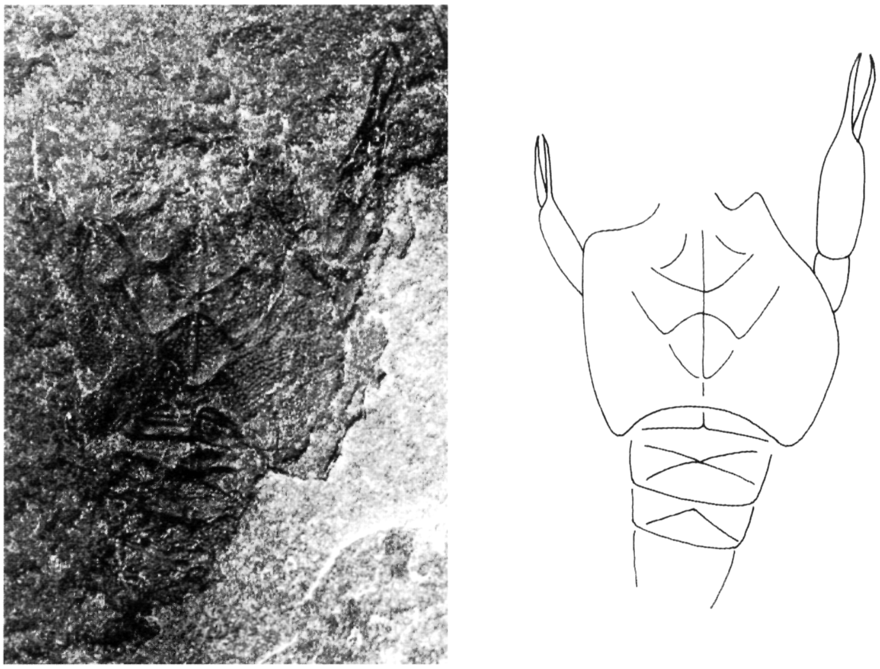


Fig. 9 – *Tetrachela raiblana* (Bronn, 1858), photo and reconstruction (× 2)

Even though the genera *Tetrachela* Reuss, 1858 and *Rosenfeldia* n.gen. share the subrectangular telson with rounded distal extremity, the presence in the new genus of a subround carapace and of a diaeresis on the exopodite exclude that this genus might belong to the family Tetrachelidae Beurlen, 1930 (Fig. 10).

The family Coleiidae Van Straelen, 1924 includes two genera, distributed from Lower Jurassic (Sinemurian) to Upper Jurassic (Tithonian): *Coleia* Broderip, 1835 and *Hellorocaris* Van Straelen, 1925. The genus *Coleia* Broderip, 1835 is known, even though with some reservations, in Indian Lower Cretaceous. The new genus *Pseudocoleia* Garassino & Teruzzi, 1993 has recently been ascribed to this family; this genus was first found near Ponte Giurino in the Argilliti di Riva di Solto, and is also present in the fauna examined of this work. It is therefore the most ancient genus known to date belonging to this family. Woods (1925) and Van Straelen (1925) summarised the main features of this family: subrectangular or subround carapace, deep cervical and branchiocardiac grooves, longitudinal median carina originating from the posterior margin of the carapace, two thin lateral carinae parallel to the median carina, subtriangular telson and exopodite with diaeresis. The genus *Rosenfeldia* n.gen. and this family share a longitudinal median carina and two thin lateral carinae. However the subrectangular telson and the lack of cervical and branchiocardiac grooves and of the diaeresis on the exopodite lead us to exclude that the genus *Rosenfeldia* n.gen. might belong to the family Coleiidae Van Straelen, 1924 (Fig. 10).

The family Polychelidae Wood-Mason, 1874 includes four fossil genera, *Willemoesiocaris* Van Straelen, 1925, *Palaeopentacheles* von Knebel, 1907, *Palaeopolycheles* von Knebel, 1907 and *Antarcticheles* Aguirre-Urreta et al., 1990, distributed from the Middle Jurassic (Callovian) to the Upper Jurassic (Kimmeridgian-Tithonian). Bernard (1953) ascribed also the three living genera *Polycheles* Heller, 1862, *Stereomastis* Spence Bate, 1888 and *Willemoesia* Grote, 1865 to the same family. Moreover the same author pointed out the fact that the genus *Eryoneicus* Spence Bate, 1882, previously considered a genus on its own, had on the contrary to be considered the larval stage of the genus *Polycheles* Heller, 1862.

Glaessner (1969) summarised the main features of this family: subrectangular carapace, spine-bearing lateral margins, strong longitudinal median carina, deep cervical groove, triangular telson and the exopodite without diaeresis.

The subround carapace, the lack of cervical groove and the subrectangular telson allow to exclude the belonging of the genus *Rosenfeldia* n.gen. to the family Polychelidae Wood-Mason, 1874. The only common characters are the longitudinal median carina and the exopodite without diaeresis (Fig. 10).

The family Eryonidae de Haan, 1841 includes four genera, distributed from Lower Lias (Toarcian) to Lower Cretaceous (Neocomian): *Proeryon* Beurlen, 1928, *Eryon* Desmarest, 1822, *Cycleryon* Glaessner, 1965 and *Knebelia* Van Straelen, 1922.

Glaessner (1969) summarized the main features of this family: subrectangular or subcircular carapace, more or less deep cervical groove, strong longitudinal median carina originating from the posterior margin of carapace, two thin lateral carinae running parallel to median carina, subtriangular telson and exopodite without diaeresis.

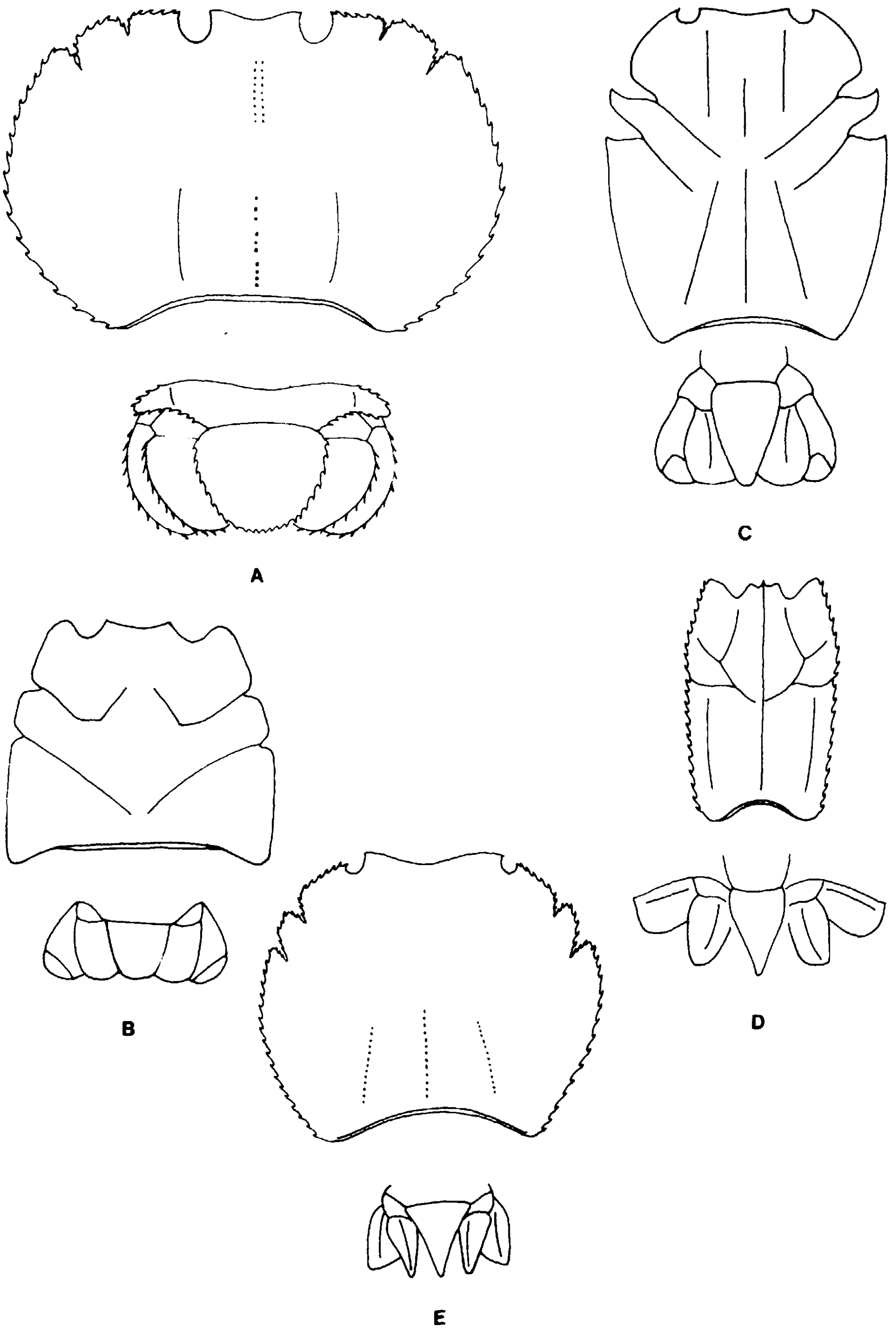


Fig. 10 – Comparison between the genera: A) *Rosenfeldia* n.gen.; B) *Tetrachela* Reuss, 1858; C) *Coleia* Broderip, 1853; D) *Polycheles* Heller, 1862; E) *Cycleryon* Glaessner, 1965

Some features of the genus *Rosenfeldia* n.gen., such as the longitudinal median carina, the two thin lateral carinae, the elongate propodus of pereiopod I, the subrectangular shape of abdominal somites and the exopodite without diaeresis, justify in our opinion the ascription to the family Eryonidae de Haan, 1841. *Rosenfeldia* n.gen. would therefore represent the most ancient genus of this family - previously known only from Lower Jurassic - known to date. Among the above-mentioned genera the one showing the most morphological analogies with the new genus is *Cycleryon* Glaessner, 1965 (Fig. 10). The two genera in fact share the toothed lateral margins of the carapace, the two deep introflections of the lateral margins of the carapace, the longitudinal median carina originating from the posterior margin of the carapace, the two thin lateral carinae running parallel to the longitudinal median carina and the subrectangular shape of the abdominal somites. There are some features, however, differentiating the two genera: the carapace in *Rosenfeldia* n.gen., is more subround than the more rounded shape of the carapace of *Cycleryon* Glaessner, 1965; in the new genus the chela of pereiopod I has a dactylus longer than the index, while in *Cycleryon* Glaessner, 1965 the index is longer than the dactylus; moreover the telson in *Rosenfeldia* n.gen. has a subrectangular shape with spine-bearing lateral margins, while in *Cycleryon* Glaessner, 1965 the telson has the triangular shape that can be found in the most typical Jurassic representatives of the family Eryonidae de Haan, 1841.

However the triangular shape of the telson should not be a constant feature of this family. In fact the specimen recently found in the Middle Jurassic (Callovian) of Antarctic, ascribed to the genus *Cycleryon* Glaessner, 1965, would further strengthen the ascription of the genus *Rosenfeldia* n.gen. to the family Eryonidae de Haan, 1841. In fact Quilty (1988), describing this specimen, pointed out the presence of a rounded, not triangular, telson. Such feature is therefore unusual for the genus *Cycleryon* Glaessner, 1965.

### Family Coleiidae Van Straelen, 1924
### Genus *Pseudocoleia* Garassino & Teruzzi, 1993

### *Pseudocoleia mazzolenii* Garassino & Teruzzi, 1993

1993 - *Pseudocoleia mazzolenii* Garassino & Teruzzi, p. 19, Figs. 35-40, Tab. IV (Figs. 3,4)

Material: 6 incomplete specimens, in bad state of preservation. The examined specimens are from Auda Mount, near Caprizzi (Socchieve).

MFSN: 1949, 1950, 6153 a-b, 16113 a-b, 16121, 16175

Garassino & Teruzzi (1993) described the species *P. mazzolenii* on the basis of a sample of 36 specimens in fair state of preservation, found near Ponte Giurino. The bad state of preservation of the examined specimens does not allow to add new elements to the detailed description previously supplied by the authors.

They are nevertheless ascribed to the species *P. mazzolenii* Garassino & Teruzzi, 1993 on the basis of the subrectangular shape of the carapace and of the dorsal carinae assemblage of the carapace, identical to the one noticed in the Ponte Giurino specimens.

### Superfamily Palinuroidea Latreille, 1803
### Family Palinuridae Latreille, 1802
### Genus *Archaeopalinurus* Pinna, 1974

### *Archaeopalinurus levis* Pinna, 1974
Figs. 21, 22

1974 - *Archaeopalinurus levis* Pinna, p. 29, Fig. 15, Tab. XIV (Fig. 1), Tab. XV (Fig. 3), Tab. XVI (Figs. 4,5)
1976 - *Archaeopalinurus levis* Pinna, p. 37, Tab. III (Figs. 3,4)
1990 - *Palinurina* sp. - Dalla Vecchia, p. 136
1991 - *Palinurina* sp. - Dalla Vecchia, p. 26
1993 - *Archaeopalinurus levis* Garassino & Teruzzi, p. 17, Tab. IV (Figs. 1,2)
1993 - *Palinurina* cfr. *longipes* Münster - Dalla Vecchia, p. 65, Fig. 5

Material: 126 specimens, mostly incomplete and in fair state of preservation. 78 are here studied in detail. Most of the specimens is from Auda Mount (Tagliamento river bed, at the foot of the mountain, near the village of Caprizzi - Socchieve), a specimen is from Rio Seazza Valley, one from Forni di Sopra and one from Rio dai Clas (Forni di Sopra).

MFSN: 1392, 1393, 1394, 1395 a-b, 1396, 1397, 1398, 1399, 1400 a-b, 1401, 1402, 1403, 1404, 1405, 1406, 1407, 1408, 1409, 1410, 1411, 1412, 1935, 1936, 1937 a-b, 1938, 1939, 1940, 1941, 1942, 1943 a-b, 1944 a-b, 1945 a-b, 1946 a-b, 1947, 1948, 5690, 16108, 16111, 16112, 16115 a-b, 16116 a-b, 16117, 16118, 16119, 16120, 16123, 16124, 16125, 16126 a-b, 16127 a-b, 16128, 16129, 16130, 16131, 16132 a-b, 16133 a-b, 16134 a-b, 16135, 16136-16165, 16137, 16138, 16143, 16144, 16147, 16148, 16149 a-b, 16150, 16151, 16153, 16154, 16156, 16157, 16158, 16159 a-b, 16160, 16162, 16163 a-b, 16164

Even though the specimens from Carnia are numerically more abundant than the few fragmentary specimens found at Cene, their state of preservation does not allow to add further data to the description of this species previously supplied by Pinna (1974) and to the following observations by Garassino & Teruzzi (1993). It was however possible to highlight a few features that led to the ascription of the examined specimens to the species *A. levis* Pinna, 1974: the presence of the spine-bearing merocerite and carpocerite of the antennae, the strong flagellum of the antennae, pereiopods I-V by several rows of spines, the subrectangular telson and the exopodite with diaeresis. Like the specimens from Cene, also those from the Dolomia di Forni do not preserve the carapace.

The species *A. levis* Pinna, 1974 was found not only at the type locality of Cene, but also at Prati di Rest and Ponte Giurino, where the best preserved specimen of the species was found, which allowed to carry out a detailed description of the tail fan and of part of the carapace (Garassino & Teruzzi, 1993, p. 17, Figs. 29, 33). Recently Dalla Vecchia (1993) reported the presence of this genus in the Unità Fonte Santa (Upper Triassic) near the town of Filettino (Lazio, Central Italy). One single incomplete specimen was found, supplied with pereiopods I-V and lacking the carapace.

Before the discovery of *Archaeopalinurus levis* Pinna, 1974 in the Norian of Cene, the species *Palinurina longipes* Münster, 1839 of the Tithonian of Solnhofen (Upper Jurassic) was known as the most ancient representative of the family Palinuridae Latreille, 1802.

A preliminary analysis of the specimens from Cene and Prati di Rest ascribed to the species *A. levis* Pinna, 1974 showed certain morphological features - such as the cephalic appendages and the tail fan - similar to those of the German species, thus raising some doubts about the true systematic validity of the genus *Archaeopalinurus* Pinna, 1974.

However the discovery of the specimens in the Argilliti di Riva di Solto and the Dolomia di Forni, - which state of preservation permitted a more detailed study of the above-stated features - allowed to dissipate any doubts on the validity of the Triassic genus.

The new description of the German species by Förster (1973) allowed a comparison with the species *A. levis* Pinna, 1974. As previously stated, the cephalic appendages and the tail fan distinguish the two species.

Even though the antennal peduncle consists of three strong articula in both species, such articula are spineless in *P. longipes* Münster, 1839 (Förster, 1973, p. 39, fig. 5) and bear small spines in *A. levis* Pinna, 1974 (Garassino & Teruzzi, 1993, p. 18, figs. 30,31).

The tail fan is also different; in *P. longipes* Münster, 1839 the telson and the uropods are spineless (Förster, 1973, p. 41, fig. 7), while in *A. levis* Pinna, 1974 the telson and the uropods are ornate by strong row of spines (Garassino & Teruzzi, 1993, p. 17, fig. 29).

Pereiopods I-V have a terminal dactylus and the articula bear rows of thin spines in both species.

Finally, it is not possible to compare the carapace of the two species, since in the *A. levis* Pinna, 1974 specimens it is lacking or partially preserved.

### Superfamily Glypheoidea Zittel, 1885
### Family Glypheidae Zittel, 1885
### Genus *Glyphea* von Meyer, 1835

#### *Glyphea* sp.

Material: 5 specimens, mostly incomplete, in bad state of preservation. 4 specimens are from Auda Mount and from the Borta landslide (both are near Caprizzi) and one specimen is from Rio Seazza (Preone).

MFSN: 1414 a-b, 1953, 1954, 16095 a-b, 16182

Even though the state of preservation of the examined specimens does not allow to carry out a detailed description, it was nevertheless possible to observe a few features of the external morphology.

First of all they are big-sized specimens: the biggest specimen (MFSN 16095 a-b) has a total length of 13.5 cm. The surface of the carapace, abdomen and pereiopod I is strongly tuberculate. In two specimens (MFSN: 9153, 16095 a-b) it is possible to observe a long and particularly strong rostrum, lacking any supra- and subrostral teeth and with a rounded distal extremity, a deep cervical groove and a branchiocardiac groove. The antennal flagella are particularly strong. The abdominal somites have a subrectangular shape. The telson has a subrectangular shape, with a rounded distal extremity. The exopodite has a strong spine on the external lateral margin, near the diaeresis and a thin longitudinal median carina.

On the basis of our observations, we believe that the feature allowing to ascribe the examined specimens to the genus *Glyphea* von Meyer, 1835 is the pattern of the cervical and branchiocardiac grooves.

However the above-stated features are not enough to clearly highlight morphological features aimed at a precise definition of a new species: that is why we prefer to leave such species indeterminate.

Until now the presence of the genus *Glyphea* von Meyer, 1835 in the Triassic was known only by the species *G. tantalus* Wöhrmann, 1892 (Wöhrmann & Koren, 1892) from the Carnian of Raibl (today Cave del Predil, Udine). However the ascription of this species to the genus *Glyphea* von Meyer, 1835 is considered doubtful by Förster (1967). The specimens found in Carnia therefore represent the first certain report on the genus *Glyphea* von Meyer, 1835 in the Upper Triassic.

### Infraorder Astacidea Latreille, 1803
### Family Platychelidae Glaessner, 1931
### Genus *Glaessnericaris* Garassino & Teruzzi, 1993

### *Glaessnericaris* sp.

Material: 1 specimen, in fair state of preservation, 3 cm in length. The specimen is from Caprizzi (Socchieve).

MFSN: 16146 a-b

The genus *Glaessnericaris* Garassino & Teruzzi, 1993 with the species *G. macrochela* Garassino & Teruzzi, 1993 was erected on a sample of 310 specimens found at Ponte Giurino, in the Argilliti di Riva di Solto (Garassino & Teruzzi, 1993). The same genus with the species *G. dubia* (Pinna, 1974) is known at Cene, in the Calcare di Zorzino.

The state of preservation of the examined specimen makes it difficult to recognize morphological features that might be enough to ascribe it to one of the two species known to date.

However we believe there are at least three features allowing to ascribe certainly this specimen to the genus *Glaessnericaris* Garassino & Teruzzi, 1993: the trend of the cervical groove, the elongate chela of pereiopod I and the subrectangular shape of the abdominal somites.

### Family, gen. et sp. indet.
Fig. 23

Material: 1 incomplete specimen in fair state of preservation. The specimen is from the northern flank of Auda Mount, near the village of Caprizzi (Socchieve).

MFSN: 1413

The specimen preserves part of somite III, somites IV-VI and the tail fan. The badly preserved telson seems to have a subrectangular shape and does not show any particular ornamentation, except a thick pit. The exopodite is run by a strong longitudinal median carina and bears a row of small spines along the proximal margin of the diaeresis, which could not be found. Also the endopodite is run by a strong longitudinal median carina. The external lateral margins of the uropods are smooth.

Even though the features make the ascription of the examined specimen difficult, we tried to compare two Triassic families, which features we believe allow to establish a possible ascription.

The family Glypheoidea Zittel, 1885 is represented in the Triassic by the genus *Pseudoglyphea* Oppel, 1861 - to which the species *P. gigantea* Garassino & Teruzzi, 1993 belongs, found near Ponte Giurino - and by the genus *Glyphea* von Meyer, 1835, first found in the examined fauna. These genera, like the examined specimen, are characterised by the presence of longitudinal median carinae on the uropods.

However the presence in *P. gigantea* Garassino & Teruzzi, 1993 of a toothed external lateral margin of the exopodite and of the longitudinal median carina only on the endopodite, excluded that the examined specimen might belong to this species.

On the contrary we do not exclude the possibility that the examined specimen could be ascribed to *Glyphea* von Meyer, 1835, even though it is not possible to observe the strong spine of the lateral margin of the exopodite, which on the contrary is present in specimens belonging to this genus. The large size both of the specimens of *Glyphea* von Meyer, 1835 and of the examined specimen, even though incomplete, would be another datum supporting a possible ascription of the latter to this genus.

The family Astacidea Latreille, 1803 is known in the Triassic with two genera: *Platychela* Glaessner, 1931, found in the Carnian of Lunz (Austria) and Raibl (today Cave del Predil, Udine) and *Glaessnericaris* Garassino & Teruzzi, 1993, found at Cene, Ponte Giurino and in the examined fauna. In the examined specimens of *Platychela* Glaessner, 1931 it is not possible to notice longitudinal median carinae on the uropods, while in *Glaessnericaris* Garassino & Teruzzi, 1993 strong longitudinal median carinae were observed on the uropods. However, if compared to this genus, the examined specimen does not show the two teeth on the lateral margins of the telson and the two teeth on the lateral margins of the exopodite near the diaeresis.

We finally believe that the features observed exclude *a priori* a possible ascription to the family Palinuridae Latreille, 1802, since both the fossil genera, such as *Archaeopalinurus* Pinna, 1974 and *Palinurina* Münster, 1839, and the living ones lack the longitudinal median carinae on the uropods.

On the basis of what observed we think that only the discovery of other better preserved specimens will allow to more clearly define what for the moment is limited to a simple report.

### Infraorder Astacidea Latreille, 1803
### Family ? Platychelidae Glaessner, 1931

### Gen. et sp. indet.
Fig. 24

Material: 1 incomplete specimen, in a bad state of preservation. The specimen is from Auda Mount (Socchieve).

MFSN: 16170 a-b

The bad state of preservation of the examined specimen does not allow to carry out a detailed morphological description, except of a few features.

The carapace is not preserved and no abdominal somites can be distinguished. The uropods are visible, not showing any longitudinal median carinae. All pereiopods are preserved. Pereiopod I has a thin and elongate propodus of the chelae; the dactylus and the index are slightly bent at the distal extremity and have an equal length. The chela of pereiopod II is short and thin. Pereiopod III is incomplete: it is possible to distinguish part of the elongate propodus, the short and stocky carpus and the thin and elongate merus. Also pereiopods IV-V are incomplete. The pleopods and the cephalic appendages are completely lacking, with the exception of the incomplete antennal flagella.

On the basis of what described, we believe that the features observed are not enough to carry out a certain generic and specific ascription of the examined specimen. However the structure of the chela of pereiopod I and the extremely thin structure of the elements of pereiopods III-V are shared by this specimen and the genus *Glaessnericaris* Garassino & Teruzzi, 1993, found at Cene, Ponte Giurino and in the examined fauna.

Only the discovery of better preserved specimens will more precisely clarify the systematic position of what for the moment is limited to a simple report.

## Conclusions

### General geologic framework of the Norian fossiliferous outcrops in Southern Alps

The Norian palaeogeography of Southern Alps was dominated by a large carbonate platform. In highly subsiding regions (Lombardy and Northern Friuli), relatively deep basins however progressively developed, largely controlled by palaeotectonic movements (Stefani et al., 1992). In these depressions, thick basinal successions accumulated (e.g. Calcare di Zorzino in central-eastern Lombardy; Dolomia di Forni in Northern Friuli). These successions were characterised by the abundance of calcareous muds exported from the nearby platform and marginal settings, and by resedimented breccias along the margin of the basins. The depressions in the Lombardy area were interspaced with shallow carbonate highs, flanked by buildup margins associated with clinostratified slope breccias or by steep fault escarpments (Jadoul, 1986; Stefani et al., 1992). Faunal assemblages with crustaceans, fishes and reptiles were preserved in the bottoms of the depressions during periods of strong sea-water stratification and anoxia. These anoxic phases in the Lombardy area were particularly common during the last period of carbonate sedimentation, while in the Carnic area are much more frequent and widely distributed (Dalla Vecchia & Muscio, 1990; Dalla Vecchia, 1991).

In Lombardy carbonate deposition was interrupted in the Sevatian (Late Norian) time by a generalized transgression; carbonate highs were drowned and the former depressions coalesced to form a larger argillaceous basin. During the transgression and basal highstanding phases the basin was often characterised by poorly oxygenated to anoxic conditions. Important faunistic associations were therefore again preserved in Lombardy in the black shales of the Argillite di Riva di Solto (Stefani et al., 1992).

These associations (e.g. Ponte Giurino, Imagna Valley, Bergamo - N Italy) (Garassino & Teruzzi, 1993) yielded a rich decapod fauna with some taxa in common with the lowstanding carbonate sequences both of Lombardy and Friuli, though with different relative abundance.

The macruran decapod crustaceans of the Dolomia di Forni increase the knowledge on the evolutionary history of decapods in the final stages of Triassic and allow at the same time to enrich the palaeoenvironmental picture of macruran decapod crustacean faunae of the Norian carbonatic platforms of Southern Alps.

The study of these specimens highlighted strong analogies with the faunae of Calcare di Zorzino (Cene and Prati di Rest) and at the same time it shares a few features with the fauna of Argilliti di Riva di Solto (Ponte Giurino) (Tab. III).

The natantians are in fact represented by genera and species already known in the Lombardy basins, such as *Antrimpos* Münster, 1839 with the species *A. noricus* Pinna, 1974, *Dusa* Münster, 1839 with the species *D. longipes* (Pinna, 1974) and *Acanthinopus* Pinna, 1974 with the species *A. gibbosus* Pinna, 1974, while the reptants already reported in the Lombardy Prealps include the genera *Glaessnericaris* Garassino & Teruzzi, 1993 with an indeterminate species, *Pseudocoleia* Garassino & Teruzzi, 1993 with the species *P. mazzolenii* Garassino & Teruzzi, 1993 and *Archaeopalinurus* Pinna, 1974 with the species *A. levis* Pinna, 1974.

In agreement with the other faunistic assemblages of the Calcare di Zorzino, as far as concerning the relative abundance of individuals, natantians represent the main percentage also in the fauna from the Dolomia di Forni. However, even though *Dusa* Münster, 1839 is numerically more abundant than the other genera, it is possible to observe a higher differentiation of the reptant forms compared to the natantian forms; such feature is shared by the fauna from Carnia and that from Ponte Giurino. This is true for the western outcrop of the Dolomia di Forni and is highly probably due - as previously pointed out - to palaeoenvironmental conditions.

The finding of the genera *Glyphea* von Meyer, 1835, *Pseudocoleia* Garassino & Teruzzi, 1993 and *Rosenfeldia* n.gen. plays a particularly important role, because it allows to partially distinguish the Friuli fauna from the other Norian faunae.

Even though in the past Wöhrmann (1892) ascribed a few specimens from the Carnian of Raibl (today Cave del Predil, Udine) to the genus *Glyphea* von Meyer, 1835, Förster (1967) questioned such attribution. The certain presence of the genus *Glyphea* von Meyer, 1835 in the Norian of Carnia represents an extremely interesting datum, since this genus was known to date with certainty only from Lower Jurassic. The appearance and progressive differentiation of glypheids during the Late Triassic would also be proven by the discovery of the genus *Pseudoglyphea* Oppel, 1861 at Ponte Giurino; as in *Glyphea* von Meyer, 1835, the maximum development of this genus will take place during Jurassic.

Tab. III - Comparison between the faunistic assemblages of Lower Carbonatic sequence and Upper Argillaceous sequence of the Norian. 1) *Antrimpos noricus* Pinna, 1974; 2) *Dusa longipes* (Pinna, 1974); 3) *Longichela orobica* Garassino & Teruzzi, 1993; 4) *Satirocaris cristatus* Garassino & Teruzzi, 1993; 5) *Acanthinopus gibbosus* Pinna, 1974; 6) *Leithorax triasicus* Pinna, 1974; 7) *Pinnacaris dentata* Garassino & Teruzzi, 1993; 8) *Glaessnericaris dubia* (Pinna, 1974); 9) *Glaessnericaris macrochela* Garassino & Teruzzi, 1993; 10) *Glaessnericaris* sp.; 11) *Archaeopalinurus levis* Pinna, 1974; 12) *Glyphea* sp.; 13) *Pseudoglyphea gigantea* Garassino & Teruzzi, 1993; 14) *Pseudocoleia mazzolenii* Garassino & Teruzzi, 1993; 15) *Rosenfeldia triasica* n.sp.

| | **Lower Carbonatic sequence** | | | **Upper Argillaceous sequence** |
|---|---|---|---|---|
| | Cene | Prati di Rest | Carnia | Ponte Giurino |
| 1 | X | X | X | |
| 2 | X | X | X | X |
| 3 | | | | X |
| 4 | | | | X |
| 5 | X | X | X | |
| 6 | X | | | |
| 7 | | | | X |
| 8 | X | | | |
| 9 | | | | X |
| 10 | | | X | |
| 11 | X | X | X | X |
| 12 | | | X | |
| 13 | | | | X |
| 14 | | | X | X |
| 15 | | | X | |

The presence of the genus *Pseudocoleia* Garassino & Teruzzi, 1993, even though with a limited number of specimens, represents another interesting aspect. Eryonoids were known to date only by the genus *Tetrachela* from the Carnian of Raibl (Glaessner, 1930). The discovery of *Pseudocoleia* Garassino & Teruzzi, 1993 (family Coleiidae Van Straelen, 1924) plays an important role not only because it introduces elements shared by the examined fauna and the chronologically slightly younger fauna from Ponte Giurino, but also because it is the first report on eryonoid crustaceans in the carbonate basinal units of the Norian.

Together with the family Coleiidae Van Straelen, 1924 the most ancient representatives of the family Eryonidae de Hann, 1841 were found, belonging to the genus *Rosenfeldia* n.gen.. The Norian age was therefore subject to a true differentiation of eryonoid crustaceans, which will reach their maximum diffusion during Jurassic, according to what proved by some Jurassic lagerstätten, such as Osteno (Sinemurian; Lugano Lake, N Italy), Lyme Regis (Sinemurian; West Country, England), La Voulte (Callovian; France), Holzmaden (Toarcian; Baden-Württemberg, Germany) and Solnhofen (Tithonian; Bavaria, Germany).

The lack of eryonoid crustaceans in the faunae of the Norian of Lombardy might be due to environmental conditions unfavourable to the settlement of these organisms. Such conditions did not seem to particularly affect other reptant forms, such as *Glaessnericaris* Garassino & Teruzzi, 1993 and *Archaeopalinurus* Pinna, 1974. The presence of eryonoid crustaceans in the Dolomia di Forni may be due to the presence of more favourable ecological conditions than the other Norian basins; their settlement will be favoured in Lombardy by the radical passage from carbonatic basinal units to clayey successions, as proven also by the sudden increase and the differentiation of the reptants forms compared to the progressive decrease in natantian forms.

On the basis of what described we can state that the macruran decapod crustacean communities in Southern Alps show, during the Norian age, a faunistic uniformity, especially in the case of Bergamo and Brescia outcrops; such uniformity is only partly maintained in the Friuli outcrops for ecological reasons. In fact, by examining the Ponte Giurino fauna (Garassino & Teruzzi, 1993), we saw that at the probable passage Alaunian-Sevatian, at the beginning of Argilliti di Riva di Solto depositions, a true turn-over of taxa took place in Lombardy, with a distinct prevalence of reptant forms.

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Photos by Giovanni Calabria - Detailed drawings by Fabio Fogliazza - Translation by Antonella Rivalta.

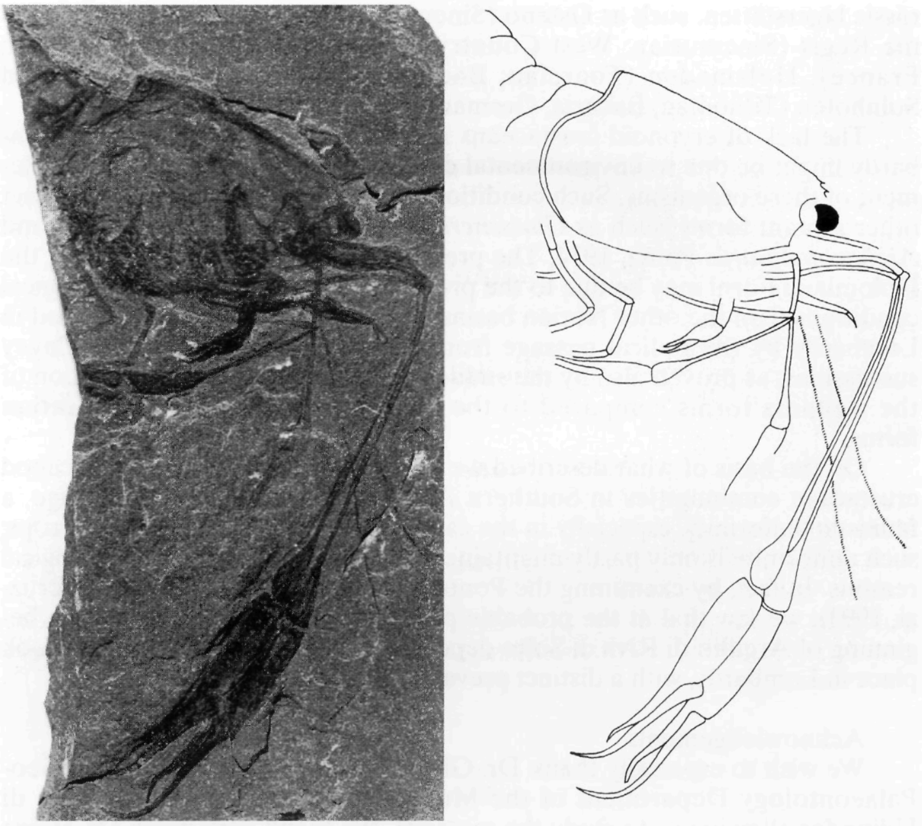

Fig. 11 – *Dusa longipes* (Pinna, 1974), n. cat. MFSN 1417, photo and reconstruction (× 0.9)

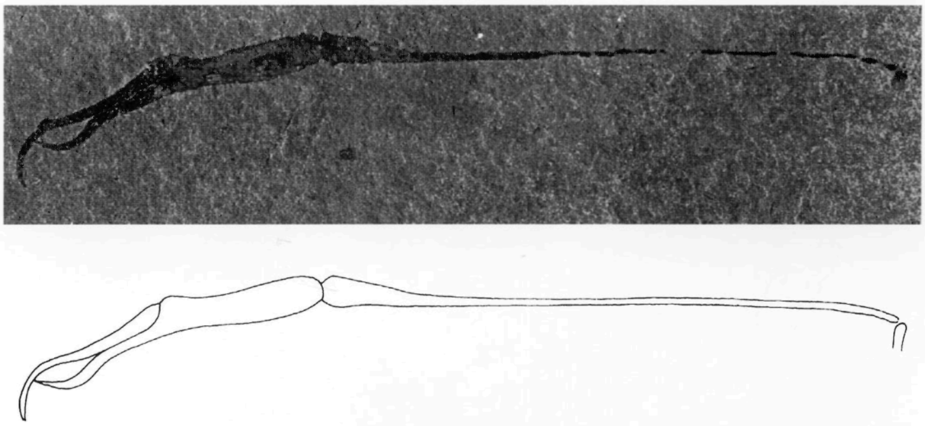

Fig. 12 – *Dusa longipes* (Pinna, 1974), n. cat. MFSN 1592, photo and reconstruction (× 1.7)

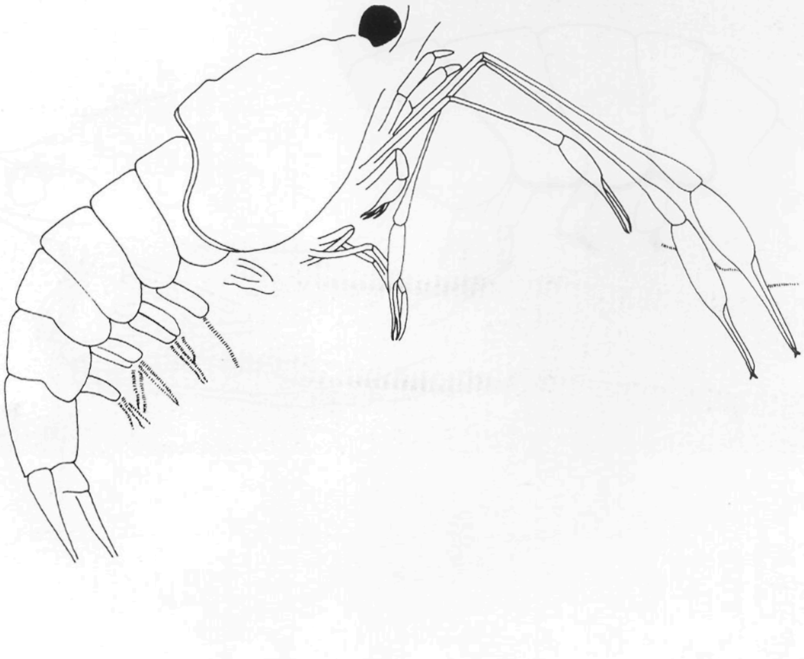

Fig. 13 – *Dusa longipes* (Pinna, 1974), n. cat. MFSN 15381, photo and reconstruction (× 1.8)

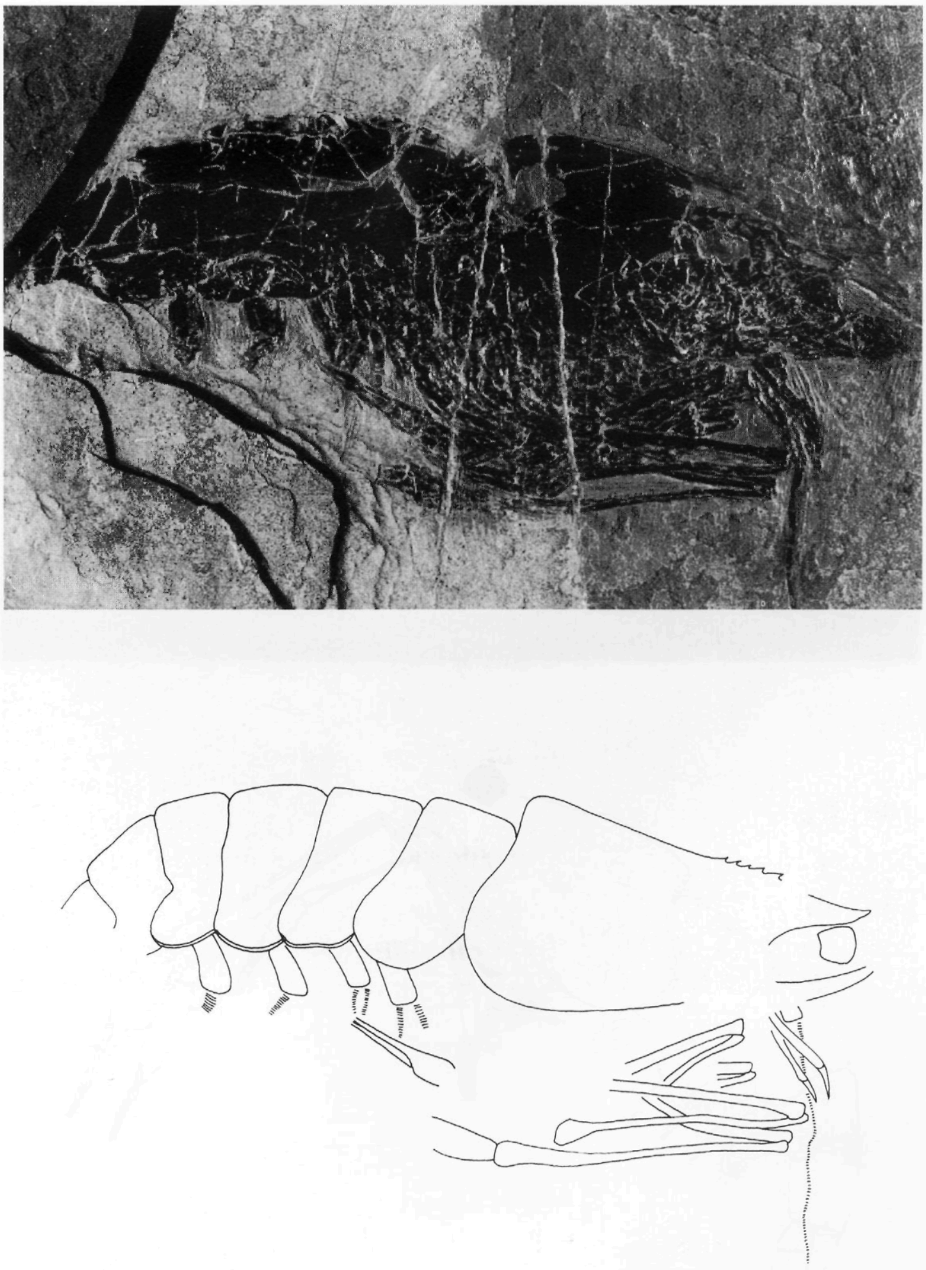

Fig. 14 – *Dusa longipes* (Pinna, 1974), n. cat. MSNM i13391 (Prati di Rest), photo and reconstruction (× 2.6)

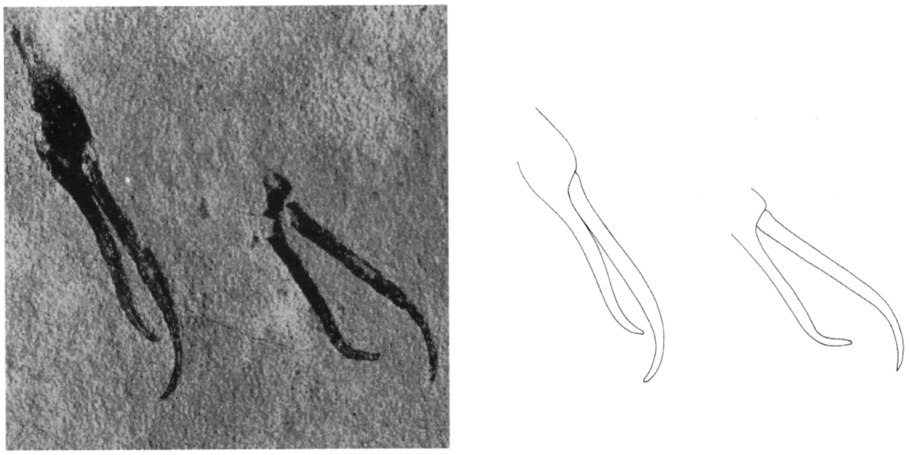

Fig. 15 – *Dusa longipes* (Pinna, 1974), n. cat. MSNM i13422 (Prati di Rest), chelae pereiopod III, photo and reconstruction (× 2.6 )

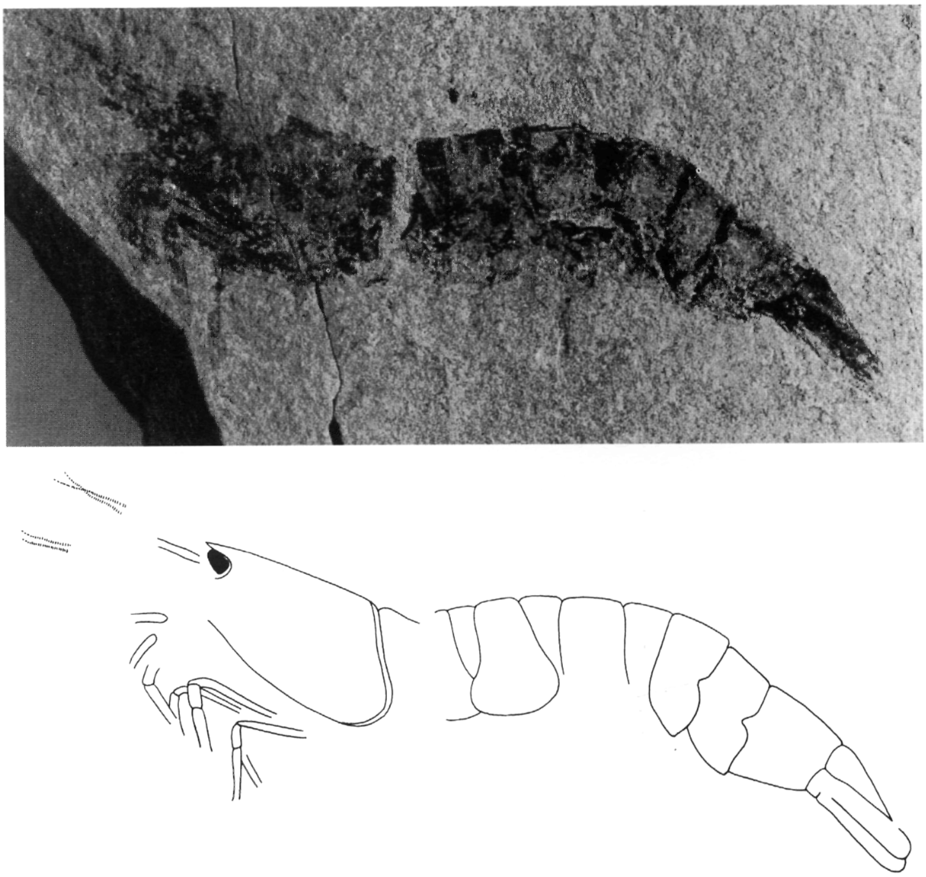

Fig. 16 – Indeterminate caridean, n. cat., MFSN 16140, photo and reconstruction (× 3)

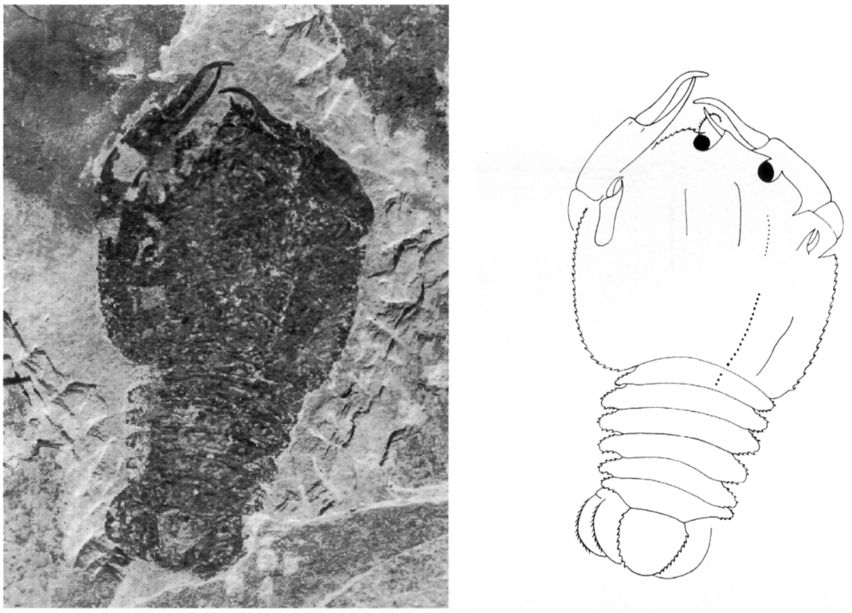

Fig. 17 – *Rosenfeldia triasica* n.gen.n.sp., holotype, n. cat. MFSN 16178, photo and reconstruction (× 1.6)

Fig. 18 – *Rosenfeldia triasica* n.gen.n.sp., n. cat. MFSN 16176, photo and reconstruction (× 1.8)

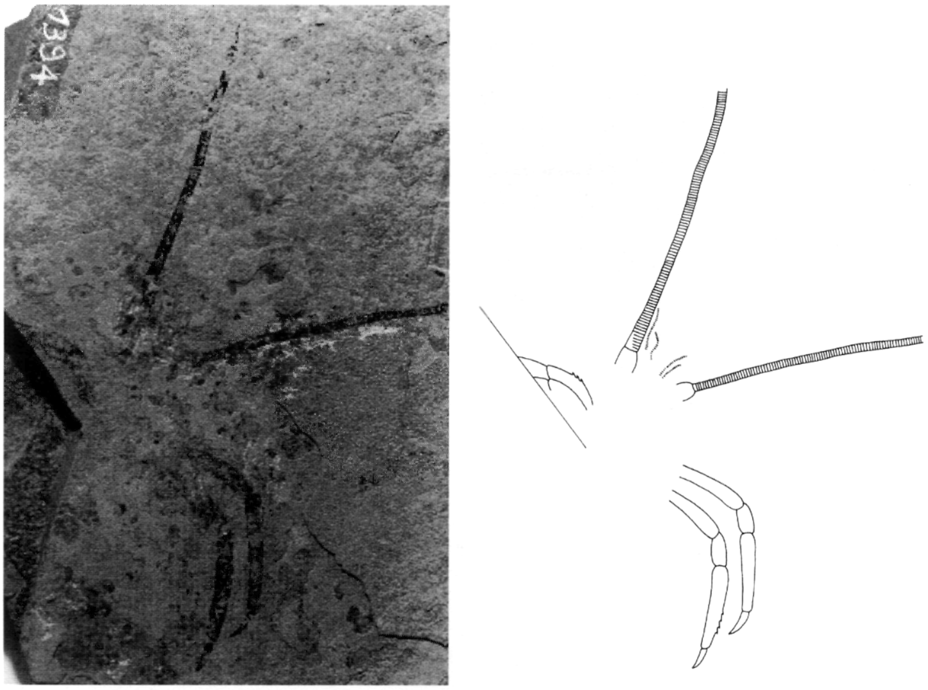

Fig. 21 – *Archaeopalinurus levis* Pinna, 1974, n cat. MFSN 1394, photo and reconstruction (× 1)

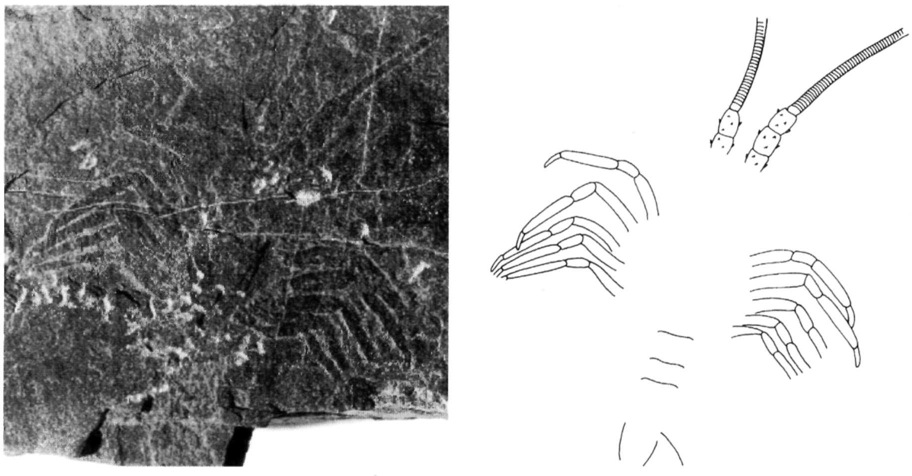

Fig. 22 – *Archaeopalinurus levis* Pinna, 1974, n cat. MFSN 16128, photo and reconstruction (x 1.6)

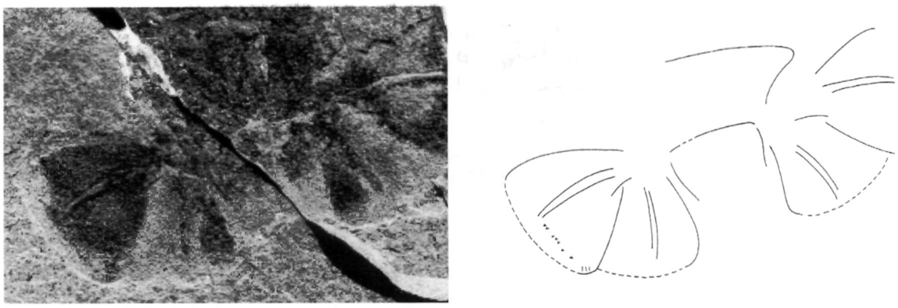

Fig. 23 – Palinuridean gen. et sp. indet., n. cat. MFSN 1413, photo and reconstruction (× 1.8)

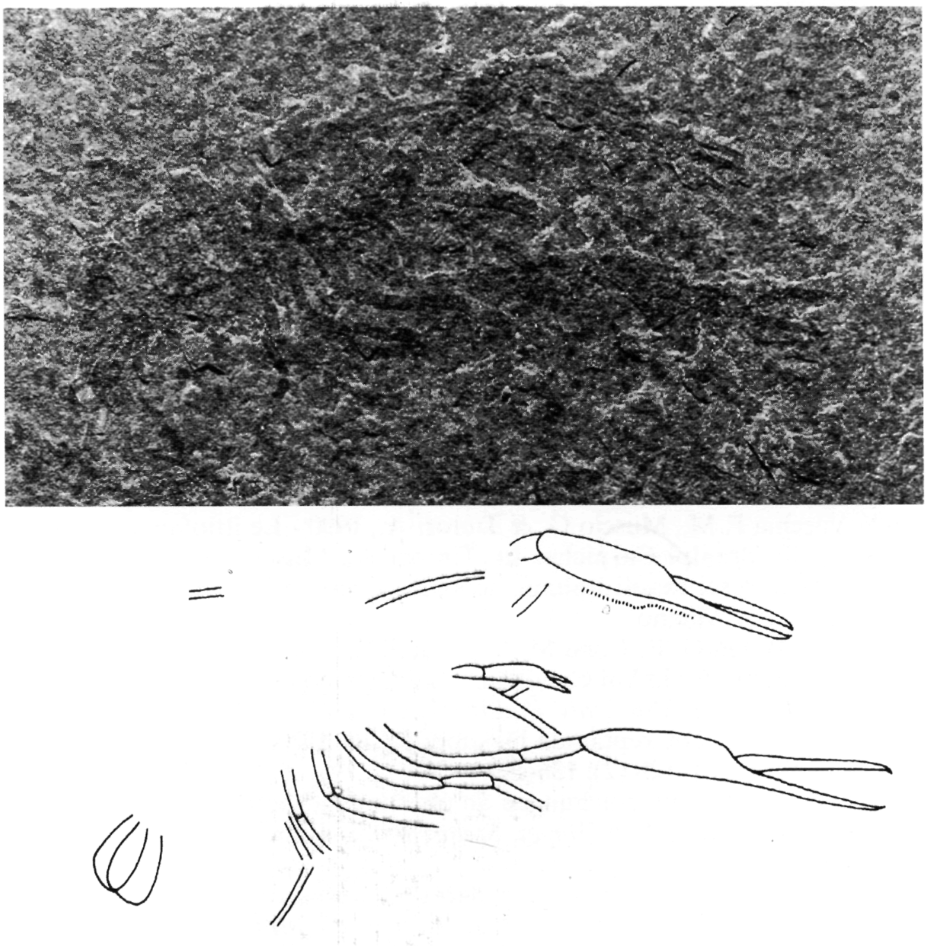

Fig. 24 – Astacidean gen. et sp. indet., n. cat. MFSN 16170, photo and reconstruction (× 1.8)

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