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Jaw parts, presumably of Cephalopoda, in the Upper Jurassic of western Greece

By OTTO RENZ[1])

ABSTRACT

Several problematic fossils collected in western Greece from the lower part of the Vigla Formation (Upper Jurassic) were investigated. They are identical with impressions from DSDP Leg 11, Site 99A, in the Bahamas, classified as "incertae sedis". These remains are interpretable as lower and upper jaws, probably belonging to a yet unknown genus of cephalopods, which is referred to as *Rhynchocameratus*. The faunal composition is restricted to those jaw parts accompanied by small lamellaptychi.

ZUSAMMENFASSUNG

Einige noch problematische Fossilien vom westlichen Griechenland aus dem unteren Abschnitt der Vigla-Formation (Oberer Jura) wurden untersucht. Sie sind identisch mit Abdrücken aus der Bohrung 99A des DSDP Leg 11 in den Bahamas, die unter «incertae sedis» beschrieben wurden. Diese Fossilien können jetzt als Ober- und Unterkiefer einer wahrscheinlich noch unbekannten Gattung von Cephalopoden gedeutet werden, die als *Rhynchocameratus* bezeichnet wird. Die Zusammensetzung der Fauna beschränkt sich auf diese Unter- und Oberkiefer und kleine Lamellaptychi.

Introduction

A dwarf fauna of Upper Jurassic age, comparable with the present assemblage from western Greece, has been described from hole 99A of Leg 11 of the Deep Sea Drilling Project (RENZ 1974). DSDP hole 99A is located in the Bahamas (latitude 23°41. 14'N, longitude 73°50.99'W), about 40 nautical miles southeast of the island of San Salvador in the Cat Gap area. The hole, under 4.914 m of water, penetrated a sequence of 248 m of sediment, from which the lower 95 m are Jurassic in age.

The fossils obtained from core 14, section 2, 23-24 cm, at a depth of 240 m, are predominantly remains of cephalopods deposited in a deep water environment of brick-red calcilutite rich in silt-sized quartz. The sediment consists of about 85% terrigenous material and of 15% carbonate.

Of special interest are abundant, flattened "leaf-like" impressions, varying in outline and ornament (RENZ 1974, p. 517, Pl. 2; p. 518, Fig. 5). Their taxonomic position remained unknown, as no comparable fossils have so far been found described. They were referred to as "incertae sedis". These impressions are accompanied by flattened internal whorls of ammonites (3-9 mm in diameter) belonging

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to *Phylloceras* and *Haploceras*. Small lamellaptychi resembling Lamellaptychus thoro (OPPEL) are scattered. Besides of cephalopods a small, not determined gastropod (length 2.3 mm), and a few carbonized plant remains are present. The nannoflora is poorly preserved, because it is strongly affected by post-depositional solution. Based on aptychi a late Oxfordian to Kimmeridgian age is suggested for this interval in the Atlantic.

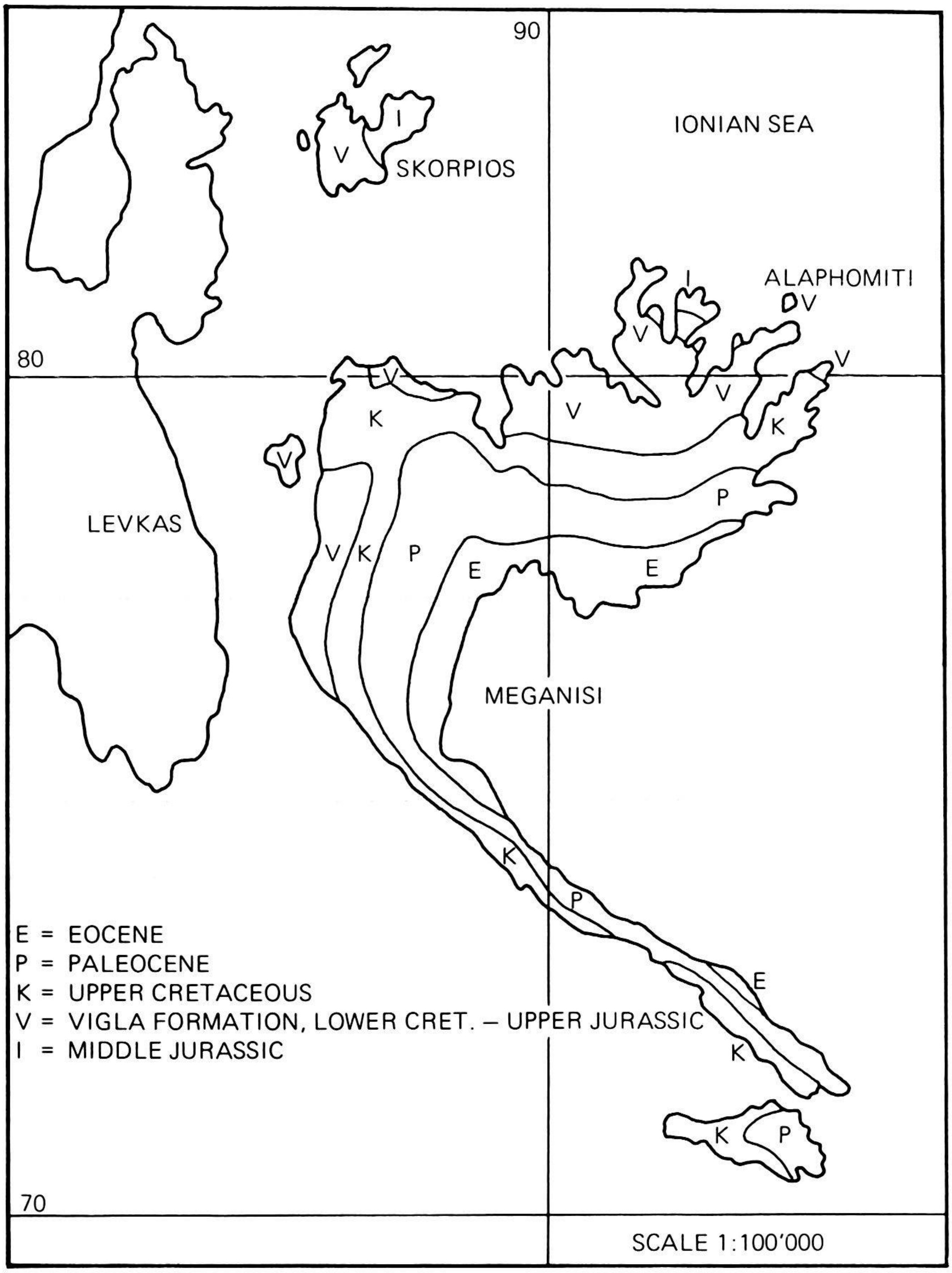


Fig. 1. Location map, based on the geological map by The British Petroleum Company Limited (1966), Sheet 1, Levkas, 1:100,000.

Recently aptychus assemblages collected by RENZ (1927; 1955, p. 190) from the Jonian Facies belt in western Greece have been reviewed. Remains identical with those "leaf-like" impressions described from hole 99A in the Bahamas appeared in samples obtained from the lower part of a thick sequence of pelagic deposits, Upper Jurassic in age, assigned to the Vigla Formation.

Occurrence

The material derives from a small island in the Jonian Sea named Alaphomiti (Fig. 1) which, owing to its smallness, is not indicated on current maps. Alaphomiti is located about 150 m north of the Jonian Island of Meganisi, situated east of Levkas.

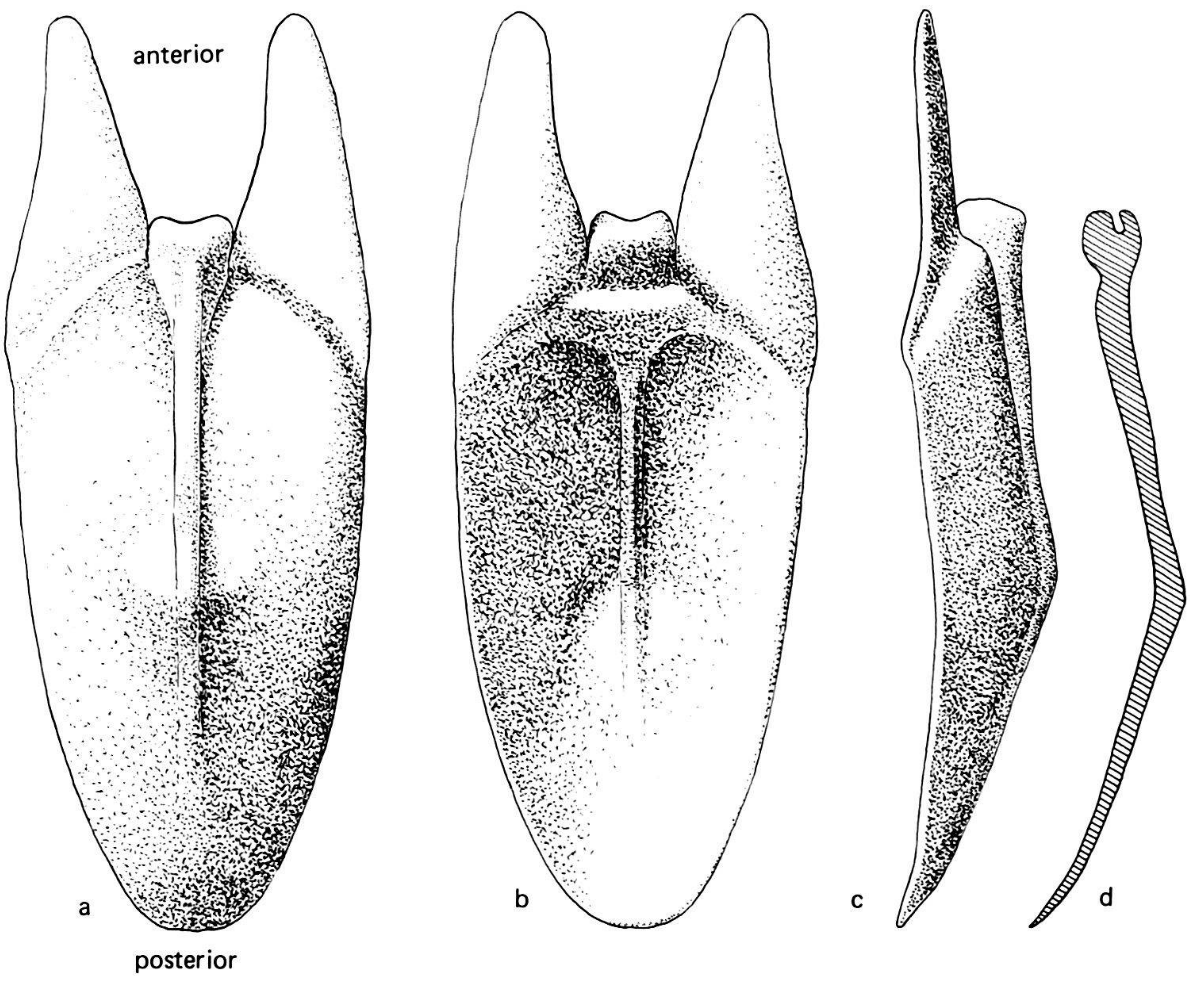


Fig. 2. Drawing based on models of lower jaw *Rhynchocameratus jonicus* n. sp. About 25×.

a = Convex surface: Prominent median keel fades out towards posterior end of shell. Anteriorly it widens into a "beak-like structure". A low bulge of shell on its posterior half is generally present.

b = Concave surface: Low and narrow median crest opposite keel on convex side is developed.

c = Lateral view showing flexure-like inward bending of shell, coinciding with base of the spurs. Anterior margin of upper jaw fits into this flexure.

d = Longitudinal section: Peculiar deepening on posterior face of "beak-like structure" corresponds to tongue-like projection of sediment in the respective cavity (Fig. 8g). Drawing by O. Garraux.

Along the deeply incised northern coast of Meganisi, deposits of Upper Cretaceous age are exposed in the west, whereas pelagic limestones and cherts of the Upper Jurassic and Lower Cretaceous (Vigla Formation) are composing the coastal region farther east. The oldest rocks exposed, underlaying the Vigla Formation, are yellow-brown cherts containing abundantly *Bositra alpina* (ROEMER), indicating a

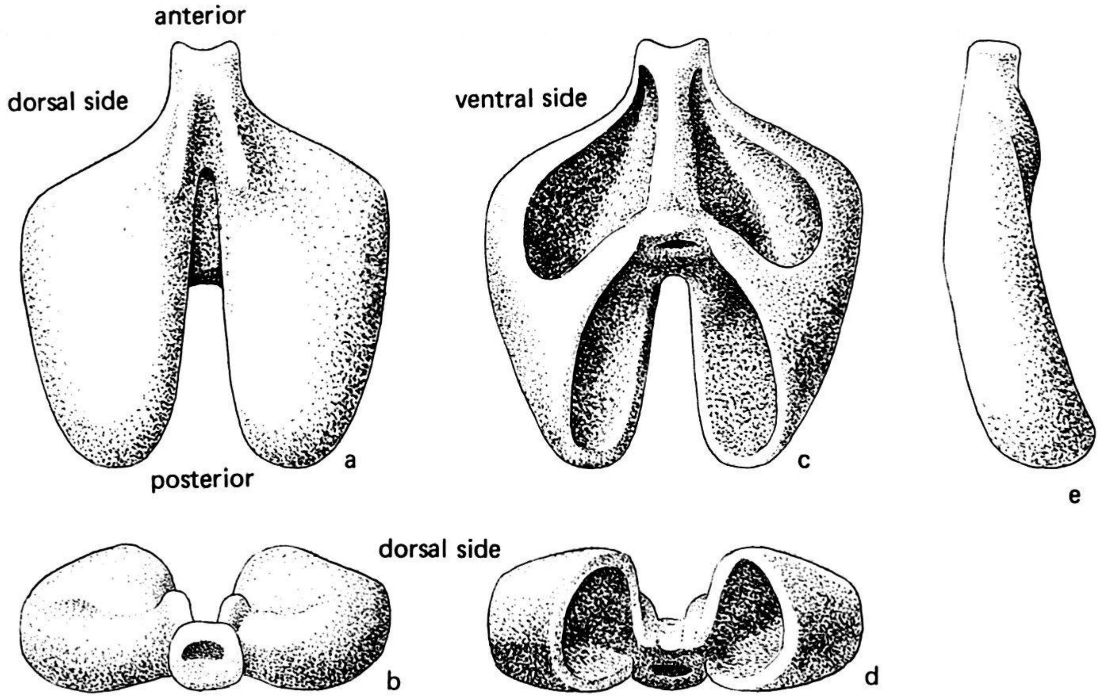


Fig. 3. Drawings based on models of upper jaw of *Rhynchocameratus jonicus* n. sp. About 25×.

a = Dorsal side: A "beak-like structure", identical with that on lower jaws, and a median furrow deepening posteriorly, are important features. Anterior margin of upper jaw fits into flexure-like bending on lower jaw (Fig. 2c). Anterior half of longitudinal furrow is flanked by parallel, elongated elevations which might have functioned as attachments for chewing muscles.

b = Front view on anterior end (dorsal side above): Anterior face of "beak-like structure" shows deepening which corresponds to a tongue-like projection of sediment in the respective cavity (Fig. 9b). Elevations flanking median furrow are indicated.

c = Ventral side: Division into a "beak-like structure", as well as an anterior and posterior compartment is shown. Anterior compartment, open on its ventral side, is separated by a median beam dividing it into two chambers. Anteriorly this beam ends in the "beak-like structure". The posterior chamber also is open on its ventral side (Fig. 9g) and separated by a narrow split on its dorsal side (Fig. 9a).

d = Front view on posterior end (dorsal side above): Longitudinal furrow on dorsal side, and two elongated elevations flanking it, are indicated. Posterior end of beam, dividing the two anterior chambers, possesses an identical deepening as present on the "beak-like structure" (Fig. 9b).

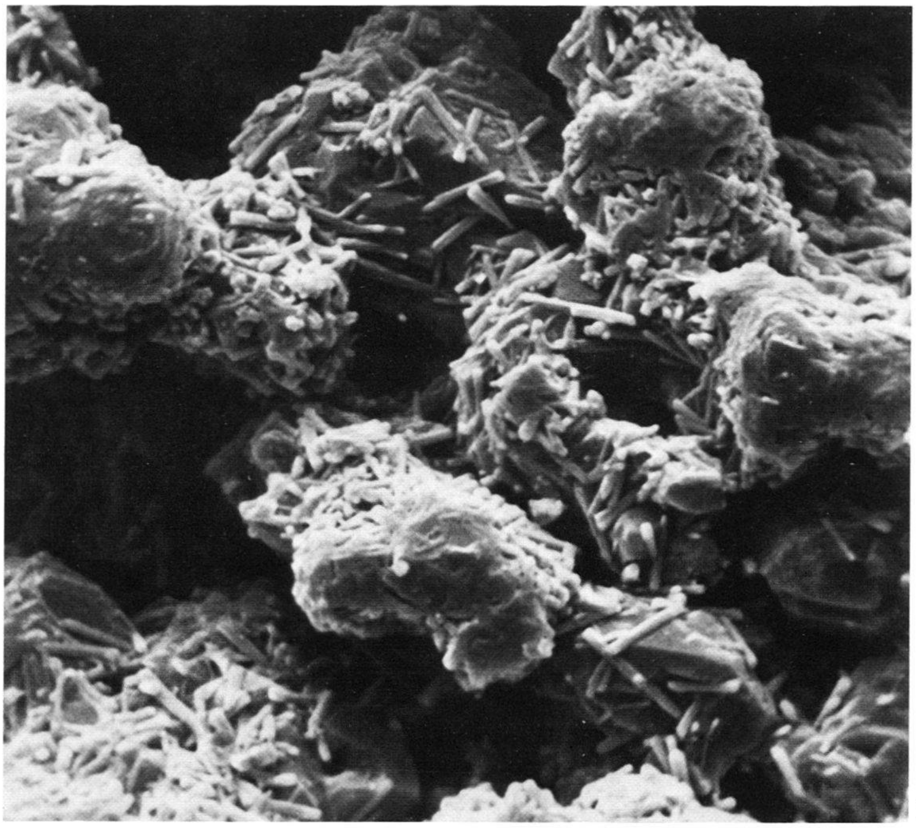
e = Side view showing two elevations flanking median furrow on dorsal side.

Fig. 4. Electron micrographs.

a = Left side: Dorsal surface of sediment-filling of anterior compartment. It is divided by a longitudinal cavity (filled originally with calcite) into two chambers. Below, the posterior compartment is indicated by a ledge of sediment filling the split dividing the dorsal side of the compartment (Fig. 9a). Right side: Impression of concave side of a lower jaw, showing narrow longitudinal furrow, corresponding to crest opposite keel on convex side. 30×.

b = Details on surface of lower jaw. Short-stalked, compact individuals of quartz crystals are covered by later generation of rather lengthened, hexagonal needles of quartz. 3,600×.

a



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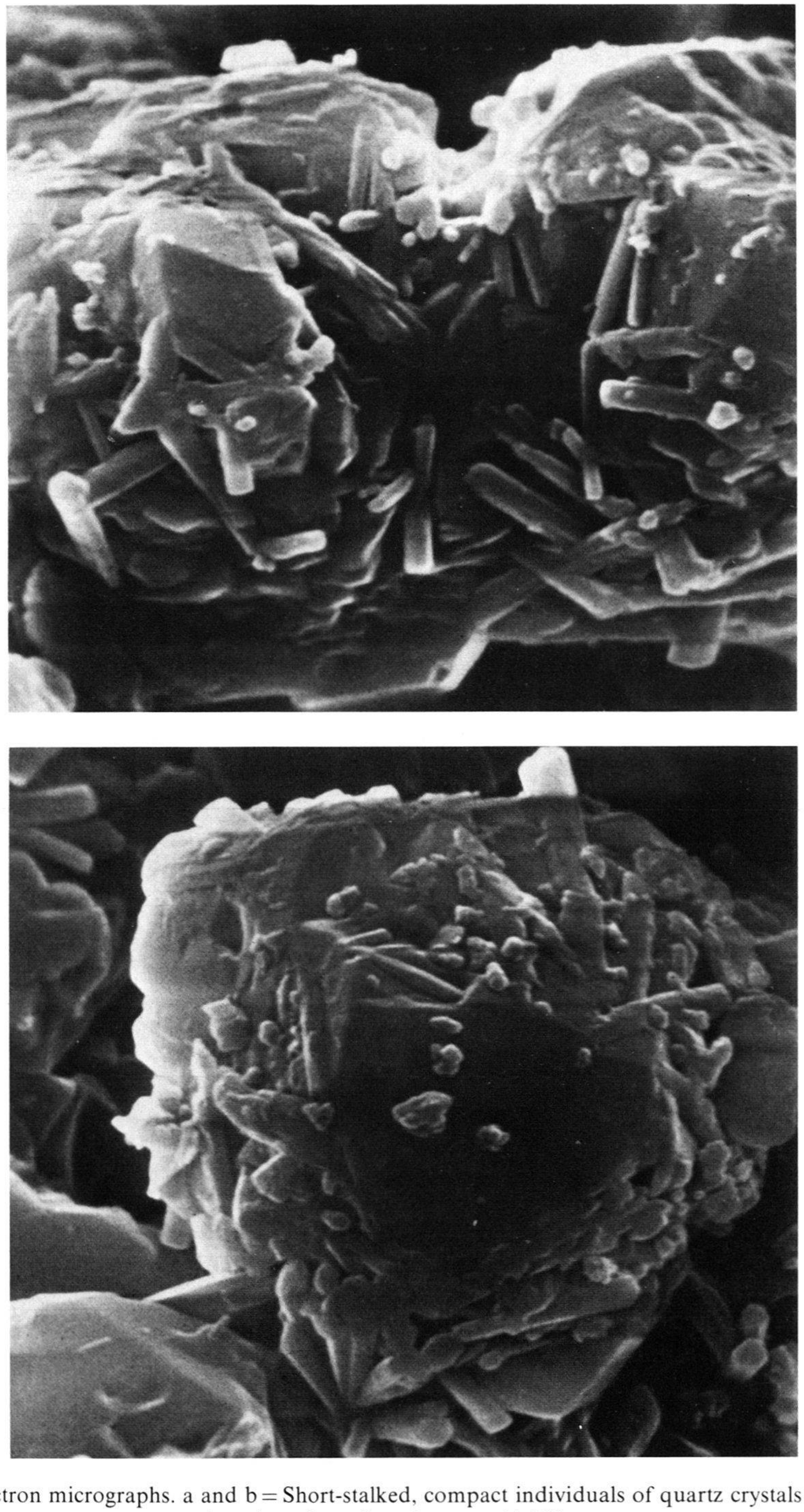


a

b

Fig. 5. Electron micrographs. a and b = Short-stalked, compact individuals of quartz crystals covered lengthened needles of quartz. 12,000×.

late Middle Jurassic age. This formation is referred to as "Upper Posidonia beds" (RENZ 1955, p. 80; BERNOULLI & RENZ 1970, Fig. 3, p. 581). It is followed by white, micritic, platy limestones, rich in Radiolaria and occasional fossil debris, interbedded with thin layers and lenses of grey-brown weathering cherts belonging to the lower part of the Vigla Formation.

The island of Alaphomiti consists predominantly of southward dipping Vigla Formation formed of white, micritic, partially very silicious limestones containing Radiolaria. The chert layers interbedded in this platy, white limestones exposed on the western side of Alaphomiti contain the present fauna. The structural connections with Meganisi are not clear. Most probably local faulting is here involved. We therefore do not know the exact stratigraphic position of the assemblage here discussed within the Vigla Formation.

Lithology and preservation

The samples which furnished the jaw parts consist of dense, light grey partially whitish weathered chert, interbedded with very porous layers. Presumably the fossils composed of calcite were embedded in a silicious mud, below the compensation depth for calcite. Shortly after deposition on the sea floor the pores of the shells were impregnated with silica, which later, during diagenesis crystallized as aggregates of quartz crystals observable at present (Fig. 5a, b). The fossils therefore are preserved as cavities in a finely crystalline, porous groundmass composed of quartz crystals (Fig. 4a, b). It might also be considered that the present fossils consisted of organic (possibly horny) material which decomposed leaving the respective cavities.

The texture of the sediment can be described as cellular to sponge-like, and porosities ranging between 30 and 70% have been obtained of layers where the fossils are densly accumulated.

A sample (P 1793) has been examined roentgenographically (Debye-Scherrer Method) by S. Graeser from the Mineralogical Institute in Basel. Dr. Graeser remarks: On the X-ray diagram exclusively reflexes of quartz could be recognized; calcite seems to be totally absent. The diagram yielded clear and sharp lines, indicating that quartz is well crystallized. On scanning pictures crystals of quartz are distinctly detectable, partly as short-stalked, compact individuals, and partly as rather lengthened needles (Fig. 5a, b).

Environment

The numerical distribution of the components of the assemblage is as follows: lower jaws about 50%, upper jaws about 40% and lamellaptychi about 10%. Sorting due to bottom currents seems to have occurred to a certain extent accumulating lower and upper jaws separately (Fig. 8e, 9i). Locally jaw parts and aptychi were concentrated very densly, and consequently were in touch with each other. After solution of the calcareous shell substance an intricate cellular texture of the sediment resulted, concealing the original morphology of individuals. Recent fungi could penetrate along such channels deeply into the rock and produced there fruit-bodies.

Preparation

Attempts to impregnate the cavities corresponding to the fossils with Araldite, and then dissolve the silica with fluorid acid failed, because of infiltration of the Araldite into the finely porous sediment surrounding the caverns. Models of wax of the fossils were prepared in order to clarify the intricate morphology, mainly of upper jaws (Fig. 2, 3).

Taxonomic position

The fossils here described are interpreted as lower and upper jaws, assumed to be connected with a yet unknown jaw-bearing group of cephalopods, from which no other parts are known. It must be mentioned that none of these jaw parts were seen in contact with one another.

These peculiar and specialized structures are considered to represent a genus referred to as *Rhynchocameratus* n. gen. The existence of several species belonging to this genus is suggested by different outlines of lower as well as upper jaws (Fig. 6–8). Eventual species are not yet distinguished by names. The association of these remains with abundant small aptychi does, however, not fully exclude the possibility that these jaw parts might belong to ammonites (compare LEHMANN 1975).

Systematic descriptions

The morphology of lower and upper jaws is quite distinct: lower jaws are bilaterally symmetrical shovel-like shells, whilst upper jaws are dividable into an anterior and a posterior compartment. Nevertheless, significant identical features observable on both jaw parts, concerning especially their anterior ends, are noticeable. The present fossils have nothing in common with rhyncholites (compare SAUNDERS, SPINOSA, TEICHERT & BANKS 1978).

Class ***Cephalopoda*** CUVIER 1797

Order and Family uncertain

Genus *Rhynchocameratus* n. gen.

Type species (herewith designated): *Rhynchocameratus jonicus* n. sp., Upper Jurassic, western Greece.

The name *Rhynchocameratus* refers to the chambered structure representing the upper jaw.

Diagnosis. – Lower jaw elongated, oval, shovel-like shell, ending anteriorly in a beak-like feature and splitting into two spurs. Upper jaw dividable into a beak-like feature anteriorly, followed posteriorly by two compartments.

Rhynchocameratus jonicus n. sp.

Fig. 2, 3, 6–9

Holotype. – NMB No. J28416 (Fig. 7a, b).

Type locality. – Island of Alaphomiti, north of Meganisi in the Jonian Sea (western Greece), Upper Jurassic (Vigla Formation).

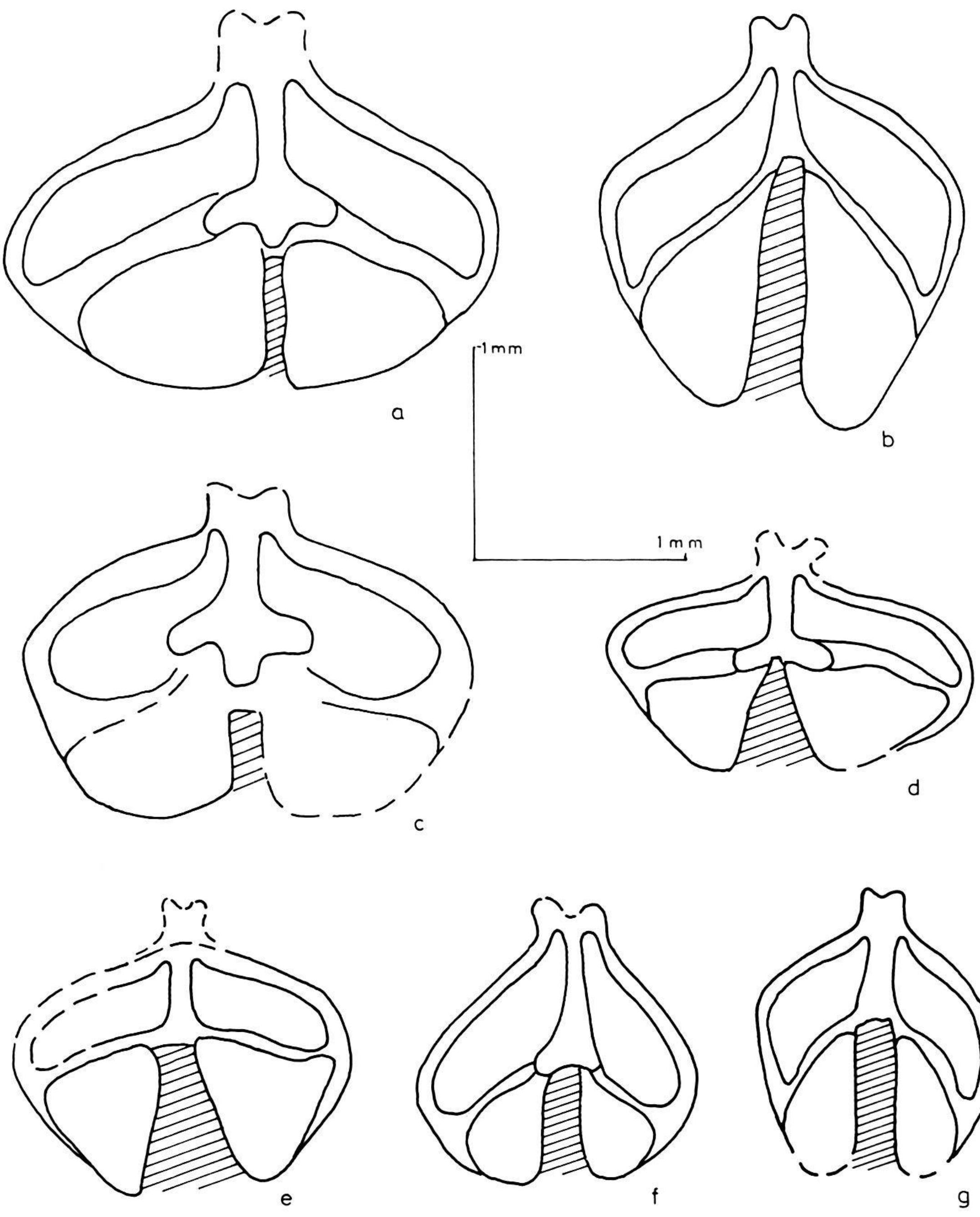


Fig. 6. Variability of upper jaws of *Rhynchocameratus jonicus* n.sp. Dorsal sides. Variable outlines of anterior and posterior compartments, filled with sediment, suggest different "species" belonging to this cephalopod genus. 25×.

a = J28437, width/length index = 1.27
b = J28433, width/length index = 0.86
c = J28439, width/length index = 1.31
d = J28440, width/length index = 1.55
e = J28441, width/length index = 1.11
f = J28442, width/length index = 1.00
g = J28443, width/length index = 0.78

Lower jaws of *Rhynchocameratus jonicus* n. sp.

Fig. 2 a–d, 7, 8

Jaw parts considered to represent lower jaws are elongated, oval, shovel- or spoon-like shells, dividing into two conspicuous spurs on their anterior end (Fig. 2a, b). The convex (outer) side of the lower jaw is raised into a longitudinal, narrow median keel lowering towards the posterior end of the shell (Fig. 2a, c). The upper surface of this keel is flattened to slightly convex. From the base of the keel the surface of the shell slopes gently, with angles around 25°, towards its lateral margins. Near its anterior bifurcation into two spurs the keel widens progressively, developing a "beak-like structure" (Fig. 2 a–d, 8g). A peculiar deepening on its anterior face is always clearly developed (Fig. 2d). It appears as a tongue-like projection of sediment, pointing posteriorly on the respective cavities (Fig. 8g). The function of this conspicuous depression is unknown. It might have served as attachment for muscles or horny parts, which soon after deposition on the sea floor desintegrated. Towards the posterior half of the lower jaw the keel crosses over a flat median bulge of the shell (Fig. 8e). The intensity of this bulge is variable on different specimens, but it generally is recognizable. It might be connected with the posterior termination of the respective upper jaw. A further outstanding feature are flexure-like inward bendings of the shell, following oblique lines from the posterior end of the "beak-like structure" towards the lateral margins of the shell (Fig. 2 a–c). The angles with the longitudinal axis reach about 55°. It is significant to note that the anterior margins of the upper jaw fit into these inflections (Fig. 3a).

On the concave (inner) side of the lower jaw, a low longitudinal, narrow, acute crest, opposing the keel on its convex side is developed. It begins on the posterior end of the "beak-like structure" and fades out towards the median bulge (Fig. 2b).

Fig. 7. Variability of lower jaws of *Rhynchocameratus jonicus* n. sp. a and b = holotype; c–k = paratypes.

a = J28416. Holotype of *Rhynchocameratus jonicus* n. sp. Width/length index = 0.46. Impression of concave surface. Longitudinal crest faintly visible. 10×.

b = J28416. Opposite side of holotype. Convex surface of holotype is slightly granular. Its longitudinal median keel is exposed. Below Lamellaptychus cf. thoro (Oppel). 10×.

c = J28423. Impression of concave surface of a sligthly weathered specimen on surface of a chert layer. 10×.

d = J28417. Impression of concave surface of a broader specimen. Narrow and low median crest is faintly recognizable (Fig. 2b). 10×.

e = J28417. Opposite convex surface covered by a pattern of rounded bulges. 10×.

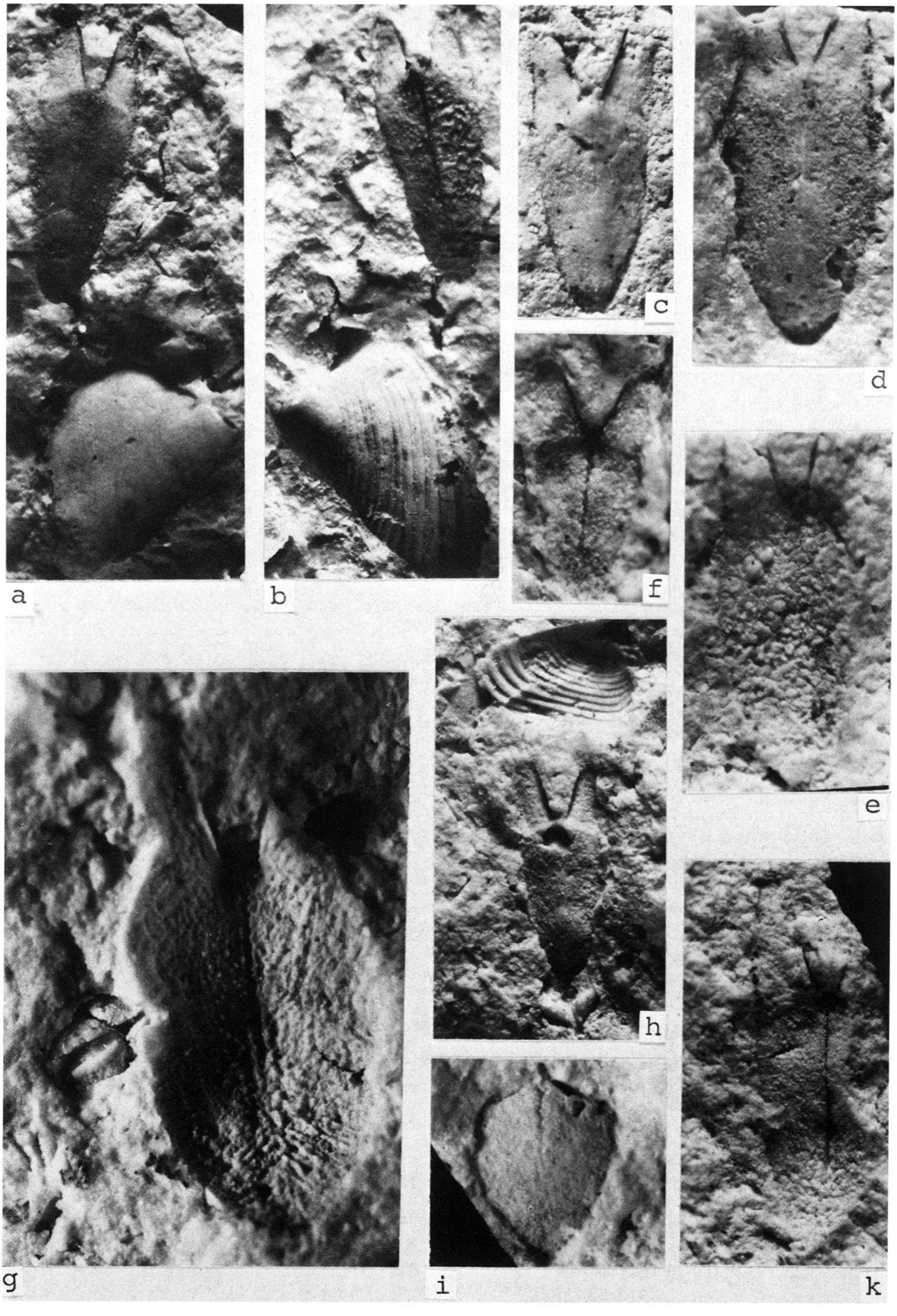
f = J28424. Convex surface of a specimen comparable with Figure 7c. Surface is clearly granulated as on holotype Figure 7b. 10×.

g = J28419. Impression of convex surface of an exceptionally long and broad specimen. Small granulae are arranged along low, meandering ridges. On left side a small upper jaw is preserved (compare Fig. 9a). 10×.

h = J28418. Lamellaptychus cf. pleiadensis (Trauth), near upper margin. Below the concave surface of a lower jaw, comparable with holotype Figure 7a. Above lower margin the anterior chambers of an upper jaw filled with sediment are exposed (Fig. 9a). 8×.

i = J28421. Impression of concave surface of a very broad and short specimen. The spurs are not preserved. Width/length ratio 0.72. 10×.

k = J28420. Finely granulated impression of convex surface of a rather slender specimen with an exceptionally narrow median keel. 10×.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e
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i
k

On impressions of the concave side this crest appears more or less clearly as a narrow groove (Fig. 4a).

The test of lower jaws displays a conspicuous porous structure, which occasionally is well preserved (Fig. 8c). The pores impregnated with silica remained intact after solution of carbonates. We might conclude that the shell consisted of two layers: an upper porous one forming the convex (outer) side of the jaw, and a much thinner, compact, originally non-porous layer covering its concave (inner) side.

The different arrangements of pores along thin parallel ledges (Fig. 8a, b), rounded bulges (Fig. 7e) or meandering folds (Fig. 8g), in connection with different outlines of the lower jaws points to the possibility that different species may be involved.

Measurements. - Lower jaws vary considerably in size and outline. As a rule the two anterior spurs of the shell are poorly preserved. The width/length ratio is therefore based on the distance between the anterior end of the "beak-like structure" and the posterior termination of the shell. The indices vary between 0.72 of broad specimens (Fig. 7i) and 0.46 of slender ones (Fig. 7a, b).

Comparison of lower jaws with the "leave-like" impressions from the Atlantic: The edges of the longitudinal keel on present specimens are indicated by several parallel lines on impressions from DSDP hole 99A. The flat median bulge of the shell can be recognized as a faint depression on the concave side of a specimen figured on Plate 2, Figure 2 (RENZ 1974). The pores arranged along ledges, meeting the lateral margins obliquely are reflected as faint riblets. The "beak-like structure" between the two spurs are, however, not preserved on specimens from the Atlantic.

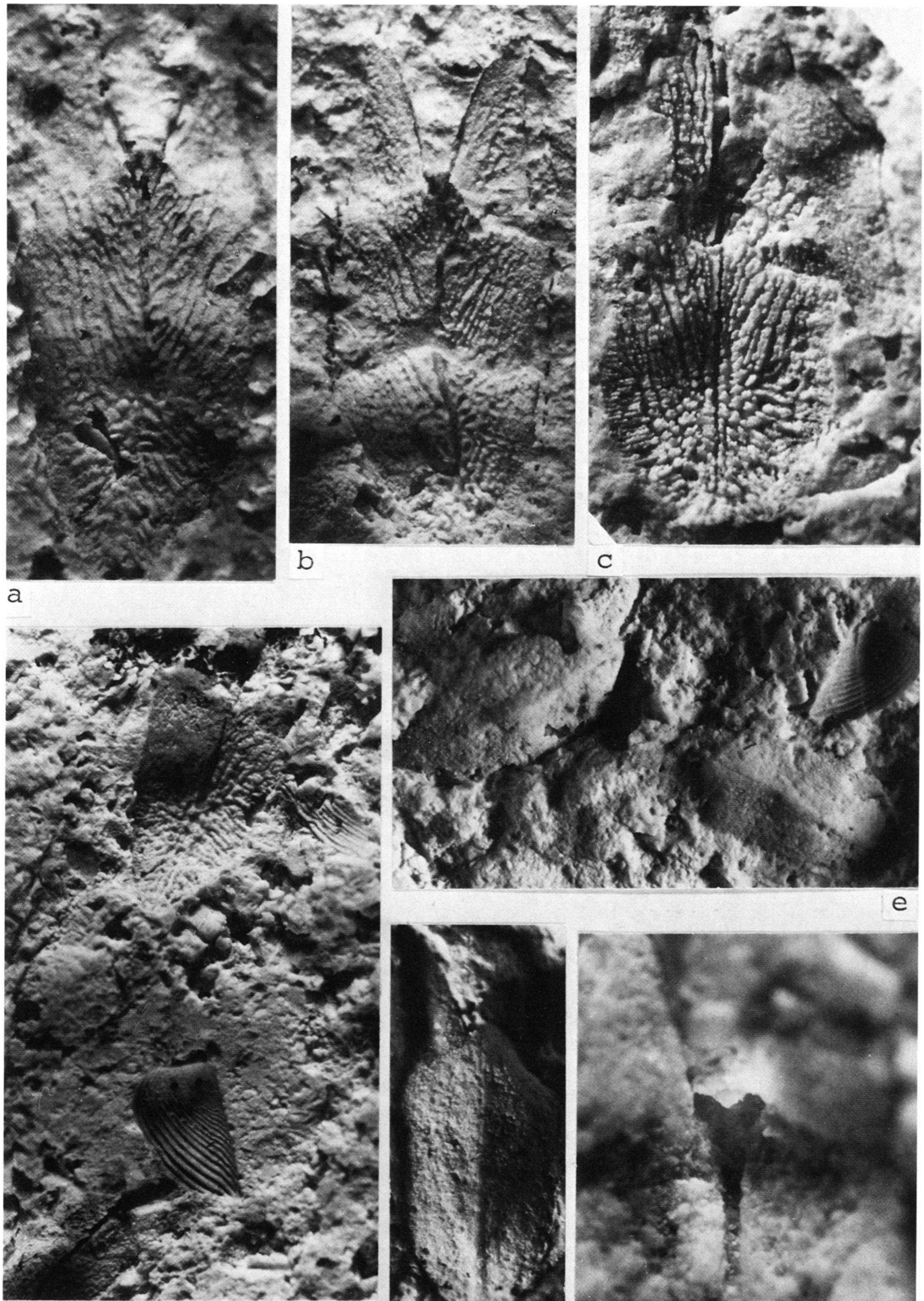
Upper jaws of *Rhynchocameratus jonicus* n. sp.

Fig. 3 a-d, 6 a-g, 9 a-h

The specimens considered to represent upper jaws can be divided into three parts: a "beak-like structure" anteriorly, followed posteriorly by an anterior and a posterior compartment (Fig. 3c).

Fig. 8. Variability of lower jaws of *Rhynchocameratus jonicus* n. sp. Paratypes.

a = J28427. Impression of convex surface of a large specimen displaying parallel, low ridges. 10×.
b = J28425. Specimen comparable with Figure 8a. 10×.
c = J28426. Impression of convex surface of a short and broad specimen. Pores of original test are exceptionally well preserved as short columns composed of quartz crystals. After deposition the pores were filled with silica, later transformed into quartz crystals (Fig. 4, 5). Upper right side is covered by a smaller, finely granulated individual with a narrow median keel comparable to Figure 7k. 10×.
d = J28429. Repartition of jaw parts and lamellaptychi: Below: Lamellaptychus beyrichi (OPPEL); upper right side: fragment of Lamellaptychus; middle left side: concave surface of a broad lower jaw; lower left corner and upper half: convex surface of lower jaws. Remains of upper jaws are recognizable in center. 10×.
e = J28422. Two impressions of concave surfaces with clearly developed median bulges. In upper right corner a small Lamellaptychus cf. beyrichi (OPPEL). 8×.
f = J28428. Impression of concave surface with median crest faintly indicated (Fig. 2b). 10×.
g = J28430. Concave surface. Cavity corresponding to the "beak-like structure" of a lower jaw. Of interest is excellently preserved tongue-like projection of sediment at anterior face of cavity (compare longitudinal section Fig. 2d). 20×.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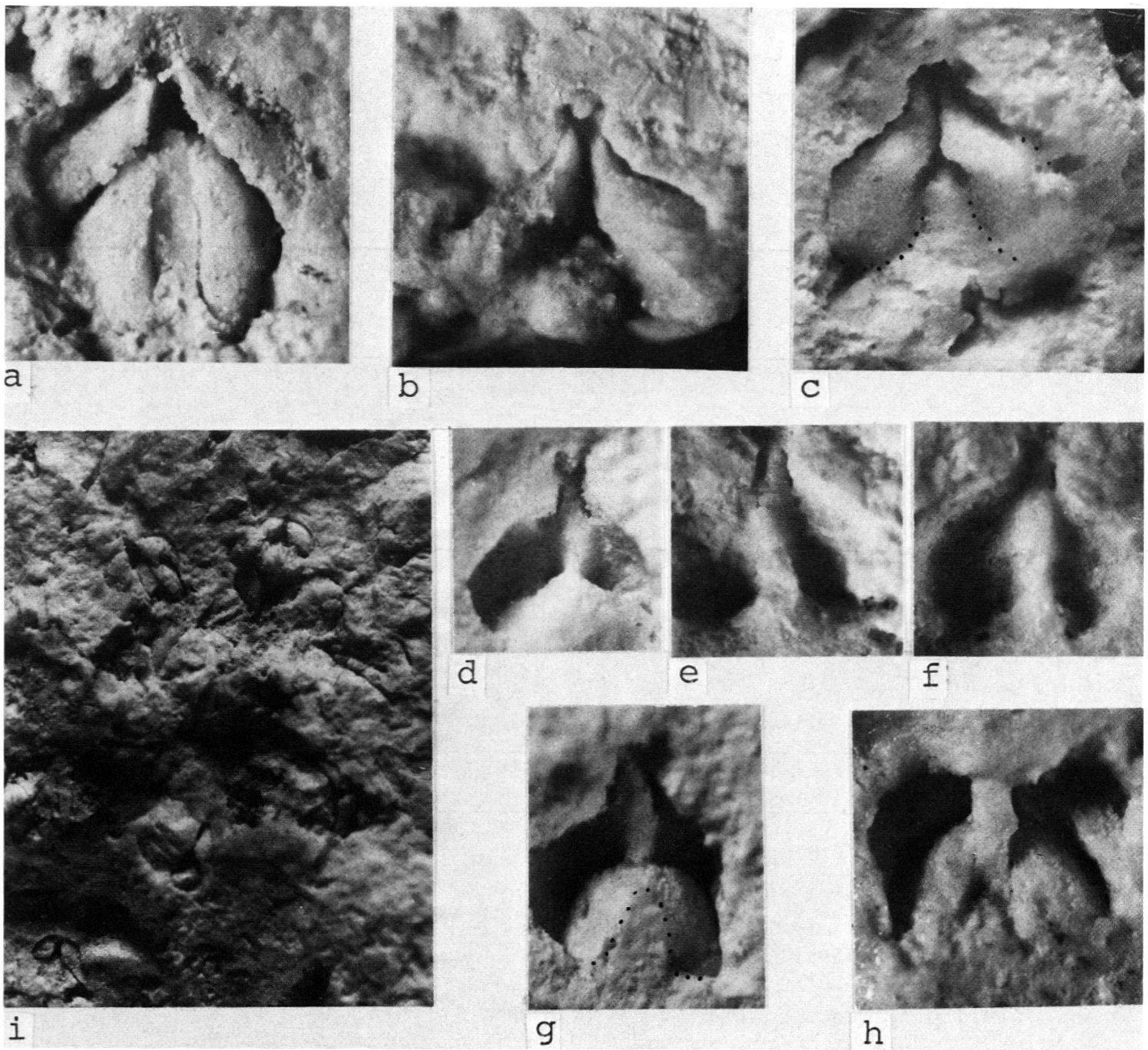
The "beak-like structure" is identical in size as well as morphology with that on the lower jaw (Fig. 8g). On the respective cavities the deepening on its anterior face is reflected by a tongue-like projection of sediment, clearly exposed in cavities on Figure 8b and d.

The anterior compartment is open on its lower (ventral) side (Fig. 3c). It is divided in two chambers by a longitudinal median beam, rising from the upper (dorsal) side of the upper jaw. Posteriorly this beam ends into a feature comparable with the "beak-like structure" developed on both jaw parts. The deepening on the posterior end of the beam also corresponds to a tongue-like projection of sediment in the cavity (Fig. 3d, 9b). It points in the opposite (anterior) direction. The function of this feature remains unknown. On the dorsal surface of the upper jaw a longitudinal median furrow of the test, facing the ventral beam, is present (Fig. 3a). In cavities this furrow shows as a ridge of sediment increasing in hight posteriorly (Fig. 9h). This furrow is flanked by parallel and elongated elevations (Fig. 3a), corresponding to elongated depressions in the cavities (Fig. 8d, e). They possibly functioned as attachements for chewing muscles. The variable outlines of anterior chambres are shown on Figure 6.



The posterior compartment is separated from the anterior one by an obliquely placed wall. A communication between the two compartments did not exist. The dorsal side of the compartment is characterized by a longitudinal, narrow split slightly diverging posteriorly (Fig. 9a). This split might be interpreted as a continuation of the longitudinal furrow on the dorsal side of the anterior compartment. On Figure 9h the sediment fillings of the furrow, as well as of the split are partly preserved as a continuous ledge of sediment. Most of the ventral side, and also the posterior end of the compartment is open.

Measurements. – The material at hand permits a determination of width/length indices of upper jaws. Figure 6 shows considerable variations ranging between 0.78 and 1.55. Obviously different "species", comparable to those suggested for lower jaws, are involved.

Additional finds of such jaw parts might be expected in the Vigla Formation of the Jonian Facies province within the interval of Upper Jurassic age. They might disclose the exact stratigraphic position of these peculiar fossils and moreover resolve problems regarding their morphology and nature.

Acknowledgments

I am grateful to Dr. Peter Jung, head of the Department of Geology, for having critically read this paper. I thank Miss Catherine Zickendraht for the photographical work.

Fig. 9. Upper jaws of *Rhynchocameratus jonicus* n. sp. Paratypes.

a = J28433. Dorsal side: The "beak-like structure" is destroyed (Fig. 3c). Sediment-filling of anterior and posterior compartments are exposed. Division into two chambers by a beam of test material (cavity) is well exposed. On posterior compartment the median split dividing its dorsal side is filled with sediment. 20×.

b = J28432. Dorsal side: Sediment-filling of posterior compartment has been removed in order to expose posterior end of beam. It shows a tongue-like sediment projection, identical in shape with that on the "beak-like structure" anteriorly (Fig. 3b, d). 20×.

c = J28436. Dorsal side: Posterior compartment has been removed. Opening of ventral side of posterior compartment is indicated (Fig. 3c). 20×.

d = J28431. Anterior end shows "beak-like structure" with tongue-like projection of sediment. Upper half of photograph displays impression of dorsal side of anterior compartment. Sediment-filling of longitudinal median furrow on dorsal side appears as a rounded ridge flanked by two parallel, narrow depressions corresponding to elevations flanking the furrow (Fig. 3a). The two elevations appear as two dark lines on both sides of the ridge; also visible on following Figure 9e and f. Posteriorly sediment of the furrow, connects with sediment within the split, dividing the dorsal side of posterior compartment.

e, f = J28445, J28444. Posterior compartment exposed on Figure 9d and g has been removed in order to obtain the complete dorsal surface of the upper jaw, as shown on Figure 3a. Sediment-filling of longitudinal furrow connects with sediment within the split dividing dorsal side of posterior compartment. 20×.

g = J28435. Ventral opening of posterior compartment is exposed and marked with dots. 20×.

h = J28434. Oblique view on sediment-fillings of posterior and anterior compartments. Ledge of sediment filling the longitudinal furrow on dorsal surface, as well as sediment within split dividing dorsal side of posterior compartment, are preserved. 20×.

i = J28438. Dense accumulation of upper jaws, probably due to bottom currents. 8×.

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