A C T A P A L A E O N T O L O G I C A P O L O N I C A
Vol. XVII 1972 No. 3

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CEPHALOPOD ARM HOOKS FROM THE JURASSIC OF POLAND

Abstract. — The paper presents descriptions of 22 morphological types of cephalopod arm hooks found mainly in three Middle and Upper Jurassic localities in Poland. The majority of them were included in 7 new genera, *Acanthuncus, Arcuncus, Cornuncus, Deinuncus, Falcuncus, Longuncus* and *Urbanekuncus* and 12 new species; the remaining 10 forms are described without specific names. Morphology of fossil cephalopod hooks, hooks of Recent calmars and jaws of fossil and Recent polychaetes are compared. It was found that the genera *Paraglycerites* Eisenack and *Arites* Kozur hitherto considered as scolecodonts appear to be cephalopod hooks. The stratigraphical value of the material is briefly discussed.

INTRODUCTION

Some Recent calmars are known to have, beside suckers, hooks on their arms. These hooks, built of hard organic matter, are commonly 0.5 to 10.0 mm long and serve to catch and hold the victim. Similar hooks have been found in ancient deposits since the Permian. Usually they were found on the surfaces of slates and rocks of the lithographic limestone type, commonly with shell fragments of cephalopods of the orders Belemnitida and Phragmoteuthida, and occasionally in coprolites and close to marine reptilian skeletons, where they represent remnants of stomach content of these reptilians. The fossil cephalopod arm with hooks was described as early as 1822 by Sternberg, who interpreted them as algal remnants. The correct interpretation of this specimen was that of Münster (fide Naef 1922, p. 180). The fossil cephalopod arm hooks were later described or mentioned by almost twenty papers, the most important of which are these by Quenstedt (1858, 1885), Kaferstein (1866), Naef (1922), Riedel (1936), Rosenkrantz (1946), Fischer (1947), E. L. Hekker & R. F. Hekker (1955), Wilczewski (1967) and Rieber (1970). However, the majority of the above papers are based on single specimens and deal with description and systematic identification of the whole animal, and hooks are not adequately described and schematically figured. A larger number of separate hooks was described by Quenstedt (1858, 1885), partly under a generic name, *Onychites*, and partly as "Kralle von Onychoteuthis" and all of them were termed onychits. Moreover, the most extensive description of fossil cephalopod arm hooks was given by Naef (1922), who summarized different morphological forms of these hooks and compared them with hooks of Recent calmar, *Ancistroteuthis lichtensteini*.

Descriptions of some onychits may also be found in papers dealing with Mesozoic scolecodonts, where they were misinterpreted as polychaete jaws. They were found together with scolecodonts in residuum after dissolution of rock samples and as they are similar to some scolecodonts in morphology and size and are also formed of hard organic matter, misinterpretation was easy. Two genera and a number of species proposed in this way (Eisenack 1939; Kozur 1967, 1970, 1971) were widely accepted within the systematics of scolecodonts (Howell 1962; Jansonius & Craig 1971). A large number of different morphological forms of onychits in the collection studied and comparisons with hooks of Recent calmars enabled the present authors to find some morphological features specific for hooks from cephalopod arms and permitting distinguish them from scolecodonts.

The material studied was extracted from limestones and marls dissolved with acids. Approximately 200 specimens were obtained from the dissolution of about forty kilogrammes of rocks from three Middle and Upper Jurassic localities; moreover, single specimens from the Oxfordian, Maestrichtian and Danian of Poland are represented in the collection. After dissolution, the residuum was not dried but the clay was scoured out and particular specimens were extracted with pipette and directly put into glicerine. This technique made it possible to collect fragile and even strongly fractured specimens. The specimens obtained differ in preservation. Some of them are complete and undeformed, while others are cracked, occasionally strongly fractured or somewhat inflatted.

Drawings given in plates were made by the authors using binocular microscope "Leitz" with drawing device and subsequently shadowed by Mrs. D. Sławik. Comparative material of Recent cephalopods was kindly supplied by the Institute of Zoology, Polish Academy of Sciences. The collection studied is housed at the Institute of Paleontology, Polish Academy of Sciences, Warsaw (Z. Pal.).

We would like to thank Prof. R. Kozłowski for encouraging us to study the acid-extracted material of Mesozoic rocks, for supplying with his own material and for his valuable advice. Thanks are also due to Dr H. Rieber, University of Zürich, for photos and correspondence, and Dr M. Lipiński, the Institute of Fishery at Gdynia for help in gathering literature and discussions concerning Recent calmar faunas.

ORIGIN OF MATERIAL

The oldest specimens in the collection were found in calcareous concretions occurring in dark clays of the Middle Bathonian, the Morrisiceras morrisi Zone (after stratigraphy of Różycki, 1953) at Blanowice, the Zawiercie area. In the residuum, cephalopod hooks are accompanied by remnants of Rhabdopleura, scolecodonts, fragments of Hydroida periderm and organic linings of foraminifer tests. In clays and concretions, ammonites, belemnites, brachiopods and pelecypods were found.

In similar facies, in calcareous concretions embedded in clays, cephalopod hooks were found in Callovian deposits at Łapiguz claypit near Łuków. Ammonite fauna of the *Kosmoceras jason*, *Kosmoceras spinosum* and Peltoceras athleta Zones is represented here (Makowski, 1952). In the residuum, cephalopod hooks are accompanied by remnants of Rhabdopleura, scolecodonts, fragments of Hydroida periderm and organic linings of foraminifer tests (Kulicki 1969, 1971). In concretions and, occasionally, in clays, ammonites, belemnites, pelecypods, gastropods, scaphopods, serpulids, and, sporadically, bryozoans, brachiopods and echinoderms occur.

A single cephalopod hook was found in white, soft limestones of the Idoceras planula Zone at Pajęczno. These limestones are characterized by abundant faunas of sponges, serpulids, bryozoans, brachipods, crinoidal stems, echinoid spines and subordinate pelecypods and small coral colonies (Wierzbowski, 1966).

A large part of the material studied was found in gray marls exposed at Tomaszów Mazowiecki, belonging to the Zaraiskites scythicus Zone of the Volgian stage (Kutek, 1962). From these deposits, Lewiński (1922) cited pelecypods, gastropods, ammonites, serpulids, brachiopods, crinoids and echinoids.

A single specimen was found in marls of the Campanian age in the borehole Magnuszew near Warsaw at depth of 623 m.

A single specimen was also found in marls of the Danian age (Pożaryska, 1952) pierced by borehole at Góra Puławska upon Vistula River, at depth of 24 m. Here, remnants of Rhabdopleura, fragments of Hydroida periderm, spicules of siliceous sponges, organic foraminifer linings and Hystrichosphaeridae were found (Pożaryska 1952; Kozłowski, 1956).

STRATIGRAPHICAL VALUE

The stratigraphical value of cephalopod arm hooks has not hitherto been known, because of the lack of studies dealing exclusively with these fossils as well as inadequate amount of material collected in continuous profile. However, the stratigraphical value of other skeletal remnants of cephalopods to which the hooks also belong, and particularly of belemnite rostra, the most common due to their high resistance to weathering, is widely accepted. According to Jeletzky (1966, p. 138) "arm hooks are invariably present in all well-preserved, identifiable belemnitid remains..." Moreover, these hooks were considered to be of diagnostic value — "Für die Artunterscheidung geben die "Onychiten" sichere Anhaltspunkte, ebenso für die Verwandschaft bestimmter Typen" (Naef 1922, p. 188). Thus it may be assumed that cephalopod arm hooks may be similar in stratigraphical value to the rostra.

Fossil cephalopod arm hooks were also sometimes found together with skeletal elements of Phragmoteuthida, which are characterized by mixture of diagnostic features of Belemnitida and Teuthida. Phragmoteuthida were assigned to Belemnitidae as a separate family by Naef (1922) or regarded as a separate order, representing independant evolutional branch, diverging from the common phylogenetic stem of Belemnitida and Teuthida (Jeletzky, 1966). Phragnoteuthida were not hitherto applied in stratigraphy, because their very fragile shells would have been preserved only in extremely favourable conditions. However, it seems probable that their individual arm hooks are of stratigraphical value. Previous authors had given some examples of arm hooks of different species of one genus which markedly differ from each other, e.g. these of *Phragmoteuthis bisinuate* (Bronn) and *Phragmoteuthis? ticinensis* Rieber (Rieber, 1970).

Arm hooks of Recent calmars are also differentiated but no fossil calmar with hooks was found (Jeletzky, 1966).

Onychits, due to their remarkably small size and organic matter resistant to acids, are more likely to be preserved than calcareous cephalopod shells, including rostra. Moreover, they are much more numerous than shells. Fossil forms commonly had two rows of hooks on each of their 8 or 10 arms, and each of these rows, as e.g. in the case of *Phragmoteuthis? ticinensis* Rieber, numbered 28 to 34 hooks (Rieber, 1970). Remarks on onychit occurrence are innumerous, according to the present authors, presumably result of inadequate methods of searching. The only method to obtain undamaged specimen is that based on dissolution of rock samples in acids and extraction of specimens from liquid residuum. In the case of Mesozoic rocks, the method of searching microfossil content through dissolution in acids has not been widely applied until recently. At present this method is becoming more and more popular, particularly among students of condonts. However, in the conodont searching, residuum is commonly dried which significantly decreases the probability of preservation of onychits. Moreover, conodonts, prior to extraction from the residuum, are commonly separated through heavy-fluid method; in such case, onychits if present, are left in light fraction and poured out thereafter.

When appropriately searched for, onychits appear to be very common, although not especially numerous microfossils of the Mesozoic. They were found in almost all localities, from which samples were dissolved. Universality of onychit occurrence is confirmed by the fact that they were described in almost all papers dealing with Mesozoic scolecodonts. Triassic onychits were not only figured by Zawidzka (1970) but she also has some specimens in her collection (personal information). The search of onychits may be far easier in the future, providing that the facies in which they are the most common will be identified.

The material studied by the present authors, except for three specimens, come from three localities of the Middle and Upper Jurassic. Among sufficiently-preserved specimens, 19 morphological forms were distinguished. Four of them were found in the Bathonian of Blanowice near Zawiercie, three — in the Callovian of Łuków, and 12 — in the Volgian of Brzostówka near Tomaszów Mazowiecki. The only close similarities between onychits previously described and these of the present paper include: 1) *Paraglycerites gracilis* n.sp. from the Bathonian and *P.* sp. *A* of the Callovian age are very similar to *P. necans* Eisenack from the Callovian of the Kaliningrad area; however, it seems that the Callovian forms are more closely related to each other than to the Bathonian form and even they may be conspecific. 2) *Acanthuncus passendorferi* n.sp. of the Volgian age is similar in shape to the hooks from arms of *Acanthoteuthis speciosa* Münster from the Upper Malm of Germany.

The above facts point to great differentiation of onychits and their presumable stratigraphical value. They may be particularly useful in the stratigraphical subdivisions of borehole sections, where available macrofauna is scarce. However, further studies are necessary for establishment of vertical succession of onychit faunas.

ARM HOOKS OF THE RECENT CALMARS

Arms of the Recent calmars are armed with suckers with conchiolin rings or hooks which are elements of specifically modified suckers. Numerous Recent calmars have arms equipped exclusively with suckers differing in size and development of conchiolin ring. Arms of calmars of the families Onychoteuthidae, Gonatidae, Enoploteuthidae and Cranchiidae are equipped both with hooks and suckers. Number of arms equipped with hooks is different in particular families; e.g. in the family Onychoteuthidae all arms are equipped with normal suckers, whereas both sucker and hooks occur on tentacles (Text-fig. 1); in Gonatidae, ventral pair of arms is covered exclusively with suckers, whereas on the rest both hooks and suckers occur; in Enoploteuthidae, both suckers and hooks occur on all arms and tentactles.

Modification of suckers into hooks both in phylo- and ontogeny was described by Naef (1922). Schematic drawings of the hook development and relation of soft parts to conchiolin ones in the family Onychoteuthidae, given in Text-fig. 2, are based on Naef's (1922) description and studies on Recent specimens of the genera *Onychoteuthis* and *Ancistroteuthis* carried out by the present authors (Pl. I, Figs. 1—3).

All Decapoda have suckers fixed on narrow, shrinkable pedicle (Text-fig. $2A_1$) and provided with conchiolin ring. The ring is of epidermal origin,

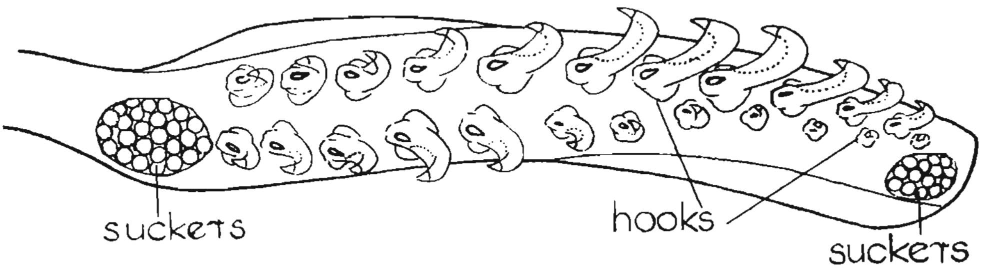

Fig. 1. Distribution of hooks and suckers on tentacle of *Onychoteuthis banksi* (Leach, 1817), Recent. (After Ferrusac & d'Orbigny, 1835-1848).

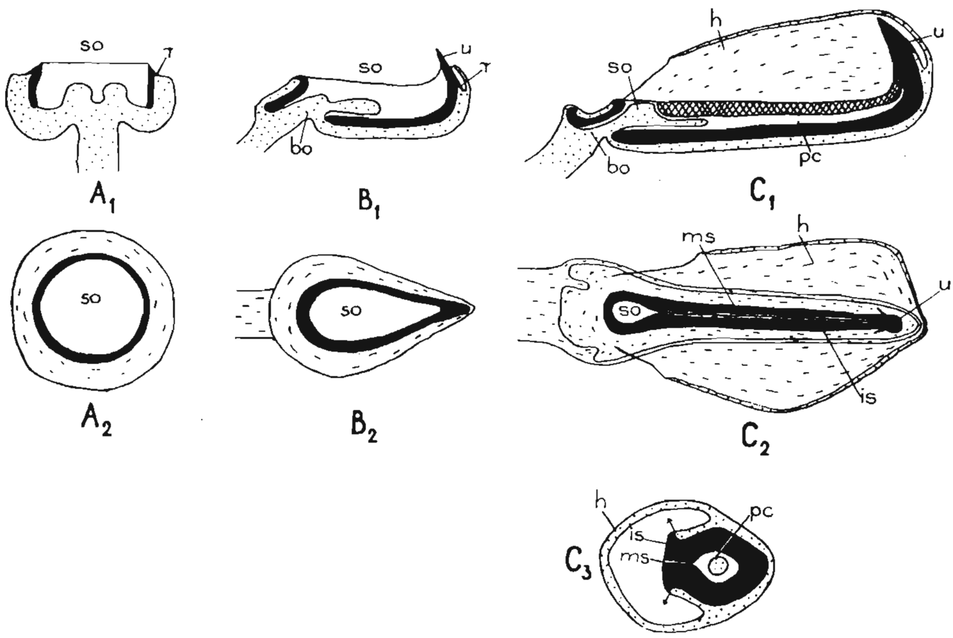

Fig. 2. Sketch drawings illustrating modification of sucker ring into hook in Recent genera *Onychoteuthis* and *Ancistrotenthis*. A_1 — cross-section through sucker, A_2 — sucker seen from above, B_1 — cross-section through transitional form, B_2 — the same seen from above, C_1 — longitudinal section through hook, C_2 — hook seen from the inner side, C_3 — cross-section through hook and soft tissues, bo — basal opening, po — pseudopulp cavity, p — projection, r — ridges, sin — sinuses, so — sucker opening, u — uncinus. (Original drawing).

sticking to soft tissues with its whole external surface. Its inner surface is formed by walls of sucker chamber. Narrow belt of thickened cuticle marking upper limit (so-called Haftring; cf. Text-fig. $2A_1$) to which soft tissues stick to conchiolin sucker ring is marked somewhat below the upper, sharp margin of the ring. Sharp sucker margin may be straight or variously denticulated (Ferussac & d'Orbigny, 1835—1848, *Loligo* Pl. 4, Fig. 1h, 1c). Transitional form between typical sucker and hook (Text-figs. $2B_1$, B_2) is characterized by extension of distal part of sucker ring and formation of sharp teeth in this part (Naef, Pompecki & Schindewolf, 1933, p. 297; Naef, 1922, Fig. 68k, l, m). Sucker so developed already works as hook. Sucker rings of many Recent calmars are modified in this way

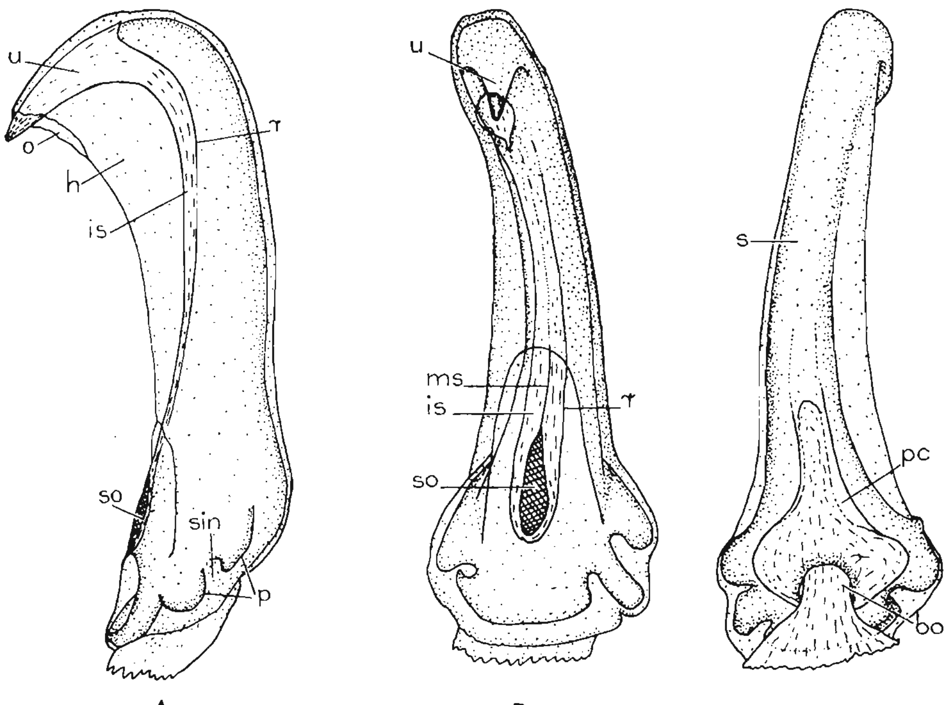

Fig. 3. Hook of *Onychoteuthis banksi* (Leach, 1817), Recent, with soft tissues. A — side view, B — view from the o uter side.
bo — basal opening, h — hood, is — interrige surface, ms — median suture, o — place where uncinal point penetrates hood, pc — pseudopulp cavity, p — projections, r — ridge, sin — sinuses, so — sucker opening, s — hook shaft, u — uncinus. (Original drawing).

(Ferussac & d'Orbigny, 1835—1848, Pl. Onychoteuthe 5, Fig. 6a, Pl. Loligopsis 4, Figs. 7, 8, 21, 22).

If further elongation of sucker ring will be accompanied by overlapping of opposite sides, hook similar to that of Recent *Onychoteuthis* or *Anci-*

stroteuthis will originate. In such a hook, base (Basal Teil des abgeänderten Hornringes), shaft (Stiel) and uncinus (Haken [1]) may be distinguished.

Hook base is widened, with sinuses (Einbuchtungen) both on left and right sides, and projections (Fortsätzen). Basal opening is developed. Hook base is specifically truncated in lateral view. Basal opening passes into an extensive cavity, penetrating and narrowing toward shaft, and, occasionally, extending up to the proximal part of uncinus. This cavity is here termed a pseudo-pulp cavity, in contrast to pulp cavity of e.g. Annelida jaws, which are of different origin. The pseudo-pulp cavity corresponds to sucker chamber (Saugkammer) of *Onychoteuthis* and *Ancistroteuthis* and is connected with external environment through reduced sucker opening (Text-fig. 2, 3). Reduced sucker opening is semicircular in proximal part, gradually narrowing toward the distal part where it passes into medial suture (Text-figs. 2, 3), formed by accretion of opposite sides of conchiolin ring. Along inner side of shaft and proximal part of uncinus, two margins sharpened in the cross-section continued (Text-fig. $2C_3$). In the proximal part, both margins joint one another somewhat below sucker opening, whereas over the distal part they joint one another on the outer margin of the hook (Text-fig. $2C_2$). Joined margins correspond to narrow belt of thickened cuticle (Haftring) of conchiolin sucker (cf. Text-figs. $2A_1$, $2C_1$); thus they mark, similarly as in the above case, the boundary between hook surface accreted with soft tissues and the surface devoid of soft tissues (Text-figs. 3, 2). Also surface of pseudo-pulp cavity is not covered with soft tissues. The proximal interior of that cavity is occupied by muscles, which enter the cavity through the basal opening but nowhere stick to its surface (Fig. $2C_1$). Strong muscle scars are located on the exterior, lower and lateral surfaces of hook base. The whole hook is additionally covered with a hood of soft tissues (Kapuze) (Pl. I, Fig. 1; Text-figs. 3, $2C_1$). The hook do not begin to work until uncinus pierces soft tissues (Text-fig. 3).

FOSSIL HOOKS AND THEIR RELATION TO RECENT CALMAR HOOKS

The specimens ranged in the genus *Onychites* by Quensted (1858) attain large size, over 10 mm in length, and are characterized by their base markedly widened and hook shaft and uncinus commonly overlapping to such a degree that both these elements are difficult to distinguish. Uncinus of the specimens of the genus *Onychites* sensu Quenstedt (1858) is never markedly curved down toward the basis. Hooks of such type were never

[1] Naef (1922) inconsistently applied the term "Haken" for the whole conchiolin form and, at the same time, only for its curved distal part.

found accompanied by other elements of cephalopod skeletons or imprints of soft parts, i.e. cephalopod arms.

The second type of hooks is represented by the specimens described as "Kralle von Onychoteuthis" by Quenstedt (1858, p. 74). Hooks found together with other remnants of cephalopods of the subclass Coleoidea and the majority of isolated hooks hitherto reported (Riedel, 1938; Hekker, 1955; Wilczewski, 1967; Fischer, 1947) as well as the specimens of the authors' collection belong here.

Up to the present, two fossils groups of Coleoidea, i.e. Belemnitida and Phragmoteuthida, have been found to be hook-bearing. Triassic representative of the order Phragmoteuthida, *Phragmoteuthis? ticinensis* Rieber, 1970, has hooks arranged in two rows on each of its ten arms (Pl. 1, Fig. 3) (Rieber, 1970). In turn, representatives of the order Belemnitida, e.g. "*Belemnoteuthis*" *montefiorei* Buckman, 1879 appear to have hooks fixed on eight arms (Jeletzky, 1966). In the case of *Acanthoteuthis (Belemnoteuthis) syriaca* Roger, a representative of *Diplobelina* (Jeletzky, 1966), hooks were found on seven or eight arms out of ten reconstructed by Roger (1944).

Assignation of hooks figured by Fischer (1947) to the representative of Aulacocerida, *Dictyoconites groenlandicus*, suggested by Fischer (l.c.) was subsequently questioned by Jeletzky (1966) as rather improbable. According to the latter author, hooks figured by Fischer (l.c.) belong to *Permoteuthis groenlandica* Rosenkrantz, 1946, i.e. to the representative of the order Phragmoteuthida. In turn, either small or large hooks figured by

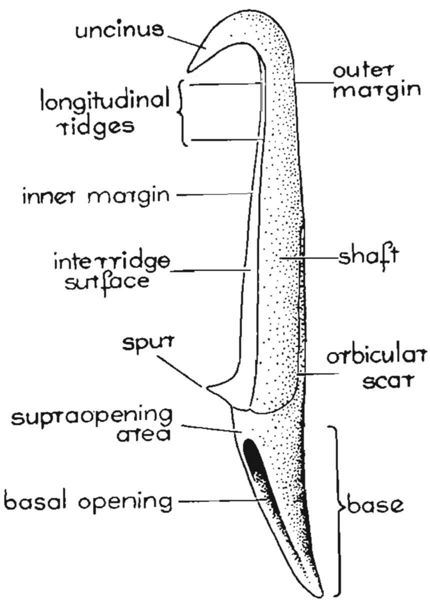

Fig. 4. Diagramatic figure of fossil arm hook with particular morphological elements distinguished.

Rosenkrantz (1946) may belong to *Permoteuthis groenlandica*, according to the present authors.

Previous studies have not shown any significant differences in structure of hooks belonging to Belemnitida and Phragmoteuthida. Of primary importance for systematic of isolated hooks is the statement of Rieber (1970, p. 33) that hooks of particular individual differ only in size (cf. Naef 1922, fig. 91; and Jeletzky 1966, Pl. 16, Fig. 3). Difference between Phragmoteuthida and Belemnitida on one side, and Recent Onychoteuthidae on the other, is expressed by differentiation in size and form of hooks on the tentacles of particular individual of the latter group (Text-fig. 3).

The structure of fossil hooks from the authors' collection is schematically presented in Text-fig. 4. In all fossil, as well as Recent hooks, three main parts may be distinguished: base, shaft and uncinus.

Base is characteristically truncated and elongated to a different degree, similarly as in all fossil hooks found together with other fragments or imprints of cephalopod skeleton (see Kaferstein, 1866, Pl. 131, Fig. 3; Naef, 1922, Fig. 68a, b, d, e and g, Fig. 91; Rieber, 1970, Fig. 3).

The Recent hooks of *Onychoteuthis* and *Ancistroteuthis* are more similar to these of the genus *Onychites* Quenstedt than to the above hooks in widening of base and truncation of it in lateral view.

Basal opening (Text-figs. 4, 5) located in the base, is commonly elongated, elliptical, somewhat narrowing pseudopulp cavity on sides and from

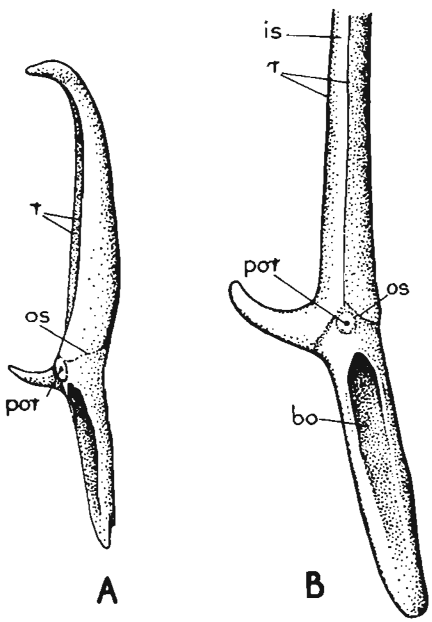

Fig. 5. *Paraglycerites gracilis* n.sp.; A — side view of the whole specimen, B — lower part of the specimen seen from below: os — orbicular scar, por — circular elevation with porus or deep depression on the top, r — longitudinal ridges. (Drawings made on the basis of electronic microscope Stereoscan photos).

above in specimens studied, Basal opening so developed is similar to that of Recent hooks of *Onychoteuthis* and *Ancistroteuthis*, differing only in stronger elongation, related to shape of the whole base.

On the upper part of the base, above basal opening, small inflatted surface (supra-opening area), more or less distinctly separated from shaft is often marked. Electron microscope studies have shown that small depression or porus is marked on this surface in the case of *Paraglycerites gracilis* (Text-fig. 5). This depression or porus may represent a skinned sucker opening.

Shaft is straight to slightly incurved in later view. Curvature of inner margin is commonly smaller than that of the external margin. Lateral inflation of shaft, as in the case of hooks of Recent *Onychoteuthis* and *Ancistroteuthis*, is commonly marked. *?Onychites felinus* n.sp. and *?Urbanekuncus* sp. C with sub-sircular cross-section of the shaft are the

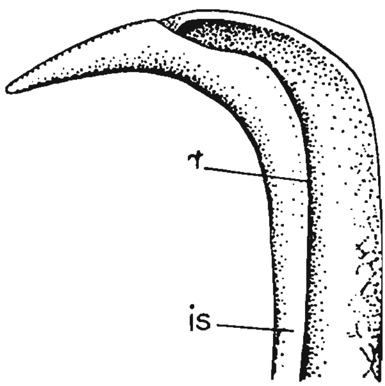

Fig. 6. Distal part of hook of *Onychoteuthis banksi* (Leach, 1817), Recent. Right and left longitudinal ridges joint in half of the height of uncinus over the outer margin area.

only exceptions. The majority of forms described in the present paper have a *spur* set on the shaft, close to its inner margin. It may be mentioned here that no similar features were found in the Recent calmar hooks. The spur is variable both in size and shape; it may be markedly long, claw-like as in the case of *Paraglycerites gracilis*, or small, knob-like, as in *Urbanekuncus* or *Longuncus*. Location of the spur differs in particular genera or species (cf. *Paraglycerites* and *Urbanekuncus* sp. C). In accordance to location of the spur on the left or right side of shaft, hooks are termed as left-spur or right-spur hooks. Both above types are distinguished in the collection.

Uncinus differs in the ratio of its length to the length of the whole specimen. Its proximal part may be inflatted or circular, just as the shaft. The genera *Paraglycerites, Deinuncus* and *Longuncus* are characterized by uncinus distinguished similarly as in *Onychoteuthis* and *Ancistroteu-*

this hooks. In the remaining fossils genera the uncinus passes obscurely into the shaft so the boundary between both these elements is difficult to delineate; in this case the uncinus is weakly incurved.

Pseudopulo cavity is situated within the base and shaft or even within the uncinus, as in Recent forms; occasionally it enters the spur providing that the latter element is sufficiently large.

Inner hook side is ornamented with two *longitudinal*, sharp *ridges* continuing parallel to one another (Text-fig. 4) and corresponding to ridges on Recent *Onychoteuthis* and *Ancistroteuthis* hooks. In the case of fossil hooks, both ridges continue upwards to the uncinus end, whereas in Recent hooks they join one another on the inner side of the uncinus, at some distance from its end (Text-fig. 4). Over the proximal part, one ridge passes through the spur or, when the spur is developed in the form of small, knob-like elevation, ends at it. Instances, when the ridges continue downward of the spur, regardless of its place of location, were not found. The ridge passing through the spur is commonly more strongly marked than the opposite ridge. Also in the case when the spur is lacking, one ridge may be stronger than the other. In a few instances in *Paraglycerites* gracilis n. sp. both ridges join one another over the proximal part (Text-Fig. 5B); but it may be supposed that here both ridges reach orbicular scar. In *Onychoteuthis* and *Ancistroteuthis*, both ridges join one another over the proximal part of the hook, below sucker opening, which fact unequivocally determines relation between soft tissues adhering hook surface and hook part non-covered with these soft tissues. Boundary to which soft tissue was accreted to proximal part of fossil hooks, devoid of sucker opening is insufficiently known. Surface delineated by the both ridges — *inter-ridge surface* — over the inner hook side fully corresponds anatomically to such surface in *Onychoteuthis* and *Ancistroteuthis* hooks. Small ridge, nonuniformly developed continues through inter-ridge surface in specimens of *Paraglycerites* and *Falcuncus* (Text-fig. 7); it is not certain whether or not this ridge is homologous with medial suture of Recent forms.

Ring-like ridge was found in *Cornuncus* nov. gen., *Urbanekuncus* sp. *C* and *?Onychites felinus* n. sp. This ridge is homologous to and presumably represents a specific modification of longitudinal ridges noted in the case of other forms.

Orbicular scar is more or less distinctly marked on all specimens of *Paraglycerites, ?Onychites felinus* n. sp. and *Urbanekuncus* sp. *B*. It is commonly located at the height of the spur in *Paraglycerites* and *Urbanekuncus*, and in half of shaft height in *?Onychites felinus* n. sp. devoid of the spur. The scar continues around shaft, forming large sinus toward the distal part over the outer side. The sinus of orbicular scar reaches bend of external margin of shaft extending up to the mid-height of shaft in *Paraglycerites* and *Urbanekuncus,* while it is smaller in *?Onychites.*

The comparison of the course of orbicular scar of *Paraglycerites* and *Urbanekuncus* with the line of the basis of hood of *Onychoteuthis* and *Ancistroteuthis* enabled the authors to suppose that the orbicular scar marked the course of the basis of hood in fossil cephalopod hooks. Shaft of Recent hooks of *Onychoteuthis* and *Ancistroteuthis* are devoid of any scar-like elevation in place where hood basis ends, although the course of

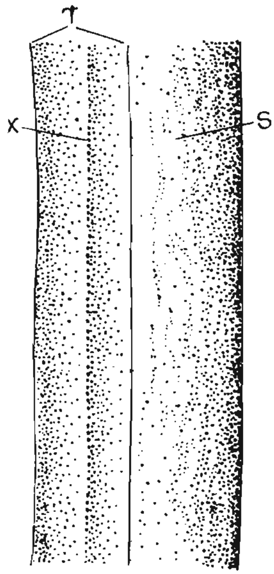

Fig. 7. *Paraglycerites* sp. shaft fragment seen from interior side; r — longitudinal ridges, x — median longitudinal ridge in the middle of interridge surface. Dráwing made on the basis of electronic microscope Stereoscan photos).

the basis of the Recent hook hood and orbicular scar of *Paraglycerites* and *Urbanekuncus* are essentially the same. (Cross-section of shaft of *Paraglycerites* and reconstruction of the hood are given in (Text-fig. 8).

Recent and fossil hooks exhibit asymmetry in relation to the plane passing through uncinus end and the middle of inner shaft side. Asymmetry of fossil hooks is manifested primarily in occurrence of the spur, and also by stronger development of one ridge, what is well marked in cross-sections (cf. Text-fig. 9). Moreover, basal opening is occasionally somewhat twisted in relation to plane of symmetry. Sometimes slight lateral distortion of hook shaft, resulting in small deviation of uncinus is marked. In Recent hooks, basal projection and sinus on one side are usually better developed than these from the other side; hook shaft is also usually sligthly bent sideways.

It follows from the above comparison that fossil hooks described by the present author correspond morphologically to Recent calmar hooks of the genera *Onychoteuthis* and *Ancistroteuthis*. Differences, as the occurrence of spur, lack of sucker opening and elongation of basal part in the majority of fossil forms may result from their higher specialization.

All Recent calmars with arms and tentactles or only tentacles equipped with hooks, are characterized by conical, elongated muscular body and are beasts of prey. The hooks serve this very nimble beasts of prey to

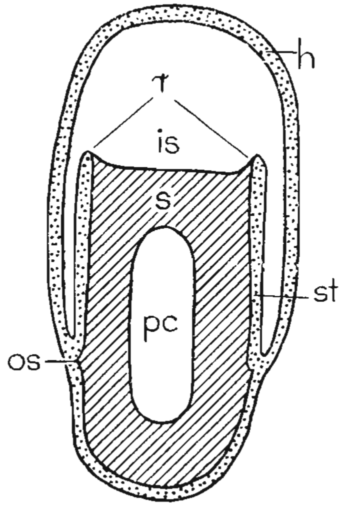

Fig. 8. Schematic cross-section illustrating relation of hood and soft tissues to hook shaft and orbicular scar in fossil forms; os — orbicular scar, pc — pseudopulp cavity, r — ridges, s — hook shaft.

hold larger victims, mainly fish until they become weak as a result of bites and poison injected by jaws (Abel, 1916, p. 28). The body of Belemnitida and Phragmoteuthida was similarly conical, markedly elongated, and with eight to ten arms equipped with two rows of hooks. This indicates that ethological features of fossil and Recent hook-bearing animals were substantially the same.

COMPARISON OF ONYCHITS AND SCOLECODONTS

Jaws of fossil and Recent polychaetes are strongly variable in morphology. Cephalopod hooks are far less differentiated but their shape is also variable. Both these organs, jaws and hooks, serve to similar purposes as the jaws of prey polychaetes also serve to catching victims. Therefore the existence of convergent forms may be inferred and knowledge of morphological details of both these groups in necessary to avoid misinterpretations. In the authors' collection numerous morphological forms of onychits occur together with Mesozoic scolecodonts. The comparative material also comprised the large collection of Paleozoic scolecodonts of Prof. Prof. Z. Kielan-Jaworowska and R. Kozłowski, Recent polychaetes and calmars. Comparative studies enabled the authors to select diagnostic features of onychits and scolecodonts, permitting easy discrimination of both these groups.

Preservation

Cooccurrence of onychits and scolecodonts in all samples make it possible to notice differences in their preservation. Scolecodonts dark-brown, with glittering external surface, are commonly better preserved than onychits, which are intensively black, usually dull, often broken or strongly fractured (Pl. XV, Figs. 2, 4, 5). Moreover, scolecodonts, contrary to onychits, easily become bleached in oxidizing solutions. These differences presumably result from differences in chemical composition and, partly, from microstructure.

Differences in preservation of the representatives of the genus *Paraglycerites* Eisenack and Paleozoic scolecodonts have already been noted by Eisenack (1939), who supposed that the former are built of chitin with large admixture of calcium or phosphate. However, Eisenack's suppositions were not based on chemical analyses. The chemical composition of neither scolecodonts nor onychits is known. The only studies on chemical composition of scolecodonts, were performed by Schwab (1966), but they have been judged uncertain by this author (Schwab, l. c). The cephalopod hooks were hitherto supposed to be formed of horny substance, chitin or conchiolin but no results of chemical analyses were cited.

Discrimination of onychits and scolecodonts exclusively based on preservation is not unequivocal. Some scolecodonts, e. g. from the family Goniadidae Kinberg, are almost black, with slightly glittering surface and hardly decolourize in exidizing solutions. However, they still differ from onychits in a number of morphological features.

Morphology

The location of basal opening is a primary feature discriminating scolecodonts and onychits. In the former, opening of pulp cavity is variable in size and shape, but always located on ventral side, marking their asymmetry; the opening is even applied in orientation of specimens. In the latter forms, opening of pseudo-pulp cavity is situated at the basis and almost symmetical. Onychits, treated as scolecodonts, cannot be oriented at all.

Ridges, delineated area to which soft tissues adhere to onychit and interridge surface way are other features discriminating scolecodonts and onychits, as they are lacking in the former ones. These ridges are sometimes weakly marked but may be found on almost all specimens in the collection.

Lower end of one of the longitudinal ridges in majority of onychits is provided with spur, set perpendicularly to lateral side of the whole onychit and commonly claw-like curved. No similar process or denticles perpendicular to lateral surface were found in scolecodonts. In turn, inner margin of scolecodonts is almost always denticulated, what is not found in onychits.

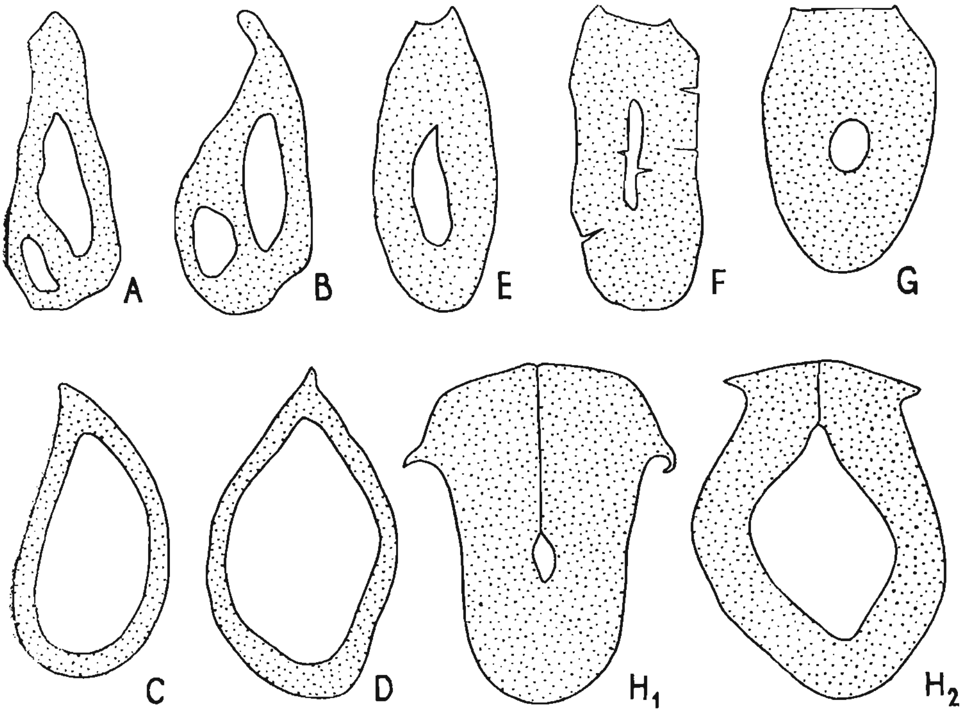

Fig. 9. Cross-section through scolecodonts (A-D) and hooks (E-H). A — *Paranereites* sp., Callovian, Łuków; B — *Glycera* sp., Recent; C — *Paulinites gladiatus* Kielan—Jaworowska, Silurian, erratic boulder; D — *Nereis* sp., Recent; E-F — *Paraglycerites* sp. indet., Bathonian, Blanowice; G — arm hook of genus et sp. indet., Bathonian, Blanowice; H — *Onychoteuthis banksi* (Leach, 1817), Recent; H_1 — cross-section through distal part of shaft H_2 — cross-section through proximal part of shaft.

Internal cavity occurs both in scolecodonts and onychits. However, there are marked differences in ratio of wall thickness to diameter of cavity. Walls of onychits are usually thicker and their cavity narrower than in scolecodonts (Text-fig. 9). This is particularly well-marked in basal part, since pulp cavity of scolecodonts becomes markedly wider toward the base than that of onychits.

Almost all scolecodonts are devoid of any sculpture, whereas surface of many onychits is covered both by ridges and thin longitudinal ribs. These ribs are often marked only over the distal part; sometimes the ribs are so fine that they are observable only under high magnification. Moreover, electron microscope studies have shown the smoothness of external surface of scolecodonts as opposed to roughness of onychit surface. This roughness may result in apparent dullness of onychits observed in reflected light.

A small morphological detail of onychits, the fine hump on their outer margin, is also of discriminant value. This hump is well-marked in the majority of onychits in a form bending of outer margin, observable in lateral view. Similar bendings are occasionally marked in different scolecodonts but are without diagnostic value.

All above differences make it easy to distinguish onychits and scolecodonts; no single morphological feature, however, is of sufficient discriminant value, since it is always possible to find a similar feature between extremely morphologically differentiated forms of scolecodonts. For example, scolecodonts of the single tooth form, commonly allocated to the genus *Eunicites* Ehlers, have an opening of pulp cavity situated symmetrically in the base, just as in onychits; scolecodonts of the genus *Arabellites* Hinde have the first, hook-like tooth with ridges somewhat similar to longitudinal ridges of onychits, differing, however, in the lack of interridge flattening which would correspond to interridge suface of onychits. Some scolecodonts, e. g. these of the genus *Langeites* Kielan-Jaworowska, are similar to onychits in relatively narrow pulp cavity. In turn some other scolecodonts are ornamented with longitudinal and transversal ribs. However, all these scolecodonts always differ from onychits in remaining morphological features and in preservation.

It may be presumed that there are also differences in internal structure. The structure of some scolecodonts was studied by Schwab (1966). Unfortunately, the structure of onychits has not yet been studied. The studies of the latter group are impeded by the small size, fragilness and opacity of specimens.

Specimens of the genus *Paraglycerites* were regarded as scolecodonts by Eisenack (1939); forms of this genus represented in the authors' collection exhibit all morphological features as well as the type of preservation characteristic of onychits. Eisenack (l. c.) based his assumptions on comparisons with jaws of Recent polychaetes of the families Glyceridae Malmgren and Nereidae Johnston. However, jaws of all Recent representatives of both these families are weakly differentiated and essentially different from hooks of the genus *Paraglycerites*. Though distal parts of Glyceridae jaws seen in the proboscis have a hook-like appearance, whole extracted jaws do not exhibit any features in common with onychits. The surface of Glyceridae jaws is ornamented but in a manner different from that of onychits. There is also one peculiar feature of Glyceridae, not found in onychits — development of two pulp cavities separated by a wall (Pl. XV, Fig. 7, Text-fig. 8). The jaws of Recent representatives of Nereidae Johnston differ from onychits in all the above features, as well as in markedly different shape and in denticulation. Morphology of jaws in both these families, Glyceridae and Nereidae, is relatively weakly differentiated.

The genus *Arites* Kozur is not represented in the authors' collection; however, there are forms, assigned to the genus *Falcuncus* nov. gen., which are very close to this genus, and at the same time, exhibit all features typical of onychits. Kozur initially regarded onychits of the genera *Arites* and *Paraglycerites* as jaws of polychaetea of the superfamily Eunices Grube (Kozur 1967), but subsequently found substantial differences between these forms and, presumably, unable to find similar forms among fossil and Recent polychaete jaws, he placed the group in question in familia incerta (Kozur, 1970; 1971). Kozur held that the forms of the genera *Paraglycerites* and *Arites* do not represent cephalopod hooks, because they often occur in deposits from which no cephalopod remains are known. Such a statement is, however, invalid, as cephalopod hooks, built of hard, acid-resistant organic substances, are more like to be preserved that thin-walled, calcium carbonate, easily soluble cephalopd shells. Shells of hook-bearing cephalopods of the orders Teuthida and Phragmoteuthida, are very fragile and completely devoid of rostrum. Their skeletal parts may onle be preserved in particularly favourable conditions. Onychits of the genus *Arites* from the Triassic of Germany are very similar to arm hooks of the cephalopod described as *Phragmoteuthis? ticinensis* Rieber from the Middle Triassic of Switzerland (Rieber 1970). In this specimen, hooks of all 10 arms are well-preserved (Pl. XIV, Fig. 4); moreover, fragments of jaws and imprint of ink sac were noted, whereas shell remains are lacking. Similir finds are quite frequent.

In deposits of the Lower Volgian age, exposed at Tomaszów Mazowiecki, whence the bulk of specimens were obtained, almost all fossils which initially had calcareous shells, i. e. ammonites, pelecypods, and gastropods, are preserved in the form of moulds. Even such thick shells as these of the pelecypod *Trigonia* underwent dissolution, and oyster shells are the only ones preserved here. Although onychits are quite frequent, no remains of dibranchial cephalopod were found.

In the case of the rich scolecodont collection housed at the Institute of Paleontology, Polish Academy of Sciences, which was studied mainly by Kielan-Jaworowska (1966) no scolecodonts difficult to distinguisch from onychits were found. However, in papers dealing with scolecodonts, there are some forms which, on the basis of descriptions and figures given, are difficult to distinguish from onychits. *Eunicites gracilis* Hinde from the Silurian of Canada, described by Hinde (1879) is such an example. However, affiliation of this form with onychits seems rather improbable.

SYSTEMATIC DESCRIPTION

In all descriptions, all dimensions, except for length, are given as their ratio to the total length of particular specimen, otherwise stated.

Genus *Acathuncus* nov.

Type species: Acanthuncus passendorferi n. sp.

Derivation of the name: Gr. *acantha* = spine, Lat. *uncus* = a hook; with reference to the genus *Acanthoteuthis* Wagner, 1832, to which the fragments of cephalopod shell with hooks similar to these of the genus proposed, were included.

Diagnosis. — Shaft slighty bent, gradually widening toward base, ovate in cross-section. Spur small, situated high, above mid-height of shaft, or lacking. Longitudinal ridges slightly elevated. Uncinus well-developed, sickle-like, gradually passing into shaft. Base in the form of sharp-angled triangle, on the continuation of shaft axis.

Occurence. — Dogger? — Malm, Poland.

Remarks. — The new genus is monotypic, erected to include single species, *Acanthuncus passendorferi* n. sp., Cephalopod hooks similar to these comprised by the above genus, are known from the Jurassic deposits since a long time. Single hooks of this type were described as "Kralle von Onychoteuthen" by Quenstedt (1858, p. 803, Pl. 99, Fig. 16), and they were found together with fragments of shell assigned to the genus *Acanthoteuthis* Wagner (1852), e. g. *Acanthoteuthis speciosa* Münster, 1839, or *A. problematica* Naef, 1922. However, descriptions and figures of these hooks, given by previous authors are insufficient for detail comparison. Occurrence of spur in these hooks was not cited, however, it might have been overlooked. The diagnosis of the genus *Acanthoteuthis*, given by Naef (1922) is as follows: "Acanthoteuthis bezeichnet Belemnoiden, deren Rostrum nicht sicher bekannt ist, während Phragmocon and Proostracum nach Art der Belemnitidae gebaut sind und die Arme, wie bei dieser, je zwei Reihen von Haken tragen". Thus this genus is not a natural taxon and it may comprise different Belemnitidae. Therefore different hooks may belong here.

Acanthuncus n. gen. differs from *Paraglycerites* Eisenack (1939) in spur markedly smaller and located higher.

Acanthuncus passendorferi n. sp.
(Pl. XV, Figs. 1—4; Pl. XVIII, Fig. 10)

Holotype: Pl. XV, Fig. 2; Z. Pal. No. V. V/89.

Type horizon and locality: Jurassic, Volgian stage, Zaraiskites scythicus Zone; Brzostówka near Tomaszów Mazowiecki.

Derivation of the name: In honour of Prof. Edward Passendorfer, the eminent Polish geologist.

Diagnosis. — Large hooks. Shaft with inner margin more arcuate than outer. Spur very small, situated close to uncinus. Longitudinal ridges weakly elevated, situated close to one another. Base equal one-third of total length.

Material. — Seven partly incomplete specimens.

Description. — Hooks 1.9 to 5.0 mm long, 0.18 wide; base ca. 0.4 long; uncinus ca. 0.13 long.

Shaft somewhat arcuate; inner margin bent stronger than outer. Hook width increases gradually toward the base, where its increment is accelerated over a short section, what results in formation of small projection, marked on inner side. Hook ovate in cross-section, somewhat narrowing toward inner side. Spur very small, knob-like, situated just below the uncinus, occasionally almost obscured. Longitudinal ridges short, weakly elevated, continuing from spur up to uncinal point gradually converging; interridge surface narrow, flat. Inner side, downward from spur, somewhat sharpened. Uncinus, strong, arcuate, with uncinal point set almost at the right angle to logitudinal axis of hook. Base long, in the form of sharp-angled triangle in lateral view. Outer margins of base and shaft not separated. Outer margin of base sometimes slightly bent outward in the lower part. Basal margin straight. Basal opening long, wide, occupying almost whole base.

Occurrence. — As the holotype.

Remarks. — Onychits of this new species are very similar in form to arm hooks of cephalopods of the species *Acanthoteuthis speciosa* Münster from the Upper Malm of Germany. These cephalopods had ten almost identical arms, every of which was equipped with hooks very similar to each other (Naef 1922). Unfortunately, these hooks were not adequately described and it is not known whether or not they had spur. Thus, detail comparison is impossible at present.

All specimens of this species in the author's collection are broken or strongly cracked. This may result from their large size.

Acanthuncus? sp.
(Pl. XV, Fig. 5)

Material. — One strongly cracked specimen with uncinus and part of base broken off, found in deposits of the Bathonian, the Morrisiceras morrisi Zone, at Blanowice near Zawiercie.

Description. — It is the largest specimen in the collection; although incomplete, attains 4,8 mm in length and 0.92 mm in width.

Shaft straight, gradually widening toward the base, with inner margin straight and outer margin very gently arcuate. Cross section ovate. Spur and logitudinal ridges unknown. Lower part of uncinus wide, arcuate, gradually joining shaft. Distal part of uncinus unknown. Base straight in upper part, not separated from shaft, forming its continaution, its lower part unknown.

Remarks.— The specimen is assigned to the genus *Acanthuncus* n. gen. with reservation, because it is unknown whether or not the spur and longitudinal ridges are developed and how lower part of the base looks like. It may be supposed that spur and longitudinal ridges were situated over the part of uncinus, which is lacking.

Genus *Arcuncus* nov.

Type species: *Arcuncus makowskii* n. sp.

Derivation of the name: Lat. *arcus* = arch, and *uncus* = a hook, from the overall shape of the hook shaft and uncinus.

Diagnosis. — Uncinus joined with shaft in a single arc. Longitudinal ridges prominent. Interridge surface wide. Spur shovel-shaped, located on the upper margin of base.

Species assigned: Monotypic genus.

Comparisons. — *Arcuncus* nov. gen. is somewhat similar to *Urbanekuncus* nov. gen. differing in shovel-like spur situated on base margin and in symmetrical cross-section of shaft and uncinus and uniformly prominent longitudinal ridges.

Occurrence. — Jurassic, Callovian, Poland.

Arcuncus makowskii n sp.
(Pl. XVII, Figs. 5—7)

Holotype: Pl. XVII, Fig. 5; Z. Pal. No. V. V/133.

Type horizon: Jurassic, Middle or Lowermost Upper Callovian.

Type locality: Łuków, Poland.

Derivation of the name: In honour of Prof. Henryk Makowski, the student of Callovian faunas of Łuków.

Diagnosis. — Hooks with shovel-like spur, located above the base. Longitudinal ridges uniformly developed. Basal opening large, not constricted in relation to width of pseudo-pulp cavity.

Material. — Five specimens; two with base and two with spur preserved.

Description. — Hooks 0.32 to 0.75 mm long; base length — 0.26 to 0.29; shaft width close to base — 0.18 to 0.19; spur length — 0.05. Shaft and uncinus forming morphological entity difficult to separate. Transverse cross-section of shaft and uncinus ovate, truncated by interridge surface. Outer margin of shaft and uncinus gently arcuate, insignificantly bent in one-third of its length; other bend occasionally marked in distal part, close to uncinal point. Inner margin similarly arcuate, with single bend marked in distal part. Longitudinal ridges prominent, uniformly developed, continuing from uncinal point up to base, where one of them reaches spur. Spur, shovel-like widened, located directly above basal opening. Interridge area relatively wide, flat and smotth, in opposite to the remaining hook surface, covered with longitudinal striae. Basal margin markedly concave in its upper part. Basal opening large, not constricted in relation to diameter of pseudo-pulp cavity.

Occurrence. — As the holotype.

Genus *Cornuncus* nov.

Type species: Cornuncus asymmetricus n. sp.

Diagnosis. — Hooks irregular in shape, with very long base. Basal opening very small, strongly constricted in relation to width of pseudo-pulp cavity. Shaft and uncinus forming one entity. Spur lacking.

Derivation of the name. — Lat. *cornus* = horn, from the shape of the hooks.

Comparisons. — *Cornuncus* nov. gen. differs from all other genera hitherto described in irregular shape, basal opening strongly constricted in relation to the width of pseudo-pulp cavity, very long base and marked individual variability.

Species assigned: Cornuncus asymmetricus n.sp. and *Cornuncus* sp. *A*.

Occurrence. — As the type species.

Cornuncus asymmetricus n.sp.
(Pl. XVIII, Figs. 1—8)

Holotype: Pl. XVIII, Fig. 5; Z. Pal. No. V. V/123.
Type horizon: Jurassic, Volgian, the Zaraiskites scythicus Zone.
Type locality: Brzostówka near Tomaszów Mazowiecki.
Derivation of the name: Gr. *asymmetros* = asymmetric, from characteristically asymmetrical structure of the hooks.

Diagnosis. — Cornuncus with base characteristically bent to the left or right, shaft and uncinus backward or spirally contorted; ring-like ridge obscured.

Material. — Eight well-preserved specimens.

Description. — Hook 1.0 to 1.4 mm long; base length equalling 0.60—0.69; shaft width near base — 0.12 to 0.21. Hook shaft and uncinus merge in one another forming single, contorted spike, sharp-pointed (Pl. XVIII, Figs. 2, 4, 5) or club-like terminated (Pl. XVIII, Fig. 4). Ring-like ridge situated approximately at mid-height, corresponding to boundary between shiny, smooth surface of spike termination and opaque, rough surface of the remaining part of hook. Base backwardly bent, differing in width in particular specimens. Basal opening situated in upper part of depression situated in the base; therefore in some cases it is difficult to find it.

Occurrence. — As the holotype.

Cornuncus sp. *A*
(Pl. XVIII, Fig. 9)

Material. — One well-preserved specimen (Z. Pal. No. V. V/127), found in the deposits of the Volgian, the Zaraiskites scythicus Zone, from Brzostówka near Tomaszów Mazowiecki.

Description. — Hook 1.4 mm long; base length 0.65; shaft width near base — 0.22. Hook bilaterally symmetrical. Shaft merged with uncinus forming sharp-pointed spike with smooth, shiny distal surface; while the remaining surface of shaft and base is opaque, rough. Base very long, with basal opening obscured, presumably skinned over. When base is broken, vast pseudo-pulp cavity may be observed.

Genus *Deinuncus* nov.

Type species: Deinuncus brevirostris n. sp.

Derivation of the name: Gr. *deinos* = terrible, from the general appearance of the hook.

Diagnosis. — Hooks with quite straight shaft and uncinus, set at almost right angle. Basal opening wide, not restricted in relation to width of pseudo-pulp cavity. Spur lacking.

Species assigned: Deinuncus brevirostris n.sp. and *D. longirostris* n.sp.

Comparisons. — *Deinuncus* nov.gen. differs from all other genera in quite straight shaft and uncinus, set almost at a right angle.

Occurrence. — Jurassic, Callovian and Volgian, Poland.

Deinuncus brevirostris n.sp.
(Pl. XVI, Figs. 6, 7)

Holotype: Pl. XVI, Fig. 7; Z. Pal. No. V. V/129.

Type horizon: Jurassic, Volgian, the Zaraiskites scythicus Zone.

Type locality: Brzostówka near Tomaszów Mazowiecki.

Derivation of the name: Lat. *breve* = short, *rostrum* = uncinus being short in relation to total length of the hook.

Diagnosis. — Hook with quite short uncinus, equalling approximately 0.20 of total length, laterally inflatted; base somewhat swelled; spur lacking.

Material. — Four specimens, two of which are complete and the remaining two with broken off base.

Description. — Dimensions of the holotype: hook 2.4 mm long; base length equalling 0.30; uncinus length — 0.22; shaft width near base — 0.15; shaft width in mid-height — 0.13. Hook shaft somewhat arcuate. Inner margin almost rectilinear, whereas outer margin gently arcuate with small bend approximately in the mid-height. Shaft and uncinus ovate in cross-section. Uncinus sharp-pointed. Shaft width quite gradually decreases toward the uncinal point. Uncinal surface covered with fine, longitudinal striae. Longitudinal ridges appear in distal shaft part and continue up to uncinal point; one ridge commonly predominating. Hook base relatively short, somewhat swelled in relation to shaft near the base; basal margin slightly concave. Basal opening large, somewhat widened in relation to the width of pseudopulp cavity.

Remarks. — One of the specimens assigned to this species, figured in Pl. III, Fig. 6, is characterized by less inclined and relatively longer uncinus. It is supposed that this specimen belongs to the species *Deinuncus brevirostris*, but is aberrantly developed.

Occurrence. — As the holotype.

Deinuncus longirostris n.sp.

(Pl. XVI, Fig. 5)

Holotype: Pl. XVI, Fig. 5; Z. Pal. No. V. V/132.

Type horizon: Jurassic, Middle or Lowermost Upper Callovian.

Type locality: Łuków.

Derivation of the name: Lat. *longus* = long, *rostrum* = uncinus, from the remarkable length of uncinus in the relation to the total length of specimen.

Diagnosis. — *Deinuncus*, the uncinus of which equals approximately half of total length of specimen.

Material: One complete specimen.

Description. — Hook 2.2 mm long; base length equalling 0.27; uncinus length — 0.56; shaft width near base — 0.26; shaft width in mid-height — 0.22. Hook shaft almost rectilinear, gradually narrowing from base toward uncinus, ovate in cross-section. Uncinus long, sharp-pointed, becoming also gradually narrower toward its sharpened point. Longitudinal ridges, the left of which is marked stronger than right, ends in the distal part of hook, 0.89 mm from base. The course of these ridges over the uncinus is obliterated in result of fossilization processes. Base short, with concave basal margin, not widened in relation to shaft width and situated on its extension. Basal opening and pseudopulp cavity similar in diameter.

Remarks. — *Deinuncus longirostris* n.sp. differes from *D. brevirostris* in markedly longer uncinus and not widened base.

Occurrence. — As the holotype.

Genus *Falcuncus* nov.

Type species: Falcuncus falcus n.sp.

Derivation of the name: Lat. *falx* = sickle, *uncus* = hook.

Diagnosis. — Uncinus long, sickle-like, gradually passing into shaft; shaft short, arcuate; spur situated close to base; longitudinal ridges situated close to one another.

Occurrence. — *Jurassic*-?Tertiary, Poland.

Comparisons. — *Falcuncus* n.gen. is similar to the genus *Paraglycerites* Eisenack, differing in arcuate bend of shaft and uncinus. *Falcuncus* n.gen. is similar in shape to the representatives of the genus *Arites* Kozur, known from the Triassic of Germany, and to hooks found together with jaws and inc-sac in the Triassic of Switzerland and identified as *Phragmoteuthis? ticinensis* Rieber (1970), differing from these Triassic forms in occurrence of spur.

Falcuncus falcus n.sp.
(Pl. XVI, Figs. 2—4)

Holotype: Pl. XVI, Fig. 4; Z. Pal. No. V. V/100.

Type horizon: Jurassic, Bathonian, the Morrisiceras morrisi Zone.

Type locality: Blanowice near Zawiercie.

Derivation of the name: Lat. *falcus* = sickle-like, from the general shape of the specimens.

Diagnosis. — Uncinus very large, strongly-developed, arcuately passing into shaft. Shaft very short, slightly arcuate, flately ovate in the cross section. Spur long, curved. Base triangular, short; basal margin straight.

Material. — Six almost complete and some fragmentary specimens.

Description. — Hooks sickle-shaped, 0.45 to 0.9 mm long: shaft width equalling 0.23; uncinus length — 0.3 to 0.4; base length — ca. 0.23. Shaft very short, slightly arcuate, almost uniformly wide along its length. Inner margin somewhat arcuate; outer margin S-shaped. Cross-ection flately ovate, obliquely truncated by narrow interridge surface on the inner side Spur thin, spike-like, somewhat curved, with length almost equal to shaft width, situated close to base. Longitudinal ridges prominent, situated close to one another. Between ridges, median suture is marked in some specimens. Spur gives rise to both longitudinal ridges; the ridge continuing on the same hook side as spur is located, begins from upper spur margin, whereas the ridge continuing along the opposite side, begins from lower spur margin. Interridge surface narrow. Below longitudinal ridges, small elevation is marked on some specimens. Uncinus long, strongly developed, arcuately passing into shaft. Base triangular, slightly bent outwards. Basal margin straight, obliquely truncating base; outer margin postero-laterally oriented.

Occurrence. — As the holotype.

Remarks. — Besides the forms described above, some specimens from the collection are characterized by shorter uncinus and longer, straighter shaft (Pl. XVI, fig. 3). These forms may belong to another species, however, their number is insufficient to clear up this question.

Falcuncus sp. *A*
(Pl. XX, Fig. 1)

Material. — A single specimen with uncinal point broken off; found in limestones of the Upper Oxfordian, the Idoceras planula Zone, at Pajęczno near Częstochowa.

Description. — Hook 0.45 mm long; maximal shaft width equalling 0.18; base length — 0.37. Shaft uniformly widening toward base, with inner margin bent distinctly stronger than outer margin. Cross-section ovate. Spur very small, knob-like, situated at shaft-base boundary. Longitudinal ridges weakly marked, obtuse. Uncinus wide in its basal part, arcuately passing into shaft; distal part of uncinus unknown. Base long, narrow, almost straight; its basal margin gently incurved; outer margin almost straight.

Remarks. — *Falcuncus* sp. A differs from *Falcuncus falcus* n.sp. in markedly shorter and obtuse spur, less prominent longitudinal ridges and distinctly longer base. The species is given neither name nor definition, because it is represented merely by single, incomplete specimen. It is the only species found in the Oxfordian rocks.

?*Falcuncus* sp. *B*
(Pl. XX, Fig. 2)

Material. — A single specimen with deformed base, found in Danian marls from the borehole at Góra Puławska near Puławy.

Description. — Hook 0.59 mm long; shaft width in midheight equalling 0.15; shaft width near base — 0.26. Shaft very short, strongly curved, slightly widening downward and thereafter strongly widening in its basal part. Cross-section semiovate, narrow from the outer side, wide from the inner side, truncated by interridge surface. Spur lacking (?). Longitudinal ridges high, sharp-crested, continuing from uncinal point up to the basal margin. Interridge area flat, wide. Outer side of shaft and base narrow.

Uncinus strongly-developed, sharp-pointed, forming together with shaft a single, regular sickle. Whole uncinus and upper part of shaft are ornamented with fine ribs. The ribs pass downward into ornamentation with finer, irregular structure. Base deformed, wide in its upper part; outer basal margin somewhat arcuate. Basal opening obscured.

Remarks. — This specimen is tentatively assigned to the genus *Falcuncus*, because it seems devoid of spur and structure of its base is unknown. Spur might have been situated at shaft-base boundary and was broken off and its trace obliterated by subsequent deformation. This is the only Danian specimen represented in the collection.

Genus *Longuncus* nov.

Type species: Longuncus longus n.sp.

Derivation of the name: Lat. *longus* — long, from the general outline of the specimens.

Diagnosis. — Hooks with long, thin shaft, small uncinus and well-developed longitudinal ridges, continuing up to the base.

Species assigned: Longuncus longus n.sp., *Longuncus longoides* n.sp.

Comparisons. — *Longuncus* nov.gen. is somewhat similar to the genus *Paraglycerites*, primarily differing in markedly longer and thinner shaft, smaller uncinus and spur rudimentary or lacking.

Occurrence: Jurassic, Volgian, the Zaraiskites scythicus Zone, Poland.

Longuncus longus n.sp.
(Pl. XX, Figs. 4—8)

Holotype: Pl. XX, Fig. 4; Z. Pal. No. V. V/105.

Type horizon: Jurassic, Volgian, the Zaraiskites scythicus Zone.

Type locality: Brzostówka near Tomaszów Mazowiecki.

Derivation of the name: Lat. *longus* = long, from the general outline of the specimens.

Diagnosis. — Hook with very long, thin shaft terminated with very short uncinus, over 50 times shorter than total hook length. Spur short, situated close to base; longitudinal ridges distinctly marked.

Material. — Nine well-preserved specimens.

Description. — Hook 1.1—1.4 mm long; base length equalling 0.19 to 0.31; uncinus length — 0.01 to 0.02; shaft width near base — 0.04 to 0.06; shaft width in mid-height — 0.02 to 0.04; spur length — 0.006 to 0.01. Hook shaft very long and thin; cross-section ovate, truncated by interridge surface. Outer shaft surface sometimes ornamented with longitudinal striae. Longitudinal ridges sharp-crested, uniformly developed. Spur short, triangular, oblique in relation to latero-internal surface of hook. Uncinus very short, relatively wide, with crochet needle-like point, bent toward base or set almost at the right angle to the shaft. Base acutely truncated. Basal opening relatively small and constricted in relation to pseudopulp cavity diameter.

Occurrence. — As the holotype.

Longuncus longoides n.sp.
(Pl. XX, Figs. 9—10)

Holotype: Pl. XX, Fig. 10; Z. Pal. No. V. V/117.
Type horizon: Jurassic, Volgian, the Zaraiskites scythicus Zone.
Type locality: Brzostówka near Tomaszów Mazowiecki.
Derivation of the name: longoides = similar to *Longuncus longus* n.sp.

Diagnosis. — Hook similar in shape to *Longuncus longus* n.sp., differing in markedly shorter shaft, longer uncinus and lack of spur.

Material. — Two well-preserved specimens.

Description. — Hook 0.5—0.8 mm long; base length equalling 0.37 to 0.41; uncinus length — 0.048 to 0.051; shaft width near base — 0.09 to 0.096; shaft width in mid-height — 0.053 to 0.069. Hook shaft circular in cross-section near base, becoming ovate and progressively laterally flattened toward distal part. Longitudinal ridges well-marked, sharp-created, appear close to base. Uncinus short, strongly bent toward base. Base elongated and truncated similarly as in *Longuncus longus* n.sp. Basal opening small, elongated, constricted in relation to pseudopulp cavity diameter.

Occurrence. — As the holotype.

? *Longuncus* sp.
(Pl. XX, Fig. 3)

Material. — A single well-preserved specimen from the Volgian, the Zaraiskites scythicus Zone of Brzostówka near Tomaszów Mazowiecki.

Description. — Hook 0.67 mm long; base length 0.47; uncinus length — 0.07; shaft width near base — 0 .11; shaft width in mid-height — 0.074. Hook shaft laterally inflatted in the cross-section. Longitudinal ridges weakly developed; spur lacking. Uncinus quite large, set almost at the right angle to shaft. Base very strongly truncated and elongated, sharp-pointed. Basal opening markedly elongated, narrow.

Remarks. — The specimen is similar in general outline to the representatives of the genus *Paraglycerites* Eisenack, differing in the lack of spur. Representatives of that genus were not hitherto found in deposits of the Volgian age, and the specimen under discussion is also similar to *Longuncus longoides* n.sp. It is assigned to the genus *Longuncus* with reservation.

Genus ? *Onychites* Quenstedt, 1858

Remarks. — Morphological details of this genus are not sufficiently known and its diagnosis is lacking. The present authors do not present their diagnosis because of insufficient material.

? *Onychites felinus* n.sp.
(Pl. XVII, Fig. 2)

Holotype: Pl.XVII, Fig. 2a; Z. Pal. No. V. V/146.
Type horizon: Jurassic, Volgian, the Zaraiskites scythicus Zone.
Type locality: Brzostówka near Tomaszów Mazowiecki.
Derivation of the name: Lat. *felinus* — cat, from the general similarity of hook to cat claw.

Diagnosis. — Hook small, circular in cross-section with sharp-pointed uncinus and ring-like ridge corresponding to uncinus-shaft boundary.

Material. — A single specimen with base broken off.

Description. — Hook 0.6 mm long; uncinus 0.1 mm long, shaft 0.11 mm wide in the lower part, uncinus 0.05 mm wide in its lower part. Shaft straight, somewhat bent in upper part, circular in cross-section; shaft surface opaque, rough. Inner margin of shaft, initially straight, becomes somewhat arcuate in the distal part. Outer margin quite sharply bent above midheight; orbicular scar passes through outer margin bend. Uncinus surface smooth and shiny; uncinus separated from shaft with ring-like ridge continuing around uncinus base.

Remarks. — The specimen is similar in shape to the largest form of the species *Onychites ornatus* Quenstedt (Quenstedt, 1885, Fig. 162), however its affiliation with this genus is uncertain because it is unknown whether or not orbicular scar and ring-like ridge are developed in the case of *Onychites*. Quenstedt's drawing does not give an unequivocal answer. Moreover, it is not certain whether or not the base of the specimen in question is similar to base of Quenstedt's forms and the size of the authors' specimen is much smaller than that of all specimens of this genus hitherto found.

Occurence: — As the holotype.

Genus *Paraglycerites* Eisenack, 1939

Revised diagnosis: Shaft long, straight to somewhat arcuate, ovate in cross-section. Spur well-developed, claw-like curved. Longitudinal ridges prominent. Orbicular scar forming high sinus on outer side. Uncinus well-developed, sharp-pointed. Base located on the continuation of shaft, not deviating from its axis.

Occurrence. — ? Triassic — Jurassic — ? Cretaceous of Europe.

Remarks. — Eisenack (1939) regarded the hooks of the genus proposed by him as polychaete jaws, therefore the diagnosis given was insufficient for distinguish them from other cephalopod arm-hook genera. The hooks of the genus *Paraglycerites* were also regarded as scolecodonts by Kozur

(1970, 1971). The latter author cited the occurrence of the genus *Paraglycerites* as early as the Rhaetian (Kozur, 1971) but figured only some Liassic specimens. The hooks of this genus are relatively the most common and usually predominate in hook assemblages.

Paraglycerites gracilis n.sp.
(Pl. XVII, Fig. 3; Pl. XIX, Figs. 1—5)

Holotype: Pl. XIX, Fig. 4; Z. Pal. No. V. V/4.
Type horizon: Jurassic, Bathonian, the Morrisiceras morrisi Zone.
Type locality: Blanowice near Zawiercie.
Derivation of the name: Lat. *gracilis* = slender, from the general shape of hook.

Diagnosis. — Shaft slightly bent. Spur long, spike-like, situated at base-shaft boundary. Uncinus arcuate, equalling 0.18 of hook length without base. Base of sharp-angled triangle outline, variable in length; basal margin straight.

Material. — Approximately 60 specimens, 15 of which are well-preserved.

Description. — Hooks 0.32 to 0.88 mm long; uncinus length equalling about 0.18 and maximal shaft width — about 0.16 length of hook without base.

Shaft long, narrow, uniform in width or even somewhat widens from base to mid-height, thereafter gradually narrowing towards uncinus. Outer margin arcuate stronger than inner margin, which, occasionally, is almost rectilinear. Cross-section of shaft inflattened ovate, truncated by interridge area on the inner side. Spur spike-like, situated at base-shaft boundary or somewhat above, equal in length to shaft width. Longitudinal ridges prominent, sharp. Spur gives rise to both longitudinal ridges: ridge continuing along this hook side, on which spur is located, begins from spur's upper margin, whereas the ridge continuing along the opposite side begins from lower spur margin.

Orbicular scar is marked on both lateral sides in the majority of specimens; this scar continues through the inner side and, below the spur, through lateral side, rising transversally upwards; on the outer side it forms a large sinus, reaching mid-height of hook; thereafter it descends and transversally passes across the opposite lateral side and ends at the height of spur. On the outer margin, the uppermost place reached by the orbicular scar is marked by bend, expressed as a small hump.

Uncinus arcuate, narrow, with point set at the right angle to the longitudinal axis of hook or slightly bent toward the base. Base of sharp-angled triangle outline, located on the continuation of shaft. Outer basal margin directed downward, indistinctly separated from outer margin of the shaft.

Basal margin straight to somewhat centripetally bent, obliquely truncating the base. Basal opening long, occupying almost whole inner side of base; occasionally obscured in its upper part, close to shaft boundary.

Occurrence. — As the holotype.

Remarks. — *Paraglycerites gracilis* n.sp. is similar to *Paraglycerites necans* Eisenack, differing in markedly shorter uncinus and stronger bending of shaft; moreover, the holotype of the species *Paraglycerites necans* is distinctly larger, with spur somewhat thinner and located markedly higher than in all specimens of the new species.

The specific variability of *Paraglycerites gracilis* n.sp. is primarily expressed by differences in base length/total hook length ratio. Therefore dimensions of uncinus length and shaft width were given in terms of ratio to the length of specimen minus base length. Uncinus length and shaft and uncinus curvatures are also variable to some extent. Small specimens are commonly characterized by shaft more strongly arcuate than the larger ones.

The hooks described by Kozur as *Paraglycerites necans* (Kozur 1970, Pl. V, Fig. 10; 1971, p. 75, Pl. XVII, Fig. 1) from the Liassic of Germany, differ from the Callovian specimens in markedly larger width and shorter and wider spur. They belong to a different species, according to the present authors.

Paraglycerites erectus n.sp.
(Pl. XIX, Figs. 6—10)

Holotype: Pl. XIX, Fig. 10; Z. Pal. No. V. V/65.
Type horizon: Jurassic, Middle Bathonian, the Morrisiceras morrisi Zone.
Type locality: Blanowice near Zawiercie.
Derivation of the name: Lat. *erectus* = straightened, from the general shape of the specimens.

Diagnosis. — Shaft straight, very long and narrow. Spur long, narrow, situated somewhat above base. Uncinus almost straight, set at the right angle to shaft. Base narrow with outer margin not separated from outer margin of shaft.

Material. — Approximately 23 incomplete specimens.

Description. — When base is not taken into account, length of specimens equals 0.50 to 1.3 mm; uncinus length equals about 0.12 of hook length without base; and uncinus width — 0.15. Shaft very long and narrow, maximally wide near base; shaft uniformly wide or slightly narrowing up to mid-height, later becoming progressively narrower. Inner margin straight, outer margin somewhat bent in mid-height. Cross-section strongly flattened, ovate, truncated by interridge surface from the inner side.

Longitudinal ridges elevated, sharp. Ridge reaching spur is higher than that from the opposite side. Spur situated close to base, long and spike-like, curved; its length usually somewhat exceeds shaft width. Uncinus almost straight to slightly curved, set almost at the right angle to shaft. Base incompletely preserved in all specimens. Outer margin of base is straight and not separated from outer margin of shaft. Basal margin incurved in its upper part. Basal opening long and narrow, obscured in uppermost part of base.

Occurrence. — As the holotype.

Remarks. — *Paraglycerites erectus* n.sp. is similar to *P. gracilis* n.sp. and *P. necans* Eisenack. It differs from *P. gracilis* n.sp. in straighter shaft and uncinus and higher located and narrower spur. In turn, it differs from *P. necans* mainly in shorter and more straight uncinus.

Specific variability is primarily expressed in differences in relative uncinus length and location of spur. The structure and length of the lower part of base is unknown.

Paraglycerites sp. *A*
(Pl. XVI, Fig. 1)

Material. — A single specimen with base and lowermost part of shaft broken off, found in the Callovian deposits at Łuków. (Z. Pal. No. V.V/86).

Description. — Incomplete specimen 0.71 mm long, 0.14 mm wide; uncinus 0.26 mm long. Shaft straight, relatively wide, becoming progressively narrower distally. Inner margin straight, outer margin bent in upper part. Cross-section truncated by interridge surface from inner part. Spur narrow, spike-like, situated at some distance from base (undeterminable because of incompleteness of the specimen). Longitudinal ridges prominent. Orbicular scar well-marked, forming high sinus on the outer side and resulting in formation of bend of outer margin, observable in side view. Uncinus long, almost straight, with point slightly turned downward. Base unknown.

Remarks. — *Paraglycerites* sp. *A* is most similar to *Paraglycerites necans* Eisenack, known from the Callovian of the Kaliningrad area, differing from the forms figured by Eisenack (Eisenack 1939, Figs. 10—11) in wider shaft. Eisenack found only two specimens of this genus, thus its specific variability is unknown. It is possible that *Paraglycerites* sp. *A* falls within the limits of specific variability of *P. necans* Eisenack.

The above specimen was found together with three other, markedly smaller and incomplete representatives of the genus *Paraglycerites* Eisenack, with obscured specific affinity. Two of them are characterized by uncinus markedly shorter than that of *P.* sp. *A*.

? *Paraglycerites* sp. *B*
(Pl. XVII, Fig. 9)

Material. — A single specimen with base broken off, found in the Upper Cretaceous, Campanian, in the borehole Magnuszew upon the Vistula River.

Description. — Hook 0.49 mm long, 0.10 mm wide. Shaft straight, gradually widening toward base. Spur wide, straight, situated at some distance (indeterminable because of the incompleteness of specimen) from the base. Longitudinal ridges weakly marked. Shallow longitudinal furrow continues from spur almost up to uncinus on both lateral sides of hook. Uncinus weakly developed, without sharpened termination and is merely marked by slight bend of constricted uppermost part of shaft. Base unknown.

Remarks. — The specimen is assigned to the genus *Paraglycerites* with reservation as it differs from typical representatives of this genus in the lack of well-developed, sharp-pointed uncinus. However, this feature may be pathological or resulting from deformation.

Genus *Urbanekuncus* nov.

Type species: Urbanekuncus mediodenticulatus n.sp.

Derivation of the name: In honour of Prof. Adam Urbanek of the Warsaw University, an outstanding student of graptolites and problems of evolution.

Diagnosis. — Hook, which shaft and uncinus form one entity and are gently arcuate, gradually widening toward base. Spur short, located high above base. Longitudinal ridges distinct.

Species assigned: Urbanekuncus mediodenticulatus n.sp.

Comparisons. — See *Arcuncus* nov. gen. (p. 399).

Occurrence. — Jurassic, Bathonian — Volgian, Poland.

Urbanekuncus mediodenticulatus n.sp.
(Pl. XVII, Figs. 10—11)

Holotype: Pl. XVII, Fig. 10; Z. Pal. No. V. V/138.

Type horizon: Jurassic, Bathonian, the Morrisiceras morrisi Zone.

Type locality: Blanowice near Zawiercie.

Derivation of the name: Lat. *medius* = middle, *denticulus* = denticle, from the spur, located approximately in the half-way from uncinal point to base.

Diagnosis. — *Urbanekuncus* with small spur located approximately in the half-way from uncinal point to base. Longitudinal ridge passing through the spur is developed stronger than that from the opposite side.

Material. — Five specimens, with base damaged.

Description. — Distance from uncinal point to upper margin of base equals 0.82 mm; shaft width near base equals 0.25 of this distance; shaft width in place where spur is located equals 0.17; spur 0.59 distant from uncinal point; spur 0.04 mm long. Shaft and uncinus representing a morphological entity and the boundary between them is difficult to trace. Cross-section ovate. Outer and inner margins gently arcuate and devoid of any stronger bends. Spur short, triangular in side view, lens-like in cross-section, and situated approximately in half-way from uncinal point to base. Longitudinal ridges continues from spur height to uncinal point. The ridge passing through the spur is stronger than opposite ridge and translocated onto lateral side, whereas the opposite ridge continues through the middle of the inner hook side; thus, the interridge area is somewhat translocated in relation to symmetry plane.

Occurrence. — As the holotype.

Urbanekuncus sp. *A*
(Pl. XVII, Fig. 8)

Material. — A single specimen, (Z. Pal. No. V. V/143), with base broken off, found in the Volgian, the Zaraiskites scythicus Zone, at Brzostówka near Tomaszów Mazowiecki.

Description. — Hook (without base) 0.93 mm long; spur situated 0.31 mm from uncinal point; lower part of shaft 0.22 mm wide; at the height of spur, shaft 0.1 mm wide; spur 0.03 mm long. Uncinus is well-differentiated in result of strong bend of inner and outer margins. Uncinus and shaft inflatted and ovate in cross-section. Longitudinal ridges distinct, continuing from spur up to uncinal point. The ridge passing through spur is prominent. Spur short and bluntly ended, situated markedly higher than that in *U. mediodenticulatus* n.sp. Its relative location cannot be accurately defined because of the lack of base and lower part of shaft.

Urbanekuncus sp. *B*
(Pl. XVII, Fig. 1)

Material. — A single specimen, (Z. Pal. No. V. V/144), with base partly broken off, found in the Volgian, the Zaraiskites scythicus Zone, at Brzostówka near Tomaszów Mazowiecki.

Description. — Hook 0.49 mm long from uncinal point to base; distance from lower end of longitudinal ridges to uncinal point 0.31 mm; shaft width uniform from base to the height of spur, equalling 0.08 mm.

Hook shaft and uncinus represent morphological entity and the boundary between them is difficult to trace. Uncinus and shaft up to two-third of distance from base are circular in cross-section, becoming later laterally inflatted up to uncinal point. Inner margin gently arcuate, outer margin slightly bent approximately at one-third of specimen height. Longitudinal ridges distinct; right ridge ended with knob-like spur. Below spur, orbicular scar is hardly discernible; it passes transversally upward through lateral sides of shaft and thereafter, forms a large sinus over outer side. Hook base, although partly broken off, appears similar to that of *Deinuncus longirostris* n.sp.

? *Urbanekuncus* sp. *C*
(Pl. XVII, Fig. 4)

Material. — A single specimen (Z. Pal. No. V. V/145) with end of base broken off and uncinal point somewhat damaged, found in the Volgian, the Zaraiskites scythicus Zone, at Brzostówka near Tomaszów Mazowiecki.

Description. — Hook 0.8 mm long; shaft 0.15 wide near base, 0.05 wide at the height of spur; spur 0.017 long.

Uncinus and shaft represent a morphological entity and the boundary between them is difficult to trace. Outer and inner margins gently arcuate; inner margin slightly concave close to base. Shaft and uncinus circular in cross-section. Spur situated very high, close to uncinal point, short and curved upwards and sidewards. Longitudinal ridges not marked. A ridge continues from upper side of spur around uncinus and ends at lower side of spur. It seems quite probable that this ridge corresponds to ring-like ridges of other specimens and represents a specific from of development of these ridges, comparable with that of *Cornuncus* n.gen. This ridge, similarly as in the latter case, separates shiny surface of termination of uncinus and opaque and rough surface of the rest of hook. Base with basal margin somewhat convex in side view; basal opening large, similar in diameter to pseudopulp cavity.

Remarks. — The above features seem to be of diagnostic value but a single specimen is insufficient for erecting a new species.

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March 1972

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CYPRIAN KULICKI & HUBERT SZANIAWSKI

HACZYKI GŁOWONOGÓW Z JURY POLSKI

Streszczenie

W pracy tej opisano 22 formy morfologiczne haczyków z ramion głowongów jurajskich z Polski, łącząc je w dziewięć rodzajów, w tym siedem nowych, dwanaście form wyodrębniono w nowe gatunki. Pozostałe dziesięć oznaczono jedynie do szczebla rodzajowego ze względu na niedostateczną ilość materiału.

Przeprowadzono szczegółowe porównanie haczyków kopalnych z haczykami współczesnych kalmarów z rodziny Onychoteuthidae. W wyniku porównania stwierdzono, że posiadają one podobny plan budowy, oraz że stosunek ich do otaczających tkanek miękkich był najprawdopodobniej taki sam. Krawędzie podłużne stanowiące granicę pomiędzy powierzchnią haczyka pokrytą tkankami miękkimi i powierzchnią pozbawioną ich są cechą bardzo charakterystyczną właściwą zarówno haczykom z ramion głowonogów kopalnych jak i współczesnych. W rodzaju *Cornuncus* oraz u *Urbanekuncus* sp. C i ?*Onychites felinus* n.sp., występuje krawędź okrężna, odpowiadająca anatomicznie krawędziom podłużnym. U większości kopalnych haczyków obserwować można ostrogę boczną, twór którego brak u głowonogów współczesnych. Wałeczek okrężny stanowi cechę charakterystyczną niektórych kopalnych rodzajów haczyków. Występowanie wałeczka okrężnego wiąże się z obecnością kaptura, ponieważ przebieg jego odpowiada przebiegowi podstawy kaptura u współczesnego *Onychoteuthis* i *Ancistroteuthis*, jakkolwiek podobnego tworu u nich nie zaobserwowano, być może ze względu na skąpy materiał porównawczy. Zróżnicowanie morfologiczne haczyków pomiędzy różnymi stanowiskami stratygraficznymi, oraz powszechność ich występowania w utworach mezozoiku, pozwala przypuszczać, że haczyki mogą być dobrymi skamieniałościami przewodnimi.

Przeprowadzono także szczegółowe porównania ze skolekodontami. Porównanie haczyków ze skolekodontami jest konieczne ze względu na ich powierzchowne podobieństwo, które powodowało dotychczas włączanie haczyków z ramion głowonogów do skolekodontów (Eisenack, 1939; Howell, 1962; Kozur, 1967, 1970, 1971; Jansonius i Craig, 1971). Wykazano, że te grupy skamieniałości wyraźnie różni szereg cech morfologicznych i zwykle stan zachowania.

ЦИПРИАН КУЛИЦКИ, ХУБЕРТ ШАНЯВСКИ

КРЮЧОЧКИ ГОЛОВНОГИХ МОЛЛЮСКОВ ИЗ ЮРЫ ПОЛЬШИ

Резюме

В работе представлено описание 22 морфологических форм крючочков рук юрских головоногих моллюсков Польши. Все формы объединены в девять родов, в том числе семь новых, а двенадцать форм получило новое видовое определение. Остальные десять форм из-за недостатка материала определены лишь до рода.

Проведено детальное сопоставление ископаемых крючочков с крючочками современных кальмаров семейства Onychoteuthidae. Сравнение показало, что они характеризуются сходными чертами строения и, по всей вероятности, одинаковым соотношением с окружающей мягкой тканью. Весьма характерным признаком, свойственным крючочкам как ископаемых, так и современных головоногих, являются продольные линии, которые представляют границу между поверхностью крючочка, покрытой мягкой тканью, и поверхностью, лишенной этой ткани. У рода *Cornuncus* и у *Urbanekuncus* sp. *C.* и *?Onychites felinus* n.sp. наблюдается кольцевая линия, анатомически эквивалентная продольным линиям. У большинства ископаемых крючочков наблюдается боковой шип или шпора — образование, которое отсутствует у ныне живущих головоногих. Кольцевой валик является характерным признаком некоторых ископаемых видов крючочков. Он связан с наличием капюшона, так как своим очертанием он отражает форму основания капюшона у современных Onychoteuthis и Ancistroteuthis, хотя у них и не наблюдалось образование такого типа, возможно из-за скудности сравнительного материала. Морфологическая дифференцированность крючочков, происходящих из разных стратиграфических местонахождений, а также их повсе-

местное распространение в мезозойских породах, позволяют судить, что они могут играть роль важных руководящих окаменелостей.

Проведено детальное сравнение крючочков со сколекодонтами. Это было необходимо в связи с тем, что из-за их внешнего сходства часто крючочки рук головоногих моллюсков относились к сколекодонтам (Эйзенак (Eisenack), 1939; Ховелл (Howell), 1962; Козур (Kozur), 1967, 1970, 1971; Янсониус и Крег (Jansonius i Craig), 1971). Доказано, что эти группы окаменелостей четко отличаются рядом морфологических признаков и, как правило, состоянием сохранности.

EXPLANATION OF PLATES

Plate XIV

Figs. 1—3. *Onychoteuthis banksi* (Leach), Recent. 1 — single hook of juvenile individual figured together with soft tissues in side view; h — hood. 2 — single hook of adult individual, seen from inner side. Hood (h) cut and fixed with pins; interridge surface, sucker opening and hook base observable. 3 — single hook of adult individual devoid of soft tissues, side view; longitudinal ridge distinct.

Fig. 4. *Phragmoteuthis? ticinensis* Rieber, Middle Triassic, Alps, Switzerland (after Rieber, 1970).

Plate XV

Figs. 1—4. *Acanthuncus passendorferi* n. sp.; 1 — uncinus and distal part of shaft: a — right side view, b — inner side view; 2 — holotype: a — left side view, b — right side view; 3 — small specimen with uncinus broken off and base damaged, left side view; 4 — specimen with uncinus and distal part of shaft broken off: a — left side view; b — inner side view. Volgian, the Zaraiskites scythicus Zone, Brzostówka near Tomaszów Mazowiecki (Z. Pal. No. V. V/88—91). See also Pl. V, Fig. 10.

Fig. 5. *Acanthuncus?* sp.; specimen with uncinus and base broken off, right side view; Volgian, the Zaraiskites scythicus Zone, Brzostówka near Tomaszów Mazowiecki; Z. Pal. No. V. V/96.

Fig. 6. *Nereis* sp., left jaw; a — dorsal view, b — ventral view; Recent, Baltic sea; Z. Pal. No. V. V/200.

Fig. 7. *Glycera* sp., jaw; a — dorsal view, b — ventral view; Recent, Mediterranean sea; Z. Pal. No. V. V/201.

Plate XVI

Fig. 1. *Paraglycerites* sp. *A*, specimen with base broken off; a — right side view, b — basal view; Middle or Upper Callovian, Łuków; Z. Pal. No. V. V/86.

Figs. 2—4. *Falcuncus falcus* n.sp.; 2 — specimen with lower part of base and spur point broken off, left side view; 3 — specimen with lower part of base and spur broken off, right side view, 4 — holotype, spur point broken off and base damaged, a — right side view, b — inner side view, c — left side view; Bathonian, the Morrisiceras morrisi Zone, Blanowice near Zawiercie; Z. Pal. No. V. V/97-100.

Fig. 5. *Deinuncus longirostris* n.sp.; holotype, a — left side view, b — inner side view; Volgian, the Zaraiskites scythicus Zone, Brzostówka near Tomaszów Mazowiecki; Z. Pal. No. V. V/132.

Figs. 6—7. *Deinuncus brevirostris* n.sp.; 6 — small specimen, left side view, 7 — holotype: a — left side view, b — inner side view; Volgian, the Zaraiskites scythicus Zone, Brzostówka near Tomaszów Mazowiecki; Z. Pal. No. V. V/128-129.

Plate XVII

Fig. 1. *Urbanekuncus* sp. *B*; specimen with base broken off, right side view; Volgian, the Zariskites scythicus Zone, Brzostówka near Tomaszów Mazowiecki; Z. Pal. No. V. V/144.

Fig. 2. ? *Onychites felinus* n.sp.; specimen with base broken off: a — left side view, b — right side view; Volgian, the Zaraiskites scythicus Zone, Brzostówka near Tomaszów Mazowiecki; Z. Pal. No. V. V/146.

Fig. 3. *Paraglycerites gracilis* n.sp.; small specimen, right side view; Bathonian, the Morrisiceras morrisi Zone; Z. Pal. No. V. V/7; see also Pl. VI, Figs. 1-5.

Fig. 4. ?*Urbanekuncus* sp. C, specimen with uncinal point broken off; a — right side view, b — inner side view; Volgian, the Zaraiskites scythicus Zone, Brzostówka near Tomaszów Mazowiecki; Z. Pal. No. V. V/145.

Figs. 5—7. *Arcuncus makowskii* n.sp.; 5- holotype, a — inner side view, b — left side view; 6 — specimen with spur broken off, left side view; 7 — uncinus and distal part of shaft of large specimen, right side view; Middle or Upper Callovian, Łuków; Z. Pal. No. V. V/133-135.

Fig. 8. *Urbanekuncus* sp. *A*, specimen with damaged base, right side view; Volgian, the Zaraiskites scythicus Zone, Brzostówka near Tomaszów Mazowiecki; Z. Pal. No. V. V/143.

Fig. 9. ?*Paraglycerites* sp. *B*, specimen with base broken off, left side view; Maestrichtian, borehole Magnuszew, depth 623 m; Z. Pal. No. V. V/87.

Figs. 10—11. *Urbanekuncus mediodenticulatus* n.sp.; 10 — holotype, a — left side view, b — inner side view, c — right side view; 11 — specimen with base broken off, right side view; Bathonian, the Morrisiceras morrisi Zone, Blanowice near Zawiercie; Z. Pal. No. V. V/138-139.

Plate XVIII

Figs. 1—8. *Cornuncus asymmetricus* n.sp.; 1a — inner side view; 1b — left side view, 2 — inner side view, 3 — small specimen, inner side view, 4a — inner side view, 4b — right side view, 4c — outer side view, 5 — holotype, a — outer side view, b — inner side view, c — left side view, 6 — specimen with uncinal point broken off, left side view, 7 — left side view, 8 — specimen with uncinal point broken off, inner side view; Volgian, the Zaraiskites scythicus Zone, Brzostówka near Tomaszów Mazowiecki; Z. Pal. No. V. V/119-126.

Fig. 9. *Cornuncus* sp. *A*; a — left side view, b — right side view; Volgian, the Zaraiskites scythicus Zone, Brzostówka near Tomaszów Mazowiecki; Z. Pal. No. V. V/127.

Fig. 10. *Acanthuncus passendorferi* n.sp.; fragment of a large specimen, left side view; Volgian, the Zaraiskites scythicus Zone, Brzostówka near Tomaszów Mazowiecki; Z. Pal. No. V. V/92.

Plate XIX

Figs. 1—5. *Paraglycerites gracilis* n.sp.; 1 — left side view; 2 — right side view, 3 — left side view, 4 — holotype, a — left side view, b — inner side view, c — right side view, 5 — right side view; Bathonian, the Morrisiceras morrisi Zone, Blanowice near Zawiercie; Z. Pal. No. V. V/1-6.

Figs. 6—10. *Paraglycerites erectus* n.sp.; all specimens with base partly or completely broken off: 6 — right side view, 7 — right side view, 8 — left side view, 9 — left side view, 10 — holotype, a — left side view, b — inner side view, c — right side view; Bathonian, the Morrisiceras morrisi Zone, Blanowice near Zawiercie; Z. Pal. No. V. V/61-65.

Plate XX

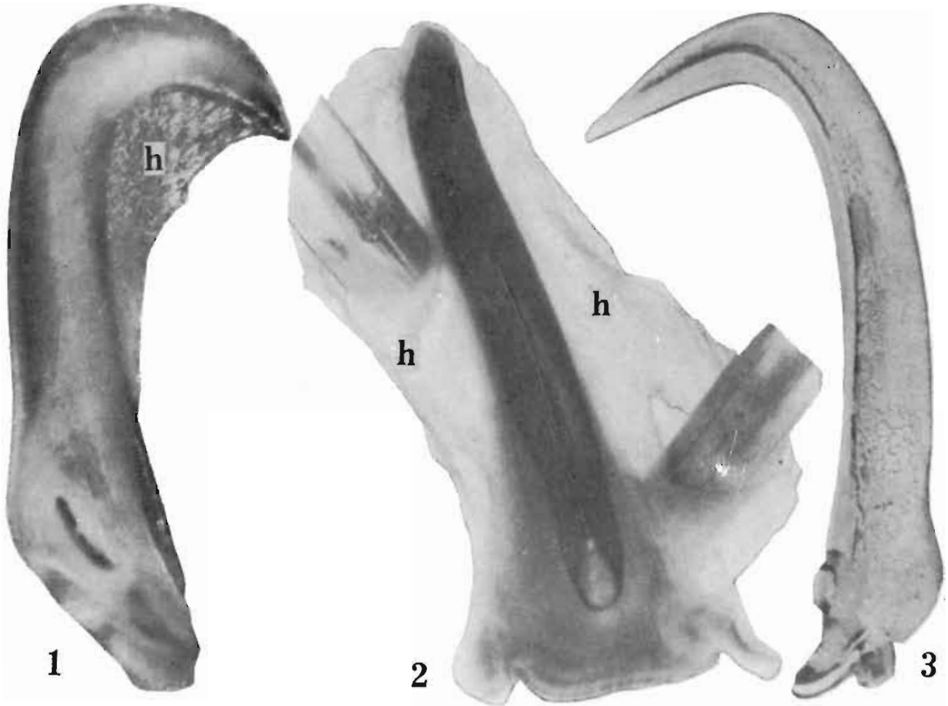
Fig. 1. *Falcuncus* sp. *A*, specimen with uncinal point broken off: a — left side view, b — inner side view, c — right side view; Oxfordian, the Idoceras planula Zone, Pajęczno near Częstochowa; Z. Pal. No. V. V/103.

Fig. 2. ?*Falcuncus* sp. *B*, specimen with base damaged; a — left side view, b — right side view; Danian, borehole Góra Puławska near Puławy, depth of 24 m; Z. Pal. No. V. V/104.

Fig. 3. ?*Longuncus* sp. *A*, right side view; Volgian, the Zaraiskites scythicus Zone, Brzostówka near Tomaszów Mazowiecki; Z. Pal. No. V. V/118.

Figs. 4—8. *Longuncus longus* n.sp.: 4 — holotype, a — outer side view, b — inner side view, c — right side view, 5a — left side view, 5b — inner side view, 6 — deformed specimen, right side view; 7 — left side view, 8 — deformed specimen, left side view; Volgian, the Zaraiskites scythicus Zone, Brzostówka near Tomaszów Mazowiecki; Z. Pal. No. V. V/105-109.

Figs. 9—10. *Longuncus longoides* n.sp.: 9 — right side view, 10 — holotype, left side view; Volgian, the Zaraiskites scythicus Zone, Brzostówka near Tomaszów Mazowiecki; Z. Pal. No. V. V/116-117.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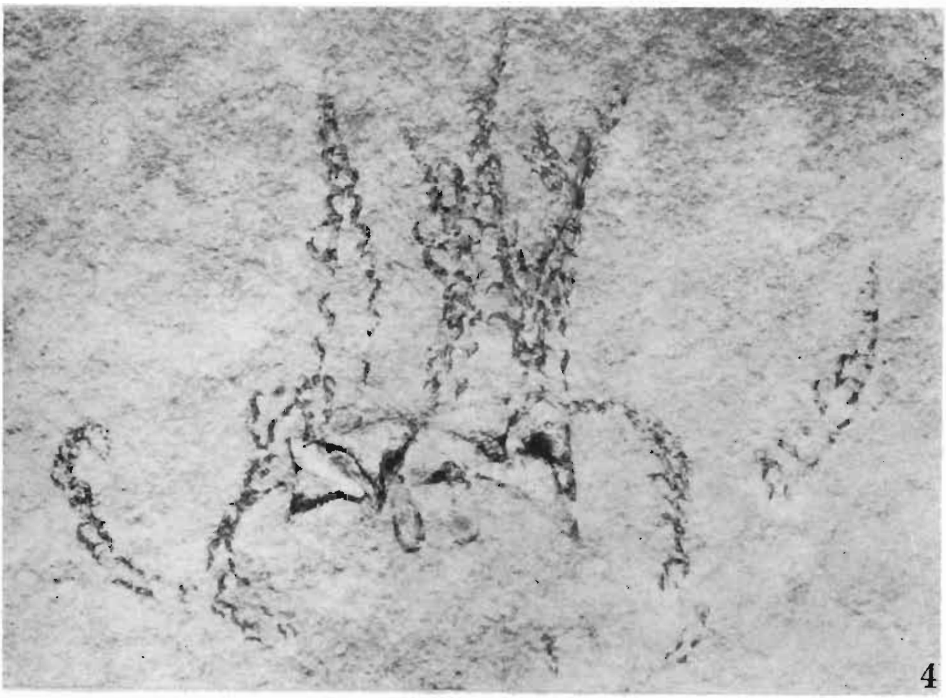
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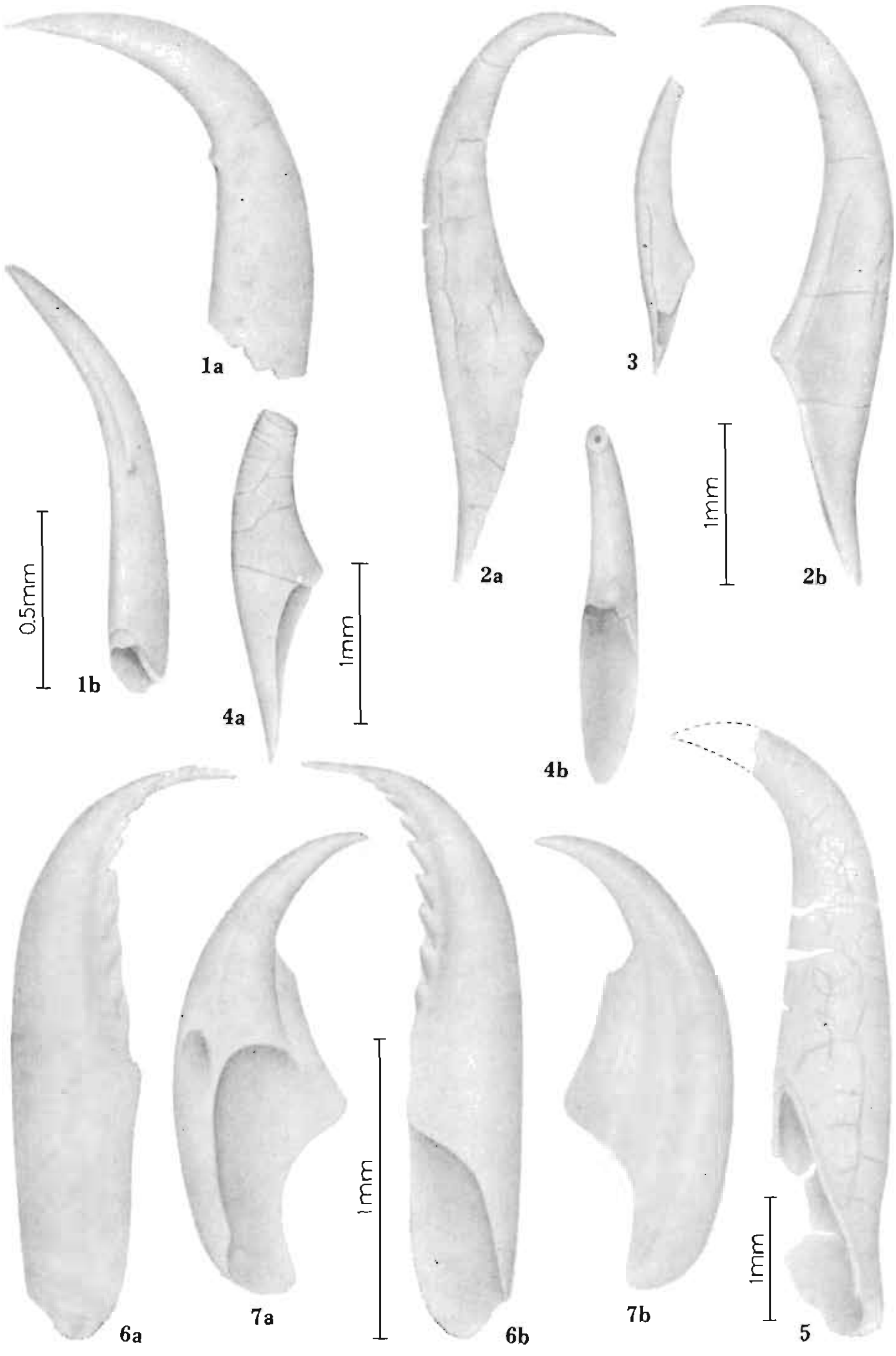
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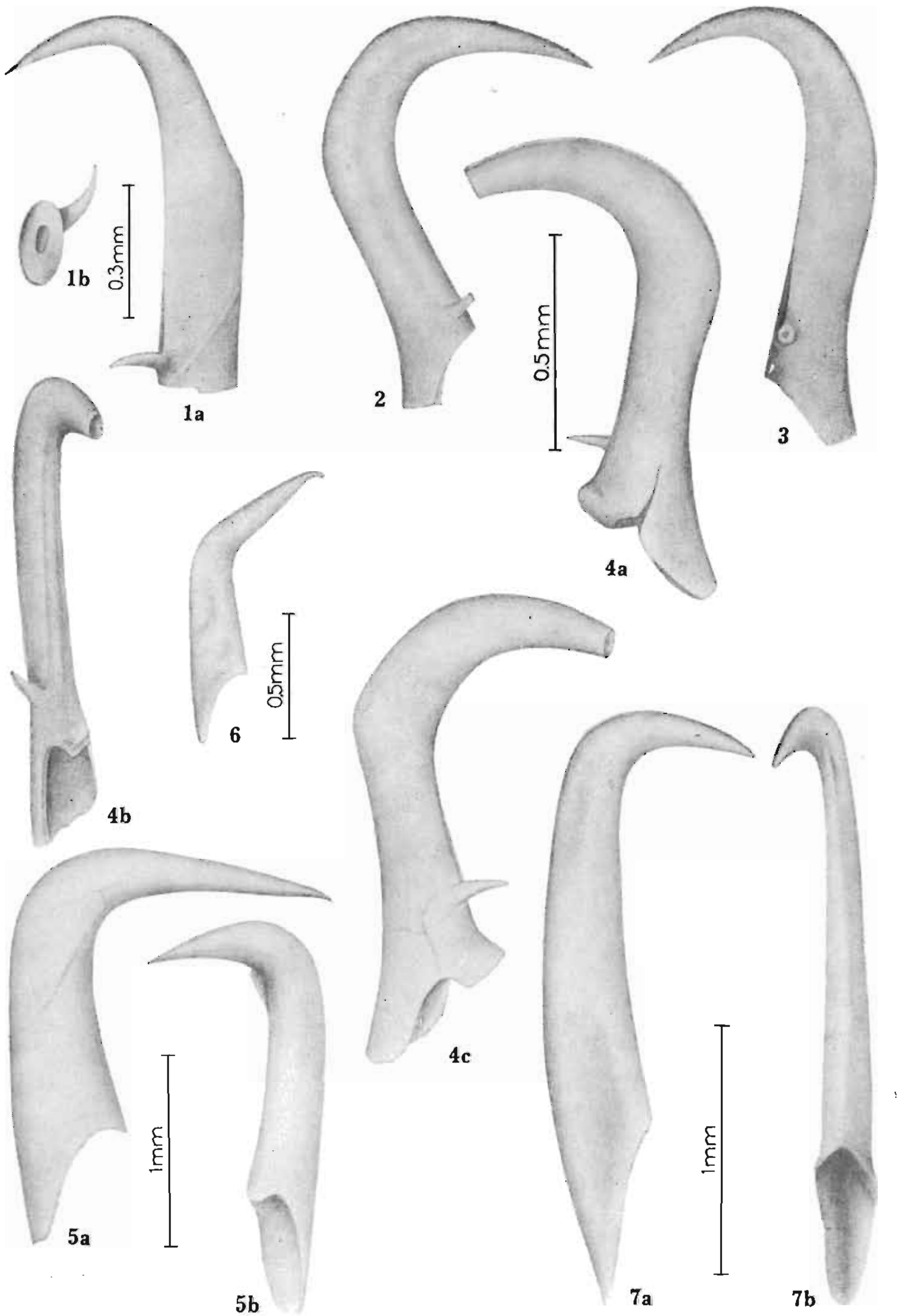
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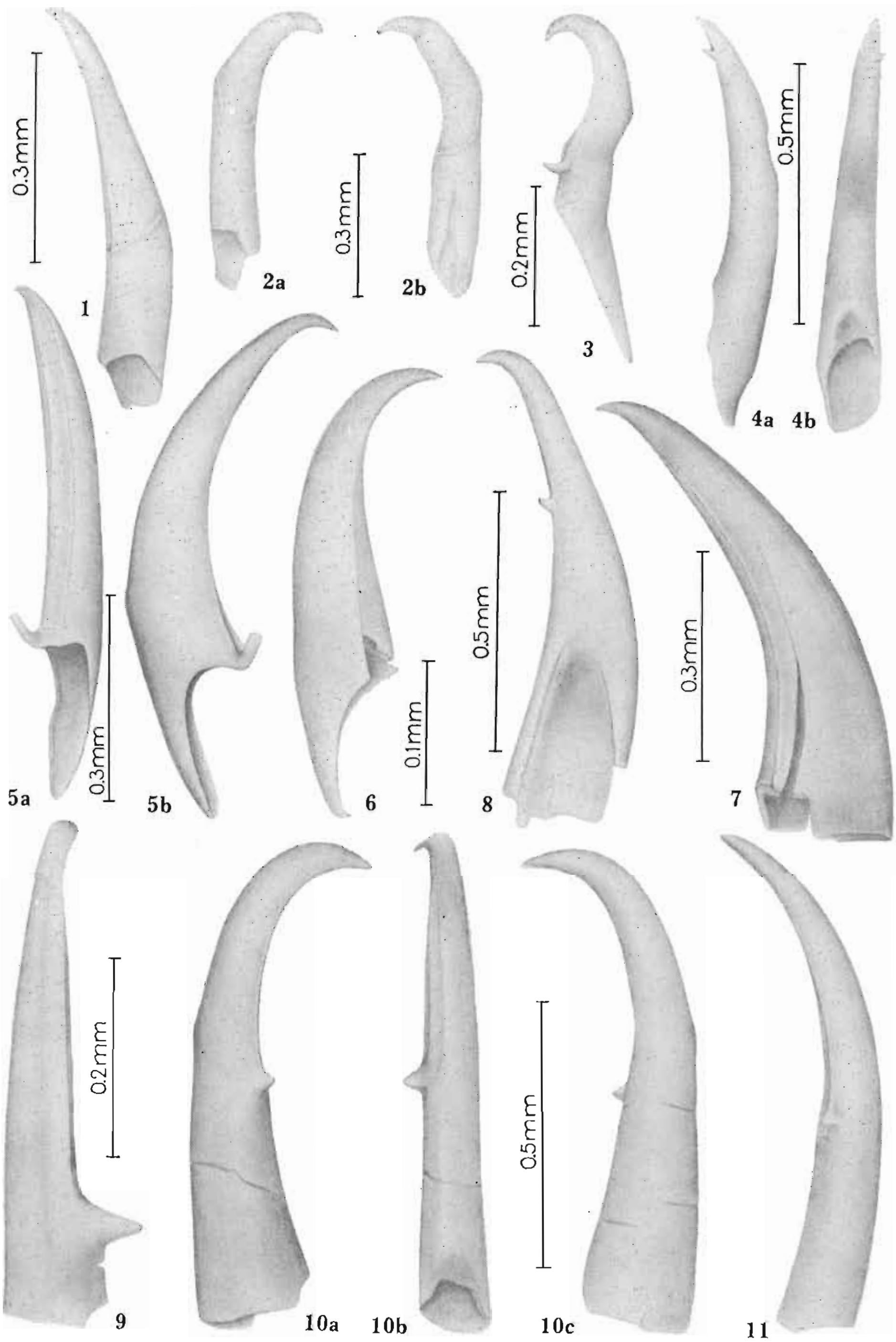
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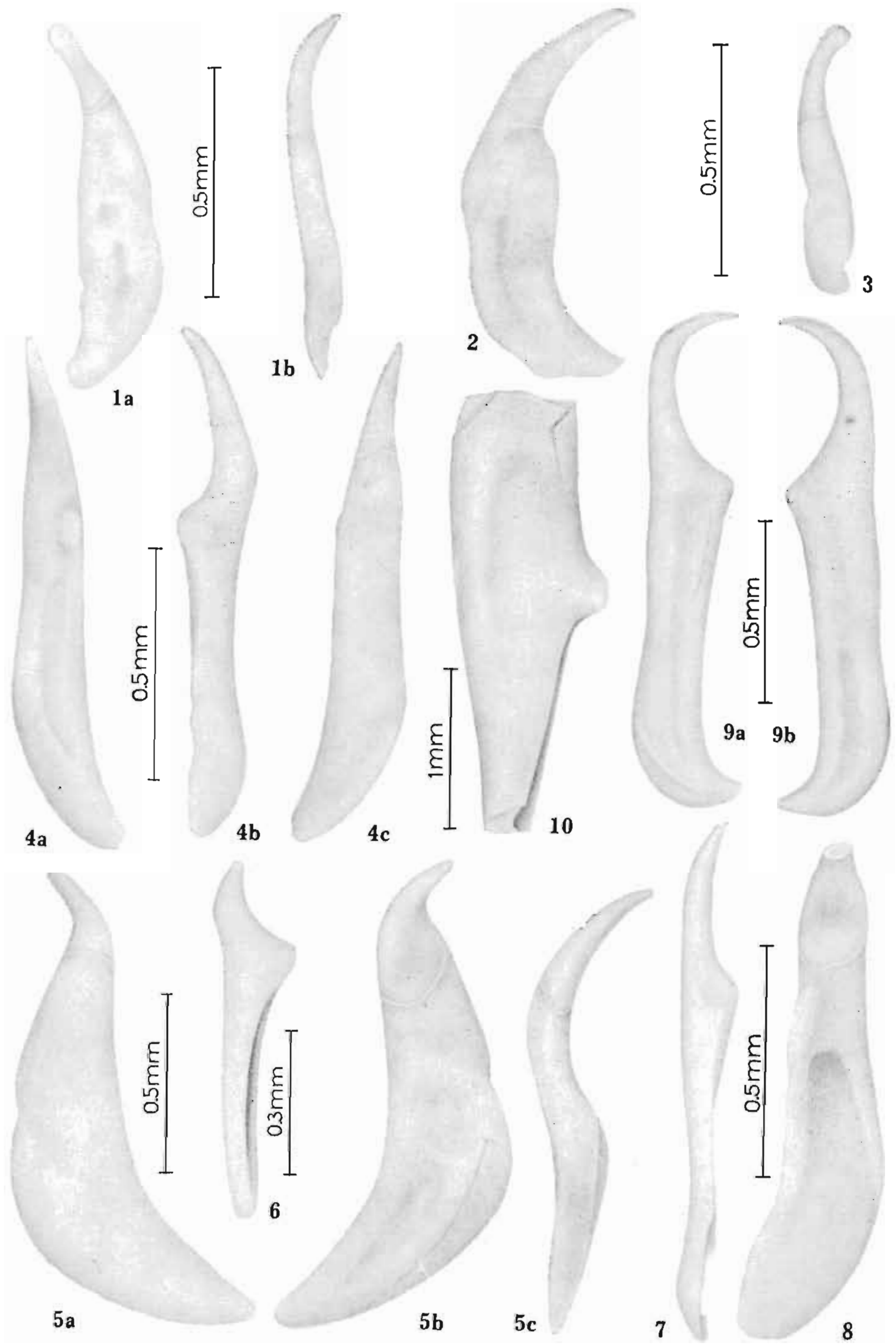
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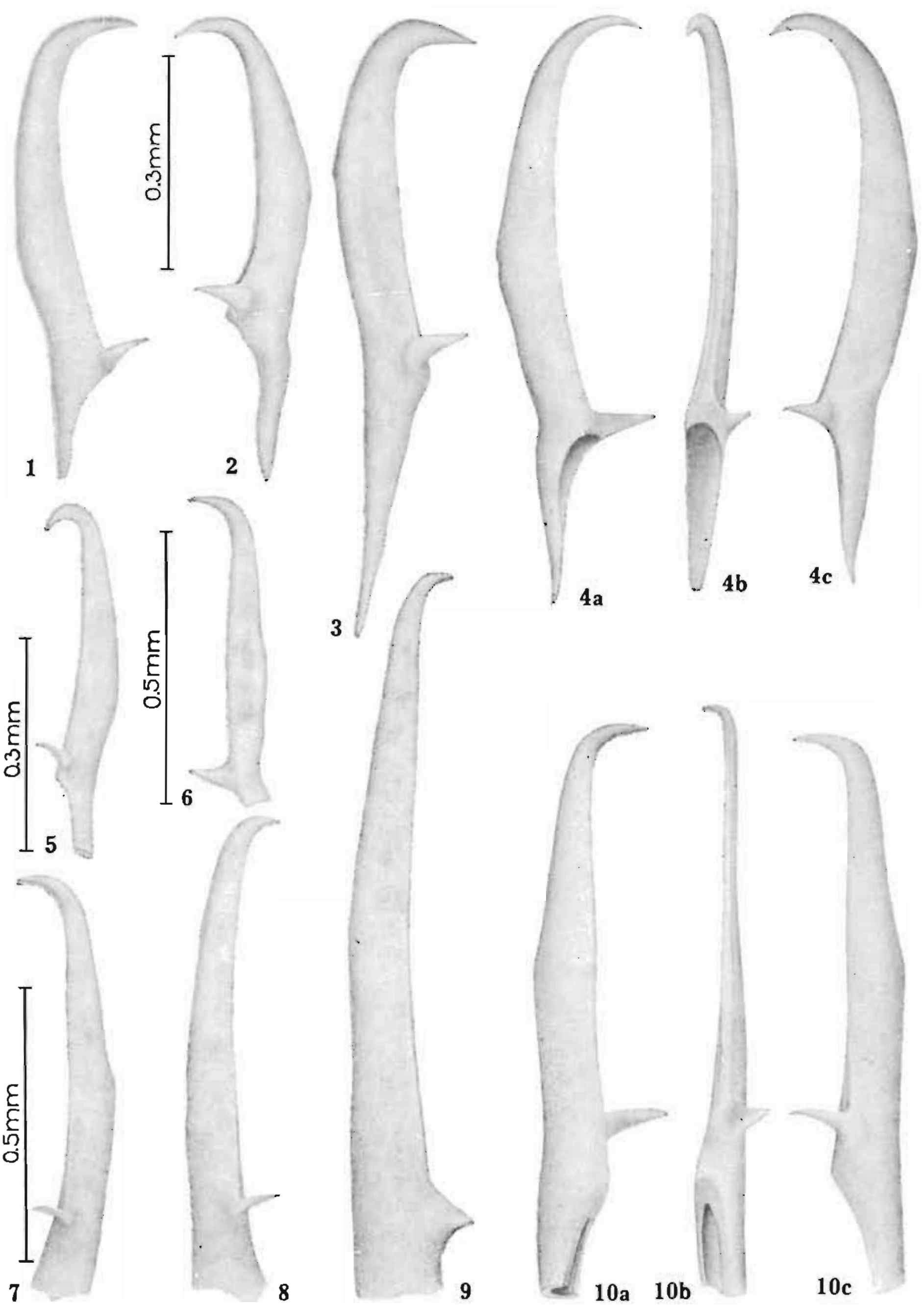
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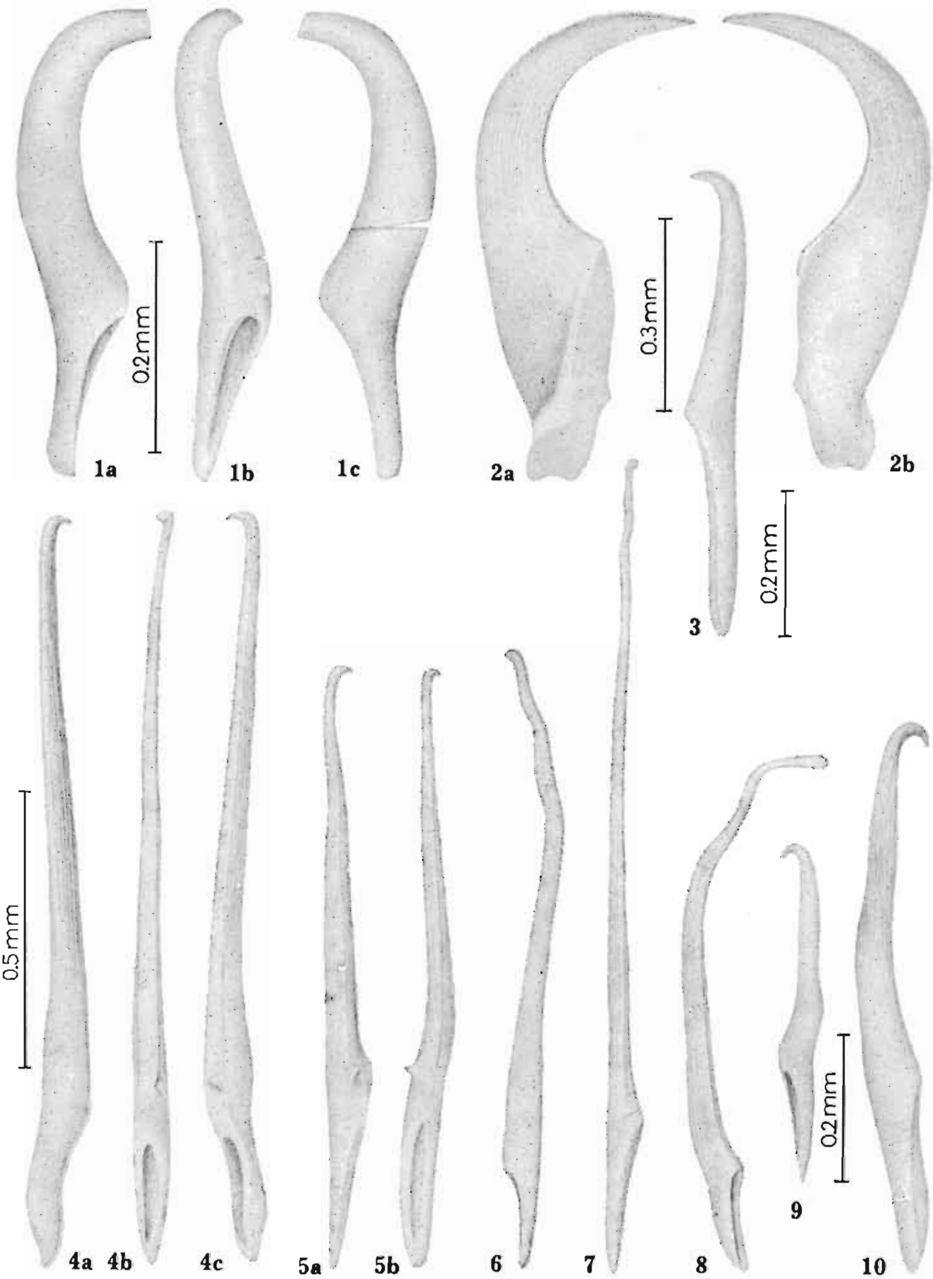
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