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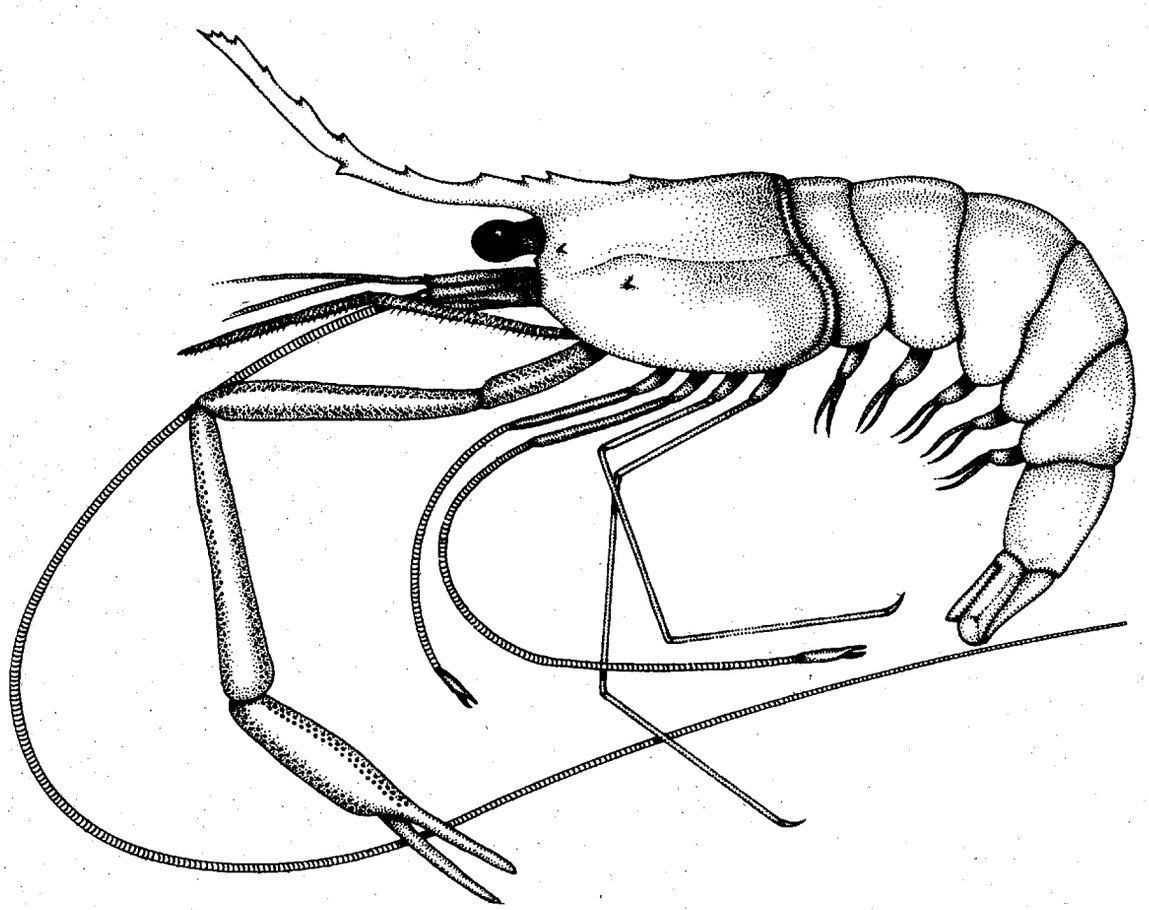
Nuova serie Volume III

Alessandro Garassino

The macruran decapod crustaceans of the Upper Cretaceous of Lebanon



Società Italiana di Scienze Naturali
Museo Civico di Storia Naturale di Milano

Milano, 1994

Between 1858 and 1881 Antonio Stoppani, the Lombard geologist and paleontologist, published 56 numbers of "Paléontologie Lombarde", illustrating the fossils of Lombardy in a series of large monographs. This was the first Italian attempt to produce a scientific journal devoted to paleontology. The chosen method of publication, as a succession of monographs, was in line with a pattern already established in other European countries. It is an indication of Stoppani's aspiration to produce a work of international value, as was also his use of French, at that time the official scientific language.

The Società Italiana di Scienze Naturali and the Museo Civico di Storia Naturale di Milano, heirs to the palaeontological tradition of Antonio Stoppani, have wish to resurrect this prestigious scientific journal, but it not will be restricted solely to the illustration of Lombard fossils.

The new "Paleontologia Lombarda" will be a scientific journal open to contributions from all paleontologists, and proposes to publish papers on fossils from all parts of the world.

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Alessandro Garassino

Sezione di Paleontologia del Museo Civico di Storia Naturale di Milano

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The macruran decapod crustaceans of the Upper Cretaceous of Lebanon

Abstract — The classic decapod crustacean fauna of the Upper Cretaceous of Lebanon is redescribed, except the brachyuran decapods. The infraorder Penaeidea includes eight genera: *Carinacaris* nov., *Libanocaris* nov., *Hakelocaris* nov., *Microchela* nov., *Macropenaeus* nov., *Acanthochirana* Strand, 1926, *Aeger* Münster, 1839 and *Benthesycimus* Bate, 1881. The new family Carpopenaeidae, with the two species *C. callirostris* Glaessner, 1945 and *C. septemspinatus* (Dames, 1886), belongs to the same infraorder. The infraorder Caridea is represented by the new genus *Odontochelion* with the species *O. cretaceum* (Roger, 1946). The infraorder Astacidea includes three species: *Eryma cretacea* Roger, 1946, *Homarus hakelensis* (Fraas, 1878), and *Pseudastacus dubertreti* Roger, 1946. In the infraorder Palinura specimens of the genera *Linuparus* White, 1847, *Palinurus* Weber, 1795 and *Palibacus* Förster, 1984 were recognized. Most of the material is from the Hakel and Hadjula outcrops, which are Lower-Middle Cenomanian in age; some is from the Sahel Alma outcrop, which is Santonian. Following this study the Lebanese fauna can be interpreted almost as a prelude to modern fauna. In fact, its novelty is evidenced above all by the penaeids which in the general shape of the body and in the structure of pereiopods show links with the modern fauna.

Riassunto - I Crostacei decapodi del Cretacico superiore del Libano.
Viene ridescritta la fauna a crostacei decapodi del Libano, senza considerare i crostacei brachiuri. L'infraordine Penaeidea comprende otto generi: *Carinacaris* nov., *Libanocaris* nov., *Hakelocaris* nov., *Microchela* nov., *Macropenaeus* nov., *Acanthochirana* Strand, 1926, *Aeger* Münster, 1839 e *Benthesycimus* Bate, 1881. Allo stesso infraordine appartiene la nuova famiglia Carpopenaeidae con le due specie *C. callirostris* Glaessner, 1945 e *C. septemspinatus* (Dames, 1886). L'infraordine Caridea è rappresentato dal nuovo genere *Odontochelion* con la specie *O. cretaceum* (Roger, 1946). L'infraordine Astacidea comprende tre specie: *Eryma cretacea* Roger, 1946, *Homarus hakelensis* (Fraas, 1878) e *Pseudastacus dubertreti* Roger, 1946. Nell'infraordine Palinura sono stati riconosciuti i rappresentanti dei generi *Linuparus* White, 1847, *Palinurus* Weber, 1795 e *Palibacus* Förster, 1984. La maggior parte del materiale proviene dai giacimenti di Hakel e Hadjula, entrambi attribuibili al limite Cenomaniano inferiore-Cenomaniano medio, e in piccola parte dal giacimento di Sahel Alma, attribuito al Santoniano. In base a questo studio la fauna libanese può essere interpretata quasi come preludio alle faune moderne. Infatti, l'aspetto moderno di questa fauna risulta evidente soprattutto nel caso dei peneidi nei quali la forma generale del corpo e la struttura dei pereiopodi sono molto simili a quelli dei peneidi attuali.

Key words: Crustacea, Decapoda, Upper Cretaceous, Lebanon

HISTORY OF RESEARCH ON THE DECAPOD CRUSTACEANS OF LEBANON

Although bibliographic sources ascribe the first mentioning of fossil fishes in Lebanon to Herodotus (450 B.C.), the most ancient written evidence dates back to the Middle Ages. In a manuscript dated 1248, later published in 1547, Sire de Joinville mentioned the discovery of fossil fishes.
«Tandis que le Roy estoit à Sayette, le apporta l'en une pierre qui se levoit par escales, la plus merveilleuse du monde; car quand l'en trouvoit entre les deux pierres la forme d'un poisson de mer. De pierre estoit le poisson; mais il ne failloit riens en sa fourme, ne yex, ne areste, ne couleur, ne autre chose que il ne feust autre tel, comme s'il feust vif. Le Roy manda une pierre, et trouva une tanche dedans, de brune couleur et de tele façon comme tanche doit estre».

After this first evidence, about five centuries passed before the fossils of Lebanon started rising a scientific interest. The palaeontological researches were directed above all about the ichtyofauna and little about the invertebrates.

The work «Note sur une nouvelle espèce de Crustacé fossile (*Penaeus libanensis*)» by Brocchi (1875) was the first publication on the fossil decapod crustaceans from Lebanon. The author described a well preserved specimen of Sahel Alma on which he based the new species *Penaeus libanensis*. Three years later, Fraas (1878) described the new species *Pseudastacus hakelensis*. The first more extensive publication on Lebanese decapod crustaceans was that of Dames (1886). The six specimens, from Sahel Alma and Hakel, were assigned as follows: one to the new species *Penaeus septemspinatus*, two to the species described by Brocchi, a fragment to the new species *Ibacus praecursor*, and two to the species *Pseudastacus hakelensis* Fraas, 1878. The decapod crustaceans only attracted attention again some 60 years later. The basis for this renewed interest was the collection belonging to the Natural History Museum of London, which was made between 1930 and 1931: it included 120 specimens from Hakel, Hadjula and Sahel Alma. Glaessner (1945) analyzed this collection, which allowed him to revise the species previously described by Brocchi and Dames on the one hand, and to create new genera and species on the other.

Almost at the same time Roger (1946) studied a rich invertebrate collection from Hakel, Hadjula and Sahel Alma, housed in Paris, partly at the Muséum National d'Histoire Naturelle, and partly at the Ecoles des Mines. Roger assigned the decapod crustaceans (around 30 specimens) partly to established species like *Penaeus libanensis* Brocchi, 1875, *Penaeus*

septemspinatus Dames, 1886, and *Pseudastacus hakelensis* Fraas, 1878, and partly to new taxa. The studies by Glaessner and Roger were published independently. Hence some of the species described by Roger are undoubtedly species described by Glaessner, which have priority since they were published one year before.

Pinna visited the Lebanese fossiliferous levels in 1974, collecting 26 specimens of decapod crustaceans presently housed at the Museo di Storia Naturale di Milano. Pinna (1975) assigned the specimens to *Acanthochirana cenomanica* Glaessner, 1945, *Carpopenaeus callirostris* Glaessner, 1945, *Homarus hakelensis* (Fraas, 1878), and *Pseudastacus dubertreti* Roger, 1946. The most recent study on the decapod crustaceans of Lebanon was published by Förster (1984). The specimens (a total of six) were assigned to the new genus *Palibacus* (Family Scyllaridae Latreille, 1825) and to the species *P. praecursor* (Dames, 1886).

THE GEOLOGICAL AGE OF THE OUTCROPS

The fossiliferous localities (Fig. 1) from which the studied material originates are located NE of the city of Beirut, on the ridges running parallel to the coast, where the Upper Cretaceous strata crop out. The Hakel, Hadjula and Maifouk outcrops are about 12 km from the sea and 45 km from Beirut, while Sahel Alma is closer to the coast, at a distance of about 20 km from the city.

The assessment of the age of the different fossiliferous localities has a long history.

Botta (1833) dealt with the age of Hakel, Hadjula and Sahel Alma, assuming that the first was younger than the second. He wrote:

«Les gisement de ces poissons (Hakel), lui est supèrieur, l'autre (Sahel Alma) se trouvant plus rapprochè du terrain sablonneux».

In order to establish the stratigraphical position of Hakel, Lartet (1869) used fossil evidence:

«Parmi les Poissons, les Tèlèostèens abondent, tand que les Ganoides font complèment dèfaut, ce qui montrerait, à dèfaut d'autre preuve que ce n'est pas une faune jurassique. On y trouve des generes vivants tels que Beryx, les Clupes tec. et des groupes caractèristiques de l'epoque crètacèe comme les Dercetis et les Eurypholis».

The first author to deal with the geology of Lebanon was Fraas (1878) who incorrectly ascribed the Hakel and Hadjula outcrops to the Turonian. During the first years of the twentieth Century Douvillé (1910) in collaboration with Zumoffen, suggested a Cenomanian age for Hadjula. With the «Traité de Géologie» by Blankenhorn (1914) and the classical work on the geology of Lebanon by Zumoffen (1926), the real geological study of Lebanese outcrops started. Dubertret & Vautrin (1937) referred Hakel, Hadjula and Maifouk to the Cenomanian and Sahel Alma to the Senonian. More detailed information on the geology of the area was supplied by the studies of Dubertret (1959, 1966). The following year Patterson (1967) referred Hakel, Hadjula and Maifouk to the Middle Cenomanian. New geological studies carried out by Hückel (1970, 1974) placed these three deposits at the Lower-Middle Cenomanian boundary, stressing, however, that Hadjula was slightly older than Hakel. The biostratigraphical study of the Lebanese outcrops by Saint-Marc (1974) confirmed Hückel's conclusion.

The age of Sahel Alma was long unknown. Studies of the microfauna by Ejel & Dubertret (1966) ascribed this deposit to be identified as belonging to the upper part of the *Globotruncana concavata* zone, i.e. to the Santonian.

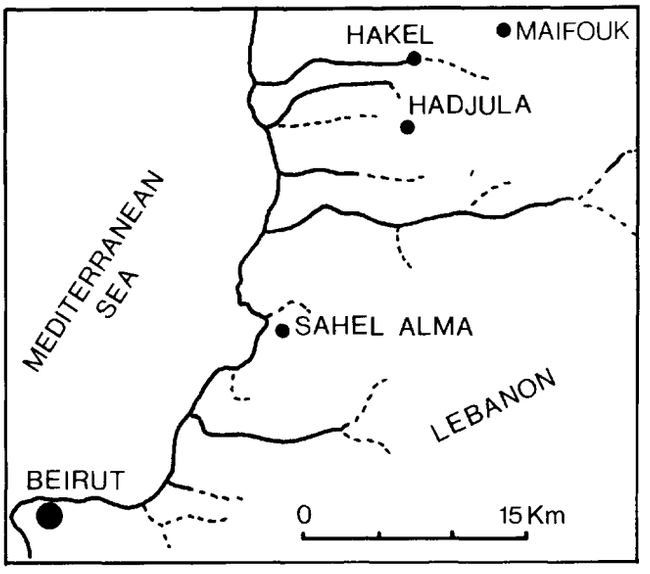


Fig. 1 - Location of outcrops.

MODES OF PRESERVATION

The fossiliferous rock varies at the different localities: at Hakel, Maifouk and Hadjula it consists of thick layers of yellow limestone with a sublithographic appearance, while at Sahel Alma the limestones are lighter in colour and softer (among the most recent studies: Hückel (1969, 1970, 1974a, 1974b) and Hemleben (1977).

The crustaceans are compressed and flattened on the surface of the rock and their preparation is made easy by the softness of the rock. The abundant material and perfect preservation of the specimens allowed a detailed reconstruction of the anatomy of all the examined species.

Material

465 specimens were available: 344 held by the Museo di Storia Naturale di Milano (MSNM) and 121, used as comparative material, held by the Natural History Museum of London (BMNH).

The collection of the Museo di Storia Naturale di Milano includes: 81 specimens of the private collection of Roland Anhoury, bought in 1983, 26 specimens collected by Giovanni Pinna in 1974, 80 specimens acquired in the last few years, 155 specimens donated by Angelo Vavassori in 1991, 1 specimen donated by Amedeo

Giani in 1992 and 1 specimen donated by Paolo Durante in 1993.

Most of the material is from Hakel, and a small proportion from Hadjula and Sahel Alma (Tab. I).

The percentages shown in Tab. I refer exclusively to the examined sample and they do not represent the real percentages of the different taxa present in the fauna.

The collection of the Museo di Storia Naturale di Milano does not include the species *Penaeus natator* Glaessner, 1945 and *Penaeus arambourgi* Roger, 1946. A study of the type of *Penaeus natator* (BMNH 59690) did not add any new details to the description provided by Glaessner (1945). Finally, the type of *Penaeus arambourgi* was not examined because it was impossible to find the original specimen.

Acronyms: MSNM: Museo di Storia Naturale di Milano; BMNH: Natural History Museum of London; IRSNB: Institut Royal des Sciences Naturelles de Belgique.

Abbreviations

R - rostrum
eel - cervical groove
An - antennal spine
SE - hepatic spine
Cr - carina
t - telson
Pt - protopodite
En - endopodite
Ex - exopodite
di - diaeresis
E - eye
A1 - antennula
A2 - antenna
ca - carpocerite
me - merocerite
i - ischiocerite
M - merus
C - carpus
P - propodus
D - dactylus
I - index

Infraorder	%	Genus	Species	N°	Locality
Penaeidea	57,2	*Carinacaris* nov.	*C. teruzzii* n. sp.	10	Hakel, Hadjula
		Libanocaris nov.	*L. rogeri* n. sp.	8	Hakel, Hadjula
		Hakelocaris nov.	*H. vavassorii* n. sp.	29	Hakel, Hadjula
		Microchela nov.	*M. rostrata* n. sp.	13	Hakel, Hadjula
		Macropenaeus nov.	*M. incertus* (Roger, 1946)	3	Hakel, Hadiula
		Acanthochirana Strand, 1926	*A. smithwoodwardi* (Van Straelen, 1940)	60	Hakel, Hadjula
		Benthesicymus Bate, 1881	*B. libanensis* (Brocchi, 1875)	5	Sahel Alma
		Aeger Münster, 1839	*A. libanensis* Roger, 1946	1	Hakel, Hadjula
		Carpopenaeus Glaessner, 1945	*C. callirostris* Glaessner 1945	52	Hakel, Hadjula
			C. septemspinatus (Dames, 1886)	16	Hakel, Hadjula
Caridea	9,3	*Odontochelion* nov.	*O. cretaceum* (Roger, 1946)	32	Hakel, Hadjula
Astacidea	26,1	*Eryma* von Meyer, 1840	*E. cretacea* Roger, 1946	50	Hakel, Hadjula
		Homarus Weber, 1795	*H. hakelensis* (Fraas, 1878)	34	Hakel, Hadjula
		Pseudastacus Oppel, 1861	*P. dubertreti* Roger, 1946	6	Hakel, Hadjula
Palinura	6,9	*Linuparus* White, 1847	*L. sp.*	4	Hakel, Hadjula
		Palinurus Weber, 1795	*P.* sp.	15	Hakel, Hadjula
		Palibacus Förster, 1984	*P. praecursor* (Dames, 1886)	5	Hakel, Hadjula

Table I - List of the species of the Lebanese outcrops.

SYSTEMATICS

Infraorder Penaeidea de Haan, 1849
Superfamily Penaeoidea Rafinesque, 1815
Family Penaeidae Rafinesque, 1815

Genus *Acanthochirana* Strand, 1926
Acanthochirana smithwoodwardi (Van Straelen, 1940)
Pl. I, figs. 1-3

1940 - *Penaeus smithwoodwardi* - Van Straelen, p. 2; pl. I, fig. 2.
1945 - *Acanthochirus cenomanicus* - Glaessner, p. 695; pl. VIII, fig. 1.
1975 - *Acanthochirana cenomanica* (Glaessner) - Pinna, p. 4, fig. 2.

Diagnosis: rostrum lacking suprarostral or subrostral teeth; rostral carina with six identical and anteriorly projecting teeth; epigastric tooth in the third anterior; cervical groove and hepatic spine; well developed 3rd maxilliped; pereiopods I-III chelate.

Type locality: Hakel.

Geological age: Cenomanian.

Material: 60 complete specimens, well preserved. The examined material allowed a more detailed analysis than those carried out by Van Straelen (1940) and Glaessner (1945).

MSNM: i4448, i6034, i6058, i8730, i12151, i12155, i12240, i12241, i12251, i12254, i12257, i12258, i12260, i12265, i12270, i12286, i12290, i 12325, i12328, i12329, i12330, i12331, i12332, i12336, i12337, i12338, i12341, i12343, i12344, i12348, i12349, i12358, i12360, i12361, i12364, i12365, i12366, i12367, i12373, i12374, i12377, i12392, i12393, i12394, i12512, i12514, i12524, i12525, i12532, i12534, i12539, i12553, i12554, i12559, i12563, i12565, i12572, i12576, i12579, i12582

Description. Fairly large elongated penaeid (the biggest specimen - MSNM i12254 - has 8 cm in length), with thin completely smooth exoskeleton and 5 to 8 cm in length.

Carapace. In lateral view, the carapace (Fig. 2) is subtrapezoid in outline and narrows considerably anteriorly as a result of the strong curvature of the

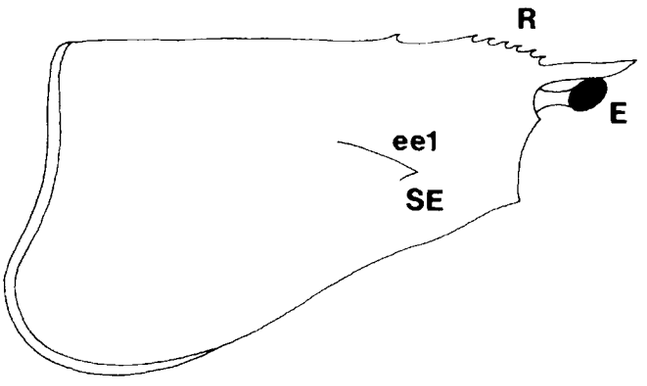


Fig. 2 - *Acanthochirana smithwoodwardi* (Van Straelen, 1940), carapace reconstruction in lateral view, line drawing.

ventral margin. The dorsal midline is straight and the posterior margin is slightly sinuous with a concavity in the middle, strengthened by a thin marginal ridge. The dorsal midline extends into a long rostrum, with an upwardly directed pointed distal extremity lacking any suprarostral or subrostral teeth. The rostral carina comprises six identical and anteriorly projecting teeth. The well differentiated epigastric tooth is located in the anterior third. The ocular incision is narrow and shallow, with weak antennal and pterygostomial angles. There is a cervical groove and an hepatic spine (MSNM: i12260, i12344, i12394).

Abdomen. The abdomen shows the typical curvature of penaeids. The tergites are rectangular in outline and tergite VI is longer than those anterior to it. The pleurae are rounded, the posterior margin is sinuous and the concavity decreasing caudally. The tail fan is preserved in very few specimens (MSNM: i6058, i12241, i12341, i12360). The telson is well developed, smooth and as long as tergite VI. The uropods have a rounded distal extremity: the endopodite is crossed by a thin median carina, while the exopodite does not show either a characteristic ornamentation or a diaeresis. The uropods are about 1/3 longer than the telson.

Cephalic appendages. The eye is carried by a thin elongate peduncle. The antennular peduncle consists of three segments (MSNM i12241): the 1st is thin and elongate, while the 2nd and 3rd are short and stocky. The scaphocerite is well developed, with an elongate shape and pointed distal extremity. The carpocerite of the antennae is short.

Thoracic appendages. The strongly developed 3rd maxilliped is as long as the carapace. The four articula are similar in length: they narrow slightly toward the distal extremity and each shows the insertion of a row of thin spines, slightly bent at the distal extremity. The pereiopods are partly preserved in some specimens (MSNM: i6034, i6058, i12241, i12258, i12360, i12366). Pereiopods I-III have an elongate merus and carpus, and long thin chelae. Pereiopods IV-V are thin and strongly elongate, with a terminal dactylus.

Abdominal appendages. The pleopods comprise a well developed subrectangular sympodite, with two long multiarticulate flagella.

Discussion

Van Straelen (1940) briefly described a complete specimen from Hakel on which he based the new species *P. smithwoodwardi*. The holotype (IRSNB 9791) reveals the typical features of the genus *Acanthochirana* Strand, 1926, including the strongly developed 3rd maxilliped and pereiopods I-III with elongate merus and carpus and long, strong chelae. Since these features are not present in the genus *Penaeus* Fabricius, 1798 to which the species was assigned, I believe that *P. smithwoodwardi* belongs to the genus *Acanthochirana*.

Glaessner (1945) described three almost complete specimens from Hakel, on which he based the new species *Acanthochirana cenomanica*. Even though the description of the type of *P. smithwoodwardi* is brief, a comparison with the type of *A. cenomanica* (BMNH 28645) made it possible to observe the same features in both species, including the well developed 3rd maxilliped, pereiopods I-III with long, strong

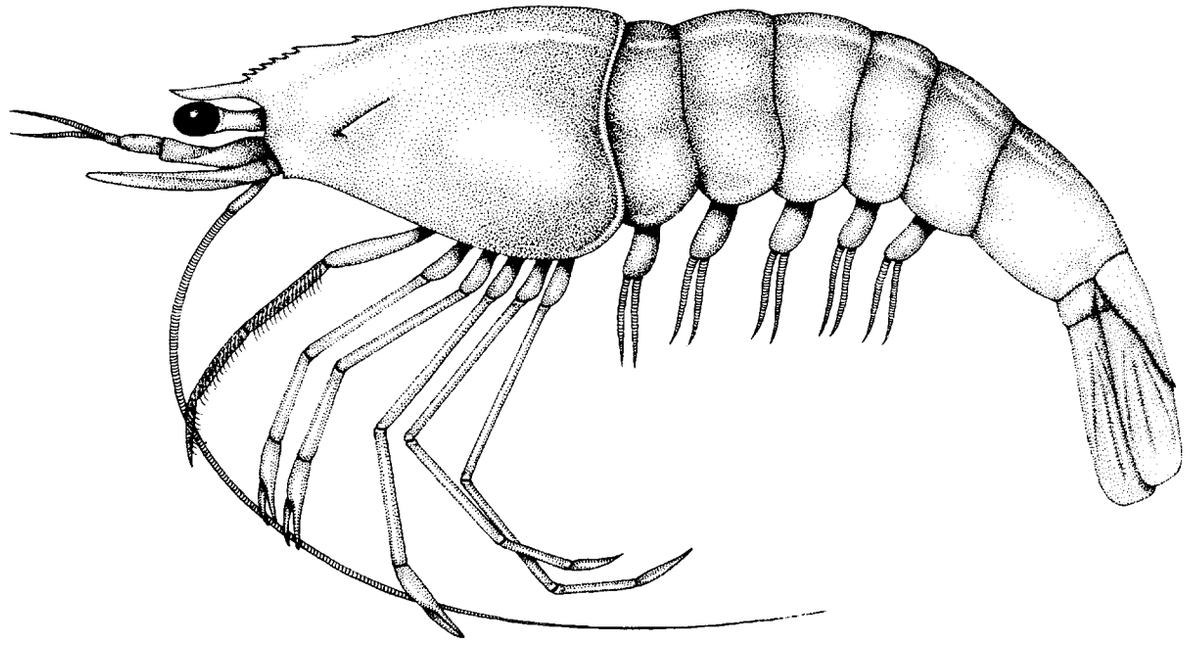


Fig. 3 - *Acanthochirana smithwoodwardi* (Van Straelen, 1940), reconstruction.

chelae, the structure of the tergites, and the pleopods with subrectangular sympodite. On the basis of these similarities I believe that the two species are synonymous. *P. smithwoodwardi*, erected before Glaessner's species, has priority over *A. cenomanica.*

Peters (1861) described a new form of arachnid as *Acanthochirus.* Oppel (1862) named a genus of penaeid from Solnhofen as *Acanthochirus*, the name already used by Peters. Strand (1926) altered Oppel's name to *Acanthochirana*, thus maintaining *Acanthochirus* for the arachnid named by Peters. Glaessner (1945) described three incomplete specimens from Hakel, assigning them to a new species *Acanthochirus cenomanicus*, not taking into account the new generic name proposed by Strand. The few specimens at his disposal allowed Glaessner to offer only a partial description of the species, which he did not illustrate. The presence of two different types of rostrum, long and short in these specimens, led Glaessner to presume that this difference was due to a distortion taking place during fossilization or to sexual dimorphism (p. 695). My examination of the specimens indicates that the assumption of a possible twist or fracture of the rostrum might be valid. In fact in the specimens with a short rostrum (MSNM: i6058, i12155, i12241, i12254, i12258, i12260, i12265, i12270, i12328, i12373, i12374, i12553) only the rostral carina is preserved, while the rostrum itself is broken. On the basis of this observation, we cannot exclude possibility that the short rostrum characterizing the Solnhofen species, *A. cordata* Münster, 1839 and *A. angulata* Oppel, 1862, is actually the remnant of a much longer original rostrum. This assumption is supported by the presence of a long, thin rostrum with a rostral carina comprises four identical and anteriorly projecting teeth in the species *A. krausei* Förster, 1967 (Förster (1967)).

Equally the interpretation of the different structure of the rostrum as the result of sexual dimorphism is not borne out by the examined sample. In fact in living penaeids (Pérez Farfante (1969)), the rostrum is not a reliable basis for distinguishing the sexes, because it does not show any substantial difference in shape, length or the number of suprarostral and subrostral teeth.

Genus *Macropenaeus* nov.

Diagnosis: long rostrum with five suprarostral teeth, the proximal of which are large and strong, the two distal small and thin; anterior epigastric tooth; pereiopods I-III chelate.

Derivatio nominis: referring to the large body.

Type species: *Penaeus incertus* Roger, 1946.

Description: as for the type species.

Macropenaeus incertus (Roger, 1946)
Pl. I, fig. 4

1946 - *Penaeus incertus* - Roger, p. 28, fig. 19; pl. 1, fig. 5.

Type locality: Hadjula.

Geological age: Cenomanian.

Diagnosis: long rostrum with five suprarostral teeth, the proximal three of which are large and strong, the two distal small and thin; epigastric tooth in the anterior third; pereiopods I-III chelate.

Material: 3 complete specimens, in a fairly good state of preservation.

MSNM: i12148, i15912, i12378

Description. Large elongate penaeid, with thin, finely tubercolate exoskeleton, 6 to 10 cm in length.

Carapace. In lateral view, the carapace (Fig. 4) is subrectangular in outline and narrows slightly anteriorly due to the weak curvature of the ventral margin. The dorsal midline is straight and the posterior margin slightly sinuous, with a concavity in the middle, strengthened by a thin marginal ridge. The dorsal midline extends into a long rostrum, with a pointed distal extremity and bearing five suprarostral teeth, of which the two distal are small and thin, and the three proximal large and strong. The epigastric tooth is in the anterior third. The ocular incision is narrow and shallow, with weakly developed antennal and pterygostomial angles. No grooves, carinae or spines are observed.

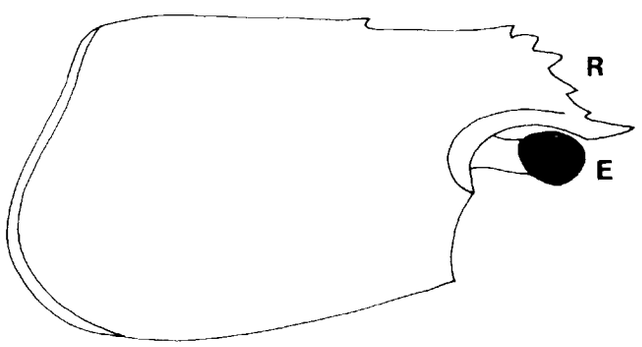


Fig. 4 - *Macropenaeus incertus* (Roger, 1946), carapace reconstruction in lateral view, line drawing.

Abdomen. The abdomen shows the typical curvature of penaeids. The tergites are rectangular in outline and tergite VI is slightly longer than those anterior to it. The pleurae are rounded and the posterior margin is slightly sinuous. The telson lacks any characteristic ornamentation. The uropods, crossed by thin median longitudinal carinae, have a rounded distal extremity. The exopodite lacks a diaeresis. The uropods are about 1/3 longer than the telson.

Cephalic appendages. The eye is carried by a thin elongate peduncle. The antennular peduncle comprises three segments: the 1st is thin and elongate, while the 2nd and 3rd are short and stocky. The scaphocerite is robust and triangular-shaped with a pointed distal extremity. The carpocerite of the antennae is short and thin.

Thoracic appendages. The pereiopods are partly preserved in the specimen MSNM i12148. Pereiopods I-III have an extremely thin and strongly elongate merus and carpus, and long thin chelae. Pereiopods IV-V are incomplete.

Abdominal appendages. The pleopods are partly preserved in the specimen MSNM i12148, where only the subrectangular sympodites are evident.

Discussion

Roger (1946) described the species *Penaeus incertus*, based on a single, poorly preserved specimen

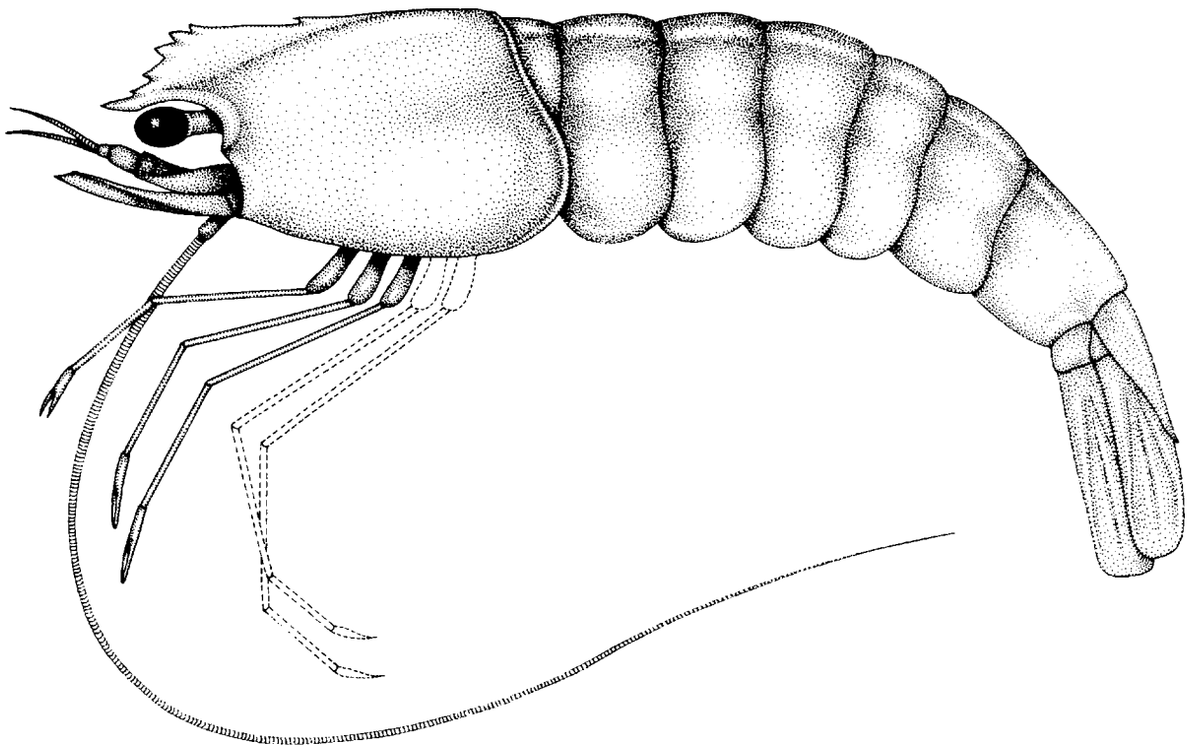


Fig. 5 - *Macropenaeus incertus* (Roger, 1946), reconstruction.

from Hadjula. He tentatively assigned this species to the genus *Penaeus*, on the basis of the general shape of the body, the abdominal pleura II and the length of tergite VI. The specimens studied show the main features of Roger's species, i.e. five suprarostral teeth separated into proximal and distal, and the well differentiated epigastric tooth. At the same time they lack some typical features of the genus *Penaeus*, such as subrostral teeth, the marked cervical and orbital-antennal grooves, and the well developed hepatic and antennal spines. For such reasons Roger's species cannot be assigned to *Penaeus*. At the same time, the features encountured, the rostrum with suprarostral teeth divided into proximal and distal, the well differentiated epigastric tooth and pereiopods I-III with long thin chelae, distinguish the specimens examined from other genera of the family Penaeidae. A new genus *Macropenaeus* is therefore proposed here for this species.

Genus *Carinacaris* nov.

Diagnosis: long rostrum with seven or eight suprarostral teeth; carapace with three pairs of carinae; pereiopods I-III chelate.

Derivatio nominis: referring to the presence of carinae on the surface of the carapace.

Type species: *Carinacaris teruzzii* n.sp.

Description: as for the type species.

Carinacaris teruzzii n. sp.
Pl. II, figs. 1-3

Derivatio nominis: dedicated to Dr. Giorgio Teruzzi, who guided me in the study of decapod crustaceans.

Holotype: MSNM i12589.

Paratypes: MSNM i12587, i12588.

Type locality: Hakel.

Geological age: Cenomanian.

Diagnosis: long rostrum bearing seven or eight identical anteriorly projecting suprarostral teeth; carapace with three pairs of carinae; pereiopods I-III chelate.

Material: 10 complete and fairly well preserved specimens.

MSNM: i12255, i12342, i12353, i12356, i12369, i12380, i12391, i12587, i12588, i12589

Description. Large elongate penaeid, with thin, finely tubercolate exoskeleton and 4 to 7 cm in length.

Carapace. In lateral view, the carapace (Fig. 6) is subrectangular in outline and narrows markedly anteriorly due to marked curvature of the ventral margin. The dorsal midline is straight and the posterior margin is strongly sinuous, with a marked concavity in the lower third covering part of tergite I, and strengthened by a thin marginal ridge. The dorsal midline extends into a long rostrum, bearing seven or eight identical anteriorly projecting suprarostral teeth.

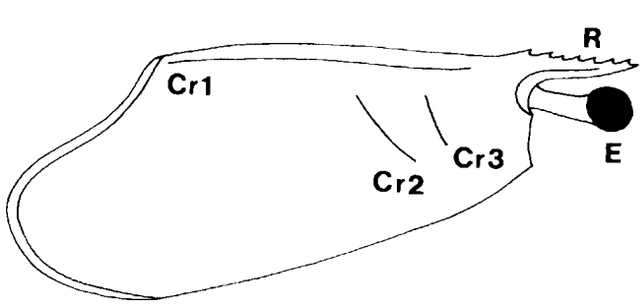


Fig.6 - *Carinacaris teruzzii* n.gen. n.sp., carapace reconstruction in lateral view, line drawing.

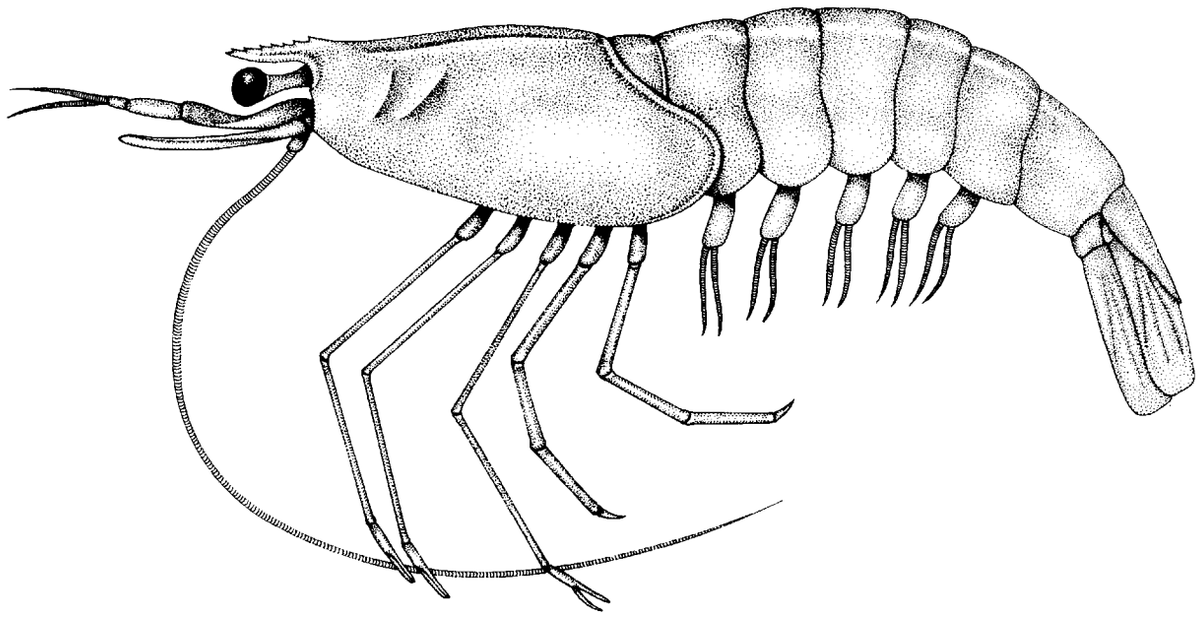


Fig. 7 - *Carinacaris teruzzii* n.gen. n.sp., reconstruction.

There are no subrostral teeth. The ocular incision is narrow and shallow, with weakly developed antennal and pterygostomial angles. The carapace has three pairs of carinae (Fig. 6): on each side, one long carina parallels the dorsal midline, close to it; to the side of it, outside its anterior part two short carinae extend anterolaterally.

Abdomen. The abdomen shows the typical curvature of penaeids. All tergites are rectangular in outline and they have slightly sinuous posterior margin. The telson lacks any characteristic ornamentation. The uropods are about 1/3 longer than the telson. The exopodite lacks a diaeresis.

Cephalic appendages. The cephalic appendages are preserved in the specimens MSNM: i12369, i12380, i12588, i12589. The eye peduncle is long and slender. The antennular peduncle comprises three segments: the 1st thin and strongly elongate, the 2nd long and thin, and 3rd short and stocky. The scaphocerite is strongly elongate, with a pointed distal extremity. The carpocerite is short and bears a flagellum as long as the body.

Thoracic appendages. The thoracic appendages are preserved in some specimens (MSNM: i12587, i12588, i12589), but not 3rd maxilliped. Pereiopods I-III have an extremely thin and strongly elongate merus and carpus and long thin chelae. Pereiopods IV-V consist of strong elongate articula, with a terminal dactylus, and they are shorter than the first three pereiopod pairs.

Abdominal appendages. The pleopods, preserved in the some specimens (MSNM: i12391, i12587, i12588, i12589), have a subrectangular sympodite bearing two long multiarticulate flagella.

Discussion

The long rostrum with seven or eight suprarostral teeth of uniform shape, the carinae on the carapace, and the structure of pereiopods I-III with thin strongly elongate merus and carpus and short thin chelae are features unknown in any other genus of the family Penaeidae. They therefore justify the erection of the new genus *Carinacaris*.

Genus Libanocaris nov.

Diagnosis: long rostrum with five suprarostral teeth; median epigastric tooth; pereiopods I-III chelate.

Derivatio nominis: from the country of origin of the examined specimens.

Type species: *Libanocaris rogeri* n.sp.

Description: as for the type species.

Libanocaris rogeri n.sp.
Pl. II, fig. 4; Pl. III, figs. 1-2

Derivatio nominis: dedicated to Jean Roger who contributed to the study of the decapod crustaceans of Lebanon.

Holotype: MSNM i12555.

Paratypes: MSNM i10396, i12390.

Type locality: Hakel.

Geological age: Cenomanian.

Diagnosis: long rostrum with five identical anteriorly projecting suprarostral teeth; median epigastric tooth; pereiopods I-III chelate.

Material: 8 complete and fairly well preserved specimens.

MSNM: i10396, i12319, i12390, i12541, i12555, i12557, i12564

Description. Large elongate penaeid, with thin completely smooth exoskeleton and 5 to 7 cm in length.

Carapace. In lateral view, the carapace (Fig. 8) is subrectangular in outline and narrows slightly anteriorly due to the weak curvature of the ventral margin. The dorsal midline is straight and the posterior margin is concave in the middle and strengthened by a thin marginal ridge. The dorsal midline extends into a long rostrum, curving upwards distally and bearing five identical anteriorly projecting suprarostral teeth. There are no subrostral teeth. The rostral carina comprises three identical anteriorly projecting teeth. The ocular incision is narrow and shallow, with weakly developed antennal and pterygostomial angles. No grooves, carinae or spines are evident.

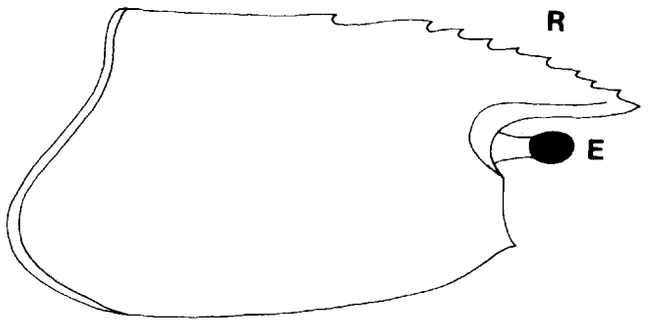


Fig. 8 - *Libanocaris rogeri* n.gen. n.sp., carapace reconstruction in lateral view, line drawing.

Abdomen. The abdomen shows the typical curvature of penaeids. The tergites are rectangular in outline and tergite VI is slightly longer than those anterior to it. The pleurae are rounded and the posterior margin is slightly sinuous. The tail fan is poorly preserved. Only the telson is evident, with a smooth surface and no ornamentation.

Cephalic appendages. The cephalic appendages are partly preserved. The eye peduncle is short and slender. The antennular peduncle, evident on the holotype, comprises three segments: the 1st thin and elongate, while the 2nd and 3rd are short and stocky. The scaphocerite is well developed, triangular shaped, with a pointed distal extremity. The carpocerite is short and thin.

Thoracic appendages. The poorly preserved 3rd maxilliped is short. It is evident on the holotype: two thin articula are evident, maybe carpus and merus, both lacking spines. Pereiopods I-II have a strong and elongate merus and carpus, and short and stocky chelae; the merus and carpus are strongly elongate in pereiopod III. Pereiopods IV-V comprise thin and elongate articula, with a terminal dactylus, and they are shorter than pereiopod III.

Abdominal appendages. The pleopods are not preserved.

Genus *Hakelocaris* nov.

Diagnosis: long rostrum with five suprarostral teeth; anterior epigastric tooth; pereiopods I-III chelate.

Derivatio nominis: from the Hakel outcrop, from which the specimens belonging to this species originate.

Type species: *Hakelocaris vavassorii* n. sp.

Description: as for the type species.

Hakelocaris vavassorii n.sp.
Pl. III, figs. 3-4; Pl. IV, figs. 1-2

Derivatio nominis: dedicated to Mr. Angelo Vavassori who donated most of the material upon which this monograph is based.

Holotype: MSNM i12248.

Paratypes: MSNM i12239, i12333, i12531.

Type locality: Hakel.

Geological age: Cenomanian.

Diagnosis: long rostrum with five identical anteriorly projecting suprarostral teeth; epigastric tooth in the anterior third; pereiopods I-III chelate.

Material: 29 complete specimens, in a fairly good state of preservation.

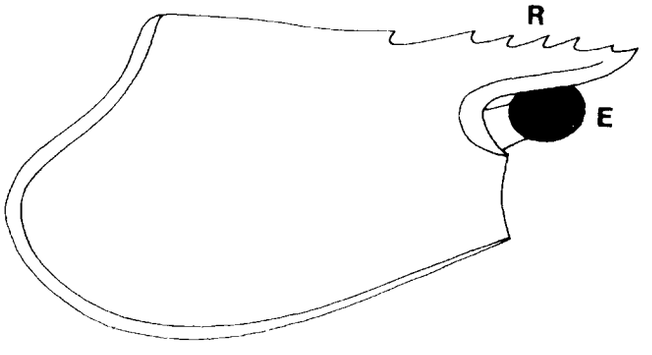


Fig. 10 - *Hakelocaris vavassorii* n.gen. n.sp., carapace reconstruction in lateral view, line drawing.

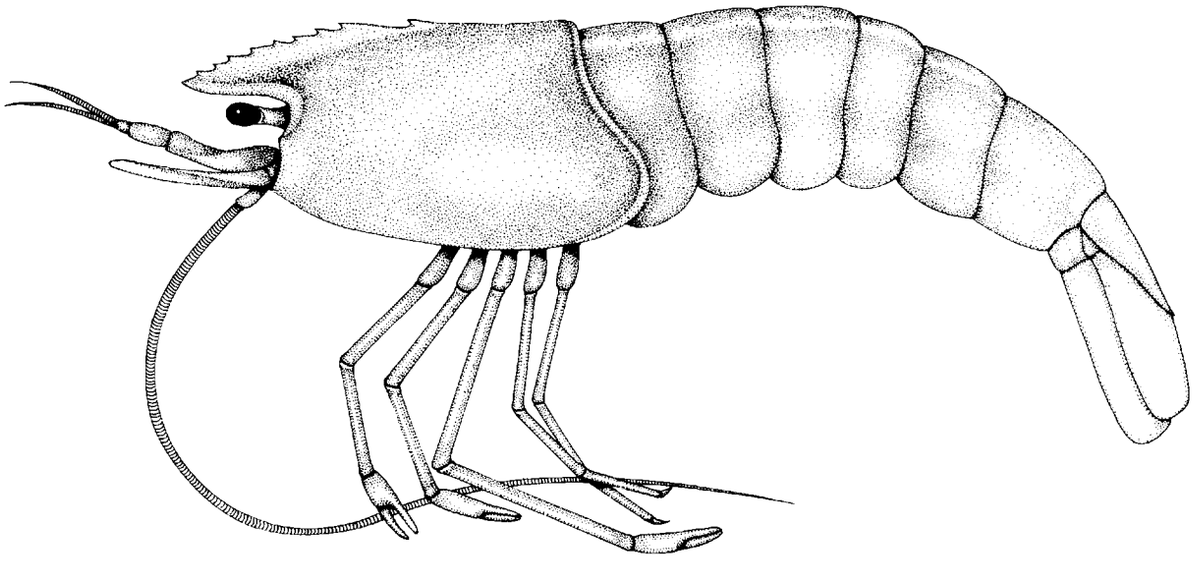


Fig. 9 - *Libanocaris rogeri* n.gen. n.sp., reconstruction.

MSNM: i10394, i12164, i12239, i12248, i12271, i12276, i12289, i12333, i12357, i12375, i12382, i12384, i12386, i12389, i12505, i12507, i12510, i12515, i12543, i12546, i12547, i12549, i12551, i12552, i12560, i12569, i12577, i12578, i12584

Description. Small elongate penaeid, with thin completely smooth exoskeleton and 3 to 6 cm in length.

Carapace. In lateral view, the carapace (Fig. 10) is subrectangular in outline and narrows slightly anteriorly due to weak curvature of the ventral margin. The dorsal midline is straight and the posterior margin is strongly sinuous, with a concavity in the lower third covering part of tergite I. The posterior and ventral margins are strengthened by a thin marginal ridge. The dorsal midline extends into a long rostrum, curving upwards distally, and bearing five identical anteriorly projecting suprarostral teeth. There are no subrostral teeth. Epigastric tooth in the anterior third. The ocular incision is narrow and shallow, with weakly developed antennal and pterygostomial angles. The carapace surface has no grooves, carinae or spines.

Abdomen. The abdomen shows the typical curvature of penaeids. All tergites are rectangular in outline and tergite VI is slightly longer than those anterior to it and has a terminal dorsal spine. The pleurae are rounded, with a slightly sinuous posterior margin. The telson is smooth and lacks any characteristic ornamentation. The length of the uropods, well preserved in the holotype, does not exceed that of the telson. The exopodite, supplied with a thin marginal carina, has a rounded distal extremity and diaeresis is absent.

Cephalic appendages. The cephalic appendages are well preserved in some specimens (MSNM: i10394, i12164, i12239, i12276, i12289, i12357, i12386, i12546). The eye peduncle is short and slender. The antennular peduncle comprises three segments: the 1st is thin and elongate, while the 2nd and 3rd are short and stocky. The scaphocerite has a triangular shape and pointed distal extremity. The carpocerite is short and thin.

Thoracic appendages. The 3rd maxilliped is not preserved. Pereiopod I has a strong and elongate merus and carpus, and a long thin chela. Pereiopods II-III have thin elongate merus and carpus, and short thin chelae. Pereiopods IV-V are thin and strongly elongate, with a terminal dactylus, and their length exceeds that of the first three pairs.

Abdominal appendages. The pleopods are not preserved.

Discussion

The rostrum with five suprarostral teeth, the well differentiate epigastric tooth, and the pereiopods I-III with short thin chelae are features that differentiate *Hakelocaris* n. gen. from the genus *Penaeus* Fabricius, 1798, which is the most similar among all the representatives of the family Penaeidae.

Genus *Microchela* nov.

Diagnosis: long rostrum with four suprarostral teeth; tergite I with subround pleura; pereiopods I-III chelate.

Derivatio nominis: refers to the small chelae of pereiopods I-III.

Type specie: *Microchela rostrata* n.sp.

Description: as for the type species.

Microchela rostrata n.sp.
Pl. IV, figs. 3-4; Pl. V, fig. 1

Derivatio nominis: refers to the long and strong rostrum.

Holotype: MSNM i12518.

Paratypes: MSNM i12340, i12350.

Type locality: Hakel.

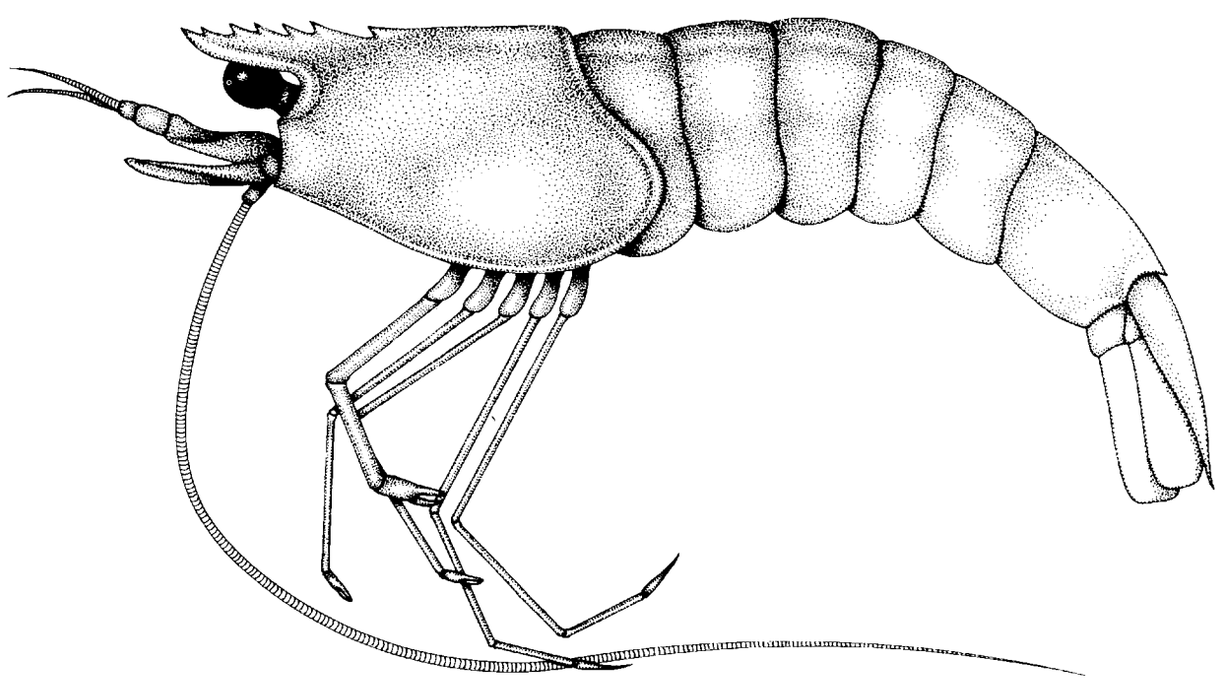


Fig. 11 - *Hakelocaris vavassorii* n.gen. n.sp., reconstruction.

Geological age: Cenomanian.

Diagnosis: long rostrum with four suprarostral teeth; pereiopods I-III chelate; tergite I with subround pleura.

Material: 13 complete specimens, in a fairly good state of preservation.

MSNM: i10395, i12247, i12273, i12334, i12340, i12345, i12350, i12370, i12516, i12518, i12519, i12596, i12597

Description. Quite large elongate penaeid, with thin completely smooth exoskeleton and 4 to 6 cm in length.

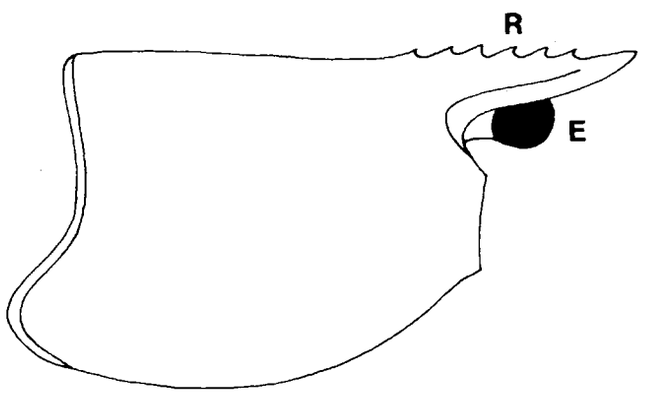


Fig. 12 - *Microchela rostrata* n.gen. n.sp., carapace reconstruction in lateral view, line drawing.

Carapace. In lateral view, the carapace (Fig. 12) is subrectangular in outline and narrows slightly anteriorly due to the weak curvature of the ventral margin. The dorsal midline is straight and the posterior margin is concave in the middle, strengthened by a thin marginal ridge. The dorsal midline extends into a long rostrum, curving slightly upwards distally, and bearing four identical anteriorly projecting suprarostral teeth. Two additional, identical teeth follow just behind, making up a short rostral carina. The ocular incision is narrow and shallow, with weakly developed antennal and pterygostomial angles. No grooves, carinae or spines are evident.

Abdomen. The abdomen shows the typical curvature of penaeids. Tergite I has a subround pleura partly overlapping the lower third of the posterior margin of the carapace and partly tergite II. Tergites IV-V have a posteriorly directed pleural margin. Tergite VI is rectangular in outline and is longer than those anterior to it. The telson lacks any characteristic ornamentation. The uropods, poorly preserved, are about 1/3 longer than the telson. The exopodite has a thin marginal carina, and is rounded distally and a diaeresis is not present.

Cephalic appendages. The cephalic appendages are well preserved in some specimens (MSNM: i12340, i12345, i12350, i12370, i12516, i12518, i12519, i12596, i12597). The eye peduncle is short and thin. The antennular peduncle comprises three segments: the 1st is thin and elongate, while the 2nd and 3rd are short and stocky. The scaphocerite is elongate with a pointed distal extremity. The carpocerite is short and thin.

Thoracic appendages. The 3rd maxilliped is not preserved. Pereiopods I-V are well preserved in the holotype and in specimen MSNM i12340. Pereiopods I-III have thin strongly elongate merus and carpus, and short very thin chelae. Pereipods IV-V comprise thin elongate articula, with a terminal dactylus. Their length does not exceed that of the first three pairs.

Abdominal appendages. The pleopods are preserved in the holotype: the sympodite is subrectangular in outline and bears two multiarticulate flagella.

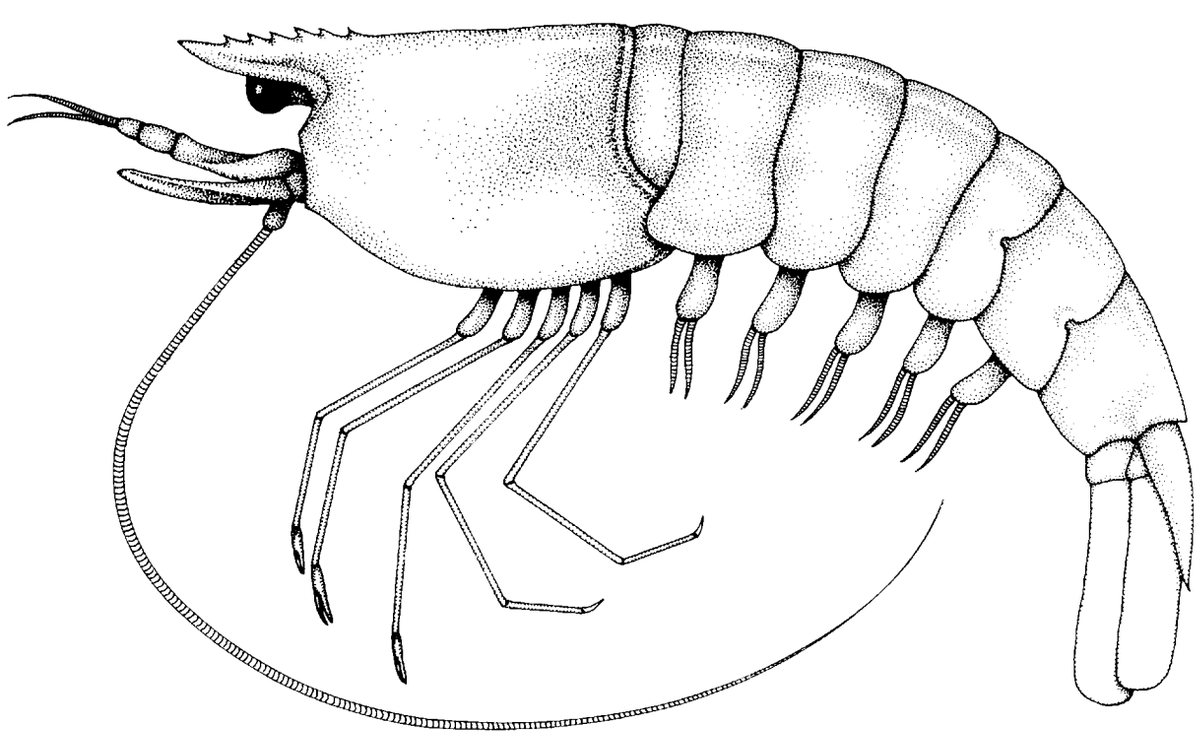


Fig. 13 - *Microchela rostrata* n.gen. n.sp., reconstruction.

Family Aristeidae Wood-Mason, 1891

Genus *Benthesicymus* Bate, 1881
Benthesicymus libanensis (Brocchi, 1875)

1875 - *Penaeus libanensis* - Brocchi, p. 609, pl. 21.
1945 - *Benthesicymus libanensis* (Brocchi) - Glaessner, p. 695, fig. 4.

Type locality: Sahel Alma.
Geological age: Santonian.
Material: 5 complete specimens, in a fairly poor state of preservation, 14 to 16 cm in length.
MSNM: i12167, i13094, i13534, i13535, i13536

The rostral carina, pereiopods I-III with long, thin chelae, the pleopods with long flagella, and the exopodite with a diaeresis are enough to identify the specimens as *Benthesicymus* Bate, 1881. The specimens are not sufficiently well preserved to allow Glaessner's description to be amplified.

Family Aegeridae Münster, 1839

Genus *Aeger* Münster, 1839
Aeger libanensis Roger, 1946

1946 - *Aeger libanensis* - Roger, p. 31, figs. 23, 24.

Type locality: Hadjula.
Geological age: Cenomanian.
Material: MSNM i6029.

The species *A. libanensis* Roger, 1946 is represented only by a 3rd maxilliped comprises four articula narrowing slightly toward the distal extremity. All the articula bear long straight spines originating from the lower-lateral margin.

Indeterminate penaeid
Pl. V, fig. 2

Type locality: Hakel.
Geological age: Cenomanian.
Material: MSNM i12523
Description. Complete elongate small penaeid (3.5 cm), in a fairly good state of preservation, with a thin completely smooth exoskeleton.

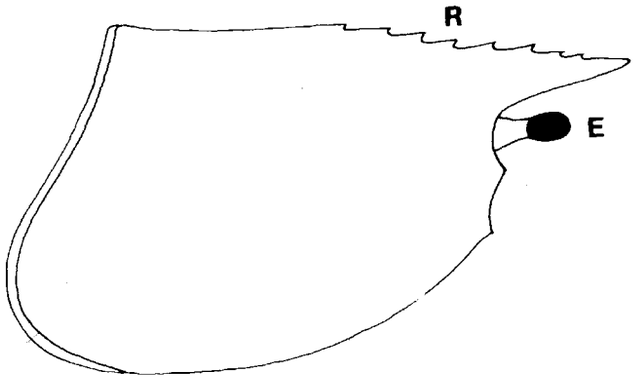


Fig. 14 - Indeterminate penaeid, carapace reconstruction in lateral view, line drawing.

Carapace. In lateral view, the carapace (Fig. 14) is subrectangular in outline and narrows markedly anteriorly due to the strong curvature of the ventral margin. The dorsal midline is straight and the posterior margin is sinuous, with a concavity in the middle. The dorsal midline extends into a long rostrum with a rounded distal extremity, and bears three identical anteriorly projecting suprarostral teeth. The rostral carina comprises five teeth. The ocular incision is narrow and shallow, with weak antennal and pterygostomial angles. The carapace surface has no grooves, carinae or spines.

Abdomen. The tergites are rectangular in shape, with a slightly sinuous posterior margin and rounded pleurae. The telson is smooth and lacks any characteristic ornamentation. The uropods, which are poorly preserved, are about 1/3 longer than the telson.

Cephalic appendages. These are badly preserved. Only the eye and the pointed distal portion of the scaphocerite are evident.

Thoracic appendages. The 3rd maxilliped is not preserved. Pereiopods I-II-IV-V comprise thin and elongate articula; it is not possible to observe chelae in pereiopods I-II. Pereiopod III has a strong and very elongate merus and carpus, and dactylus and index of the chela are slightly bent at distal extremity.

Abdominal appendages. The pleopods comprise a subrectangular sympodite bearing two short multiarticulate flagella.

Discussion

The specimen differs from other penaeids in the long rostrum with three suprarostral teeth, the rostral carina comprising five identical teeth and the strong elongation of pereiopod III. As only a few features can be observed on the single available specimen, it is difficult to characterize this form satisfactorily; hence it is left as indeterminate.

Family Carpopenaeidae nov.

Diagnosis: subrectangular carapace; long rostrum with suprarostral and subrostral teeth; pair of long longitudinal carinae laterally on the carapace; well developed 3rd maxilliped; multiarticulate carpus of pereiopods II-III; exopodite with a diaeresis.

Discussion. Glaessner (1945) described 35 almost complete specimens from Hakel and Hadjula on which he based the new genus *Carpopenaeus*. Even though the author assigned the new genus to the infraorder Penaeidea, he did not include it in the family Penaeidae, probably because of the presence of a multiarticulate carpus in pereiopods II-III. The presence of a well developed rostrum with suprarostral and subrostral teeth, a longitudinal median carina running along the whole length of the carapace, and above all pereiopods II-III with a multiarticulate carpus warrant the erection of a new family Carpopenaeidae, which includes the single genus *Carpopenaeus* Glaessner, 1945 with the two species *C. callirostris* Glaessner, 1945 and *C. septemspinatus* (Dames, 1886). A multiarticulate carpus in pereiopods II-III is not known from any other representative of the infraorder Penaeidea, but it is present in pereiopod II of three families of the infraorder Caridea: Hyppolytidae Bate, 1888, Processidae Dort-

mann, 1896 and Pandalidae Bate, 1888. However, the family Carpopenaeidae differs from the above-mentioned families in having a pair of lateral carinae, in the strong pereiopod I which is well developed and as long as the body, and in the normal overlap of abdominal pleura I on II, not viceversa. These attributes allow the family Carpopenaeidae to be assigned to the infraorder Penaeidea de Haan, 1849.

It is interesting to note that the representatives of the family Carpopenaeidae combine penaeid features, such as the lack of a subround pleura in tergite II and the absence of a diaeresis on the exopodite, with a caridean feature, such as the multiarticulate carpus in pereiopod II. This family is presently known only from the Lebanon.

Genus *Carpopenaeus* Glaessner, 1945
Carpopenaeus callirostris Glaessner, 1945
Pl. V, figs. 3-4; Pl. VI, figs. 1-3

1945 - *Carpopenaeus callirostris* - Glaessner, p. 698, fig. 2; pl. VIII, fig. 2.
1975 - *Carpopenaeus callirostris* - Glaessner - Pinna, p. 4. fig. 3.

Type locality: Hakel.
Geological age: Cenomanian.
Diagnosis: long rostrum bent upwards distally, with ten suprarostral teeth and one subrostral tooth; epigastric tooth in the anterior third; longitudinal lateral carina; gastro-orbital and hepatic spines; well developed 3rd maxilliped; pereiopod I strongly elongate, bearing two parallel rows of tubercles; pereiopods II-III with multiarticulate carpus; exopodite with a diaeresis.
Material: 52 complete specimens, in a fairly good state of preservation, 4 to 9 cm in length.
MSNM: i4454; i4455, i4456, i4458 i4459, i4460, i4461, i4462, i4463, i4464, i4465, i4466, i4467, i4468, i4469, i4470, i4471, i4472, i4473, i5908, i5924, i5928, i6010, i6011, i6012, i6015, i6017, i6019, i6021, i6023, i6028, i6031, i6036, i6041, i6043, i6052, i6055, i6057, i6060, i6061, i7889, i8732, i10970, i11837, i12160, i12168, i12252, i12321, i12322, i12501, i12586, i13524
Discussion. The genus *Carpopenaeus* was erected by Glaessner (1945) on 35 almost complete specimens, on the basis of the following features:
very long rostrum with anterior part bent upwards, with one subrostral tooth, two small teeth at the distal extremity and six suprarostral teeth; longitudinal lateral carina running from the posterior margin to the anterior margin of the carapace; gastro-orbital and hepatic spines; pereiopod I with long strong chela; pereiopods II-III with multiarticulate carpus and very small chelae; thin pereiopods IV-V with a terminal dactylus; exopodite with a diaeresis.

The excellent preservation state of the specimens held by the Museo di Storia Naturale di Milano allowed me to discover new features not detected by Glaessner: presence of an epigastric tooth in the anterior third, ten suprarostral teeth, antennular peduncle comprises three thin and elongate segments, long strong carpocerite bearing a flagellum which length is about twice as much as the body, 3rd maxilliped with a row of small spines, originating from the lower margin of the articula, and pereiopod I bearing two rows of strong tubercles (the latter feature is present in the large specimens, such as MSNM: i6028, i12322) (Fig. 15).

The examined specimens have a length varying from 4 to 9 cm. Study of the ratios between 1) total body length and the length of pereiopod I and 2) between carapace length and the length of the rostrum of 7 examined specimens (Tab. II) revealed that pereiopod I grew allometrically, while the rostrum grew proportionally smaller as the length of the carapace increased (Fig. 16).

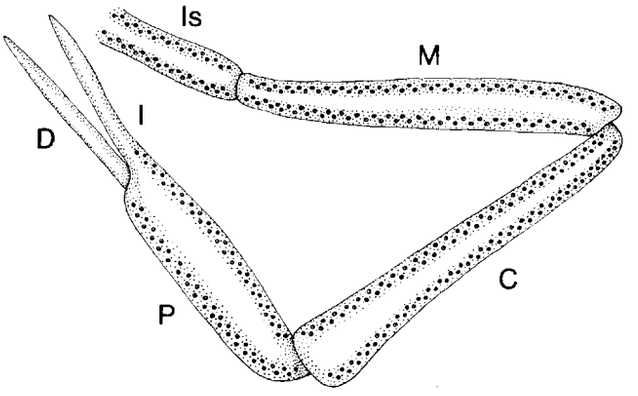


Fig. 15 - *Carpopenaeus callirostris* Glaessner, 1945, first pereiopod with ornamentation, line drawing.

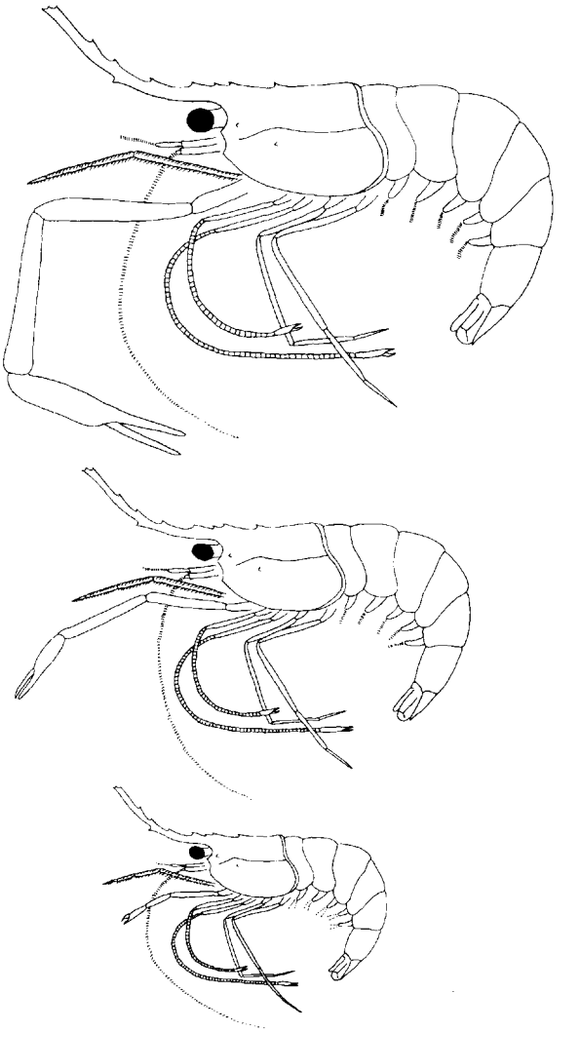


Fig. 16 - Ontogenetic stages of *Carpopenaeus callirostris* Glaessner, 1945.

Table II - Morphometric measures of seven specimens of *Carpopenaeus callirostris* Glaessner, 1945.

MSNM	Total lenght (cm)	Rostrum (cm)	Merus, carpus, propodus, lenght (cm)	Carapace lenght (cm)
i7889a	4.5	1.5	0.5	
i7889b	5	2	0.66	1.2
i6061	6	2	-	1.7
i4454	7	-	0.9	1.8
i6057	9	-	1.2	2
i6028	9	-	1.5	2
il2322	9	1.8	2.8	2.8

MSNM	Ratio total lenght/periopod I lenght
i7889a	4.5/1.5 = 3
i7889b	5/1.8 = 2.7
i4454	7/2.7 = 2.5
i6057	9/3.6 = 2.5
i6028	9/4.5 = 2
il2322	9/8.4= 1
MSNM	**Ratio carapace lenght/rostrum lenght**
i7889a	1/1.5 = 0.6
i7889b	1.2/2 = 0.6
i6061	1 .7/2 = 0.8
il2322	2.8/1.8= 1.5

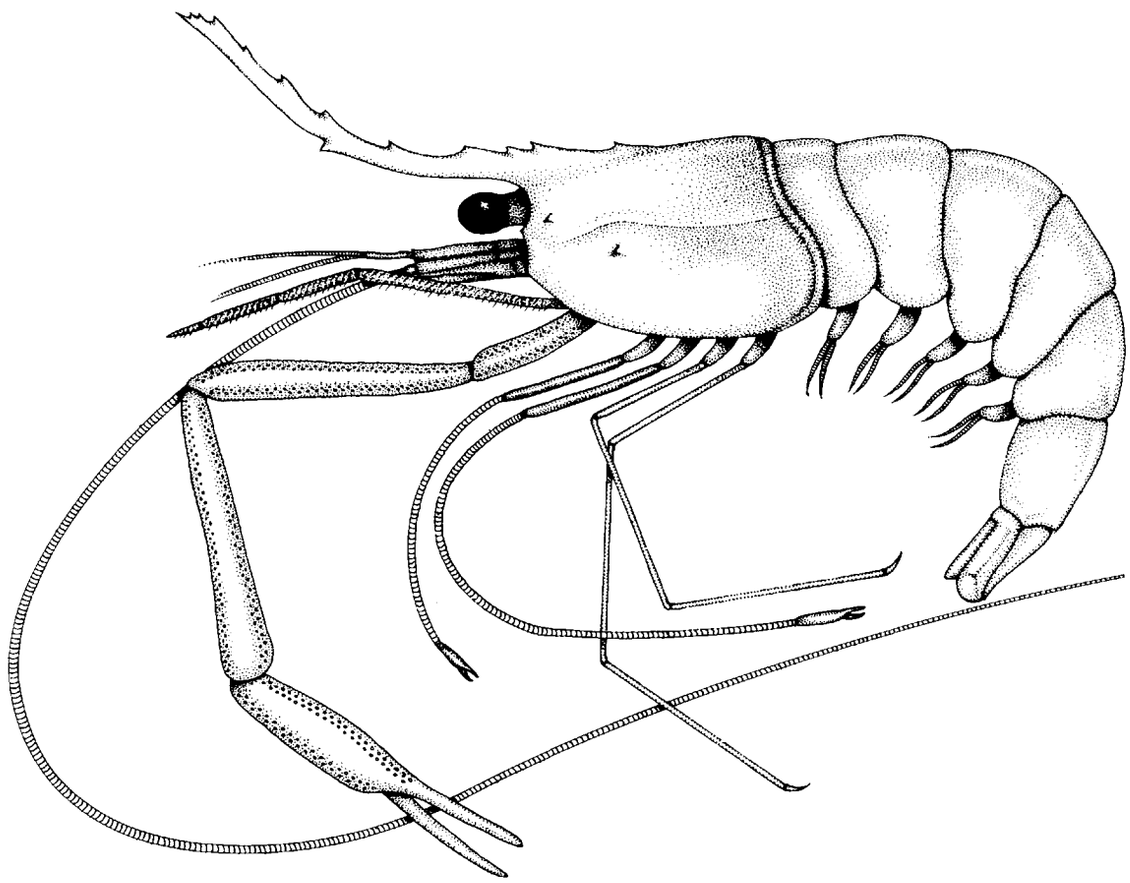


Fig. 17 - *Carpopenaeus callirostris* Glaessner, 1945, reconstruction.

Carpopenaeus septemspinatus (Dames, 1886)
Pl. VI, fig. 4; Pl. VII, figs. 1-4

1886 - *Penaeus septemspinatus* - Dames, p. 554; Tab. XIII, Fig. 1.
1922 - *Penaeus septemspinatus* Dames - Balss, p. 131.
1929 - *Penaeus septemspinatus* Dames - Glaessner, p. 310.
1930 - *Penaeus septemspinatus* Dames - Van Straelen, p. 4.
1945 - *Carpopenaeus septemspinatus* (Dames) - Glaessner, p. 699; pl. VIII, fig. 3.

Type locality: Hakel.
Geological age: Cenomonian.

Diagnosis: long rostrum with seven suprarostral teeth and one subrostral distal tooth; median epigastric tooth; gastro-orbital spine; two parallel longitudinal lateral carinae; pereiopod I strongly elongate with short strong chela; pereiopods II-III with multiarticolate carpus; telson with toothed ventral lateral margin and with three mobile spines on the lateral surface.

Material: 16 complete specimens, in a fairly good state of preservation. The examined material made possible a new description of the species.

MSNM: i4457, i8400, il2262, il2263, il2320, il2324, il2327-il2567, il2347, il2359, il2379, il2520, il2521, il2544, il2583-il2592, il2594, il2595

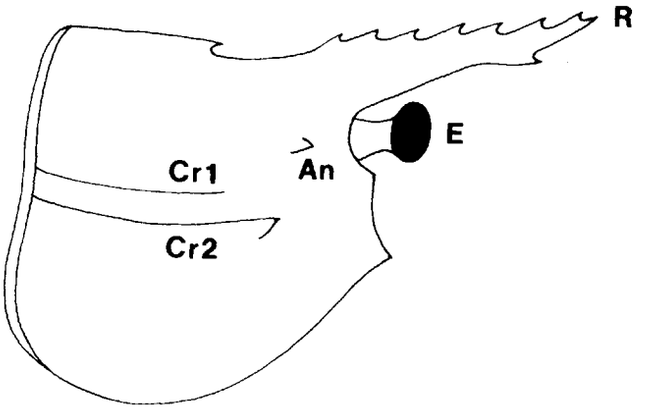


Fig. 18 - *Carpopenaeus septemspinatus* (Dames, 1886), carapace reconstruction in lateral view, line drawing.

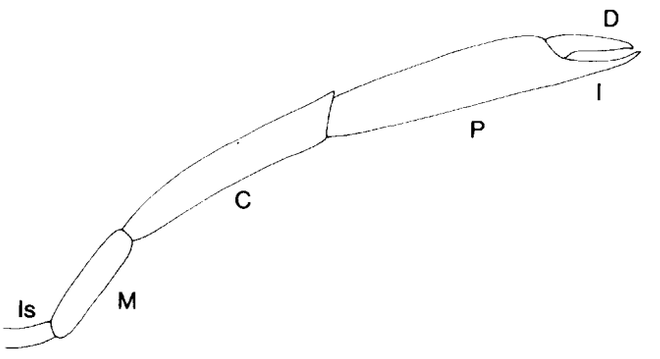


Fig. 19 - *Carpopenaeus septemspinatus* (Dames, 1886), first pereiopods, line drawing.

Description. Large elongate penaeid (the biggest specimen has 7 cm in length), with thin completely smooth exoskeleton and 3 to 7 cm in length.

Carapace. In lateral view, the carapace (Fig. 18) is subrectangular in outline and narrows slightly anteriorly due to the weak curvature of the ventral margin. Dorsal midline with slight convexity in the anterior third and sinuous posterior margin, with a weak concavity in the middle, and strengthened by a thin marginal ridge. The dorsal midline extends into a long upwardly directed rostrum with rounded distal extremity, bearing seven identical and anteriorly projecting suprarostral teeth, and one subrostral distal tooth. There is one median epigastric tooth. The ocular incision is narrow and shallow, with weak antennal and pterygostomial angles. Two longitudinal lateral carinae extend from the posterior margin forwards over about 2/3 of the carapace, following a curvilinear path. The lower carina ends with a well developed spine. A gastro-orbital spine is evident.

Abdomen. The posterior margin of the first three tergites is sinuous, while in tergite IV-V it is posteriorly protuded. The telson has a toothed ventral margin and three mobile spines along the lateral surface. The poorly preserved uropods are about 1/3 longer than the telson.

Cephalic appendages. The eye peduncle is thin and elongated. The scaphocerite is triangular with pointed distal extremity. The carpocerite is short and stocky.

Thoracic appendages. The 3rd maxilliped is preserved only in one specimen (MSNM i12520): the four articula, bearing small spines, narrow slightly toward the distal extremity. Pereiopod I has strongly elongate carpus and propodus, with a short strong chela, bearing an index that is slightly longer than dactylus, both with pointed distal extremity (Fig. 19). Pereiopods II-III have multiarticolate carpus and short thin chelae. The pereiopods IV-V are incomplete and their reconstruction in Fig. 21 is inferred from *C. callirostris* Glaessner, 1945.

Abdominal appendages. The pleopods are poorly preserved.

Discussion

Dames (1886) erected the new species *Penaeus septemspinatus* on the basis of two specimens from Hakel. The holotype of this species, housed at the Museum für Naturkunde der Humboldt-Universität of Berlin (MB.A.215-K66), was reviewed by Glaessner (1945). The presence of pereiopod III with multiarticolate carpus was enough to assigne Dames's specimens to the new genus *Carpopenaeus* Glaessner, 1945. The study of the holotype allowed me to highlight some features, such as the rostrum with seven suprarostral teeth and one subrostral distal tooth, the two longitudinal lateral carapace carinae and the multiarticulate state of pereiopods II-III enough to ascribe the examined specimens herein to this species.

C. septemspinatus (Dames, 1886) differs from *C. callirostris* Glaessner, 1945 in having seven suprarostral teeth and one single subrostral distal tooth, in the presence of two longitudinal parallel lateral carinae (Fig. 20), in pereiopod I with a short strong chela and in three mobile teeth laterally on the telson. The two species share the epigastric tooth, the gastro-orbital spine, the 3rd maxilliped bearing a row of spines and the pereiopods II-III with multiarticulate carpus.

The examined specimens have a length varying from 3 and 7 cm. Also for *C. septemspinatus* morphometric measurement were carried out in this case on 5 examined specimens (Tab. III). Study of the ratios between 1) total body length and the length of pereiopod I and 2) between carapace length and the length of the rostrum revealed that pereiopod I and the rostrum grew allometrically, if compared to the overall growth of the animal and to the increase in length of the carapace.

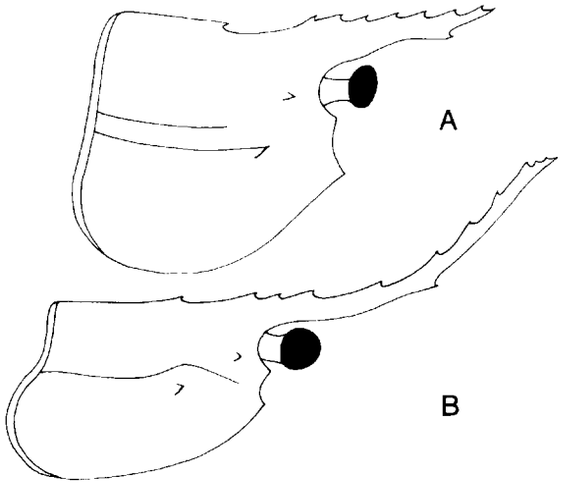


Fig. 20 - Comparison between the carapaces of *C. septemspinatus* (Dames, 1886) (A) and *C. callirostris* Glaessner, 1945 (B).

Table III - Morphometric measures of five specimens of *Carpopenaeus septemspinatus* (Dames, 1886).

MSNM	Total lenght (cm)	Rostrum (cm)	Carpus, propodus, lenght (cm)	Carapace lenght (cm)
il2594	3	0.6	-	0.5
il2544	3.5	0.6	0.5	0.7
il2583	4	0.7	-	0.8
il2324	5	1	1.5	1.2
il2327	7	1.2	1.6	1.7

MSNM	Ratio total lenght/periopod I lenght
il2544	3.5/1 .5 = 2.3
il2262	4/3 = 1.3
il2324	5/4.5 = 1.1
il2327	7/4.8= 1.4
MSNM	**Ratio carapace lenght/rostrum lenght**
il2594	0.5/0.6 = 0.8
il2544	0.7/0.6= 1.1
il2583	0.8/0.7= 1.1
il2324	1.2/1 = 1.2
il2327	1.7/1.2= 1.4

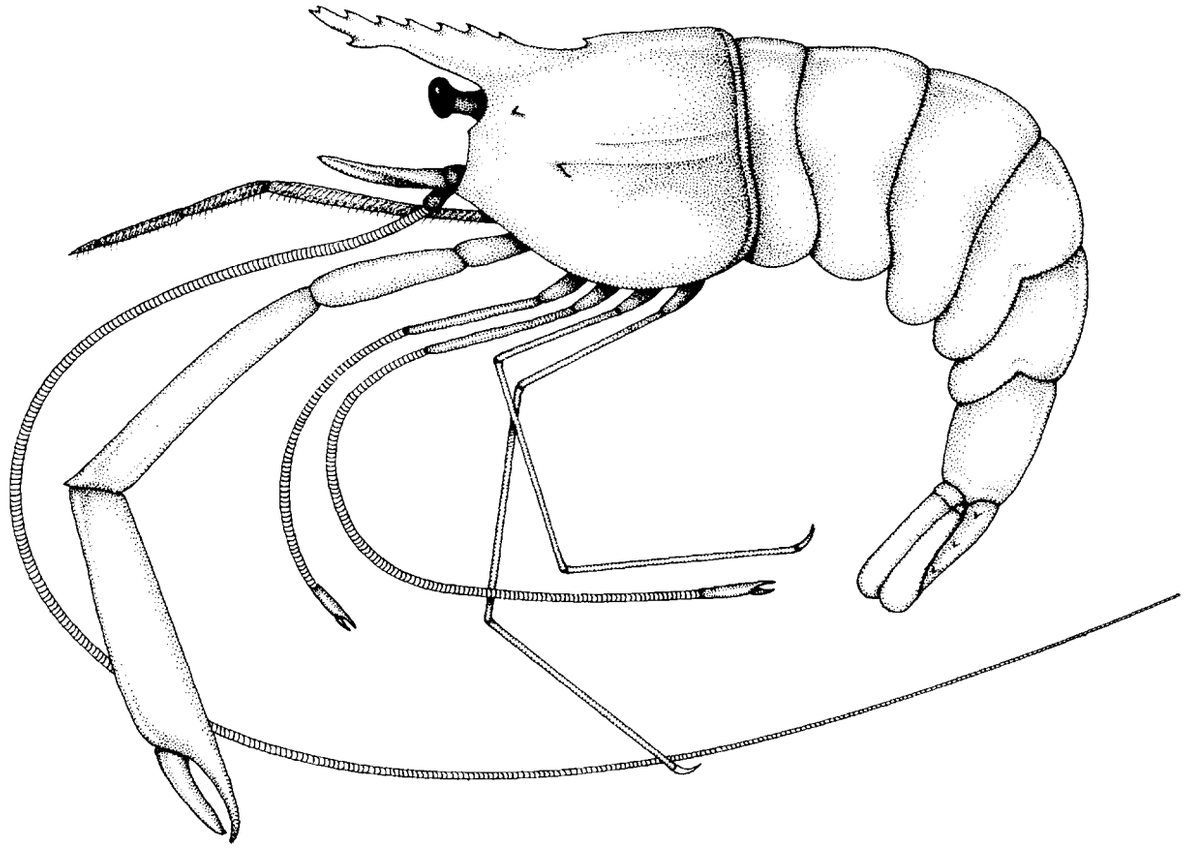


Fig. 21 - *Carpopenaeus septemspinatus* (Dames, 1886), reconstruction.

Infraorder Caridea Dana, 1852
Family Oplophoridae Dana, 1852

Genus *Odontochelion* nov.

Diagnosis: short rostrum, denticulate dorsal midline of carapace; tergite II with subround pleura overlapping pleura of 1st and 3rd one; pereiopods I-V with a terminal dactylus.

Derivatio nominis: from odous, odontos = tooth and cheleion = carapace.

Type species: *Notostomus cretaceus* Roger, 1946.

Description: as for the type species.

Odontochelion cretaceum (Roger, 1946)
Pl. VIII, figs. 1-4

1946 - *Notostomus cretaceus* - Roger, p. 35, fig. 28.

Type locality: Hadjula.

Geological age: Cenomanian.

Diagnosis: extremely short rostrum: denticulate dorsal midline of the carapace; row of three longitudinal denticulate carinae; tergite II with subround pleura slightly overlapping that of the 1st and 3rd one; tergite VI with two pairs of denticulate lateral carinae in addition to median dorsal carina of similar appearance; pereiopods I-V with a terminal dactylus;

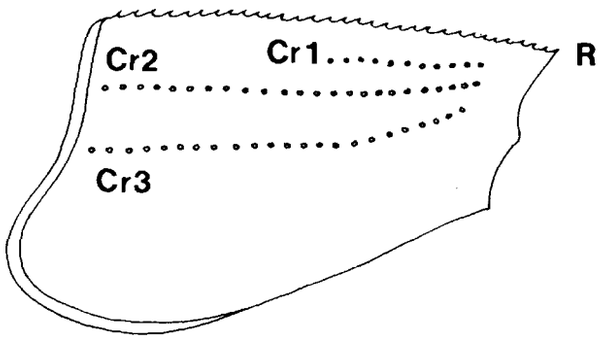


Fig. 22 - *Odontochelion cretaceum* (Roger, 1946), carapace reconstruction in lateral view, line drawing.

pereiopods I-II supplied with posterolaterally directed small spines arranged in a continuos row.

Material: 32 small complete specimens, in a fairly good state of preservation. Most of the specimens are laterally compressed. The abundant examined material made it possible to carry out a more detailed analysis than that by Roger which was based on a sample of only five specimens.

MSNM: i10398, i10400, i12264, i12277, i12279, i12381, i12385, i12387, i12395, i12508, i12509, i12511, i12513, i12517, i12528, i12529, i12530, i12533, i12535, i12536, i12537, i12540, i12542, i12550, i12558, i12561, i12568, i12570, i12574, i12575, i12585, i12590

Description. Small elongated caridean (the biggest specimen - MSNM i12542 - has 4 cm in length), with thin, smooth exoskeleton and 3 to 4 cm in length.

Carapace. In lateral view, the carapace (Fig. 22) is subrectangular in outline and narrows slightly anteriorly due to the weak curvature of the ventral margin. The dorsal midline is straight and the posterior margin is sinuous, with a concavity in the middle, and strengthened by a thin marginal ridge. The rostrum is very short. The ocular incision is narrow and shallow, with weakly developed antennal and pterygostomial angles. As already observed by Roger, the dorsal midline is finely denticulate. Parallell to it, two pairs of long denticulated carinae extend over the lateral and dorsolateral surface of the carapace. Between these and the midline carina, there is an additional but much shorter see in many specimens (MSNM: i10381, i10387, i10400, i12511, i12528, i12529, i12536, i12540, i12542, i12558, i12568, i12570, i12575, i12590).

Abdomen. Tergite I has a subround pleura overlapping that of the first and the third one. Tergite VI is rectangular in outline and is slightly longer than those anterior to it. It also shows one medial two pairs of lateral finely denticulate thin carinae extending the whole length of the tergite (MSNM: i12508, 12530, i12535, i12540, i12585, i12590). The telson is smooth and lacks any characteristic ornamentation. The uropods, poorly preserved, are about 1/3 longer than the telson.

Cephalic appendages. The cephalic appendages are partly preserved in some specimens (MSNM: i12277, i12508, i12511, i12517, i12529, i12536, i12537, i12588, i12568, i12570, i12574, i12585). The eye peduncle is thin and elongated. The scaphocerite is triangular in outline with pointed distal extremity. The carpocerite is short bearing a flagellum as long as the body.

Thoracic appendages. The thoracic appendages are well preserved in some specimens (MSNM: i10381, i12277, i12279, i12395, i12511, i12517, i12528, i12529, i12535, i12536, i12537, i12542, i12558). The 3rd maxilliped is not preserved. Pereiopods I-V have a terminal dactylus. Pereiopods I-II have short and stocky articula. All of these carry a single row of short spines on the lateral surface. Dactylus is stronger and more elongate than that of the other pairs. Pereiopods III-IV-V comprise thin, elongate spineless articula.

Abdominal appendages. The pleopods are not preserved.

Discussion

Although with some reservations, Roger referred the studied specimens to the genus *Notostomus* Milne Edwards, 1881 on the basis of the dorsal and lateral denticulate carinae. He also did not realize, because of the poor material at his disposal, that his species shared another important feature with the genus *Notostomus*, that is the lack of chelae in all pereiopods. These features are nevertheless not enough to justify such a generic affiliation. I believe in fact that the longitudinal carinae of species described by Roger are much different from those in *Notostomus*, both in the denticulation and in the direction (Fig. 23). Moreover in *Odontochelion cretaceum* (Roger, 1946) the pleura of tergite II is less rounded than in representatives of the genus *Notostomus*, and tergite VI has the already mentioned denticulate median and lateral carinae. I therefore regard it justified to erect the new genus *Odontochelion*.

The new genus is ascribed to the family Oplophoridae Dana, 1852, the only family in which pereiopods I-V are provided with a terminal dactylus (Holthuis (1955)). Seven genera belong to this family. Amomg these, *Notostomus, Acanthephyra, Meningodora, Ephyrina* and *Hymenodora* have a denticulate median dorsal carina of the carapace and pereiopods I-V divided into two short and three long, features shared also by the genus *Odontochelion*.

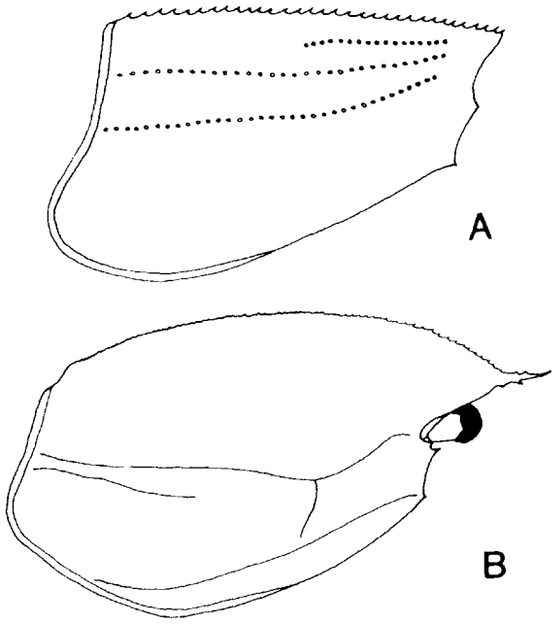


Fig. 23 - Comparison between the carapaces of *Odontochelion* n. gen. (A) and *Notostomus* Milne Edwards, 1881 (B).

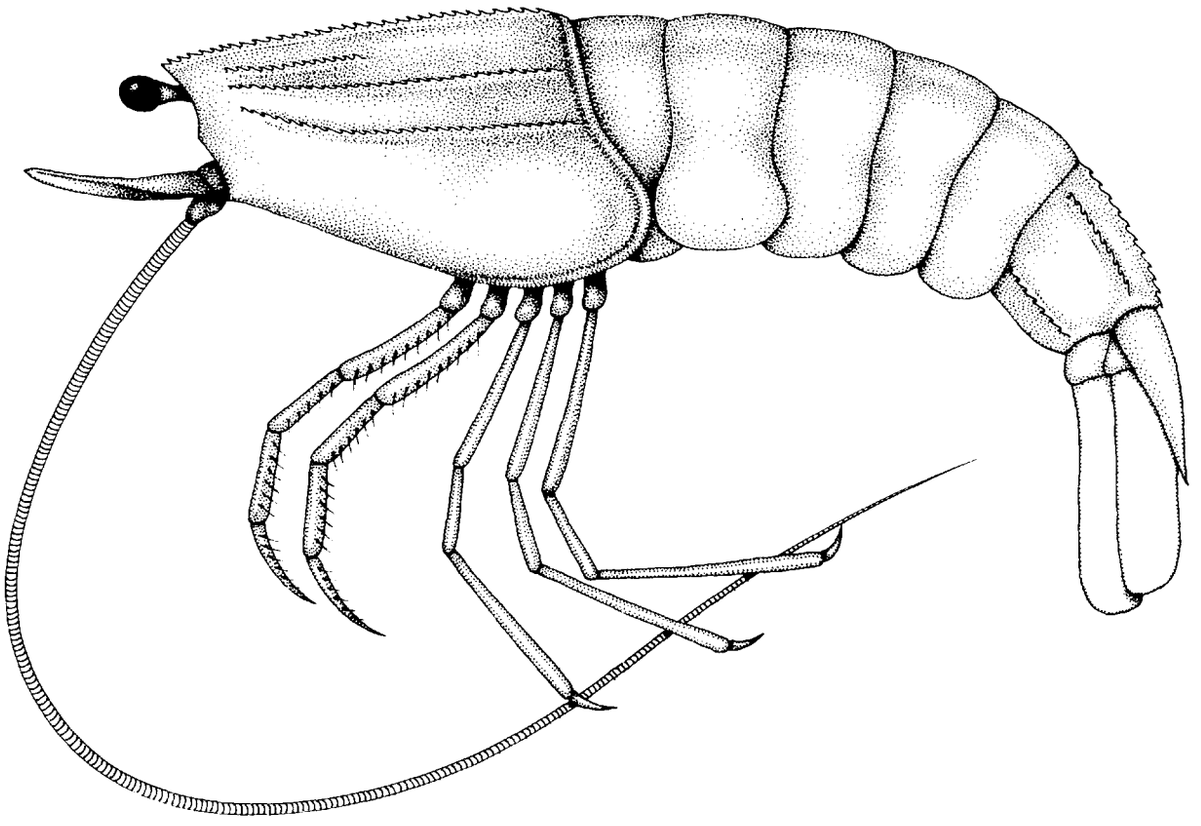


Fig. 24 - *Odontochelion cretaceum* (Roger, 1946), reconstruction.

Infraorder Astacidea Latreille, 1803
Family Erymidae Van Straelen, 1924

Genus *Eryma* von Meyer, 1840
Eryma cretacea Roger, 1946
Pl. IX, figs. 1-4; Pl. X, figs 1-3

1946 - *Eryma cretacea* - Roger, p. 42, fig. 31; pl. IX, fig. 7.

Type locality: Hakel.
Geological age: Cenomanian.
Diagnosis: short rostrum bearing two pairs of suprarostral teeth; deep cervical groove; chelae of pereiopod I with index longer than dactylus; distal extremity of the telson supplied with median spine; exopodite with a diaeresis.
Material: 50 complete specimens, in a fairly good state of preservation. Most of the specimens are dorsoventrally flattened (34) and some in lateral view (16). The different preservation modalities and the abundant material allowed a more accurate and detailed analysis than the one carried out by Roger, being based on two specimens only.
MSNM: i8728, i12162, i12268, i12269, i12272, i12278, i12280, i12281, i12282, i12283, i12284, i12285, i12287, i12288, i12291, i12292, i12293, i12294, i12296, i12297, i12298, i12299, i12300, i12301, i12302, i12304, i12305, i12306, i12307, i12308, i12309, i12310, i12311, i12312, i12313, i12314, i12315, i12316, i12317, i12326, i12362, i12363, i12368, i12371, i12376, i12418, i12522, i12526, i12581, i12593
Description. Small elongated erymid with thin strongly tubercolate exoskeleton and 1.5 to 2.5 cm in length.

Carapace. In lateral view, the carapace (Fig. 25A) is subrectangular in outline and narrows slightly anteriorly. The dorsal midline is straight and slightly bends by the cervical groove, while the posterior

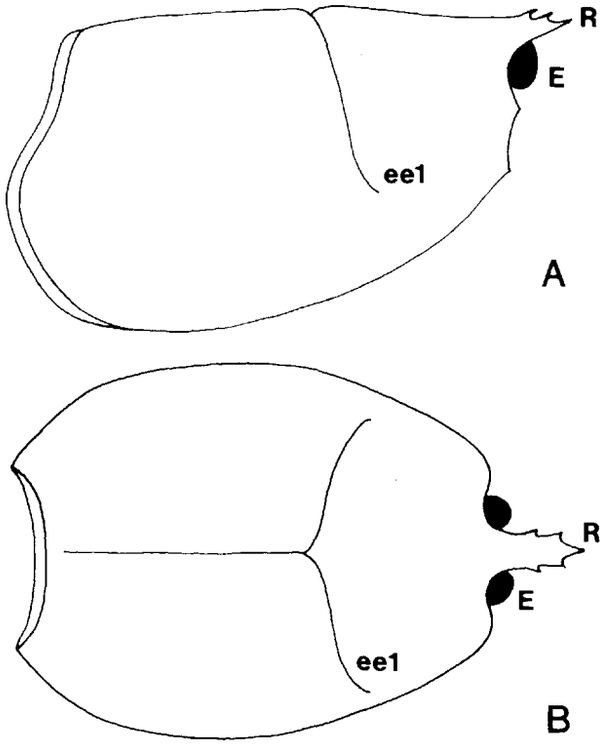


Fig. 25 - *Eryma cretacea* Roger, 1946, carapace reconstruction in lateral view, line drawing (A); carapace reconstruction in dorsal view, line drawing (B).

margin is sinuous, with a concavity in the middle. In dorsal view, the carapace (Fig. 25B) is subrectangular in outline and narrows slightly toward the deep ocular incisions; the lateral margins are rounded, while the posterior margin is slightly forward bent. The dorsal midline extends into a short rostrum, pointed at the distal extremity and bearing two pairs of suprarostral teeth (MSNM: i12304, i12308, i12317). From the dorsal midline, the cervical groove extends straight anterolaterally then bends slightly forward in the antennal region.

Abdomen. The lower margin of all the sternites ends with a point in the middle. The uropods are not longer than the telson (MSNM: i12281, i12308, i12312) (Fig. 26), which is subtriangular in outline and narrows slightly toward the rounded distal extremity, bearing a small median spine; three thin carinae, one median and two lateral, run along the telson, while each of the lateral margins has a well developed spine. The exopodite has a straight diaeresis fringed by a row of small spines; the external margin bearing a developed spine, articulated at the diaeresis. The endopodite has a small spine in the upper third of the lateral margin and a thin longitudinal carina extends along it (MSNM 12293). Laterally, both endopodite and exopodite are finely tuberculated and fringed (MSNM: i12280, i12307, i12309).

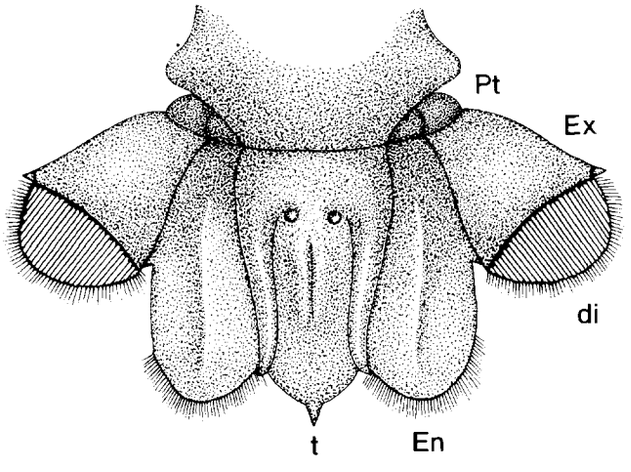


Fig. 26 - *Eryma cretacea* Roger, 1946, tail fan with ornamentation, line drawing.

Cephalic appendages. Ther cephalic appendages are well preserved in three specimens only (MSNM: i12285, i12314, i12315). In specimen i12314 it is possible to observe the antennular peduncle, comprising only two segments: the 2nd thin and elongate and 3rd short and stocky. On the same specimen, the antennal peduncle preserves the merocerite and the carpocerite, both short and stocky; the flagellum is as long as the body.

Thoracic appendages. The 3rd maxilliped is evident only in a few specimens (MSNM: i12280, i12283, i12292, i12293, i12297, i12305, i12307, i12312, i12314, i12368). In specimen i12314 four spineless articula are evident, all of the same size, weakly narrowing toward the distal extremity. Pereiopod I is strongly developed with chelae, without eterochely (Fig. 27). Propodus of the chelae is strong and stocky, with an index longer than dactylus, both bent at the distal extremity and bearing six small teeth on inner margin. Carpus is short and stocky, while merus is thin and elongate. The surface of the chelae is fringed by small spine-like tubercles. The lateral margins of merus, carpus and propodus bear a row of small spines. Pereiopods II-III have thin elongate articula and small chelae with inner dactylus. Pereiopods IV-V, with thin elongate articula, have a terminal dactylus and propodus of pereiopod V bears a row of small spines on the lateral side (MSNM: i12285, i12293).

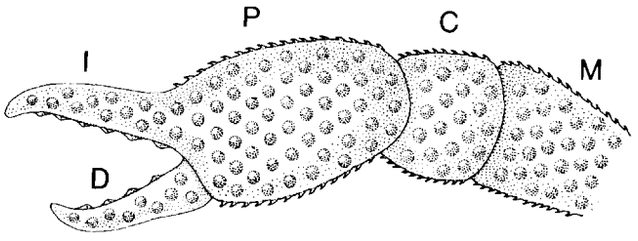


Fig. 27 - *Eryma cretacea* Roger, 1946, first pereiopod with ornamentation, line drawing.

Abdominal appendages. The pleopods are not preserved.

Family Nephropidae Dana, 1852
Genus *Homarus* Weber, 1795

Homarus hakelensis (Fraas, 1878)
Pl. X, fig. 4; Pl. XI, figs. 1-4

1878 - *Pseudastacus hakelensis* - Fraas, p. 346; pl. VI, fig. 1.
1886 - *Pseudastacus hakelensis* Fraas - Dames, p. 557; pl. XIII, fig. 3; pl. XIV, fig. 1.
1929 - *Pseudastacus hakelensis* Fraas - Glaessner, p. 351.
1945 - *Homarus hakelensis* (Fraas) - Glaessner, p. 701; pl. VIII, fig. 4, 5.
1946 - *Pseudastacus hakelensis* Fraas - Roger, p. 38; pl. V, fig. 4, 5, 6.
1975 - *Homarus hakelensis* (Fraas) - Pinna, p. 4, fig. 4.

Type locality: Hakel.
Geological age: Cenomanian.
Diagnosis: long rostrum bearing two pairs of suprarostral teeth; deep cervical groove; strong heterochely of pereiopod I; subrectangular telson; exopodite with a diaeresis.
Material: 34 complete specimens, in a fairly good state of preservation. Most of the specimens are preserved dorsoventrally flattened (24) and a small part are laterally compressed (10). The abundant material available allowed a more accurate and detailed analysis than the one carried out by Roger (1946) that was based on ten specimens only. Glaessner (1945) revised the genus.
MSNM: i4449, i4450, i4451, i6013, i6016, i6020, i6024, i6027, i6037, i6038, i6039, i6040, i6047, i6048, i6049, i6050, i6054, i6059, i6853, i6854, i7601, i8733, i11835, i11836, i12153, i12166, i12238, i12246, i12250, i12259, i12388, i12527, i12562, i12958
Description. Large elongate astacidean, with thin finely granulate exoskeleton and 5 to 7 cm in length.
Carapace. In dorsal view, the carapace (Fig. 29A) is subtrapezoidal in outline and narrows slightly toward the fairly deep ocular incisions. The lateral

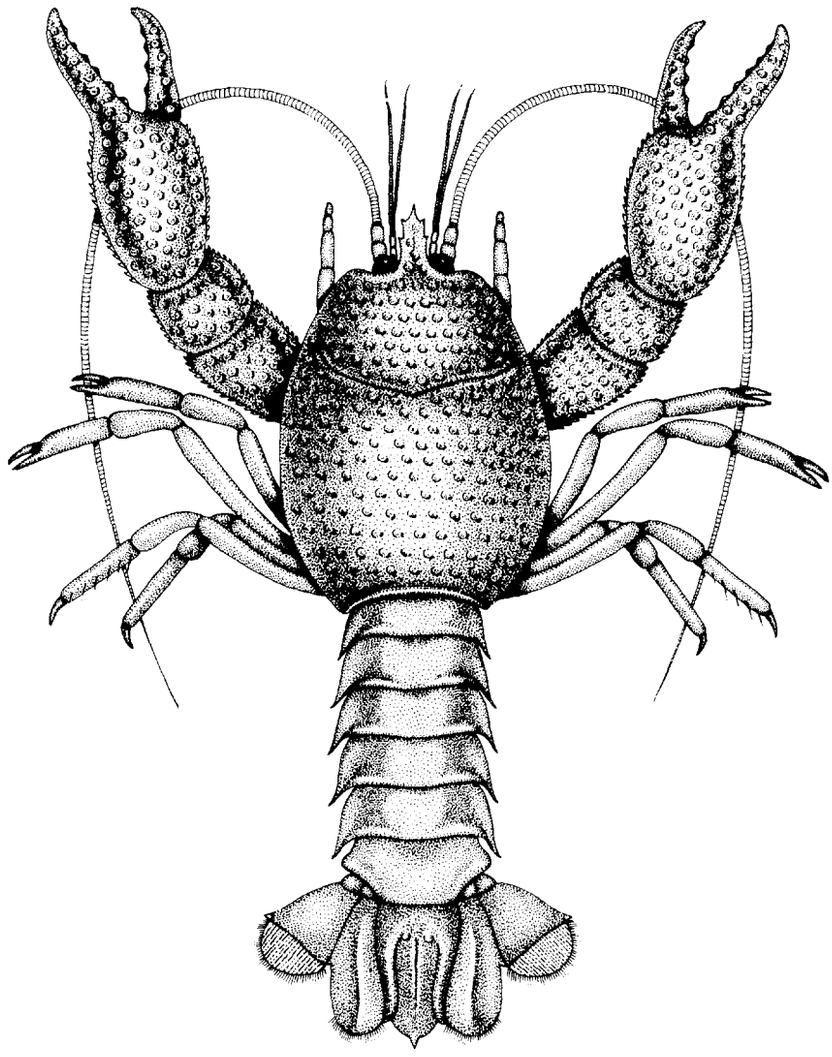


Fig. 28 - *Eryma cretacea* Roger, 1946, reconstruction.

margins are rounded, while the posterior one is slightly forward arcuate. In lateral view, the carapace (Fig. 29B) is subrectangular in outline and narrows slightly anteriorly. The dorsal midline is straight, slightly bent by the cervical groove, while the posterior one is sinuous, with a concavity in the middle. The dorsal midline extends into a short rostrum, with pointed distal extremity and bearing two pairs of suprarostral teeth (MSNM: i6016, i6047, i6050, il1835, il1836, il2259). The cervical groove is straight from the dorsal midline then bends slightly forward the antennal region.

Abdomen. The abdominal tergites are rectangular in outline and narrowing caudally. The tail fan (Fig. 30) is well preserved in some specimens (MSNM: i6013, i6038, i6039, i6049, i7601, il2238, il2250, il2388). The telson is subrectangular in outline with a rounded distal extremity and it does not show any characteristic ornamentation. The exopodite and the endopodite are not longer than the telson. The exopodite has a straight diaeresis: the upper margin bears a row of small spines, while the external margin bears a well developed spine at the diaeresis. The lateral margin of exopodite is finely tubercolate. The lateral margin of the endopodite bears a small spine in the distal margin. The distal margins of the exopodite and the endopodite are finely fringed.

Cephalic appendages. The cephalic appendages are well preserved in almost all specimens (Fig. 31). The eye peduncle is short and slender (MSNM i7601). The antennular peduncle comprises three thin elongate segments. The antennal peduncle (MSNM il2166) comprise ischiocerite, merocerite and carpocerite, all of the same length; a flagellum is articulated to the carpocerite, and it is longer than the body (MSNM i6047: 10 cm). The scaphocerite consists of a triangular exopodite, with a pointed distal extremity articulating with a rectangular basicerite (MSNM i6853).

Thoracic appendages. The 3rd maxilliped is not preserved.

Pereiopod I is strongly heterochelous (Fig. 32), One chela is strongly elongate (MSNM: i6039, i8733: 5 cm) with dactylus and the longer index bent at the distal extremity and bearing a row of small teeth along the inner margins. The inner side of propodus has a row of six strong spines. The other chela is short and stocky (MSNM: i6037, i6048, i7601, il1835, il1836: 3 cm) with dactylus and index bent at the distal extremity and bearing large tubercles along the inner margins. Also in this chela the inner side of propodus exhibits a row of strong spines (MSNM il1836). Carpus of pereiopod I is short and stocky, while merus is thin and elongate.

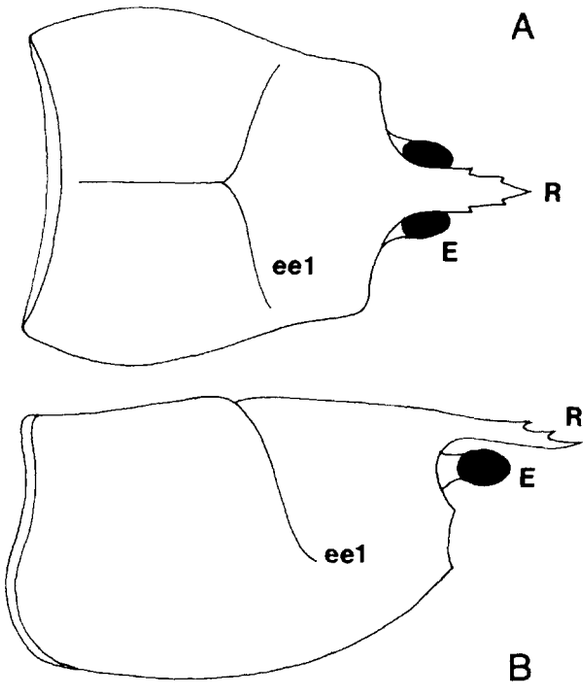


Fig. 29 - *Homarus hakelensis* (Fraas, 1878), carapace reconstruction in dorsal view, line drawing (A); carapace reconstruction in lateral view, line drawing (B).

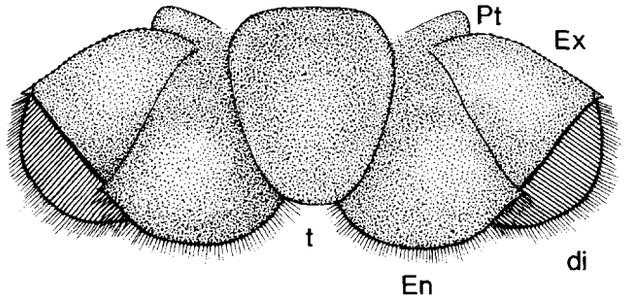


Fig. 30 - *Homarus hakelensis* (Fraas, 1878), tail fan with ornamentation, line drawing.

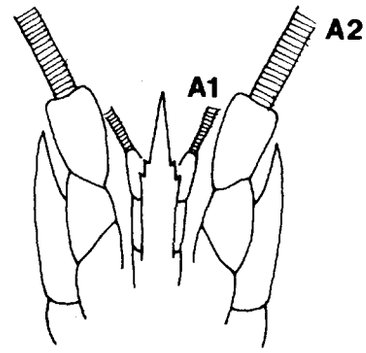


Fig. 31 - *Homarus hakelensis* (Fraas, 1878), cephalic appendages, line drawing.

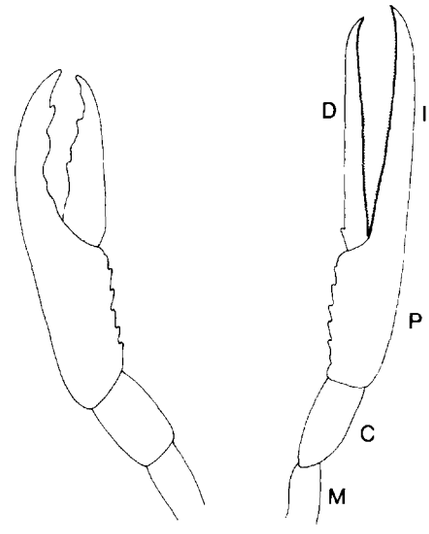


Fig. 32 - *Homarus hakelensis* (Fraas, 1878), first pair of pereiopods, line drawing.

Pereiopods II-III comprise thin elongate articula and they have small chelae with inner dactylus. Pereiopods IV-V are thin, elongate and with a terminal dactylus.

Abdominal appendages. The long multiarticulate flagella are evident only in the specimen MSNM i12238.

Genus *Pseudastacus* Oppel, 1861
Pseudastacus dubertreti Roger, 1946

1946 - *Pseudastacus dubertreti* - Roger, p. 40; pl. V, fig. 3.
1975 - *Paraclythia dubertreti* (Roger) - Pinna, p. 4, figs. 5-6.

Type locality: Hadjula.
Geological age: Cenomanian.
Material: 6 complete specimens, in a fairly poor state of preservation, 3 to 6 cm in length.
MSNM: i4452, i4453, i6046, i12156, i12267, i12303

Roger (1946), erected the species *P. dubertreti* on the basis of five poorly preserved specimens, which allowed only an incomplete description. Although the new specimens, can be assigned to Roger's species due to the carinate rostrum and the poorly heterochelous of the chelae of pereiopod I, they nevertheless do not allow a more detailed description of the species.

I think that the assignment of the examined specimens by Pinna (1975) to genus *Paraclythia* is not correct. In fact, some features such as the carinate rostrum, the poorly heterochelous of the chelae of pereiopod I and the lack of longitudinal carinae on the carapace assigne the specimens to the genus *Pseudastacus* and not to the genus *Paraclythia.*

Infraorder Palinura Latreille, 1803
Superfamily Palinuroidea Latreille, 1803
Family Palinuridae Latreille, 1802
Genus *Linuparus* White, 1847

Linuparus sp.
Pl. XII, figs. 1-3

Type locality: Hakel.
Geological age: Cenomonian.
Material: 4 complete specimens, in a fairly poor state of preservation.
MSNM: i6063, i6064, i10406, i12323

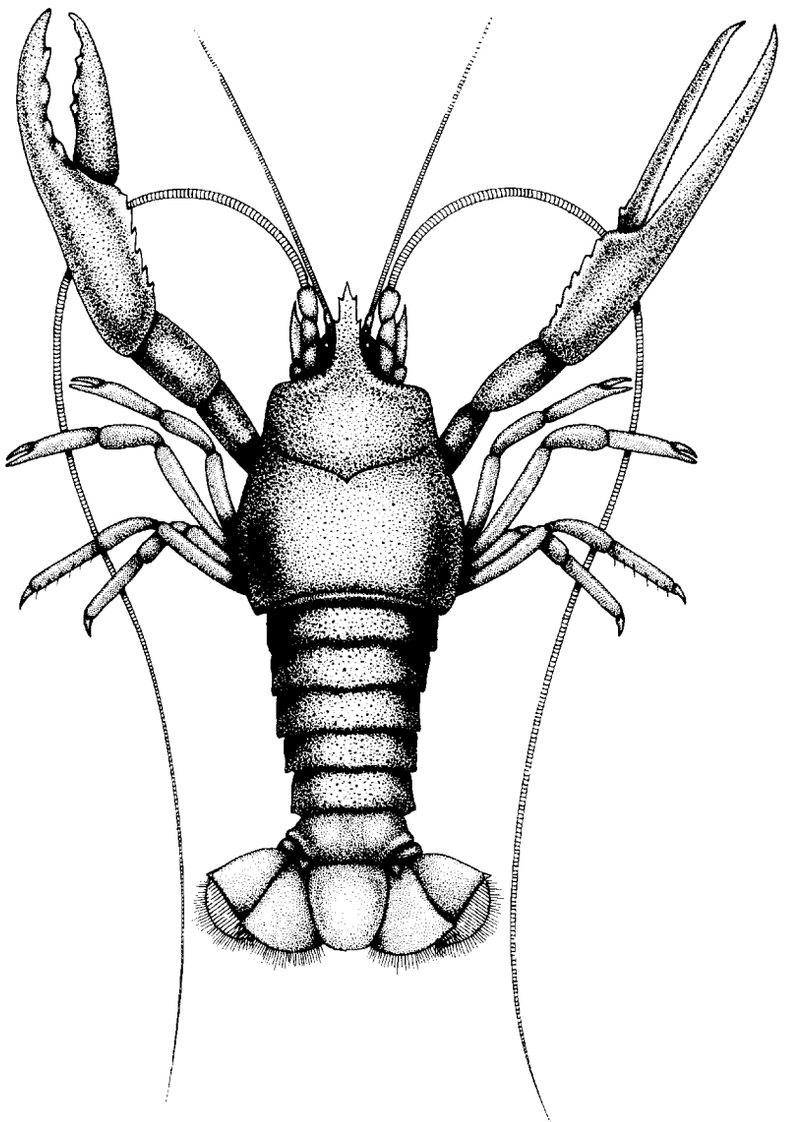


Fig. 33 - *Homarus hakelensis* (Fraas, 1878), reconstruction.

Description. Large elongate palinurid (the specimen MSNM i10406 has 20 cm in length), with thin finely tubercolate exoskeleton and 4 to 20 cm in length.

Carapace. In dorsal view, the carapace (Fig. 34) is subrectangular in outline and narrows slightly toward the cervical grooves, then it widens again toward the anterior margin. The posterior margin is forwardly arcuate and strengthened by a thin marginal ridge. The ocular incisions are large and shallow and two small spines form a prolungation of the margin. There is no rostrum. A median carina extends from the posterior margin to the deep cervical groove.

Abdomen. The abdomen is poorly preserved. The tergites are rectangular in outline and narrowing caudally. Only specimen MSNM i6063 preserves the exopodite with a diaeresis.

Cephalic appendages. The antennular peduncle comprises three segments: the 1st is thin and elongate, the 2nd and 3rd are short and stocky. The antennal peduncle consist of short and strong ischiocerite, merocerite and carpocerite. A flagellum as long as the body articulates to the carpocerite. The lateral margins of these articula bear a row of small spines and a spatula-shaped lamina (Fig. 35).

Thoracic appendages. The thoracic appendages are only partially preserved. All the pereiopods have a terminal dactylus and lack ornamentation. Their length is not assessed.

Abdominal appendages. The pleopods are not preserved.

Discussion

The examined specimens are assigned to the genus *Linuparus* White, 1847 because of the lack of a rostrum and the marked longitudinal median carina, ending at the cervical groove.

This genus, well represented in the Cretaceous, is known in the Turonian of France through the species *L. euthymei* (Roman & Nazeran, 1820). In the Senonian of Germany, Sweden and Bohemia occurs the species *L. dulmenensis* (Becks MS), (Geinitz, 1849), in Belgium the species *L. strailí* (Forir, 1887), in the State of Alberta (Canada) the species *L. cana-*

densis (Whiteaves, 1884) and finally in the Niobrara Group (South Dakota, USA) the species *L. atavus*, recently considered as synonymous with *L. canadensis*. Its presence is doubtfully recorded in the Aptian of the Isle of Wight and of England through *L. carteri* (Reed, 1911). It is signalled also in the Upper Cretaceous of Vancouver Islands and of Hornby (Canada) through *L. vancouverensis* (Whiteaves, 1895), in Seymour Islands (Antarctic) through *L. macellarii* Tshudy & Feldmann, 1988, in New Jersey and Delaware through *L. richardsi* Roberts, 1962, in Montana through *L. pustolosus* Feldmann, Bishop & Kammer, 1977, in Texas through *L. tarrantensis* Davidson, 1963 and in Jugoslavia through *L. petkovici* Bachmayer & Markovic, 1955. Finally the species *L. bererensis* Secretan, 1964 in the Santonian-Campanian and the subspecies *L. bererensis multispinosus* Secretan, 1964 in the Campanian have been signalled, both from the NW of Madagascar.

In the seas of today the genus *Linuparus* is represented by the species *L. trigonus* from Japan, *L. sordidus* from the South China sea and *L. somniosus* from the western Indian Ocean and Mozambique.

The poor state of presevation of the esamined material hindered a specific assignment of the specimens.

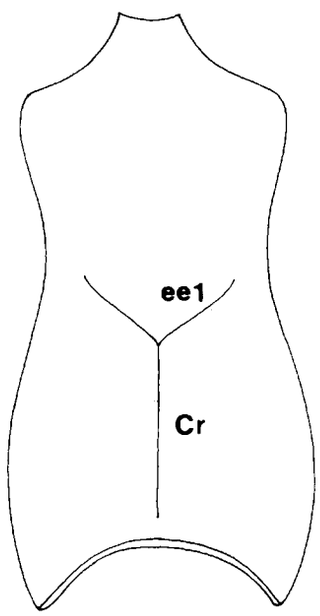


Fig. 34 - *Linuparus* sp., carapace reconstruction in dorsal view, line drawing.

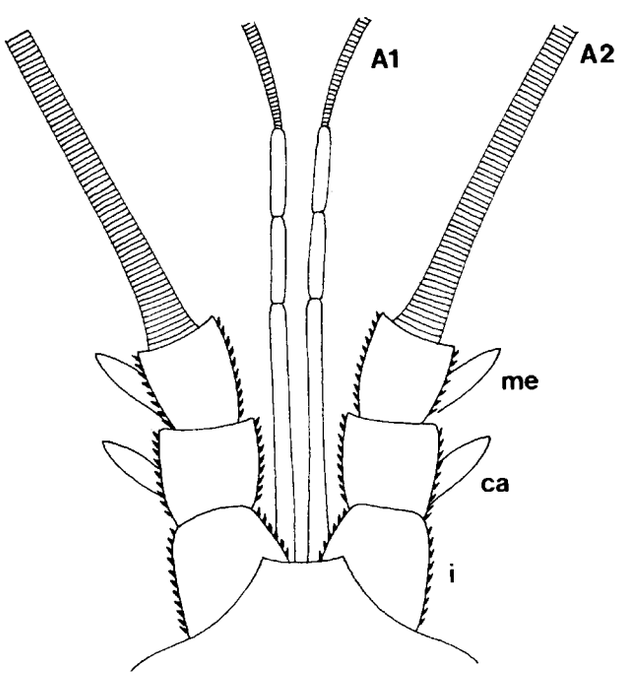


Fig. 35 - *Linuparus* sp., cephalic appendages, line drawing.

Genus *Palinurus* Weber, 1795

Palinurus sp.

Pl. XII, fig. 4; Pl. XIII, figs. 1-3

Type locality: Hakel.

Geological age: Cenomanian.

Material: 15 specimens, mostly complete, in a fairly poor state of preservation. The specimens are preserved laterally compressed (8) and dorsoventrally flattened (7).

MSNM: i6014, i6018, i6035, i6042, i6045, i12152, i12169, i12179, i12244, i12245, i12249, i12253-i12318, i12506, i12566, i12635

Description. Large elongate palinurid (the specimen MSNM i6014 has 15 cm in length), with thin strongly tubercolate exoskeleton and 1.5 to 15 cm in length.

Carapace. In dorsal view, the carapace (Fig. 36) is subrectangular in outline and narrows slightly toward the cervical grooves, then it widens again toward the anterior margin. The posterior margin is forwardly arcuate and strengthened by a thin marginal ridge. The ocular incisions are narrow and shallow and two marked spines form a prolungation of the margin. No rostrum is evident. Two weak longitudinal lateral carinae end at the very deep cervical groove.

Abdomen. The abdomen is poorly preserved. The tergites are rectangular in outline and narrowing caudally. The tail fan is poorly preserved: the exopodite with a diaeresis is evident only in two specimens (MSNM: i6018, i12169).

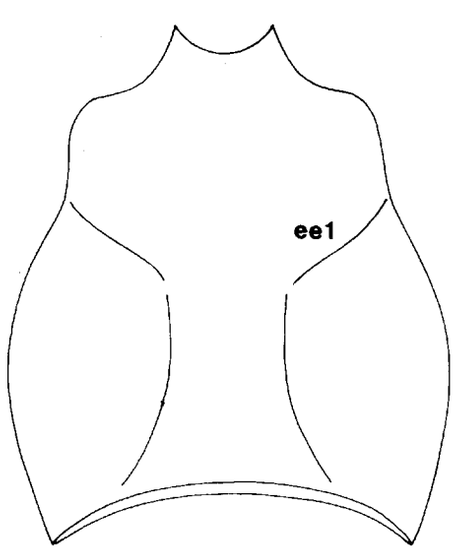


Fig. 36 - *Palinurus* sp., carapace reconstruction in dorsal view, line drawing.

Cephalic appendages. The antennular peduncle comprises three segments: the 1st is thin and elongate, the 2nd and 3rd are short and stocky; the length of the flagellum is half that of the antennal flagellum. The antennal peduncle consists of short and strong ischiocerite, merocerite and carpocerite. A flagellum as long as the body articulates to the carpocerite. The lateral margins of the articula bear a spatula-shaped lamina (Fig. 37).

Thoracic appendages. Pereiopods I-V have a long and strong terminal dactylus (MSNM: i6045, i12152, i12635). The surface of pereiopods is finely tuberculate.

Abdominal appendages. The pleopods are not preserved.

Discussion

The examined specimens have a subrectangular carapace and the longitudinal lateral carinae end at the very deep cervical groove. This combination of features is enough to ascribe them to the genus *Palinurus* Weber, 1795.

This genus is recorded from the Turonian of Bohemia through the species *P. woodwardi* Fritsch, 1887 and from the Senonian of Germany through the species *P. baumbergicus* Schlüter, 1862. *P. desmaresti* de Zigno, 1915 is the only species from the Tertiary, collected in the Lutetian (Middle Eocene) of Veneto.

At present the genus *Palinurus* is represented by the species *P. longimanus*, *P. truncatus* and *P. vulgaris*, geographically limited to the Atlantic Ocean and the species *P. gilchristi*, limited to the south-east coast of South Africa (George & Main (1967)).

The poor state of preservation of the examined material hindered a specific assignment of the specimens.

Family Scyllaridae Latreille, 1825
Genus *Palibacus* Förster, 1984

Palibacus praecursor (Dames, 1886)

1886 - *Ibacus praecursor* - Dames, p. 555; Tab. XIII, fig. 2.
1929 - *Ibacus praecursor* Dames - Glaessner, p. 225.
1945 - *Parribacus ? praecursor* (Dames) - Glaessner, p. 703.
1946 - *Ibacus praecursor* Dames - Roger, p. 38.
1984 - *Palibacus praecursor* (Dames) - Förster, p. 58; Tab. 1, figs. 1-6.

Type locality: Hakel.
Geological age: Cenomanian.
Material: 5 specimens, in a fairly poor state of preservation, four of which are incomplete and one has small size (2 cm).
MSNM: i8407, i8729, i10401, i12242, i12243

The examined specimens are assigned to this species on the basis of the cephalic appendages and of the system of grooves. Due to the incompleteness of the specimens, no new data are achived as compared to the description by Förster (1984).

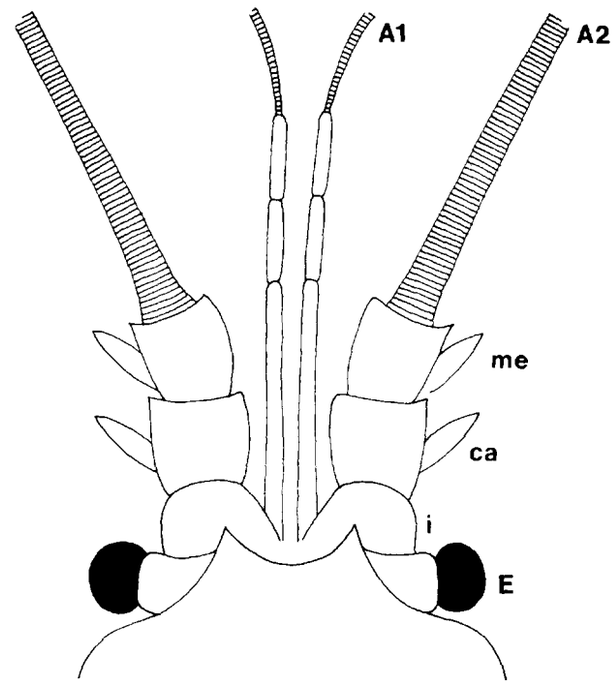


Fig. 37 - *Palinurus* sp., cephalic appendages, line drawing.

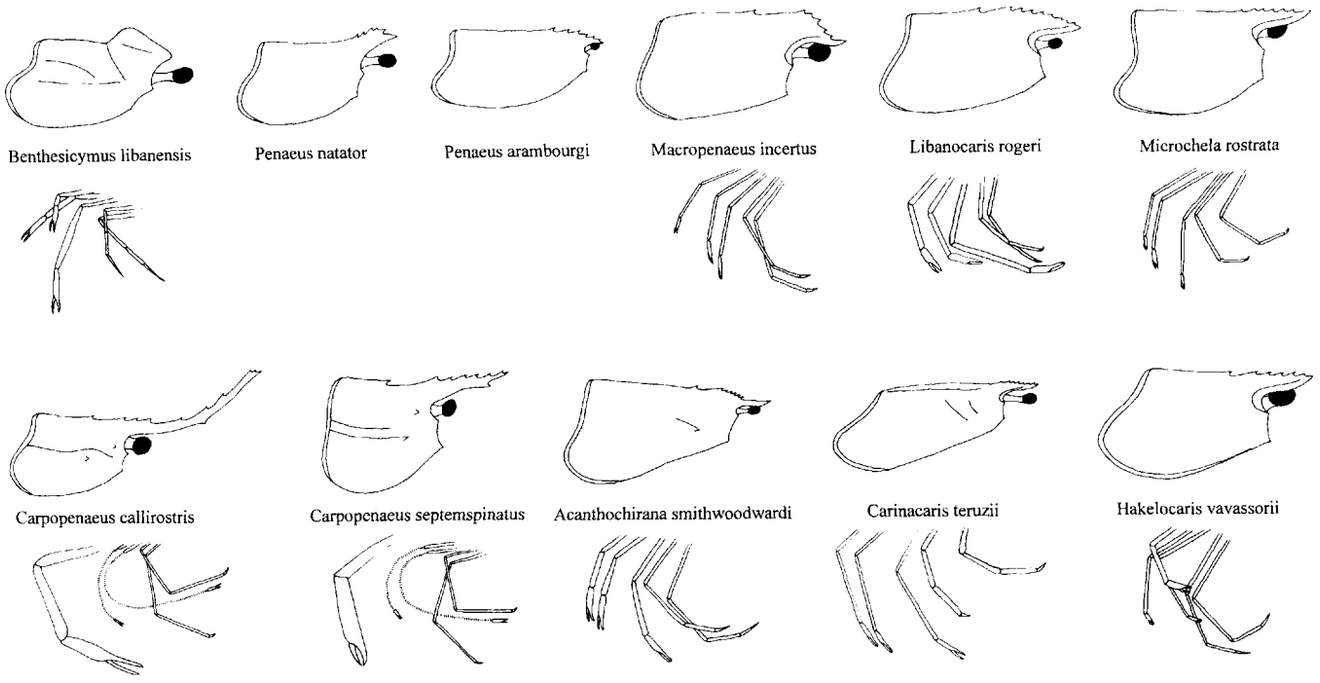
CONCLUSIONS

Up to twenty years ago knowledge of Mesozoic decapod crustaceans was mostly limited to a few classic sites: Grès à Voltzia (Schythian; Vosges, France), Lyme Regis (Sinemurian; West Country, England), Holzmaden (Toarcian; Baden-Württemberg, Germany) and the important faunal assemblages of Solnhofen and Eichstätt (Kimmeridgian; Bavaria, Germany) and Lebanon (Cenomanian).

Additional data were recently obtained with the discovery of Triassic lagerstätten of Norian age from Northern Italy: Cene (Seriana Valley, Bergamo province, Pinna (1974)); Prati di Rest (Valvestino, Brescia province, D'Aversa (1974) and Pinna (1976)); Val Preone (Udine province, Dalla Vecchia (1991), Garassino et alii (work in progress)), and Norian-Rhaetian age: Ponte Giurino (Imagna Valley, Bergamo province, Garassino & Teruzzi (1993)). Moreover, excavations organized by the Museo di Storia Naturale di Milano led to a more detailed description of decapod crustaceans from Lower Triassic of NW Madagascar (Garassino & Teruzzi, in press), already cited by Van Straelen (1933), considered to be the most ancient, significant decapod assemblage known to date, since the attribution to decapod crustaceans of the species *Palaeopalaemon newberryi* Whitfield, 1880 from Upper Devonian of North America (Schram, Feldmann & Copeland (1978)), known only by few specimens, is still discussed (see for instance Felgenhauer & Abele (1983)).

Finally, the description of the Sinemurian species from Osteno (SW Lugano Lake, N. Italy, Pinna (1968, 1969), Garassino & Teruzzi (1990), Teruzzi (1990) and Garassino, in press), further increased our knowledge about this group of crustaceans.

Table IV - Summarizing table of penaeid species preserved in Lebanese outcrops.



The Lebanese fauna, the richest decapod macrurous crustacean association of the Cretaceous in both abundance and diversity, presents a mixing of «old» taxa, typical of the Jurassic faunas, and of «new» taxa, which will further characterize Tertiary decapod fauna. Its novelty is evidence by all represented infraorders.

Penaeids in the general shape of the body and the structure of pereiopods I-III, show links with modern forms. For what concerning pereiopods I-III, Triassic and Jurassic penaeids have pereiopods I-III with long and robust chelae; besides, they have small pleopods. This may indicate that most Triassic and Jurassic penaeids led an essentially epibenthonic way of life.

In contrast, the long pleopods and above all pereiopods I-III with short and extremely thin chelae indicate that the Lebanese penaeids were probably pseudonectonic forms, like as living ones. Only the species *C. callirostris* Glaessner, 1945 and *C. septemspinatus* (Dames, 1886) that have pereiopod I extremely elongated with a robust chela and small pleopods led probably an epibenthonic life. Another difference between Triassic-Jurassic forms and Lebanese ones is given by the less marked grooves on the carapace of the latter.

To the infraorder Astacidea Latreille, 1803 belong, on the one hand, the mesozoic genus *Eryma* von Meyer, 1840, well represented in the Jurassic of Osteno and Solnhofen, and, on the other hand, the living genus *Homarus* Weber, 1795. The infraorder Palinura Latreille, 1803 also includes genera with moder representatives, such as *Palinurus* Weber, 1795, *Linuparus* White, 1847 and *Palibacus* Förster, 1984. In contrast, the dominant palinurids from Upper Triassic to Upper Jurassic, such as the glypheids, the mecochirids and the eryonoids, are no longer present, probably replaced in their ecologic niches by the radiating brachyuran decapods.

Brachyuran decapods are in fact well represented in this fauna, with the genera *Lophoraninella* Glaessner, 1945, *Geryon* Kröyer, 1837, *Portunus* Weber, 1795, and *Paranecrocarcinus* Van Straelen, 1936; all these genera appear for the first time and are already abundant and diverse (Glaessner (1945), Roger (1946) and Förster (1968)), prefiguring the great development of brachyurans among benthic decapod crustaceans.

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REFERENCES

BACHMAYER F. & MARKOVIC B., 1955 - Ein bemerkenswerter crustaceen-fund: *Linuparus petkovici* nov. spec. aus kreideschichten von Jugoslawien. *Zborn. Radova geol. Inst. Beograd.,* Belgrado, 8: 383-392

BALSS H., 1922 - Studien an fossilen Decapoden. *Paläont. Zeitschr.,* 5(I): 123-147

BLANKENHORN M., 1914 - Syrien, Arabien und Mesopotamien. *Hand. der Reg. Geol.,* Heidelberg, Bd. 5, Abt 4

BOTTA P. E., 1833 - Observations sur le Liban et l'Anti-Liban. *Mém. Soc. Geol. Fr.,* Paris, I: 135-160

BROCCHI P., 1875 - Note sur une nouvelle espèce de Crustacé fossile (*Penaeus libanensis*). *Bull. Soc. Geol. Fr.,* Paris, 3: 609-610

BRUGNOLI GIOFFREDI L., MONECHI S. & PINNA G., 1975 - I Crostacei Decapodi del Cretacico superiore del Libano della collezione del Museo Civico di Storia Naturale di Milano. *Natura Soc. it. Sci. Nat., Museo civ. St. nat. e Acquario civ.,* Milano, 66(1-2): 3-12

DALLA VECCHIA F. M., 1991 - Note sulla stratigrafia, sedimentologia e paleontologia della Dolomia di Forni (Triassico superiore) nella Valle del Rio Seazza (Preone, Friuli-Venezia Giulia). *Gortania,* Udine, 12: 7-30

D'AVERSA A., 1974 - Crostacei decapodi fossili ai Prati di Rest. Catalogo dei reperti e tentativo di classificazione. *«Natura Bresciana» Ann. Mus. Civ. St. Nat.,* Brescia, 11: 107-137

DAMES W., 1886 - Ueber eininge Crustaceen aus den Kreidablagerungen des Libanon. *Zeitsch. deut. geol. Gesells.,* Berlin, 38: 551-575

DAVIDSON E., 1963 - New Linuparid Crustaceans from the Upper Cretaceous of Texas. *Bull. Amer. Paleont.,* New York, 46 (206): 69-77

DOUVILLÉ H., 1910 - Etude sur les Rudistes (Rudistes du Liban). *Mém. Soc. Géol. Fr.,* Paris, 41: 52-75

DUBERTRET L., 1959 - Contribution à la stratigraphie et à la paléontologie du Crétacé et du Nummulitique de la marge N.W. de la pénisule arabique. *Notes et Mém. Moyen-Orient.,* Paris, 7: 193-220

DUBERTRET L., 1966 - Liban, Syrie et bordure de pays voisins. Première partie: tableau stratigraphique. *Notes et Mém. Moyen-Orient.,* Paris, 8: 249-358

DUBERTRET L. & VAUTRIN F., 1937 - Révision de la stratigraphie du Crétacé du Liban. *Notes et Mém. Ht. Comm. Syrie et Liban,* Paris, 2: 43-73

EJEL F. & DUBERTRET L., 1966 - Sur l'age précis du gisement de poissons et de crustacés crétacés de Sahel Alma (Liban). *C. R. Somm. Soc. géol. Fr.,* Paris, 9: 353-354

FELDMANN R. M., BISHOP G. A. & KAMER T.W., 1977 - Macrurous decapods from the Bearpaw Shale (Cretaceous: Campanian) of Northeastern Montana. *J. Pal.,* 51(6): 1161-1180

FELGENHAUER B. E. & ABELE L. G., 1983 - Phylogenetic relationships among shrimp-like decapods. *Crustacean Issues,* Rotterdam, 1: 291-311

FÖRSTER R., 1967 - Zur kenntnis natanter Jura-Dekapoden. *Mitt. Bayer. Staatssamml. Paläont. hist. Geol.,* München, 7: 157-174

FÖRSTER R., 1968 - *Paranecrocarcinus libanoticus* n.sp. (Decapoda) und die Entwicklung der Calappidae in der Kreide. *Mitt. Bayer. Staatssamml. Paläont. hist. Geol.,* München, 8: 167-195

FÖRSTER R., 1984 - Bärenkrebse (Crustacea, Decapoda) aus dem Cenoman des Libanon und dem Eozän Italiens. *Mitt. Bayer. Staatsslg. Paläont. hist. Geol.,* München, 24: 57-66

FRAAS O., 1878 - Geologische aus dem Libanon. *Jahresh. d. Ver. f. vaterl. Naturk. in Württemberg,* Stuttgart, 34: 257-391

GARASSINO A., (in press) - The family Erymidae Van Straelen, 1924 and the superfamily Glypheoidea Winckler, 1883 in the Sinemurian of Osteno in Lombardy (Crustacea, Decapoda). *Atti Soc. it. Sci. Nat. Milano,* Milano

GARASSINO A. & TERUZZI G., 1990 - The genus *Aeger* Münster, 1839 in the Sinemurian of Osteno in Lombardy (Crustacea, Decapoda). *Atti Soc. it. Sci. Nat. Milano,* Milano, 131(5): 105-136

GARASSINO A. & TERUZZI G., 1993 - A new decapod crustacean assemblage from the Upper Triassic of Lombardy (N. Italy). *Paleontologia Lombarda,* Milano, Nuova Serie, I

GARASSINO A. & TERUZZI G., (in press) - Studies on Permo-Trias of Madagascar. 3. The decapod crustaceans of the Ambilobé region (NW Madagascar). *Atti Soc. it. Sci. Nat. Milano,* Milano

GEORGE R.W. & MAIN A. R., 1967 - The evolution of Spiny Lobsters (Palinuridae): a study of evolution in the marine environment. *Evolution,* Chicago, 21(4): 803-820

GLAESSNER M., 1929 - Crustacea Decapoda. Fossilium catalogous. I. Animalia. Pars. 41, Berlin

GLAESSNER M., 1945 - Cretaceous Crustacea from Mount Lebanon, Syria. *Ann. Mag. nat. Hist.,* London, 12(11): 694-707

HEMLEBEN CHR. VON, 1977 - Rote Tiden und die oberkretazischen Plattenkalke im Libanon. *N. Jb. Geol. Paläont. Mh.,* Stuttgart, 4: 239-255

HOLTHUIS L. B., 1955 - The recent genera of the Caridean and Stenopodidean shrimps (Class Crustacea, Order Decapoda, Supersection Natantia) with keys for their determination. *Z. Ver.,* Leiden, 26-31: 1-157

HÜCKEL U., 1969 - Die kretazischen Fischschiefer-Vorkommen Haqel und Hjoula im Nord-Libanon (östlich Ibail). *Dipl. Arb.,* unveröff. Ms., Tübingen

HÜCKEL U., 1970 - Die Fischschiefer von Haqel und Hjoula in der Oberkreide des Libanon. *N. Jb. Geol. Paläont. Abh.,* Stuttgart, 135(2): 113-149

HÜCKEL U., 1974a - Vergleich des Mineralbestandes der Plattenkalke Solnhofens und des Libanon mit anderen Kalken. *N. Jb. Geol. Paläont. Abh.,* Stuttgart, 145(2): 153-182

HÜCKEL U., 1974b - Geochemischer Vergleich der Plattenkalke Solnhofens und des Libanon mit anderen Kalken. *N. Jb. Geol. Paläont. Abh.,* Stuttgart, 145(3): 279-305

JOINVILLE J. DE, 1248 - L'Histoire du roi Saint-Louis

LARTET L., 1869 - Essai sur la Géologie de la Palestine et des contrées avoisinantes telles que l'Egypte et l'Arabie. Premiere partie. Paris

OPPEL A., 1862 - Ueber jurassische Crustaceen. *Bayer. Staates. Paläont. Mitteil.,* Stuttgart, 1: 1-120

PÉREZ FARFANTE I., 1969 - Western Atlantic Shrimps of the Genus *Penaeus. Fishery Bulletin,* Washington, 67(3): 461-590

PETERS, 1861 - *Monats ber. Akad. Wiss. Berlin,* Berlin, 509

PINNA G., 1968 - Gli Erionidei della nuova fauna sinemuriana a crostacei decapodi di Osteno in Lombardia. *Atti Soc. it. Sci. Nat. Milano,* Milano, 107: 93-134

PINNA G., 1969 - Due nuovi esemplari di *Coleia viallii* Pinna, del Sinemuriano inferiore di Osteno in Lombardia (Crustacea, Decapoda). *Ann. Mus. St. nat. Genova,* Genova, 77: 626-632

PINNA G., 1974 - I crostacei della fauna triassica di Cene in Val Seriana (Bergamo). *Mem. Soc. it. Sci. Nat. Museo Milano,* Milano, XXI(1): 5-34

PINNA G., 1976 - I crostacei triassici dell'Alta Valvestino (Brescia). *«Natura Bresciana» Ann. Mus. Civ. St. Nat.,* Brescia, 13: 33-42

ROBERTS H. B., 1962 - The Upper Cretaceous decapod crustaceans of New Jersey and Delaware. In: RICHARDS H. G. et alii. The Cretaceous fossils of New Jersey. *Bull. N. J. Div. Geol.,* 61: 163-192

ROGER J., 1946 - Les invertébrés des couches a poissons du Crétacé supérieur du Liban. *Mém. Soc. Géol. Fr.,* Paris, 23: 1-92

SAINT-MARC P., 1974 - Etude stratigraphique et micropaléontologie de l'Albien, du Cenomanien et du Turonien du Liban. *Notes et Mém. Moyen-Orient.,* Paris, 13: 8-342

SCHLÜTER H. C. VON, 1872 - Die Macruren Decapoden der Senon- und Cenomanian-Bildugen Westphalens. *Zeit. D. Geol. Gesell.,* Berlin, 14: 702-749

SCHRAM F. R., FELDMANN R. M. & COPELAND M. J., 1978 - The late Devonian Palaeopalaemonidae and the earliest Decapod Crustaceans. *J. Pal.,* 52(6): 1375-1387

SECRETAN S., 1964 - Les crustacés décapodes du Jurassique supérieur et du Crétacé de Madagascar. *Mém. Mus. Nat. Hist. Nat.,* Paris, 14: 1-224

STRAND E., 1926 - Miscellanea nomenclatoria zoologica et palaeontologica. I-II. *Arch. Naturgesch.,* Berlin, 92A, Hft 8: 40-41

TERUZZI G., 1990 - The genus *Coleia* Broderip, 1835 (Crustacea, Decapoda) in the Sinemurian of Osteno in Lombardy. *Atti Soc. it. Sci. Nat. Milano,* Milano, 131(4): 85-104

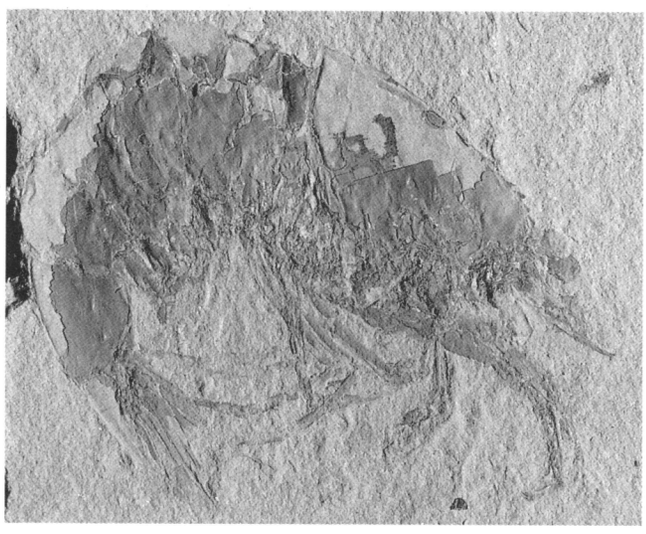
TSHUDY D. M. & Feldmann R. M., 1988 - Macruran decapods and their epibionts from the Lopez de Bertodano Formation (Upper Cretaceous). Seymour Island, Antarctica. *Geol. Soc. Am. Mem.,* 169: 291-301

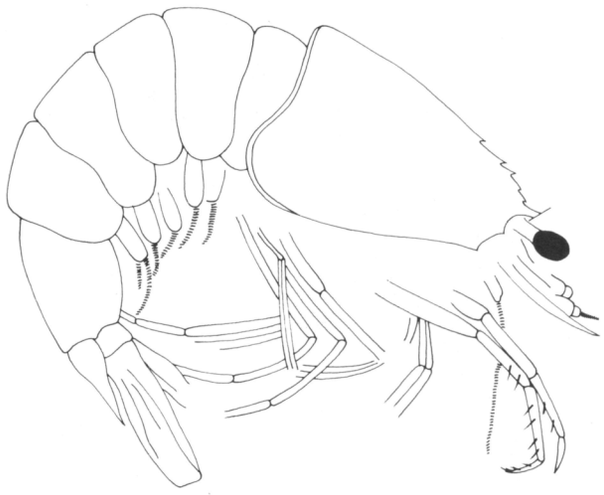
VAN STRAELEN V., 1930 - Sur des Crustacés Décapodes Natantia de la Période Crétacique. *Bull. Mus. Hist. nat. Bel.,* Bruxelles, 6(8): 1-8

VAN STRAELEN V., 1933 - *Antrimpos madagascariensis* Crustace Decapode du Permotrias de Madagascar. *Bull. Mus. Hist. nat. Bel.,* Bruxelles, 9(15): 1-3

VAN STRAELEN V., 1940 - Pénéides nouveaux Méso- et Cénozoiques. *Bull. Mus. Hist. nat. Bel.,* Bruxelles, 16(8): 1-5

ZUMOFFEN G., 1926 - Géologie du Liban. Paris





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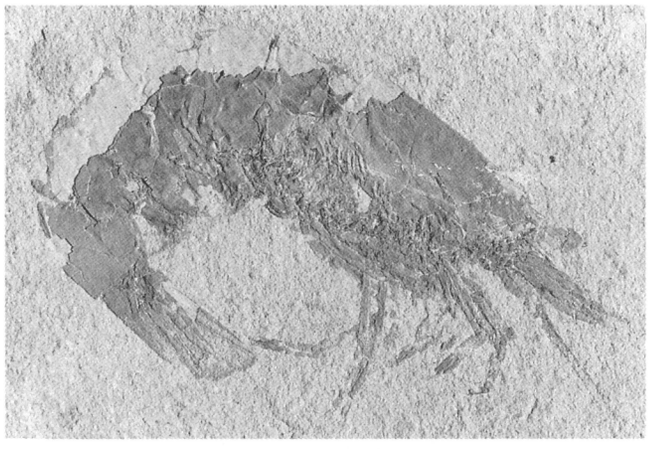

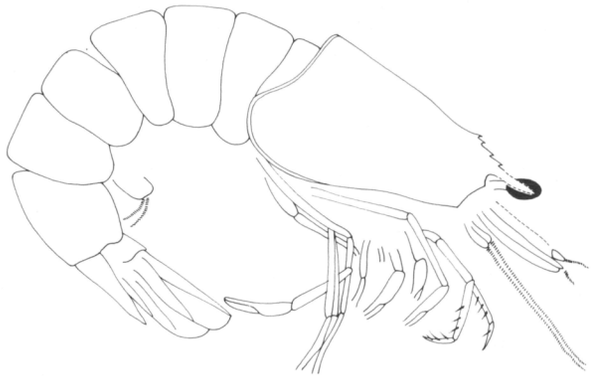

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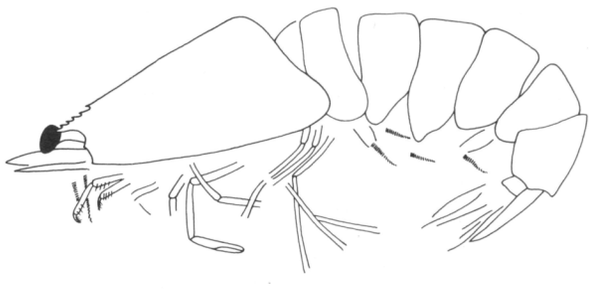

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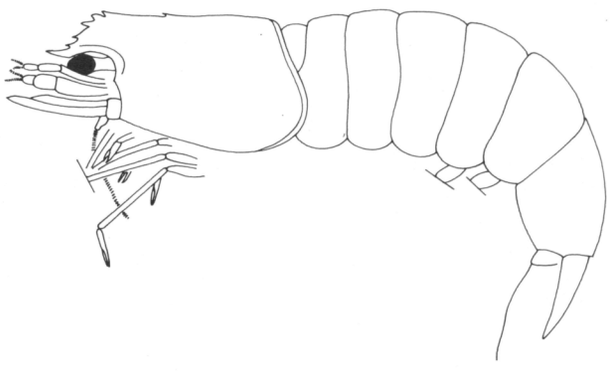

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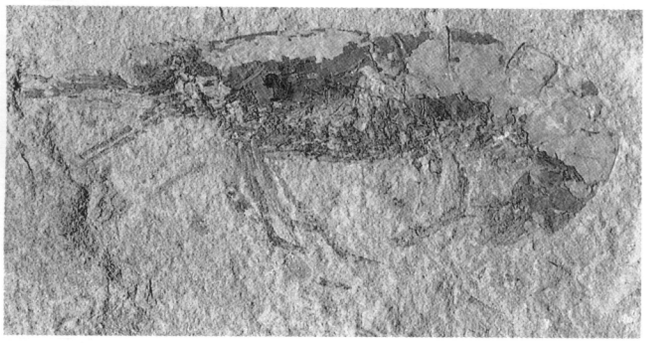
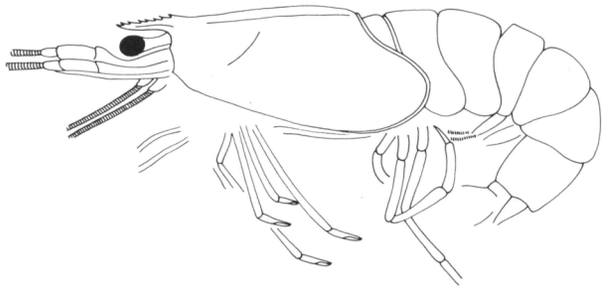
Plate I - 1) *Acanthochirana smithwoodwardi* (Van Straelen, 1940), n.cat. MSNM i12241, photo and reconstruction (x 2); 2) *Acanthochirana smithwoodwardi* (Van Straelen, 1940), n.cat. MSNM i12360, photo and reconstruction (x 2); 3) *Acanthochirana smithwoodwardi* (Van Straelen, 1940), n.cat. MSNM i12394, photo and reconstruction (x 1.6); 4) *Macropenaeus incertus* (Roger, 1946), n.cat. MSNM i12148, photo and reconstruction (x 1).





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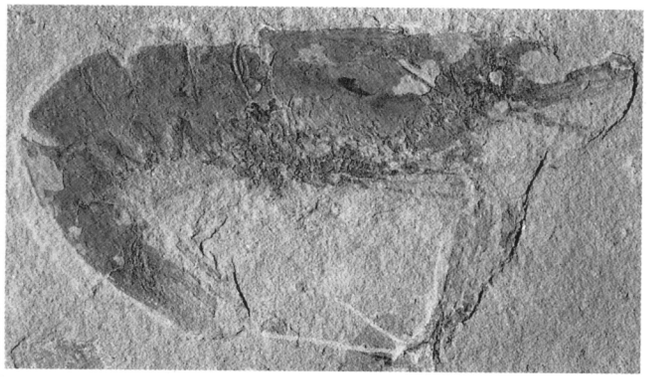

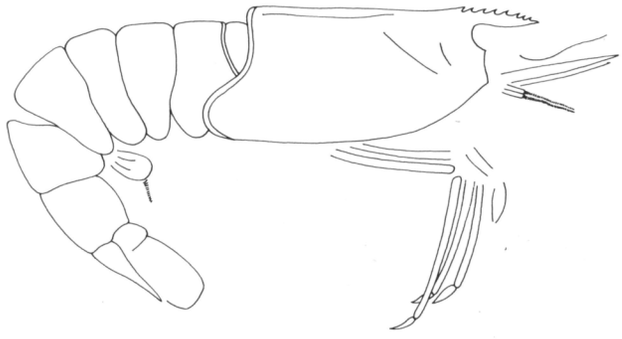

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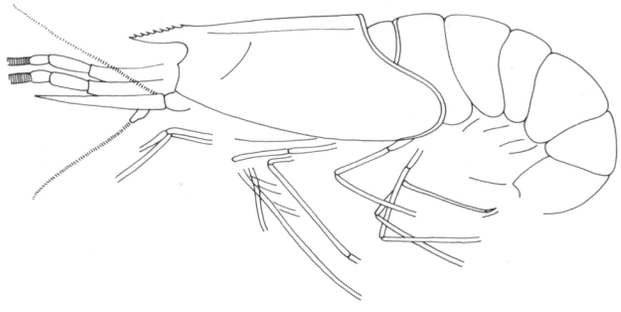

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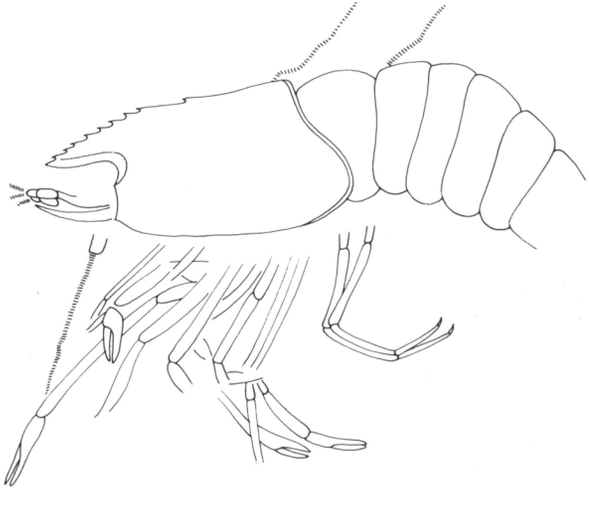

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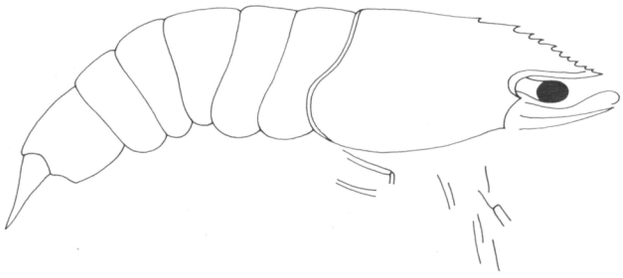
Plate II - 1) Carinacaris teruzzii n.gen. n.sp., holotype, n.cat. MSNM i12589, photo and reconstruction (x 1.4); 2) Carinacaris teruzzii n.gen. n.sp., n.cat. MSNM i12587, photo and reconstruction (x 2); 3) Carinacaris teruzzii n.gen. n.sp., n.cat. MSNM i12588, photo and reconstruction (x 1.5; 4) Libanocaris rogeri n.gen. n.sp., holotype, n.cat. MSNM i12555, photo and reconstruction (x 2.6).



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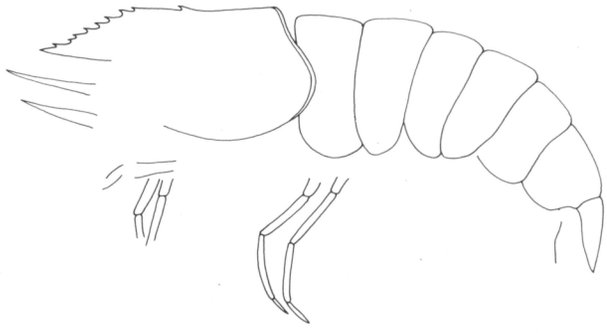

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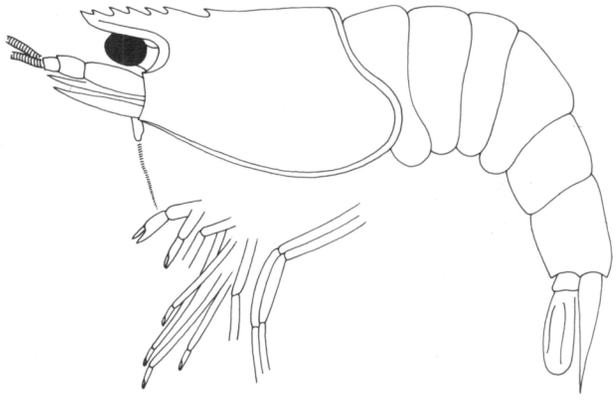

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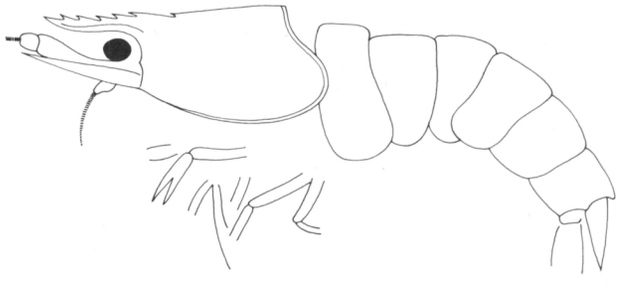

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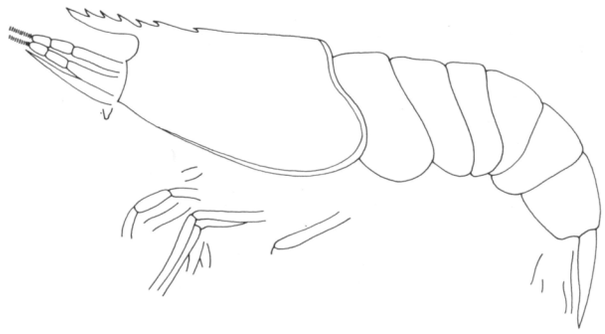
Plate III - 1) *Libanocaris rogeri* n.gen. n.sp., n.cat. MSNM i10396, photo and reconstruction (x 1.5); 2) *Libanocaris rogeri* n.gen. n.sp., n.cat. MSNM i12390, photo and reconstruction (x 1.8); 3) *Hakelocaris vavassorii* n.gen. n.sp., holotype, n.cat. MSNM i12248, photo and reconstruction (x 2.9); 4) *Hakelocaris vavassorii* n.gen. n.sp., n.cat. MSNM i12239, photo and reconstruction (x 2.2).



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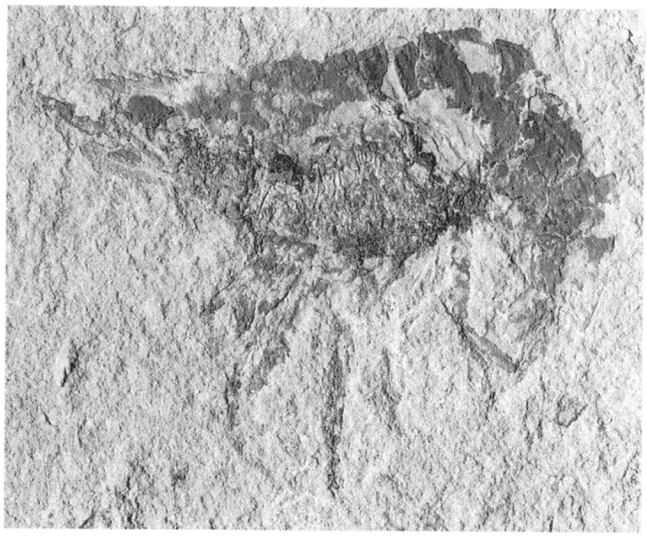

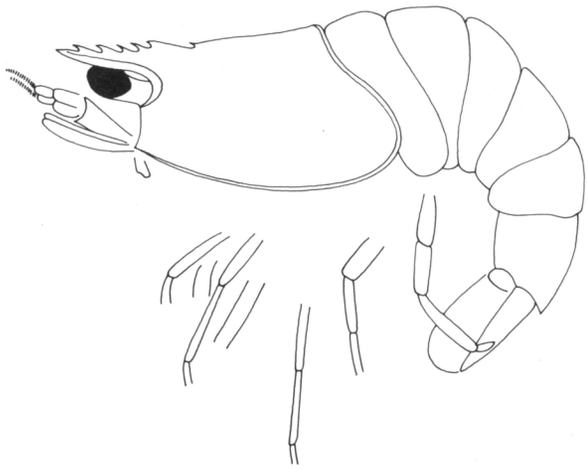

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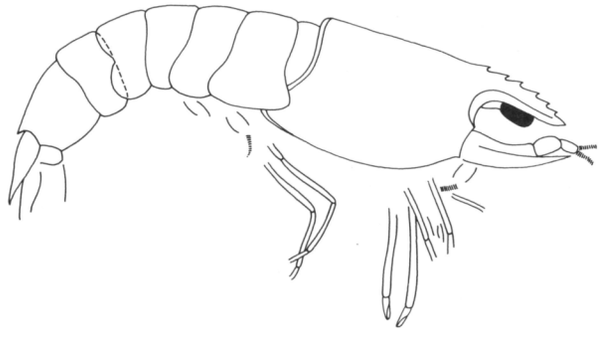

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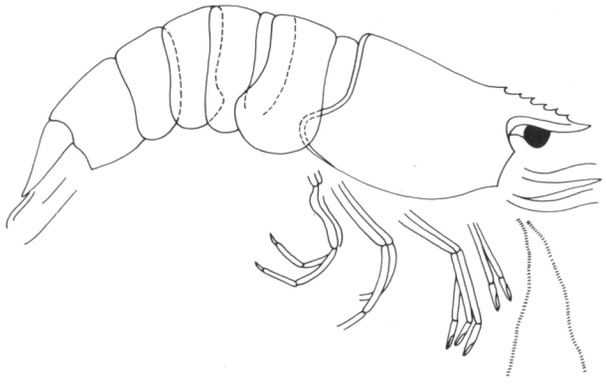

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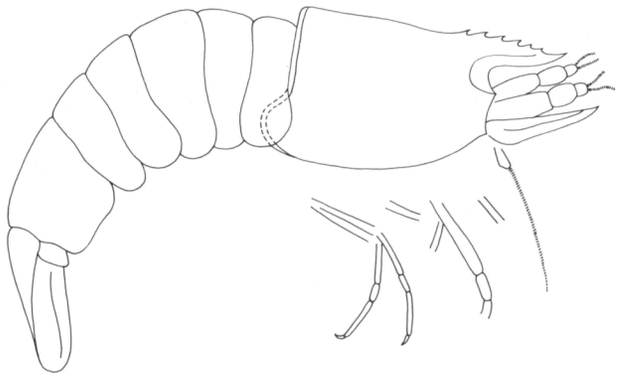
Plate IV - 1) *Hakelocaris vavassorii* n.gen. n.sp., n.cat. MSNM i12333, photo and reconstruction (x 2); 2) *Hakelocaris vavassorii* n.gen. n.sp., n.cat. MSNM i12531, photo and reconstruction (x 2.7); 3) *Microchela rostrata* n.gen. n.sp., holotype, n.cat. MSNM i12518, photo and reconstruction (x 1.2); 4) *Microchela rostrata* n.gen. n.sp., n.cat. MSNM i12340, photo and reconstruction (x 1.5).



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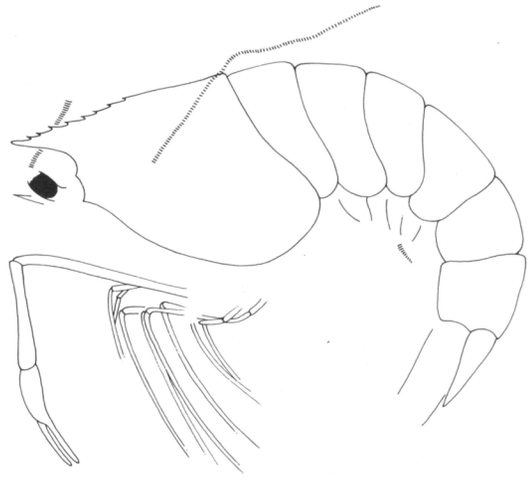

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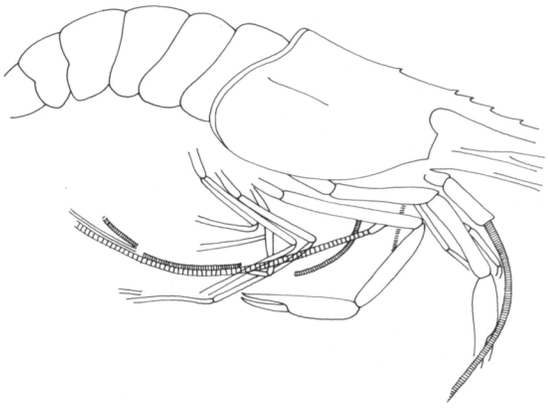

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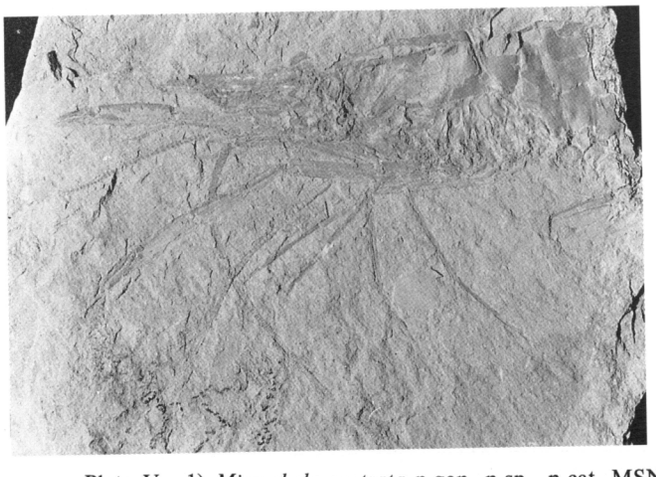

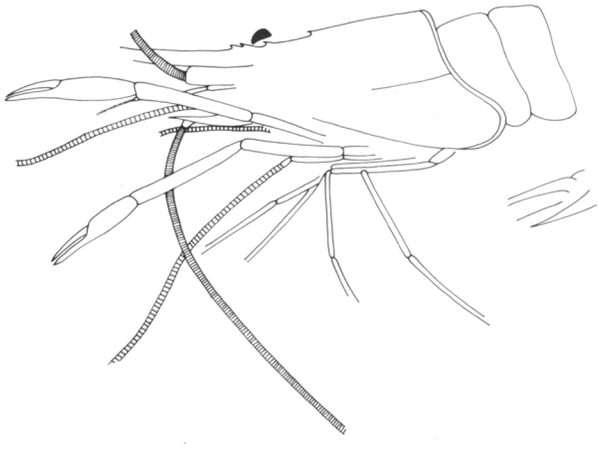

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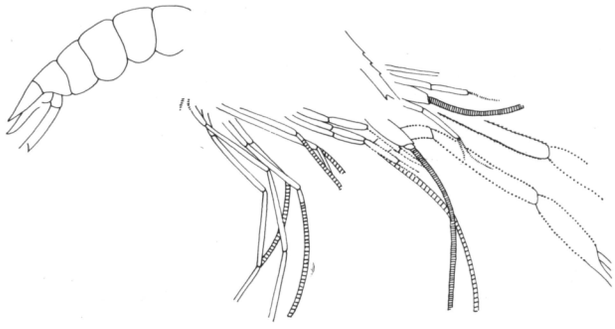
Plate V - 1) *Microchela rostrata* n.gen. n.sp., n.cat. MSNM i12350, photo and reconstruction (x 2.5); 2) *Indeterminate penaeid,* n.cat. MSNM i12523, photo and reconstruction (x 3.1); 3) *Carpopenaeus callirostris* Glaessner, 1945, n.cat. MSNM i12501, photo and reconstruction (x 1); 4) *Carpopenaeus callirostris* Glaessner, 1945, n.cat. MSNM i6021, photo and reconstruction (x 1).



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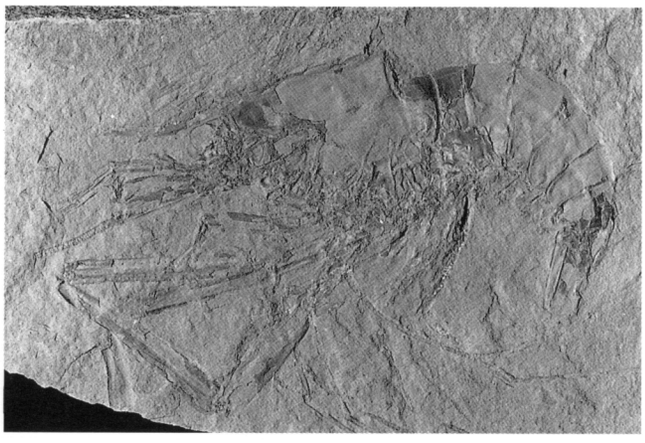

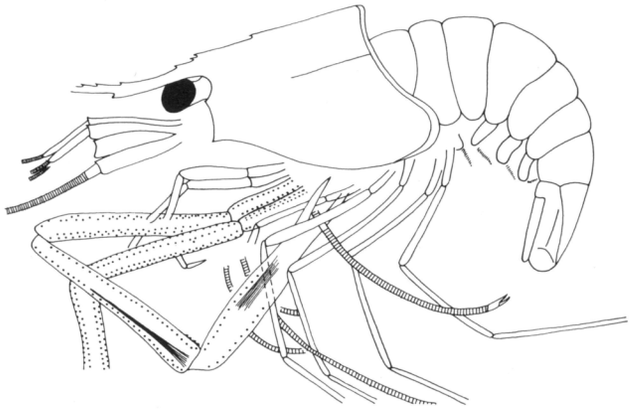

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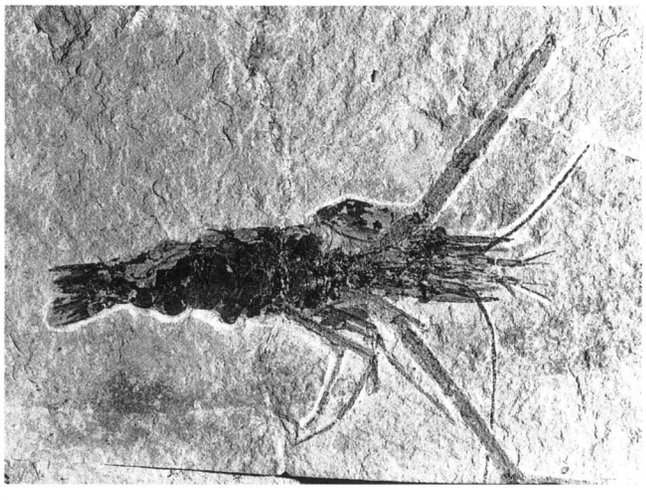

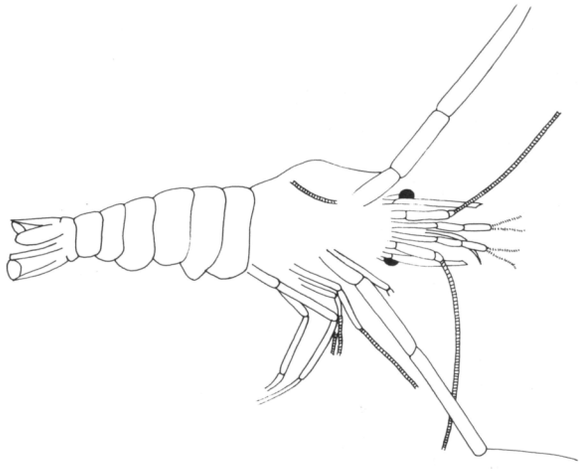

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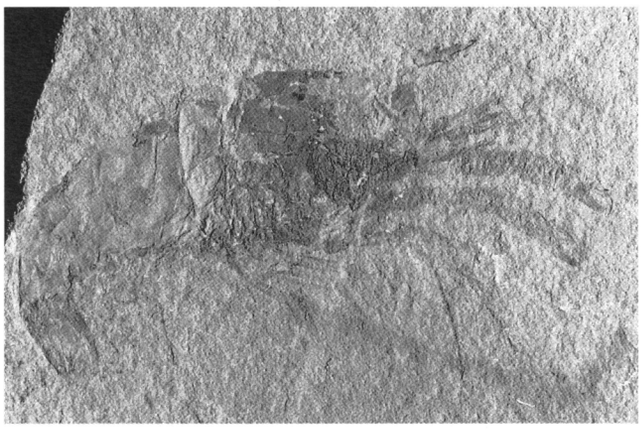
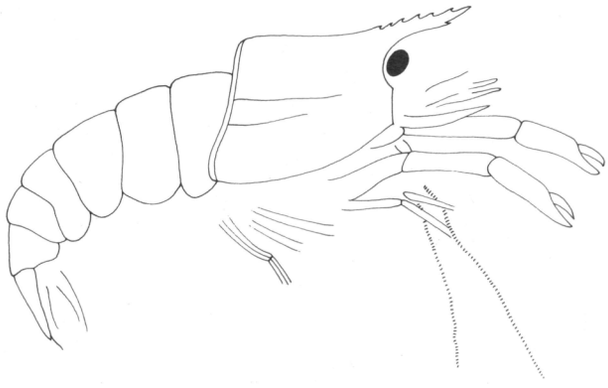
Plate VI - 1) *Carpopenaeus callirostris* Glaessner, 1945, n.cat. MSNM i6031, photo and reconstruction (x 1.2); 2) *Carpopenaeus callirostris* Glaessner, 1945, n.cat. MSNM i12322, photo and reconstruction (x 1.1); 3) *Carpopenaeus callirostris* Glaessner, 1945, n.cat. MSNM i13524, photo and reconstruction (x 1.8); 4) *Carpopenaeus septemspinatus* (Dames, 1886), holotype, MB.A. 215 (K66), photo and reconstruction (x 1.2).





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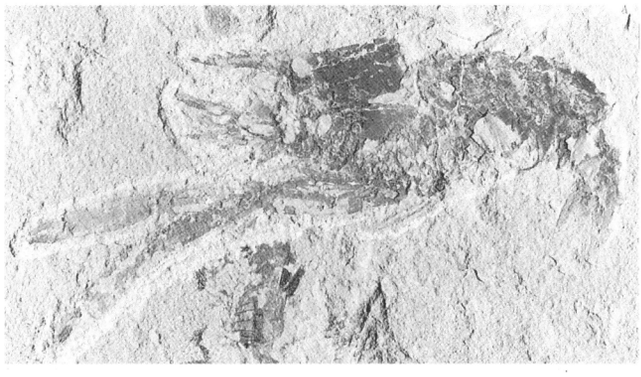

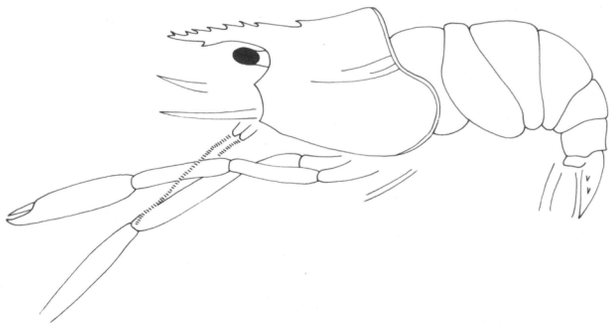

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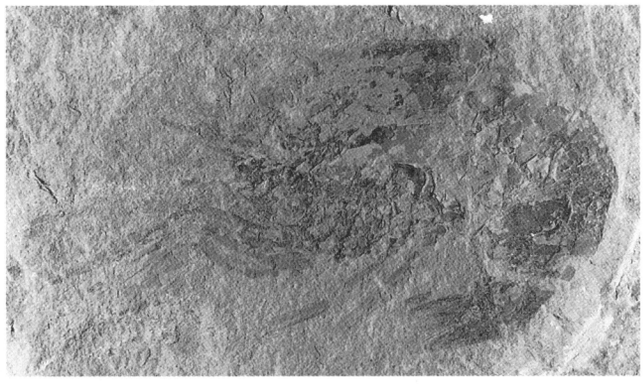

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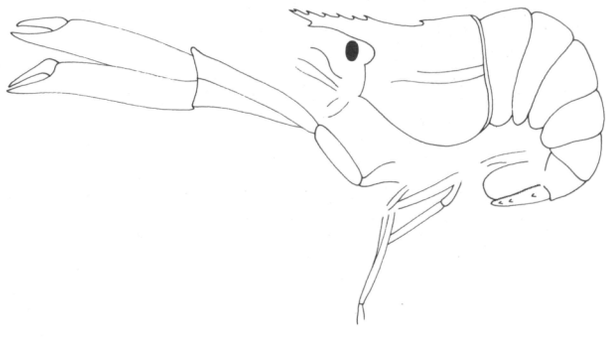

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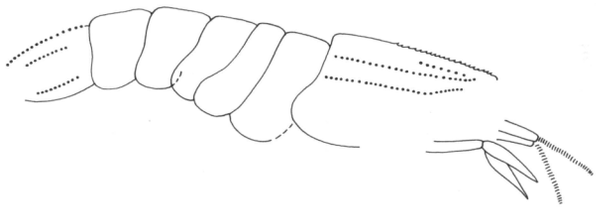
Plate VII - 1) *Carpopenaeus septemspinatus* (Dames, 1886), n.cat. MSNM i12544, photo and reconstruction (x 2.5); 2) *Carpopenaeus septemspinatus* (Dames, 1886), n.cat. MSNM i12320, photo and reconstruction (x 1.8); 3) *Carpopenaeus septemspinatus* (Dames, 1886), n.cat. MSNM i12263, photo and reconstruction (x 1.4); 4) *Carpopenaeus septemspinatus* (Dames, 1886), n.cat. MSNM i12324, photo and reconstruction (x 1.3).



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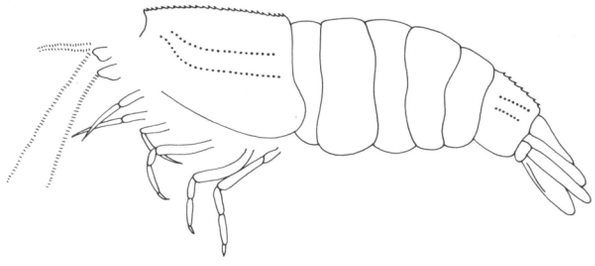

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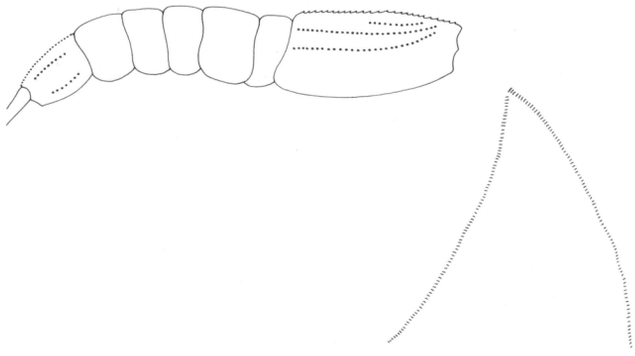

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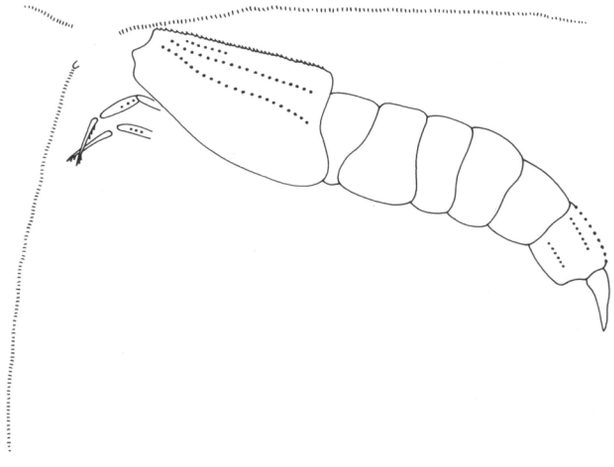

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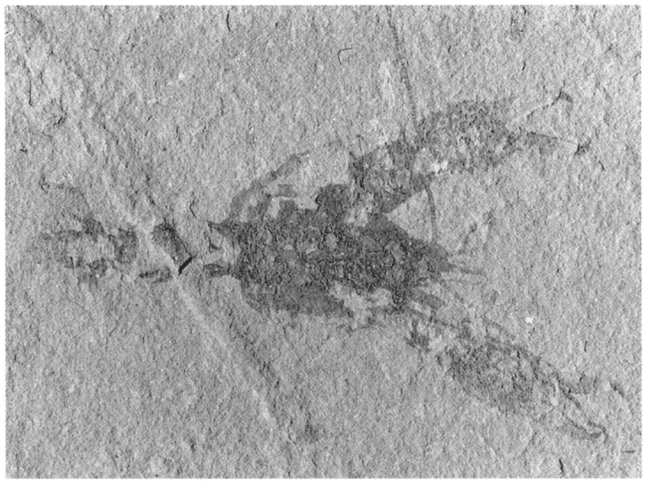
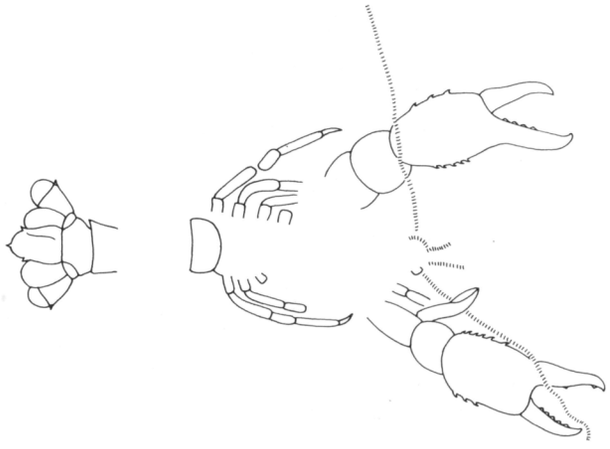
Plate VIII - 1) *Odontochelion cretaceum* (Roger, 1946), n.cat. MSNM i12590, photo and reconstruction (x 2.5); 2) *Odontochelion cretaceum* (Roger, 1946), n.cat. MSNM i12530, photo and reconstruction (x 2.4); 3) *Odontochelion cretaceum* (Roger, 1946), n.cat. MSNM i12568, photo and reconstruction (x 2.4); 4) *Odontochelion cretaceum* (Roger, 1946), n.cat. MSNM i12558, photo and reconstruction (x 2.7).





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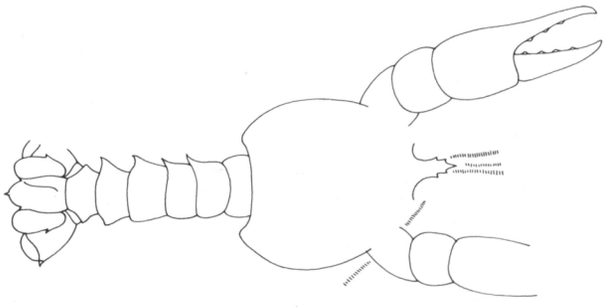

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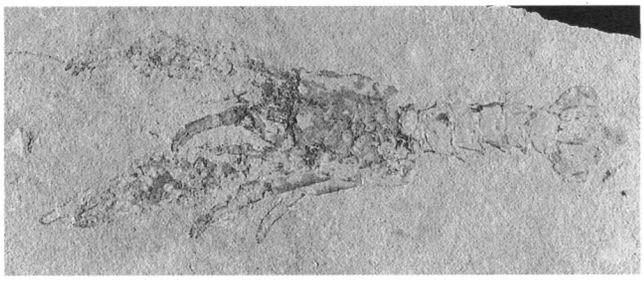

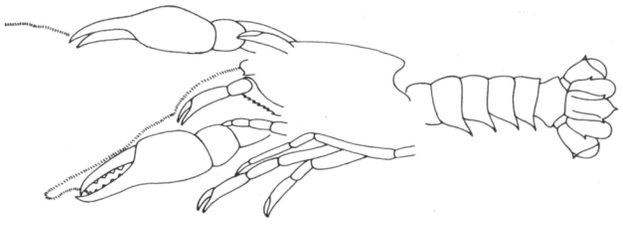

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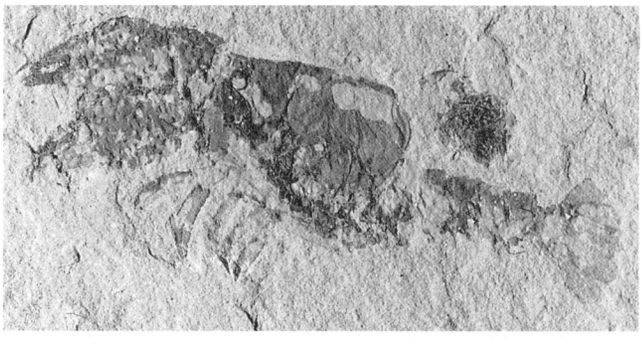
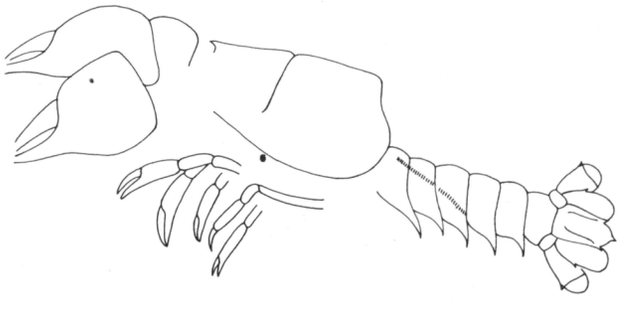
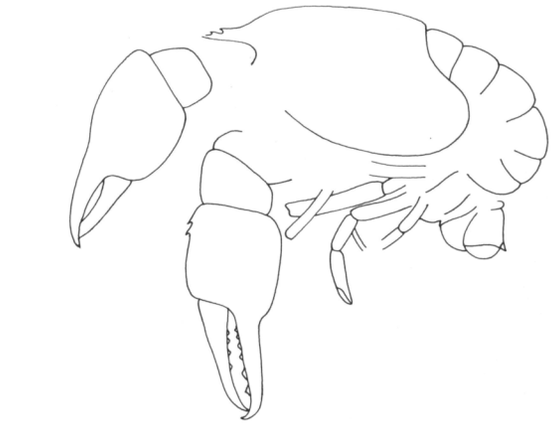




4

Plate IX - 1) *Eryma cretacea* Roger, 1946, n.cat. MSNM i12368, photo and reconstruction (x 2.3); 2) *Eryma cretacea* Roger, 1946, n.cat. MSNM i12308, photo and reconstruction (x 2.4); 3) *Eryma cretacea* Roger, 1946, n.cat. MSNM i12288, photo and reconstruction (x 2); 4) *Eryma cretacea* Roger, 1946, n.cat. MSNM i12289, photo and reconstruction (x 2.5).



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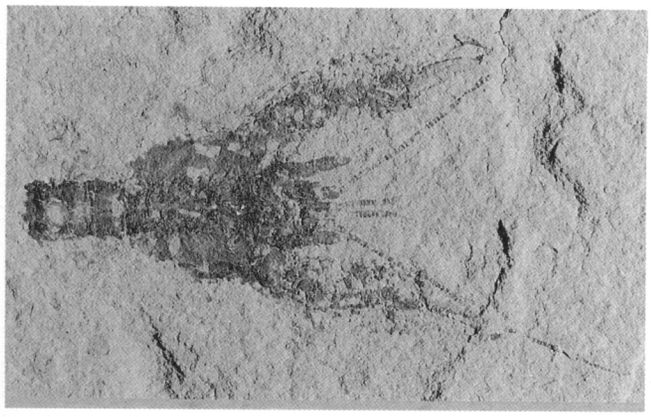

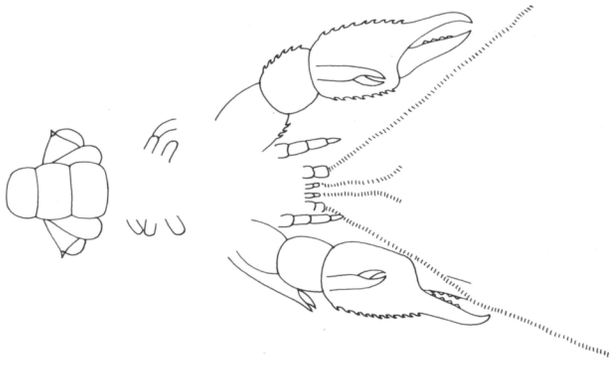

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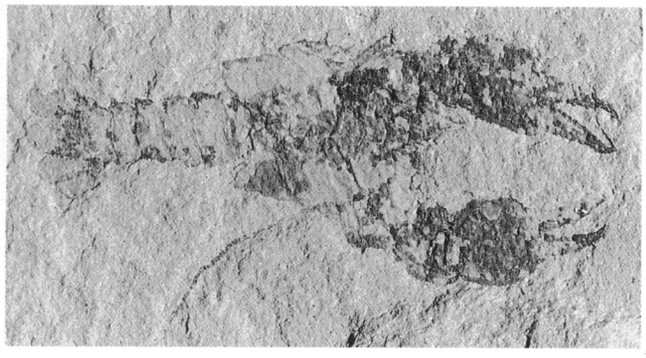

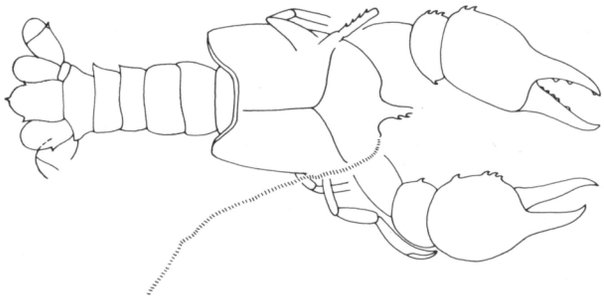

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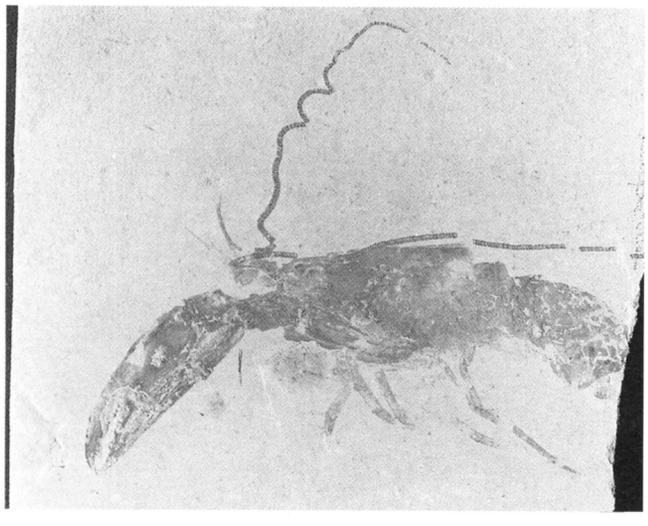
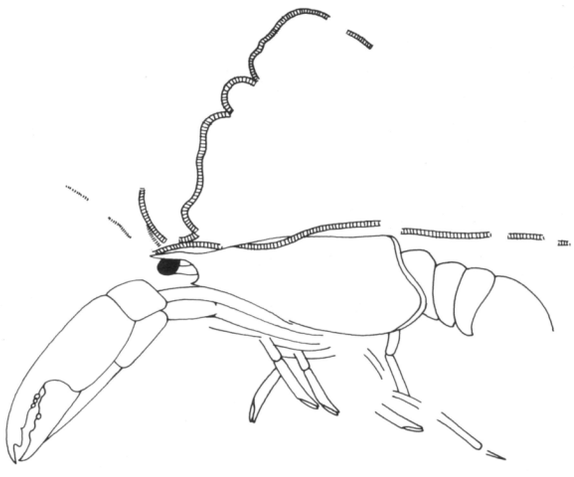
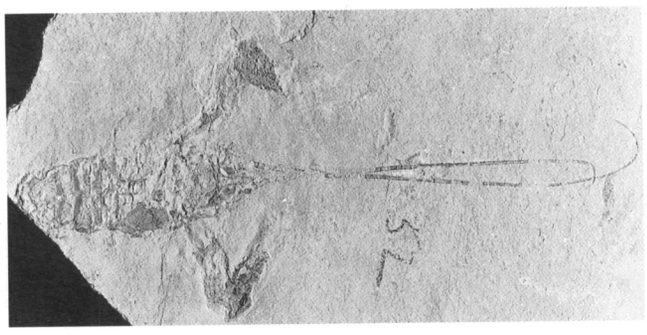
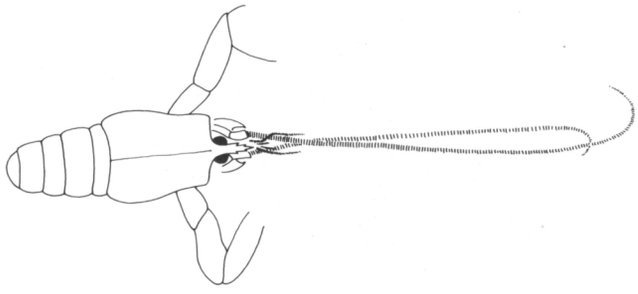




4

Plate X - 1) *Eryma cretacea* Roger, 1946, n.cat. MSNM i12269, photo and reconstruction (x 3.1); 2) *Eryma cretacea* Roger, 1946, n.cat. MSNM i12314, photo and reconstruction (x 2.2); 3) *Eryma cretacea* Roger, 1946, n.cat. MSNM i12317, photo and reconstruction (x 1.2); 4) *Homarus hakelensis* (Fraas, 1878), n.cat. MSNM i7601, photo and reconstruction (x 0.9).





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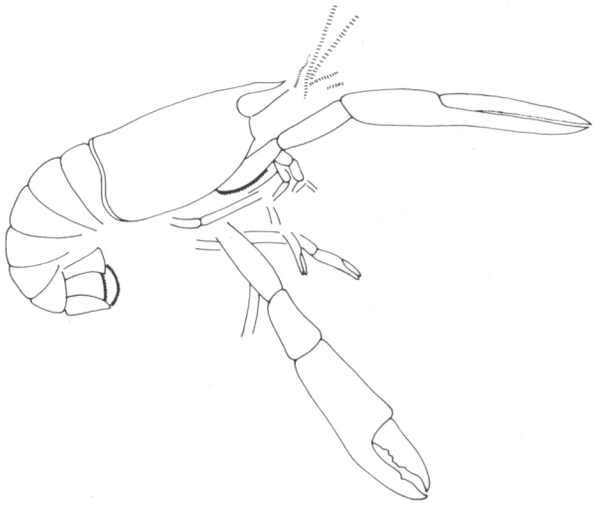

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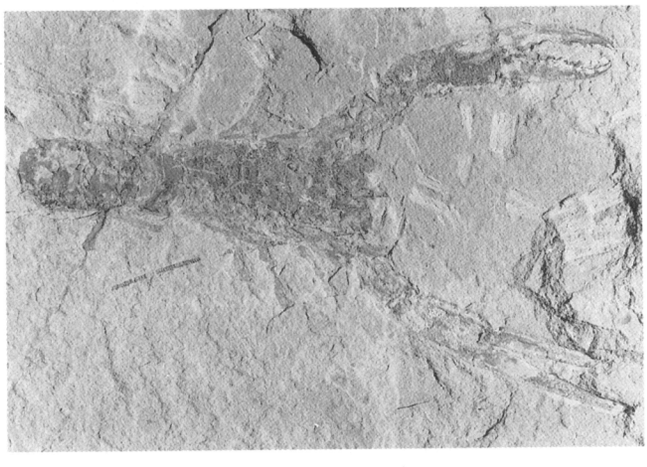

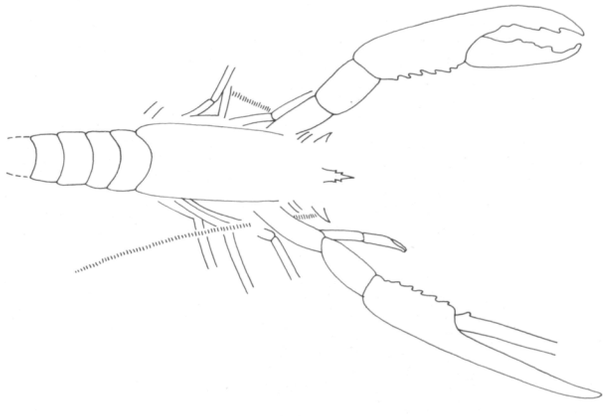

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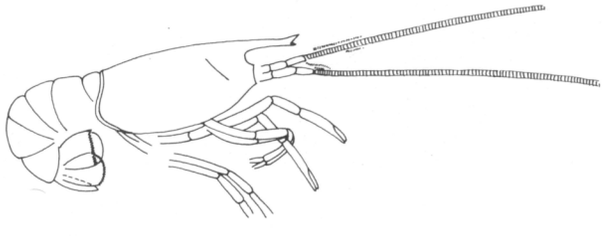
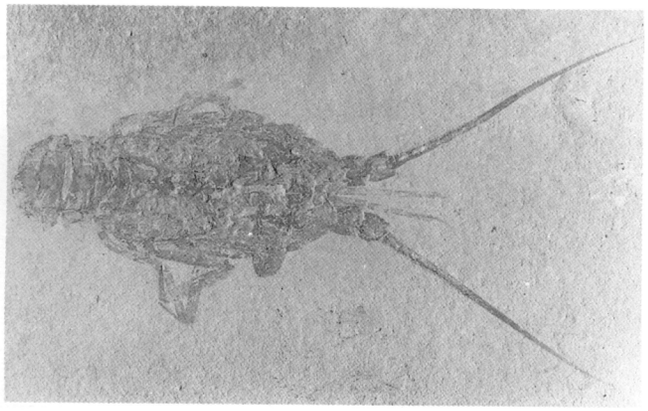
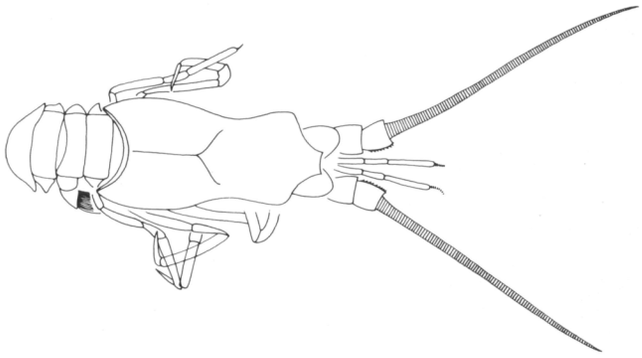


4

Plate XI - 1) *Homarus hakelensis* (Fraas, 1878), n.cat. MSNM i6047, photo and reconstruction (x 0.5); 2) *Homarus hakelensis* (Fraas, 1878), n.cat. MSNM i11835, photo and reconstruction (x 1); 3) *Homarus hakelensis* (Fraas, 1878), n.cat. MSNM i11836, photo and reconstruction (x 0.8); 4) *Homarus hakelensis* (Fraas, 1878), n.cat. MSNM i12598, photo and reconstruction (x 0.8).





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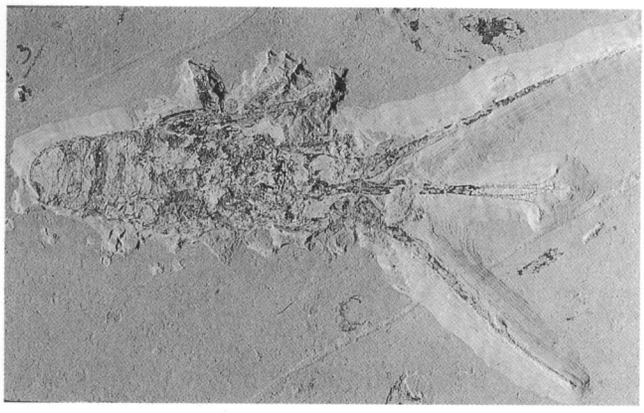

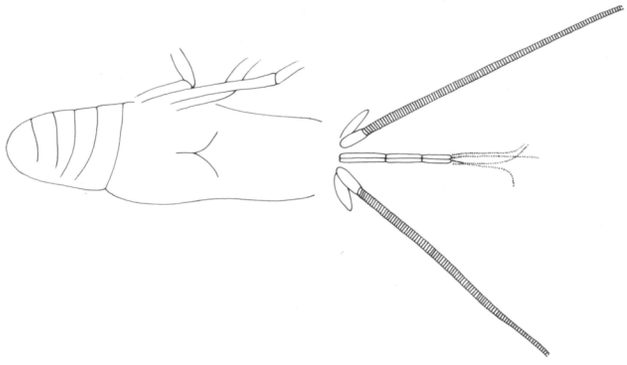

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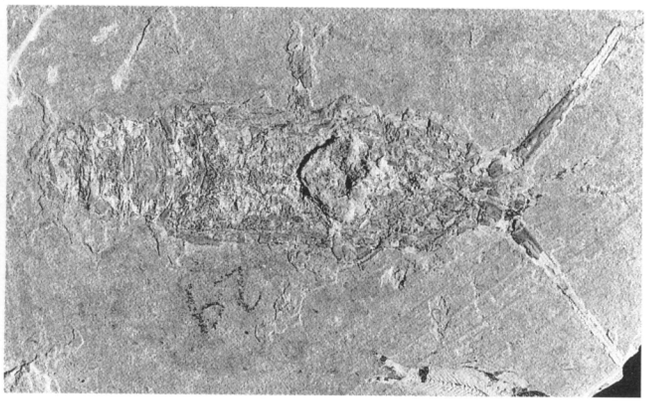

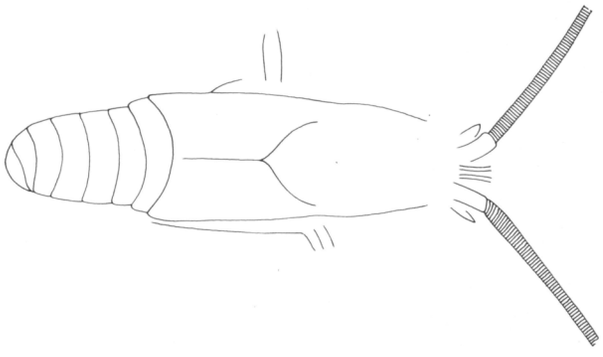

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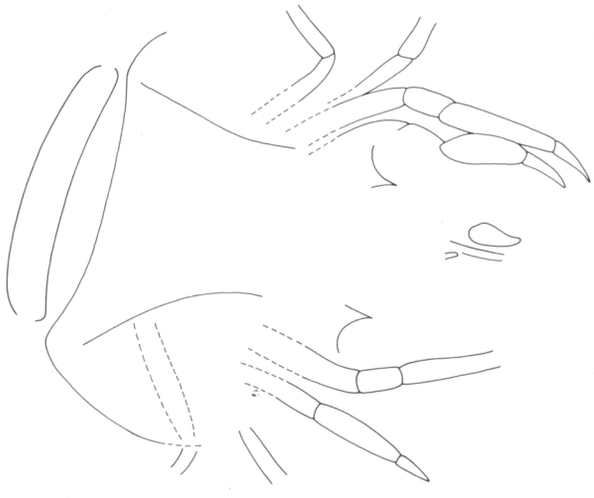
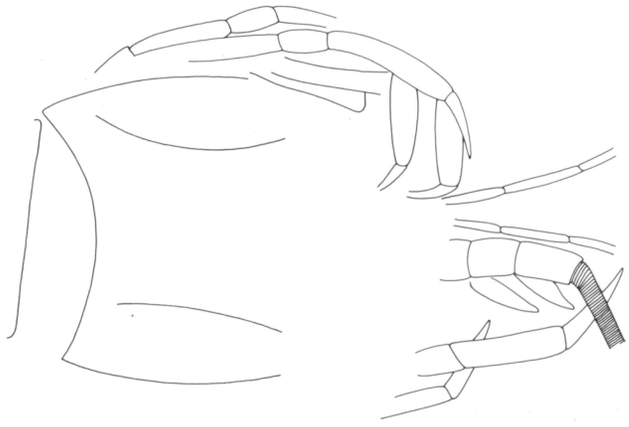


4

Plate XII - 1) *Linuparus* sp., n.cat. MSNM i6063, photo and reconstruction (x 1.4); 2) *Linuparus* sp., n.cat. MSNM i10406, photo and reconstruction (x 0.2); 3) *Linuparus* sp., n.cat. MSNM i6064, photo and reconstruction (x 0.6); 4) *Palinurus* sp., n.cat. MSNM i12245, photo and reconstruction (x 2).



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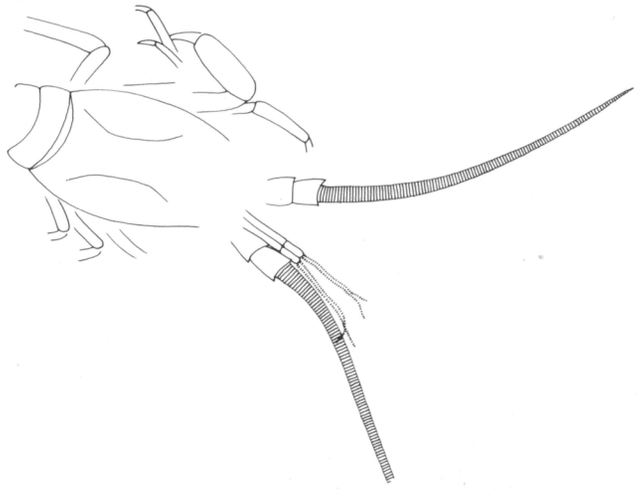

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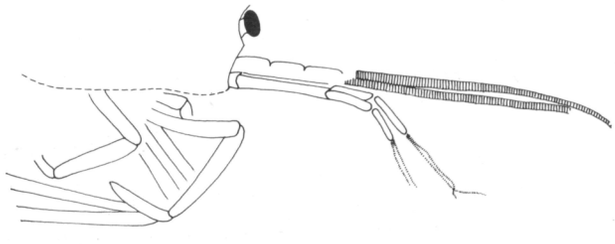

3

Plate XIII - 1) *Palinurus* sp., n.cat. MSNM i12179, photo and reconstruction (x 0.75); 2) *Palinurus* sp., n.cat. MSNM i6045, photo and reconstruction (x 0.4); 3) *Palinurus* sp., n.cat. MSNM i12635, photo and reconstruction (x 0.4).

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