acta
geologica
polonica

Vol. 29, No. 3 Warszawa 1979

REINHARD FÖRSTER

Decapod crustaceans from the Korytnica basin (Middle Miocene; Holy Cross Mountains, Central Poland)

ABSTRACT: The assemblage of brachyuran remains from the Korytnica basin (Middle Miocene; Holy Cross Mountains, Central Poland) contains 23 different forms belonging to 10 genera at least. Since all specimens are fragments of finger tips, the majority has been referred to higher taxonomic units such as genus or family; only in a minority an identification to the specific level was possible. According to its composition the assemblage indicates a tropical/subtropical shallow-water environment, and it displays certain affinities to the Recent decapod fauna of the Indo-Pacific.

INTRODUCTION

Remains of decapods are not uncommon in the Miocene strata of the Vienna or Pannonian basins in which several localities yield them even amazingly abundant (*cf.* Glaessner 1928; Bachmayer 1953, 1962; Lörenthey & Beurlen 1929; Stancu & Andreescu 1968; Müller 1975, 1976). It has therefore been somewhat surprising that from the Fore-Carpathian basin in Southern Poland the only hitherto described species (Reuss 1867) was "*Microdium nodulosum* Reuss", a single carapace of presumably *Lobocarcinus* from Wieliczka. Recently, a study of diverse decapod remains, the finger tips including, from both the Fore-Carpathian Depression as well as the Carpathians has been undertaken by the present author (Förster 1979).

Within the rich assemblages of fossils from the Korytnica basin in the Holy Cross Mts, the decapods are an accessory element only (*cf.* Bałuk & Radwański 1977). The present study is based on 845 fragments from the Korytnica Clays (*cf.* Bałuk & Radwański 1977, p. 98), and 4 fragments from the lithothamnian marly limestones exposed at Siedliska near Górki (*cf.* Radwański 1969, p. 85 and Pl. 32, Fig. 2).

The Korytnica material was obtained during sifting the clay samples; that may be one of the reasons why all specimens are fragments of the finger tips only, one

of the most calcified and therefore most resistant parts of the decapods. Furthermore, all are small fragments, usually less than one centimeter in length. They are derived predominantly from juvenile individuals (with the exception of *Calappa*) in which the specific character of the adults often has not yet developed.

Literature on both living as well as fossil decapods usually is inadequate for identification of such material. Emphasis has been placed on the features of the carapace, while description and illustration of chelipeds have been neglected mostly. Furthermore, the chelae of fossil decapods are usually not, or only incomplete and poorly preserved. To complicate the classification of single fragments, many crabs show not only a sexual dimorphism, but also distinctive differences in size and shape between right and left chela. In many decapods the males have stronger claws. In Brachyura a functional difference is documented by a stout crusher claw with broad blunt teeth and a slender and finely denticulate nipper claw. No descriptions exist for the tips of the fingers. A thorough study on the basis of detailed comparative examination of living decapods had to be undertaken, particularly on the variability of the fingers.

It appears that almost identical fingers (in shape and ornamentation) can occur in various species not only of the same genus but of related genera. There is a considerable intraspecific variability in the arrangement of the teeth of the cutting edge, especially in chelae with numerous teeth like the nipper claw of the Portunidae. On the other hand, single species of a genus may have developed a completely different type of finger which according to its function may exist in the same homeomorph form in another unrelated family. Finally, it appears that even in species with explicit heterochelous claws and in spite of an excellent dexiochiry both chelae can be developed identically as a nipper claw. This is relatively common in juvenile individuals of such genera in which the crusher claw occurs only in adult animals. And it is common in injured crabs where the lost crusher claw is regenerated. The first to regenerate is a nipper claw until the original crusher claw has been transformed after further moltings. Furthermore reversal of regenerated right and left chelae can occur. All this means that the incomplete and often not very characteristic fossil remains are, for the most part, insufficient for a definitive classification. Consequently, it is not surprising that isolated fingers did not rouse much interest (*cf.* Holthuis 1949, Janssen 1972) and usually have not been collected at all.

The purpose of this study is twofold. First, to report the existence of a diverse decapod fauna from the Middle Miocene (Badenian) deposits of the Korytnica basin. Secondly, to draw attention to the fact that such decapod remains as finger tips are not uncommon. Their more satisfactory identification will however be possible when a full monographic revision of all decapods from the Middle Miocene of the Paratethys basins is prepared. The heretofore collected rich material of finger tips is particularly known in the collections of the Naturhistorisches Museum in Vienna (*see* Bachmayer 1962, p. 39).

Acknowledgements. The author thanks Prof. Dr. A. Radwański and Doc. Dr. W. Bałuk for the loan of the material. The photos have been taken by F. Höck. All specimens are deposited in the collection of the Institute of Geology, University of Warsaw.

SYSTEMATIC DESCRIPTION

Infraorder **Anomura** Milne-Edwards, 1832
Family **Paguridae** Latreille, 1802
Paguridae gen. et sp. indet.
(Pl. 1, Fig. 1)

Remarks. — A short (5.5 mm) stout tight dactylus (movable finger) from Górki closely resembles *Petrochirus priscus* (Brocchi) in its coarse sculpture with a uniform dense granulation. It differs by its extraordinary short, compact shape, while *Petrochirus priscus*, this common and in the Mediterranean Middle Miocene strata widely distributed pagurid, has long and slender fingers. In its

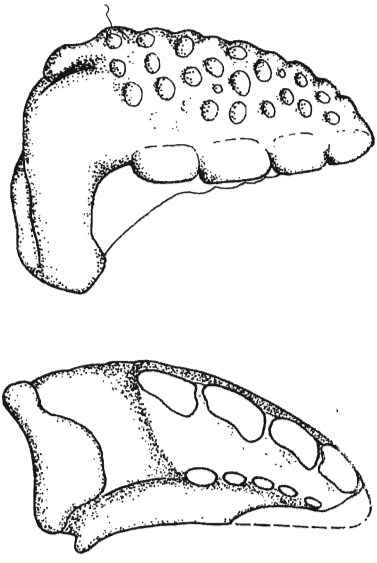


Fig. 1
Paguridae gen. et sp. indet.
Dactylus, right chela; views of outer surface and cutting edge, showing two rows of teeth

robust shape the fragment corresponds more with the fingers of *Paguristes*. This genus is reported from the Mediterranean "Tortonian" by two representatives, *P. hungaridus* Lörenthey & Beurlen and *P. substriatiformis* Lörenthey & Beurlen. Both species, however, do not show the characteristic granulation. Until now, no further hermit crabs have been reported from the Vienna and Pannonian basins and the dactylus may be assigned to a new species.

Infraorder **Brachyura** Latreille, 1803
Section **Oxystomata** Milne-Edwards, 1834
Family **Calappidae** de Haan, 1833
Genus *CALAPPA* Weber, 1795
Calappa aff. *heberti* Brocchi, 1883
(Pl. 1, Figs 2 and 4)

Material: 75 fragments (2—22 mm long) composing:
55 dactyli, right cheliped
18 fixed fingers, right cheliped
2 dactyli, left cheliped.

Remarks. — The laterally extremely compressed chelae, used as a shelter fitting closely over the mouth-parts, show such characteristic features that even small fragments can be easily identified. The strongly calcified compact fingers are very resistant against transport and disintegration. Often

they are completely preserved; even complete chelae are not uncommon, especially the robust right crusher claw. Therefore it is not surprising that chelae of *C. heberti* have been described repeatedly, not only from the "Tortonian" of the Vienna Basin (Lörenthey & Beurlen, 1929, p. 130; Glaessner 1930, p. 168; Beurlen 1939, p. 136; Bachmayer 1962, p. 40), but also from the "Tortonian" of

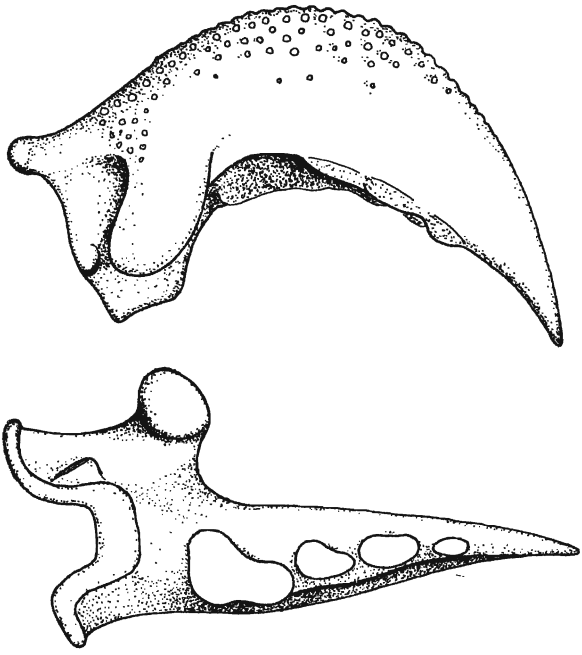


Fig. 2
Calappa aff. *heberti* Brocchi, 1883
Dactylus, right chela; views of outer surface and cutting edge, showing the large proximal tooth that projects outward and which is used for opening shells of mollusks

Portugal (Veiga 1954, 1958; Galopim 1959) and the late Miocene of Spain (Via 1948) and possibly of northern Germany (Janssen 1972).

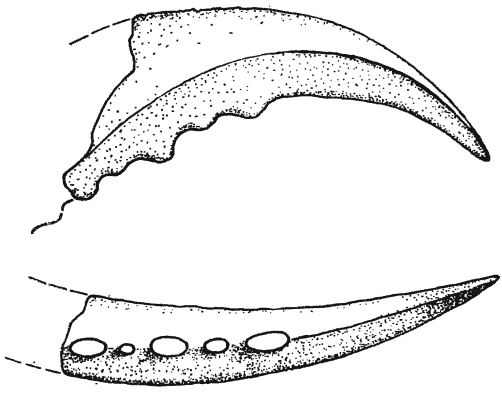


Fig. 3
Calappa aff. *heberti* Brocchi, 1883
Dactylus, left chela; views of inner surface and cutting edge

In the Korytnica material, *Calappa* makes up only 9% of the decapod remains, but among these range the largest fragments of the fauna up to 22 mm in length. Most of them are however small, and they are derived from juvenile individuals. The smallest, but complete dactylus measures 2.6 mm only. In accordance with the results of Bachmayer (1962), the movable finger of the right

cheliped, *i.e.* the crusher claw dominates (55 fragments), while the more fragile nipper claw is represented only by two dactyli. In shape, ornament and the other features they are similar to the material from the Vienna Basin (Bachmayer 1962).

Genus *MURSIA* Desmarest, 1823

Mursia sp.

(Pl. 4, Fig. 1)

Remarks. — A small (4.8 mm) dactylus of a right cheliped agrees in general with the movable fingers of Recent Calappidae: triangular in cross-section with a sharp upper margin and a relatively broadened lower margin, armed with eight unequal blunt teeth. Tip unarmed, smooth and downturned. First tooth minute, second and third teeth larger, equal in size and shape, fourth tooth dominant; towards articulation there appear two rows of teeth: outer with two teeth of equal size, and inner with the larger last tooth (teeth formula: 1223^{23}_{22}). On the inner surface of the finger, a series of short transverse notches similar to the stridulating organ of the Recent genus *Mursia* is visible.

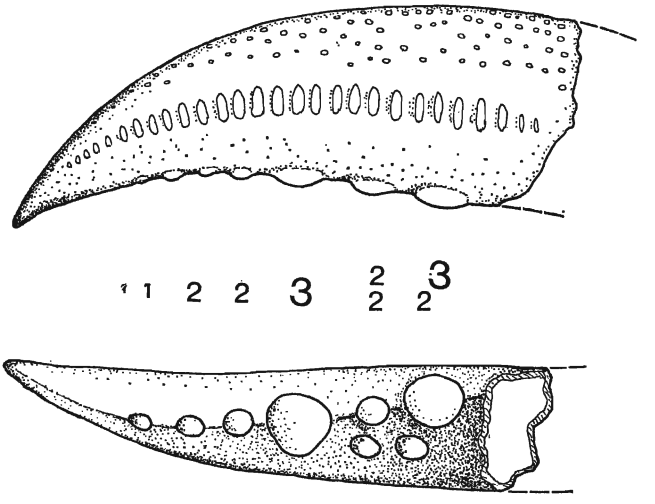


Fig. 4. *Mursia* sp.

Dactylus, right chela; view of inner surface showing the series of nothes, forming the stridulating organ, and view of cutting edge; teeth formula is indicated

The genus *Mursia*, both Recent and fossil, is known only from the Pacific (including the Oligocene of Panama). The presented dactylus would be a further reference to a wider distribution of this genus during Miocene times. According to Dr. P. Müller (*pers. comm.*), *Parthenope loczyi* Müller (*see* Müller 1974, p. 277) can be assigned to the genus *Mursia*, supporting the occurrence of *Mursia* in the Vienna Basin. On the other hand *Mursia* sp., a single carapace from the Middle Miocene of northern Germany figured by Höpfner (1974), must be placed probably in *Calappilia*.

Section **Brachyrhyncha** Borradaile, 1907

Family **Portunidae** Rafinesque, 1815

Portunidae gen. et sp. indet.

(Pl. 2, Fig. 1 and 5; Pl. 3, Fig. 1 and 2)

Material: 67 fragments (3—10 mm long) composing:
36 dactyli, right cheliped
12 dactyli, left cheliped
18 fixed fingers, right cheliped
1 fixed finger, left cheliped.

DACTYLUS: Moderately curved, downward and inward; slender, occasional with dagger-shaped smooth and distinct downturned tip. Surface composed of five smoothly rounded ridges, separated by four narrow grooves: two of the ridges are on the outer, two on the inner surface, one dorsal. Dorsal surface broadly rounded. Grooves fading toward the tip. Teeth on both sides joined by elongated pits (for tufts of hair), which form a narrow groove proximal towards the articulation; they disappear distally towards the tip. Teeth irregular, acute; the larger ones alternating with smaller ones. Dactylus of the right chela with a characteristic large basal tooth at the proximal end, projecting strongly backward. Teeth formula variable (1121431415). Outer and dorsal surface proximal coarsely granulated, largest granules on the dorsal ridge; smooth surface innerside and towards the tip.

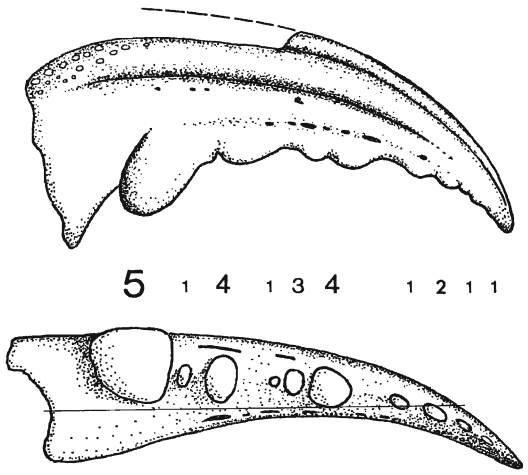


Fig. 5
Portunidae gen. et sp. indet., cf. *Macropipus* sp.
Dactylus, right chela; views of outer surface and cutting edge; teeth formula is indicated

With 12 fragments the dactyli of the left cheliped are not so common. They agree in size, shape and sculpture with those of the right chaliped, but they show a more uniform dentation and lack the large basal tooth.

All these dactyli resemble very closely those of *Macropipus*, a genus represented by three species in the "Tortonian" of the Vienna and Pannonian basins, viz. *M. kuehni* Bachmayer, *M. pygmaeus* (Brocchi) and *M. rakosensis* (Lörenthey & Beurlen). They display minor differences such as the shorter and stouter shape. A similar dactylus has also been figured by Glaessner (1928, p. 182, and Pl. 3, Fg. 7) from the "Tortonian" of Grinzing, Vienna Basin.

FIXED FINGER: Among the Korytnica material there occur remains of the fixed finger, which agree in all observable features with the dactyli. The surface shows the same 5 rounded ridges and

---

PLATE 1

1 — Paguridae gen. et sp. indet.; dactylus. right chela; ×8

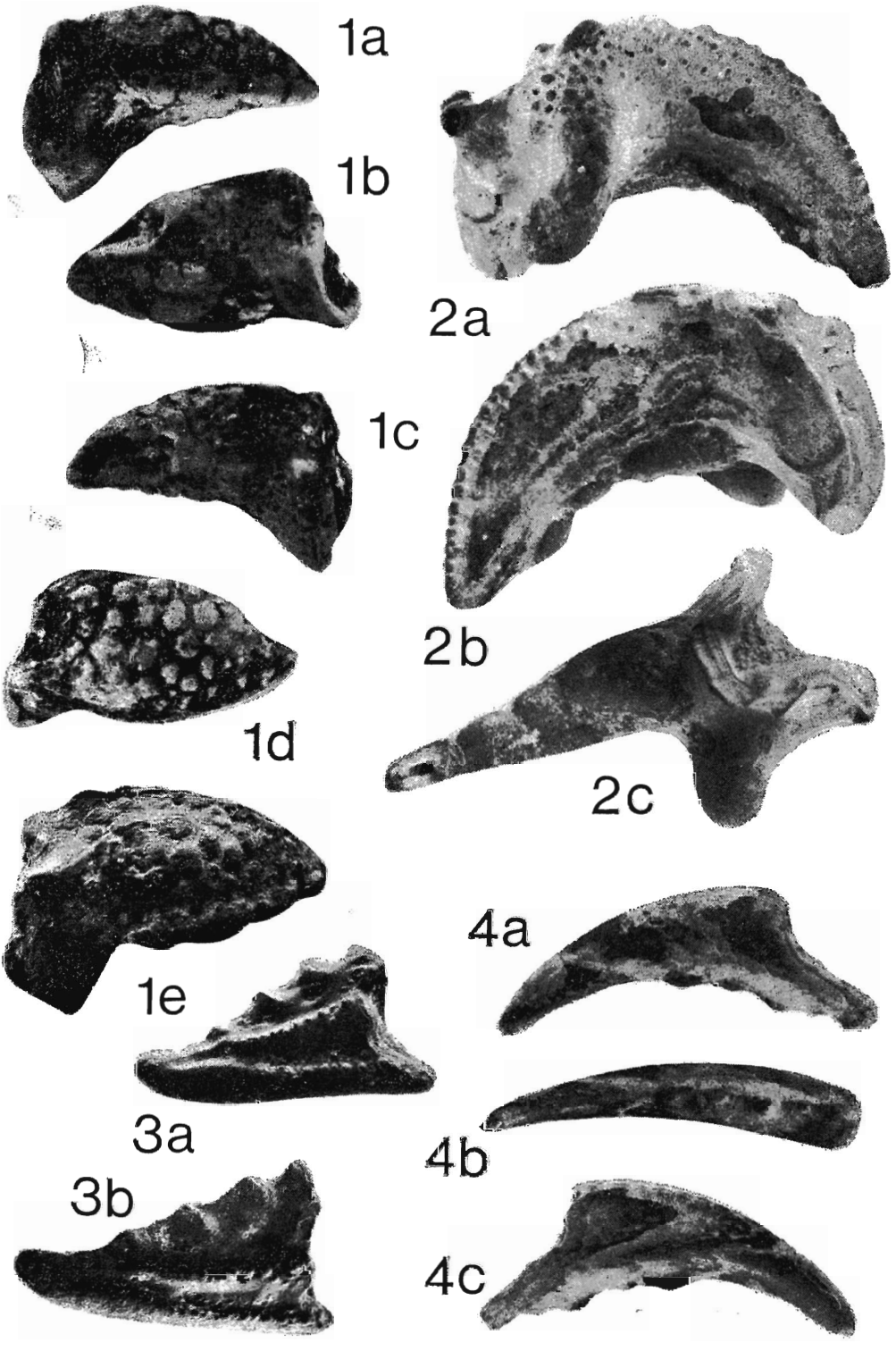
1a view of outer surface showing teeth of the cutting edge; *1b* cutting edge with two rows of blunt teeth; *1c* inner surface; *1d* dorsal surface; *1e* dorsal/lateral view of outer surface with teeth of the cutting edge; same specimen, but scanning electron micrograph (*SEM*; ×8.5)

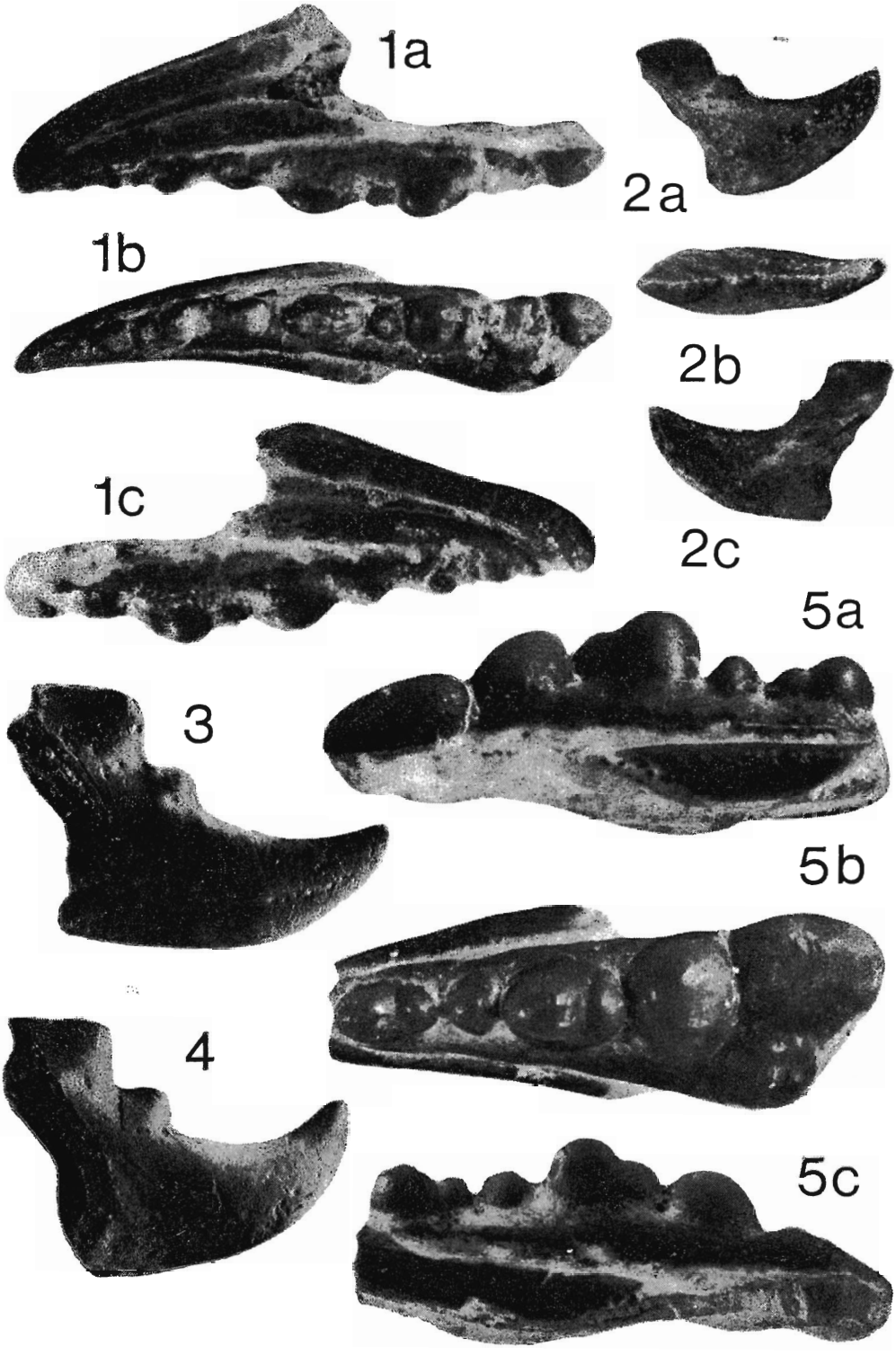
2 — *Calappa* aff. *heberti* Brocchi, 1883; dactylus, right chela (crusher claw); ×4; views of outer (*2a*) and inner (*2b*) surface, and cutting edge (*2c*), showing the large proximal tooth, projecting outward

3 — Portunidae gen. et sp. indet.; fixed finger, left chela; ×15 (*SEM*)

3a outer surface, showing the two granulated ridges; *3b* same specimen, but dorsally tilted, showing acute cutting edge

4 — *Calappa* aff. *heberti* Brocchi, 1883; dactylus, left chela (nipper claw); ×8; view of outer surface, cutting edge and inner surface


1a
1b
1c
1d
1e
2a
2b
2c
3a
3b
4a
4b
4c


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

a similar, but coarser granulation. They differ remarkably from all Recent representatives of the genus *Macropipus* in the triangular arrangement of the basal teeth.

Teeth of the cutting edge unequal with different height, acute (1232445355²6). The three basal teeth are arranged in a triangle; the smallest tooth situated at the inner, the largest at the outer edge. Both are broadly rounded and considerably shallower than the preceding tooth.

Among the Recent Portunidae examined, only representatives of the genera *Callinectes* and *Charybdis* seem to have such a triangular arrangement of the last three teeth. The genus *Charybdis* has been reported from Hungary (Müller 1975, p. 510) and from the "Tortonian" of the Near East (Glaessner 1933, p. 11). The present material is insufficient even for a generic placing. A better knowledge of the portunid chelae would be necessary for a more satisfactory classification. Besides the three mentioned species of *Macropipus* the chelae of the following portunid species must be compared: *Colneptunus radobojanus* Bittner, *Necronectes schafferi* Glaessner, *Portunus stenaspis* (Bittner) and *Portunus granulatus* Milne-Edwards, especially the chelae of juvenile individuals.

Portunidae gen. et sp. indet.
(Pl. 1, Fig. 3)

Material: 2 fragments, fixed fingers, left cheliped (2.2 and 2.3 mm).

Remarks. — The two fragments differ from the other portunid fixed fingers in their much longer tip. The teeth are not joined by the narrow groove, but by single extraordinary deep pits on both sides. The most characteristic features are the ridges of the outer surface. They are narrow and edged, covered by a row of small granules like a string of pearls. The two ridges are separated

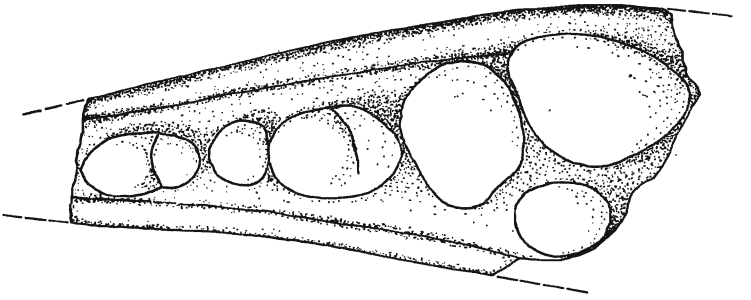


Fig. 6. Portunidae gen. et sp. indet.
Fixed finger, right chela; view of cutting edge, proximal part

by a broad, shallow depression. The fingers of some Recent species of *Macropipus* with a more granulated surface, e.g. *M. rugosus* from the Gulf of Guinea, show a similar ornamentation, though the ridges are more broadened and rounded. In spite of the characteristic ridges the two pieces are too fragmentary for classification.

PLATE 2

1 — Portunidae gen. et sp. indet., cf. *Macropipus* sp.; dactylus, left chela; ×8; views of outer (*1a* surface, cutting edge (*1b*), and inner surface (*1c*)

2 — ?*Ozius* sp.; fixed finger, right chela; ×8; views of outer (*2a*) surface, cutting edge (*2b*), and inner surface (*2c*)

3 — ?*Ozius* sp.; fixed finger, right chela; ×12 (*SEM*); view of outer surface

4 — ?*Ozius* sp.; fixed finger, right chela; ×12 (*SEM*); view of outer surface

5 — Portunidae gen. et sp. indet.; fixed finger, right chela; ×8; views of outer surface (*5a*), cutting edge, showing the proximal broadening (*5b*), and inner surface (*5c*)

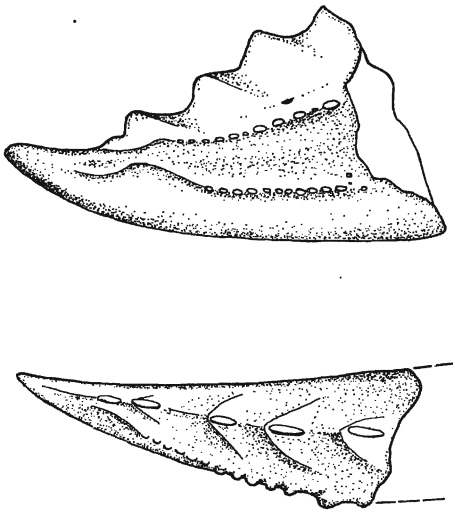


Fig. 7
Portunidae gen. et sp. indet.
Fixed finger, left chela; view of outer surface with two granulated ridges

Superfamily **Xanthoidae** Dana, 1851
Family **Xanthidae** Dana, 1851
Genus *PILUMNUS* Leach, 1815
?*Pilumnus* sp.
(Pl. 3, Fig. 6; Pl. 5, Figs 1 and 3)

Material: 21 fragments comprising:
6 dactyli, right cheliped (3—7 mm long)
2 dactyli, left cheliped (4—6 mm)
8 fixed fingers, right cheliped (2—5 mm)
2 fixed fingers, right cheliped (3—6 mm)
1 fixed finger, right cheliped (13 mm)
1 fixed finger, right cheliped (8 mm), from Siedliska.

Remarks. — Stout, robust dactylus, tip moderately downturned and slightly inward curved. Surface with two dorsal rows of setiferous pits, proximal increasing in size and finally forming a groove towards articulation. Inner surface with a medial row of pits. Teeth joined by a row of fine

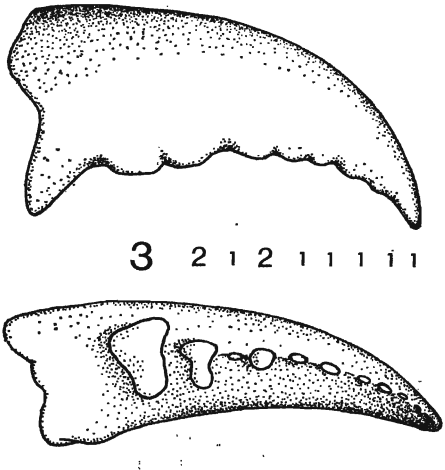


Fig. 8
Pilumnus sp.
Dactylus, right chela; views of outer surface and cutting edge; teeth formula is indicated

pits on both sides, but forming no groove. Teeth unequal, diminishing gradually in size towards tip (1112123). Proximal tooth broadened, of subtriangular shape. Surface mainly smooth, only the basal part with fine granules, especially on the dorsal ridge; frequently with a transverse row of granules, separating a depression in front of the articulation.

FIXED FINGER short, high and thick. Inner surface with two deep and narrow grooves, ending before and behind the first tooth of the cutting edge. Outer surface with a medial row of pits. Teeth joined by a row of setiferous pits. Teeth unequal; proximal of the third (or fourth) tooth cutting

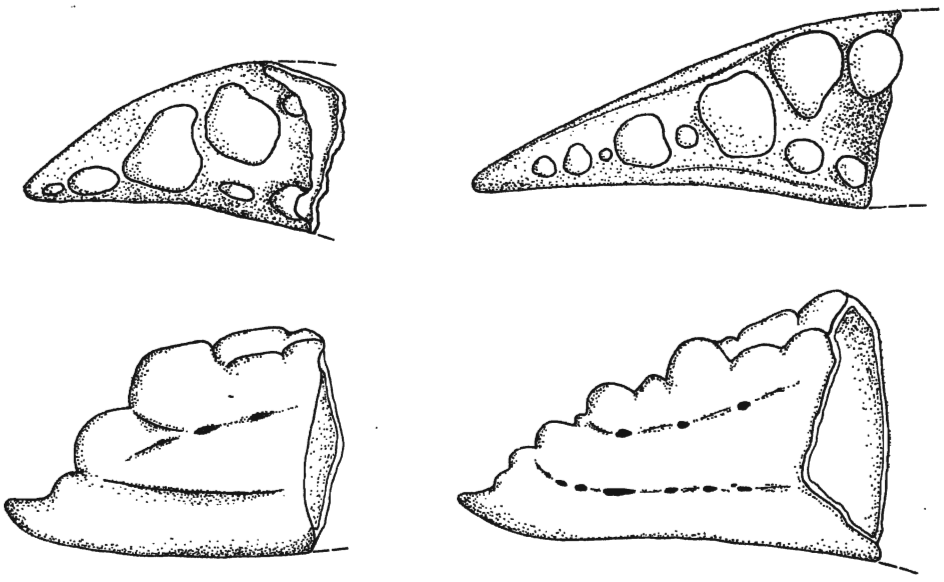


Fig. 9. ?*Pilumnus* sp.
Fixed fingers of right chelae; views of cutting edge and inner surface

edge broadened with two pairs of teeth side by side (123^{31}_{12}). Remaining surface smooth with diminutive pits. Four fragments, among them a larger specimen from Siedliska, differ by a slender shape with minor developed grooves and pits, a less rising cutting edge and by more numerous and unequal teeth (12314^{32}_{22}).

All these fragments resemble the fingers of *Pilumnus* in outline shape and ornamentation. They are similar to fingers from the Vienna basin, which have been refered to the genus *Pilumnus* by Glaessner (1928) and Bachmayer (1953). The genus *Pilumnus* has also been reported from the Pannonian basin (Lörenthey & Beurlen 1929; Müller 1974, 1975, 1976).

The investigated fragments display also some similarities to *Menippe*, particularly in the dentation. The fingers of *Menippe*, however, differ by a more modified surface with distinct grooves and deep rows of pits. Finally, the fixed fingers show close affinities to those of *Eriphia:* in the development of two proximal pairs of teeth they even correspond much better with the genus *Eriphia* than with *Pilumnus*, in which such a broadening of the cutting edge occurs only as an exception. These fixed fingers probably must be refered to the genus *Eriphia*.

Genus *OZIUS* Desmarest, 1823

?*Ozius* sp.

(Pl. 2, Figs 2—4; Pl. 4, Figs 2—7; Pl. 5, Fig. 2)

Material: 353 fragments of the dactylus comprising:
205 right cheliped (4—11 mm)
148 left cheliped (4—9 mm)
89 fragments of the fixed finger
68 right, 21 left cheliped (max. 5 mm long).

DACTYLUS slender, laterally compressed, with a smooth, dagger-shaped and downturned tip. Teeth acute, elongate and shallow; in lateral view triangular, except the last two basal teeth. These are broadened and bluntly rounded the last massive crushing tooth elongated and projecting obliquely outward. Surface smooth without distinct features. Only a weak row of fine pits in the dorsal

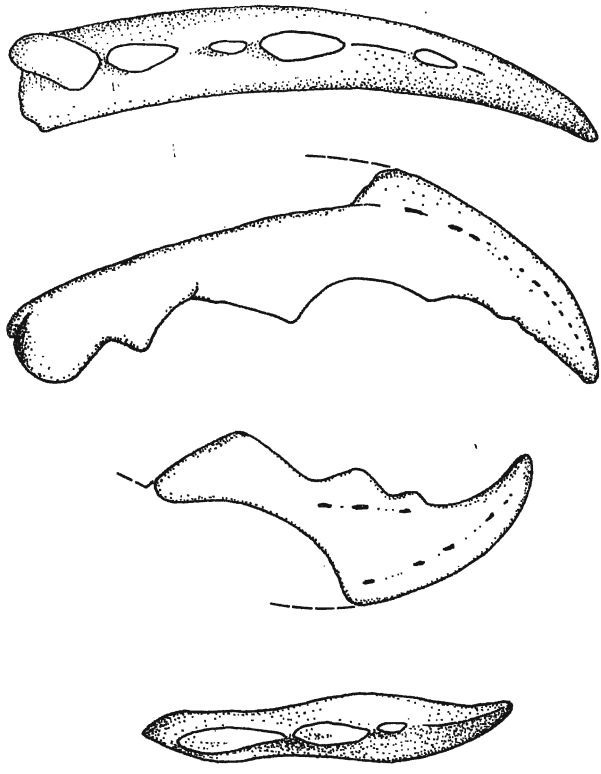


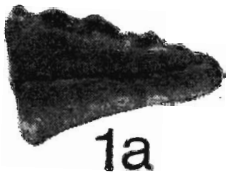
Fig. 10. *?Ozius* sp.
Dactylus and fixed finger of right chela; views of outer surfaces and cutting edges

part of both sides and occasionally small pits at the distal base of the teeth. With more than 300 specimens by far (42%) the most abundant type in the Korytnica material, these dactyli show relationships to various genera of the Menippinae or Pilumninae. The presence of a robust crushing tooth proximal of an otherwise acute cutting edge in some more complete right dactyli excludes

---

PLATE 3

1–2 — Portunidae gen. et sp. indet., cf. *Macropipus* sp.
1 Dactylus, right chela; ×8; views of outer surface (*1a*), cutting edge (*1b*), and inner surface (*1c*), showing the large proximal tooth, projecting outward
2 Dactylus, left chela; ×8; views od outer surface (*2a*), cutting edge (*2b*), and inner surface (*2c*)
3–5 — Decapoda gen. et sp. indet., forma *A*
3 Dactylus, left chela; ×12 (*SEM*); view of inner surface
4 Dactylus, left chela; ×8; views of outer surface (*4a*), cutting edge (*4b*), and inner surface (*4c*), showing the irregular dentation
5 Dactylus, right chela; ×8; views of outer surface (*5a*), cutting edge (*5b*), and inner surface (*5c*)
6 — *?Pilumnus* sp.
Fixed finger, right chela; ×20; views of cutting edge (*6a*) and outer surface (*6b*), showing the broadened proximal part with two rows of teeth



1a

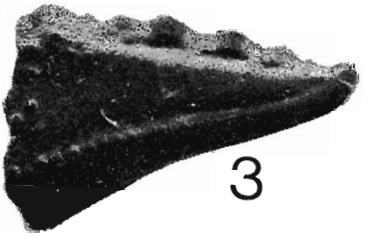
2a

1b

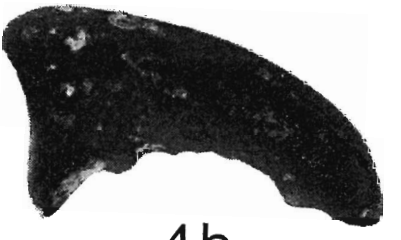
2b

1c

2c



3

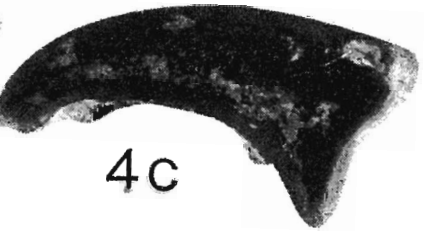


4a

4b

5a

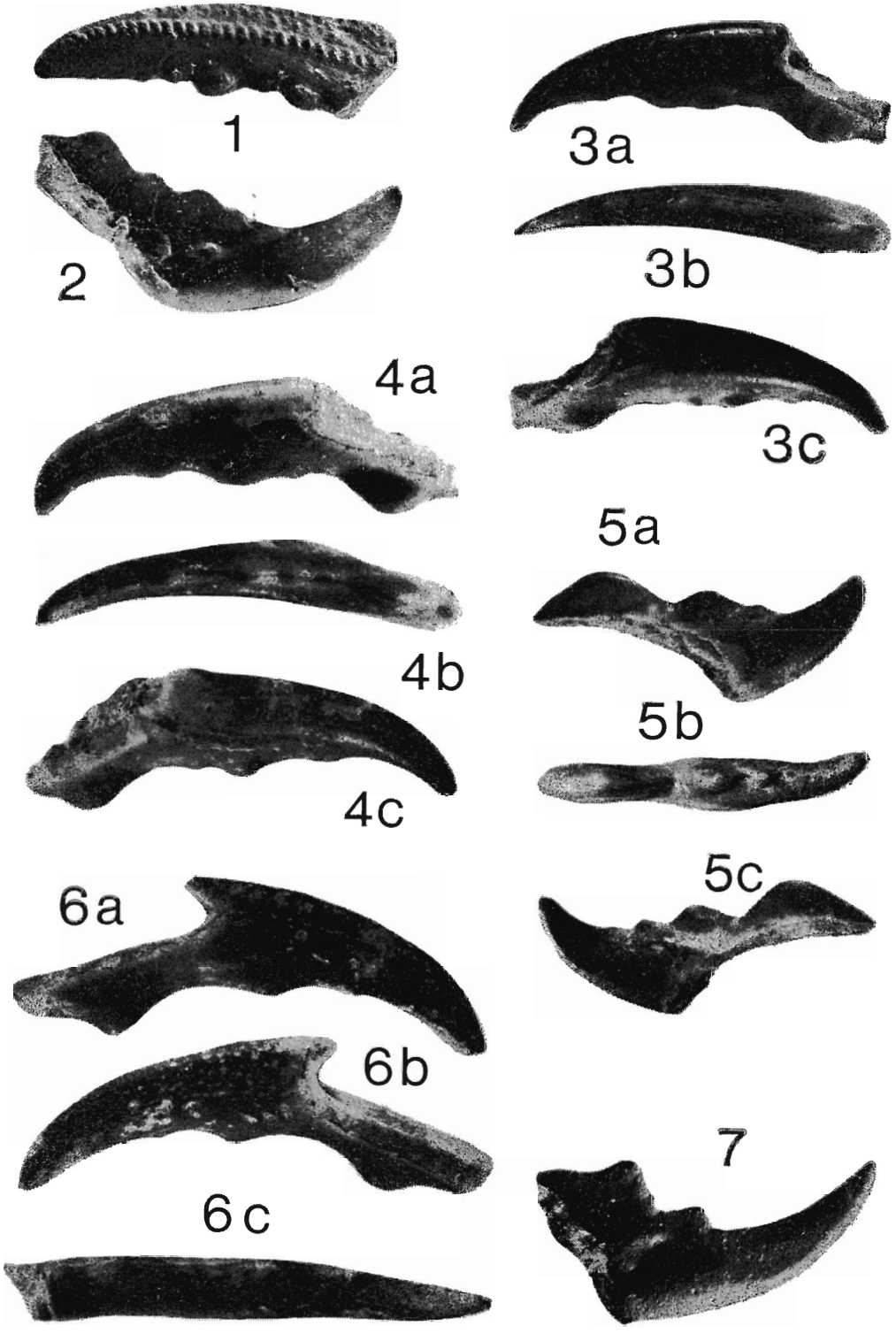
5b



4c

5c

6


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

all members of the genera *Eriphia*, *Menippe* or *Pilumnus*, the more frequent genera of the Xanthidae in the Vienna and Pannonian basins. The closest affinities show chelipeds of the Recent genus *Ozius* Desmarest, distributed in the Indo-Pacific and in Central America.

Similar fingers with a similar saw-blade-shaped cutting edge appear in *Paragalene*, but the right dactylus of this member of the Geryonidae lacks a proximal crushing tooth.

FIXED FINGER: The most frequent type of all fixed fingers in the assemblage is very poorly preserved, at the best only fragments of the tip and the next three teeth. Long, dagger-shaped tip, acute and distinctly curved upwards. Cutting edge acute, rising rapidly like a staircase. Teeth increasing in size; in lateral view triangular. Surface smooth. A single deep pit at the base of the first (distal) tooth on the inner surface. Outer surface with a row of fine pits at the base of the teeth. A weak row of fine pits, distally diminishing, appears on the ventral (outer) third on both sides.

A similar long and curved tip has not been observed in all chelipeds compared, fossil or Recent, though the trend to develop longer curved pincers on the tips of the fixed finger is common in many species of the Menippinae or Pilumninae. The essential difference is the weak modification of the inner and outer surface without any deeper longitudinal grooves. All studied representatives of these two subfamilies show two more or less deeply developed longitudinal grooves, ending at the base of the first and the second tooth and separating the first tooth distinctly from the smooth tip and the subsequent large second tooth. This pattern is observable in both chelipeds in the index of the crusher claw as well as in the nipper claw.

The remains under consideration are too fragmentary for classification. The similarities in the long curved pincers, the smooth and little modified surface of the movable and fixed fingers and last not least the fact that both are the most abundant form-types (dactyli=42%, fixed fingers 10% of total assemblage or 50% of all movable and 59% of all fixed fingers) suggest that both types may belong to the chelae of one species.

Genus *XANTHO* Leach, 1804
Xantho cf. *vulgaris* (Glaessner, 1926)
(Pl. 5, Fig. 4)

Material: 1 dactylus, right cheliped (7.2 mm long).

Remarks. — Robust, stout dactylus; tip spoon-shaped, the cutting edge of the tip not preserved. Cutting edge external; unequal dentation. Single, large tooth immediately behind the cutting edge of the spoon-shaped tip; another large and broadened tooth at the proximal end (teeth formula: spoon-shaped cutting edge of the tip, 31123). Surface smooth; dorsally an indistinct row of fine pits on both sides, extending in a short groove towards the articulation; both, pits and groove deeper developed on outer surface. In the distal (anterior) part of the spoon-shaped cavity two elongated, deep pits for tufts of hair. The unique dactylus shows close relationships to the dactyli of *Chlorodiella*, *Xantho* and *Titanocarcinus vulgaris* Glaessner in its spoon-shaped tips. Particularly *Xantho* has a comparable dentation with a similar dominant tooth closely behind the cutting edge of the tip; the pits of the cavity occupy similar positions.

PLATE 4

1 — *Mursia* sp.

Dactylus, right chela; ×12 (*SEM*); view of inner surface showing the notches of the stridulating organ

2–7 — ?*Ozius* sp.

2 Fixed finger, left chela; ×12 (*SEM*); view of inner surface
3 Dactylus, left chela; ×8; views of outer surface (*3a*), acute cutting edge (*3b*), and inner surface (3)
4 Dactylus, left chela; ×8; views of outer surface (*4a*), cutting egde (*4b*), and inner surface (*4c*)
5 Fixed finger, right chela; ×8; views of outer surface (*5a*), cutting edge (*5b*), and inner surface (*5c*)
6 Dactylus, right chela; ×8; views of outer surface (*6a*), cutting edge (*6b*), and inner surface (*6c*)
7 Fixed finger, left chela; ×12 (*SEM*); view of inner surface

An examination of the spoon-shaped fingers from the Vienna basin, and regarded as fingers of *Titanocarcinus vulgaris* Glaessner by Glaessner (1928) and Bachmayer (1953), showed that there is no difference between these fingers, the Korytnica specimen, as well as the fingers from Łychów, Skotniki and Pińczów (Förster 1979). Unfortunately, none of the fingers or chelae described by Glaessner and Bachmayer had been collected attached to a carapace. Bachmayer (1953, p. 256) reported that a single chela had been found close to a carpace of *T. vulgaris*, and he concluded that these fingers should belong to *T. vulgaris* on the basis of the abundant occurrence of carapaces and

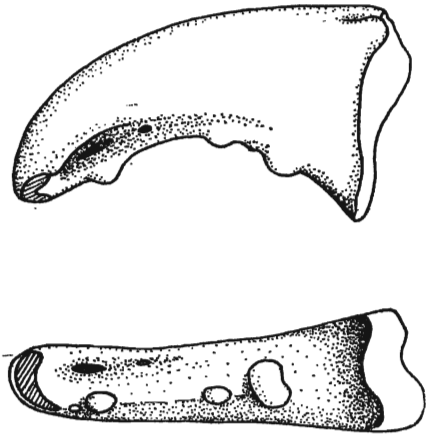


Fig. 11
Xantho cf. *vulgaris* (Glaessner, 1928)
Dactylus, right chela; views of inner surface and cutting edge, showing spoon shaped tip

chelae/fingers in the same horizons. But even so, the generic position of these carapaces is doubtful as there are much more differences in the pattern of the carapaces between *T. vulgaris* and the prevailing Paleogene members of the genus *Titanocarcinus* (including the type species *T. serratifrons* Milne-Edwards) than between those of the genus *Xantho*. It therefore seems much more likely to include the carapace of *T. vulgaris* as well as these spoon-shaped fingers into the genus *Xantho*.

Similar spoon-shaped tips are also developed in many Grapsidae, but the grapsid dactyli differ in a much finer and narrower dentation with more equal teeth.

Decapoda gen. et sp. indet., forma *A*
(Pl. 3, Figs 3—5; Pl. 5, Fig. 5)

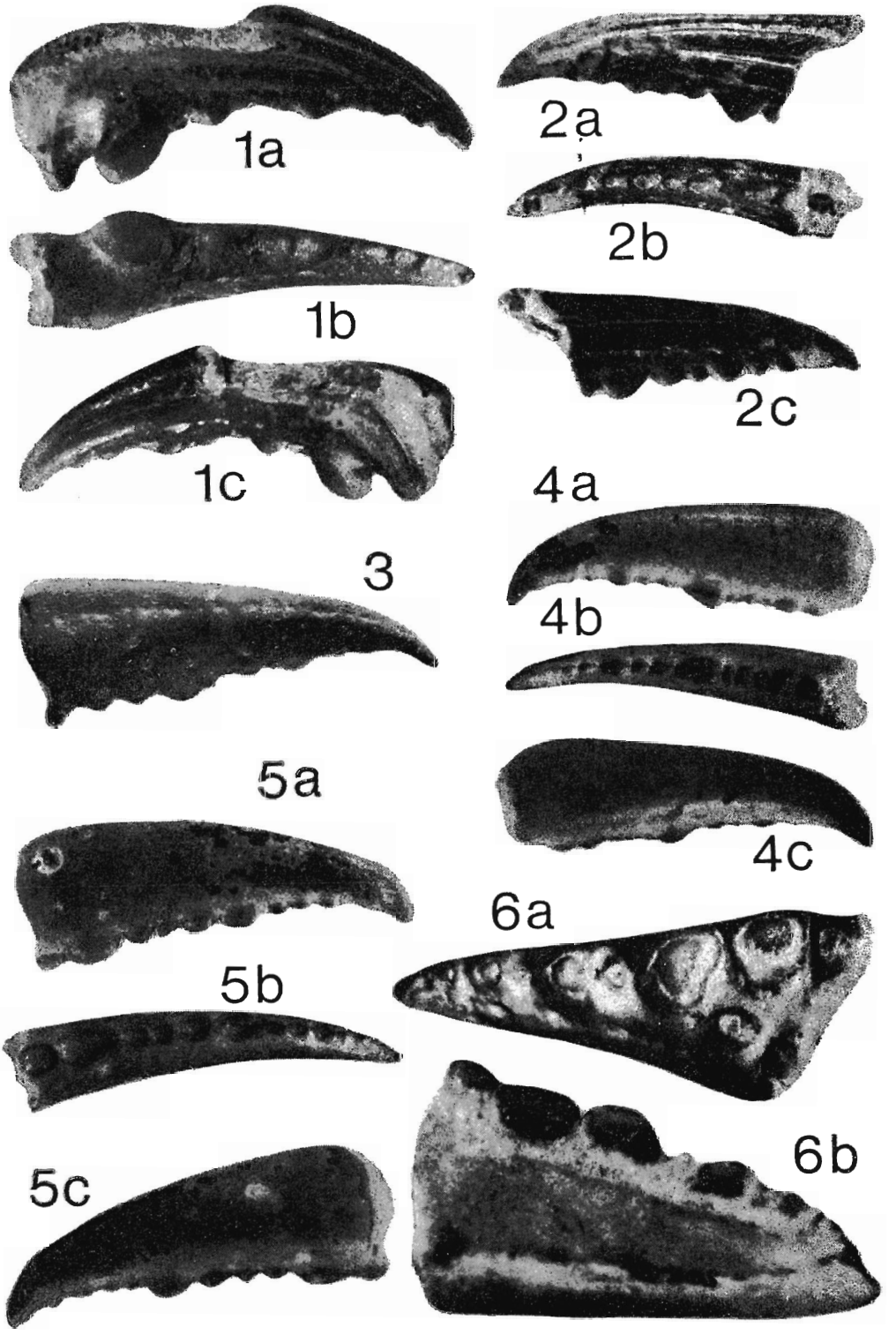
***Material*: 203 fragments comprising:**
123 dactyli, right cheliped (3.5—9 mm long)
80 dactyli, left cheliped (3—7 mm).

Remarks. — Slender, laterally compressed dactylus, moderately curved inward and downward; in cross-section high oval. Dentation very variable; teeth unequal, subtriangular, distally acute,

---

PLATE 5

1 — *?Pilumnus* sp.
Fixed finger, right chela; ×8; views of outer surface (*1a*), cutting edge (*1b*), and inner surface (*1c*)
2 — *?Ozius* sp.
Dactylus, right chela; ×8; views of outer surface (*2a*), cutting edge (*2b*), and inner surface (*2c*)
3 — *?Pilumnus* sp.
Fixed finger, right chela; ×12 (*SEM*); view of outer surface
4 — *Xantho* cf. *vulgaris* (Glaessner, 1928)
Dactylus, right chela; ×8; views, of outer surface (*4a*), cutting edge (*4b*), and inner surface (*4c*), showing the spoon-shaped tip
5 — Decapoda gen. et sp. indet., forma *A*
Dactylus, right chela; ×8; views of outer surface (*5a*), cutting edge (*5b*), and inner surface (*5c*)
6 — Decapoda gen. et sp. indet., forma *B*
Fixed finger, right chela; ×15 (*SEM*); views of inner surface, showing the two ridges


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

proximally often rounded. A single prominent tooth among a series of smaller teeth on the distal (anterior) part of the cutting edge; teeth formula variable (1111321423223 or 111322243335 or 111132243225). Surface smooth or very finely granulated except for a row of fine pits occasionally forming a shallow groove on the proximal dorsal part of both sides. Sporadic deep pits occur at the base of single teeth.

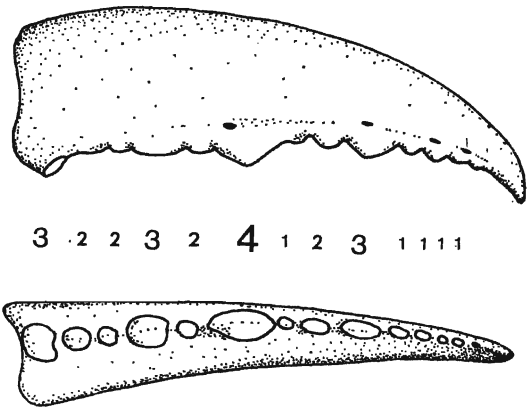


Fig. 12
Decapoda gen. et sp. indet., forma *A*
Dactylus, right chela; views of outer surface and cutting edge; teeth formula is indicated

Thought these dactyli are reasonably common (24% of the total assemblage) it was not possible to refer them to a genus or even to a family. The absence of characteristic features, the variablility in the dentation (total number and sequence of teeth) and the little modification of the surface (indistinct grooves or rows of fine pits only) made the more detail identification hopeless. The high variability even suggests that these fingers may belong to various species. Comparative examinations of Recent crabs showed that similar dactyli can develop in the nipper claws of Xanthoidea as well as in the Cancridea or Portunoidea.

Decapoda gen. et sp. indet., forma *B*
(Pl. 5, Fig. 6)

Material: 5 fragments (2—3.5 mm long) comprising:
4 fixed fingers of the right, one of the left cheliped.

Remarks. — Distal part of the fixed finger are only preserved. Tip robust, moderately upward-curved; cutting edge rapidly rising. Teeth increasing in size, acute. Outer surface smooth with a weak medial row of fine pits and single pits at the base of the teeth. Inner surface modified by two ridges: first ridge situated ventrally near lower edge, rising at the level of the first tooth, second ridge rising more dorsally at the level of the second/third tooth. The both ridges separated by a deep, elongated pit. These characteristic features could not be observed in any Recent or fossil cheliped studied for comparison. The best affinities show the Calappidae, for example *Matuta*, but none of the fixed fingers have developed a comparable ventral ridge and a similar dominant pit.

ECOLOGICAL AND BIOGEOGRAPHICAL REMARKS

Fragmentary preservation and the resulting insufficient identification of the majority of the decapod assemblage from Korytnica are not very promising for ecological or biogeographical information. The assemblage contains dominantly fragments of

juvenile individuals, and the only exception are the massive fingers of *Calappa* with fragments of adult specimens up to more than 22 mm in length. The predominance of the movable fingers (82%) is common to other occurrences of decapod remains embedded in diverse clayey beds. It is regarded to indicate a selection prior

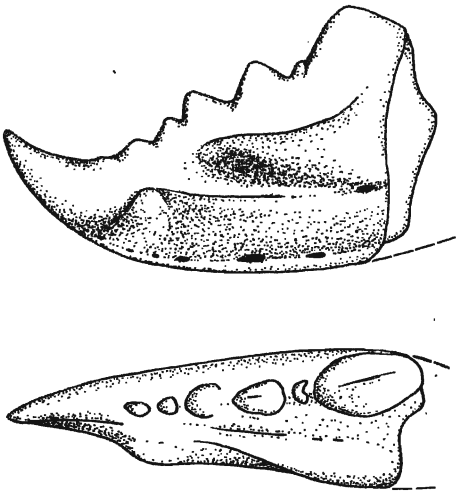


Fig. 13
Decapoda gen. et sp. indet., forma *B*
Fixed finger, right cheliped; views of inner surface with two ridges and cutting edge

to fossilization. The more calcified and therefore more resistant dactyli usually have been shifted away during the initial stages of decay of the dead animals or moults often dropping away from the still floating carcass. They thus avoid a longer transport and they usually have been embedded earlier than the carcasses which are destroyed by the action of carnivorous and bacterial feeders and by post-mortem decalcification.

The abundance of remains of *Calappa* supports the conclusion that members of this genus might be much more reponsible for the damages in gastropod shells found in the Korytnica Clays than the rare hermit crabs, even considering that chances for the fossilisation of hermit crabs are altogether less favorable than for the strongly calcified claws of *Calappa*. In particular, the gastropod shells with deep narrow incisions as figured by Bałuk & Radwański (1977, Pls 10—12; *cf.* also Radwański 1977, Pl. 12) correspond perfectly to the shell-opening mechanism of *Calappa* described by Shoup (1968). The large basal, outward and downward projected tooth of the dactylus, and the two protuberances on the outer surface of the fixed finger fit together when the chela is closed, thus breaking the portion of the shell that is bridged between them. Successively pieces of the shell are broken out in the figured pattern of a narrow deep incision until the enclosed animal is exposed. In this way *Calappa* efficiently opens shells of gastropods and other mollusks to feed the soft parts, or even more frequently it searches in the same way for the shell-domiciling hermit crabs.

According to the composition of the Korytnica assemblage, the intertidal and supralittoral zones can be excluded as well as the deeper parts of the neritic zone. None of the inhabitants characteristic of these zones have been recognized: neither

any representative of the Thalassinoidea, Corystidae, Grapsidae, and Ocypodidae typical of the littoral, nor any Homaridae, Homolidae, Dorippidae, and Geryonidae of the deeper waters. The high percentage of *Calappa* (9%) and *Ozius* (52%), both inhabitants of the littoral zone of the tropical seas, and the likewise shallower water preferring Portunidae suggest a distinctly warm and quite shallow-water biotope. The composition of the assemblage, as discussed with systematic description of its particular components, shows certain affinities to the Recent decapod fauna of the tropical Indo-Pacific (*cf. also* Bałuk & Radwański 1977, Förster 1979).

Bayerische Staatssammlung für Paläontologie
und historische Geologie,
Richard-Wagner Strasse 10,
D-8000 München 2, Bundesrepublik Deutschland

REFERENCES

BACHMAYER F. 1953. Die Dekapodenfauna des tortonischen Leithakalkes von Deutsch-Altenburg (Niederösterreich). *Mitt. Geol. Ges. Wien*, **44**, 237—262. Wien.

— 1962. Die Calappiden (Crustacea, Decapoda) aus den tortonischen Ablagerungen des Wiener Beckens. *Ann. Naturhistor. Mus. Wien*, **65**, 39—46. Wien.

BAŁUK W. & RADWAŃSKI A. 1977. Organic communities and facies development of the Korytnica basin (Middle Miocene; Holy Cross Mountains, Central Poland). *Acta Geol. Polon.*, **27**, (2) 85—123. Warszawa.

BEURLEN K. 1939. Neue Decapoden-Krebse aus dem ungarischen Tertiär. *Paläont. Zt.*, **21**' 135—160. Stuttgart.

FÖRSTER R. 1979. Decapod crustaceans from the Middle Miocene (Badenian) deposits of Southern Poland. *Acta Geol. Polon.*, **29** (1), 89—106. Warszawa.

GALOPIM de CARVALHO A. M. 1959. Malacostracas das formacoes glauconiosas do Miocénico superior do litoral a norte do Cabo Espichel. *Bol. Mus. Labor. Miner. Geol. Fac. Cienc., Univ. Lisboa*, **8**, 77—82. Lisboa.

GLAESSNER M. F. 1928. Due Dekapodenfauna des österreichischen Jungtertiärs. *Jb. Geol. B.-A.*, **78**, 161—219. Wien.

— 1930. Dekapodenstudien. *N. Jb. Miner. Geol. Paläont.*, BB **63**, 137—176. Stuttgart.

— 1933. New Tertiery Crabs in the Collection of the British Museum. *Ann. & Mag. Natur. Hist., Ser. 10*, **12**, 1—28. London.

— 1969. Decapoda. *In*: MOORE R. C., Treatise on Invertebrate Paleontology, Part R (Arthropoda 4), R399—533. Lawrence.

HÖPFNER G. 1974. Krabben *Mursia* Desmarest und *Panopeus* H. Milne-Edwards. *Der Geschiebesammler*, **9**, 31—32. Hamburg.

HOLTHUIS L. B. 1949. Fossil decapod crustacea from Miocene and younger deposits of the Netherlands. *Meded. Geol. Sticht. N.* S., **3**, 55—68. Heerlen.

JANSSEN R. 1972. Beiträge zur Kenntnis der Bryozoa, Vermes, Crustacea und Echinodermata aus dem nordwestdeutschen Mittel- und Obermiozän. *Veröff. Überseemus. Bremen*, A **4**, 71—108. Bremen.

LÖRENTHEY E. & BEURLEN K. 1929. Die fossilen Dekapoden der Länder der Ungarischen, Krone. *Geol. Hungarica, Ser. Palaeont.*, **3**, 1—420. Budapest.

MÜLLER P. 1973. Decapoda (Crustacea) fauna a budapesti miocénböl (1). *Földt. Közl.*, **104**, 119—132. Budapest.

— 1974. Decapoda (Crustacea) fauna a budapesti miocénböl (2). *Földt. Közl.*, **104**, 275—287. Budapest.

— 1975. Decapoda (Crustacea) fauna a budapesti miocénböl (3). *Földt. Közl.*, **105**, 506—515. Budapest.

— 1976. Decapoda (Crustacea) fauna a budapesti miocénböl (4). *Földt. Közl.*, **106**, 149—160. Budapest.

PAPP A., ZAPPE H., BACHMAYER F. & TAUBER A. F. 1947. Lebensspuren mariner Krebse. *Sitzungsber. Österr. Akad. Wiss., Math.-naturwiss.* Kl., **155**, 271—317. Wien.

RADWAŃSKI A. 1969. Lower Tortonian transgression onto the southern slopes of the Holy Cross Mts. *Acta Geol. Polon.*, **19** (1), 1—164. Warszawa.

— 1977. Present-day types of trace in the Neogene sequence; their problems of nomenclature and preservation. *In*: T. P. CRIMES & J. C. HARPER (*Eds*), Trace Fossils **2** (*Geol. J. Spec. Issues*, **9**), 227—264. Liverpool.

REUSS A. E. 1867. Die fossile Fauna der Steinsalzablagerung von Wieliczka in Galizien. *Sitzungsber. k. Akad. Wissensch. Wien*, **55** (1), 17—182. Wien.

SHOUP J. B. 1968. Shell opening by crabs of the genus *Calappa*. *Science*, **160** (No. 3830), 887—888. Washington.

STANCU I. & ANDREESCU E. 1968. Fauna tortoniana din regiunea Rugi-Delinesti (Bazinul Caransebesului). *Stud. Cerc. Geol. Geofiz. Geogr., Ser. Geol.*, **13**, 455—471. Bucuresti.

VEIGA FERREIRA O. da 1954. Malacostraceos do Miocénico marinho de Portugal. *Com. Serv. Geol. Portugal*, **35**, 57—78. Lisboa.

— 1958. Descoberta de "*Calappa heberti*" no Tortoniano do Penedo (Cabo Espichel). *Com. Serv. Geol. Portugal*, **42**, 203—207. Lisboa.

VIA L. 1948. Braquiuros fósiles de Barcelona y sus alrededores. *An. Esc. Peritos Agr. Espec. Agropec. Serv. Techn. Agricult.*, **7**, 143—152. Barcelona.

YANAKEVICH A. N. 1969. Zur Charakteristik von Krabben aus miozänen biohermen Kalken des nordwistlichen Moldaviens. *Paläont. Sborn.*, **6**, 25—27. Lvov.