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# Nine new genera and 24 new species of the Munidopsidae (Decapoda: Anomura: Galattheoidea) from the Jurassic Ernstbrunn Limestone of Austria, and notes on fossil munidopsid classification

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(With 16 figures)

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## Abstract

Nine new genera, 24 new species, and two new combinations within the Munidopsidae are detailed within this paper. New genera established in this paper are: *Ambulocapsa*, *Ankylokypha*, *Aulavescus*, *Bullariscus*, *Cracensigillatus*, *Culmenformosa*, *Octoeurax*, *Pegomyrmekella*, and *Vetoplautus*. New species established in this paper are: *Ambulocapsa altilis*, *Ambulocapsa bachmayeri*, *Ambulocapsa novacula*, *Ambulocapsa sentosa*, *Ankylokypha parabola*, *Aulavescus exutus*, *Aulavescus tectus*, *Bullariscus arcuatorus*, *B. gibbernodus*, *B. patruliusi*, *B. triquetrus*, *Culmenformosa glaessneri*, *Culmenformosa nephelepera*, *Culmenformosa triastrixosa*, *Cracensigillatus gracilirostrus*, *Cracensigillatus prolatus*, *Gastrosacus aequabus*, *G. levocardiacus*, *G. limacurvus*, *G. pisinnus*, *G. torosus*, *Octoeurax acaresprora*, *Pegomyrmekella chaulia*, and *Vetoplautus latimarginus*. New combinations in this paper are: *Gastrosacus ubaghsi* (PELSENEER, 1886) and *Cracensigillatus acutirostrus* (MOERICKE, 1889). Additionally, the genus *Galatheites* BALSS, 1913, is reinstated. Lectotypes are designated for *Cracensigillatus acutirostrus*, *Galatheites zitteli*, *Gastrosacus meyeri*, *Gastrosacus wetzleri*, and *Paragalathea verrucosa*. *Munitheites* LÖRENTHEY (in LÖRENTHEY & BEURLEN, 1929) is reassigned to the Pylochelidae within the Paguroidea. A standard terminology for the fossil munidopsids is proposed within this work in order to simplify the diagnoses and descriptions. Two diagnostic keys using dorsal carapace characteristics are provided to distinguish between the families within the Galattheoidea and the genera within the Munidopsidae using characters available in fossils.

**Keywords:** Munidopsidae, Galattheoidea, Ernstbrunn Limestone, Tithonian, new taxa, Pylochelidae, squat lobsters

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### Zusammenfassung

In der vorliegenden Arbeit werden neun neue Gattungen, 24 neue Arten und zwei neue Kombinationen von Munidopsidae vorgestellt. Die neuen Gattungen sind: *Ambulocapsa*, *Ankylokypha*, *Aulavescus*, *Bullariscus*, *Cracensigillatus*, *Culmenformosa*, *Octoeurax*, *Pegomyrmekella* und *Vetoplautus*. Die neuen Arten sind: *Ambulocapsa altilis*, *Ambulocapsa bachmayeri*, *Ambulocapsa novacula*, *Ambulocapsa sentosa*, *Ankylokypha parabola*, *Aulavescus exutus*, *Aulavescus tectus*, *Bullariscus arcuatorus*, *B. gibbernodus*, *B. patruliusi*, *B. triquetrus*, *Culmenformosa glaessneri*, *Culmenformosa nephelepera*, *Culmenformosa triastrixosa*, *Cracensigillatus gracilirostrus*, *Cracensigillatus prolatus*, *Gastrosacus aequabus*, *G. levocardiacus*, *G. limacurvus*, *G. pisinnus*, *G. torosus*, *Octoeurax acaresprora*, *Pegomyrmekella chaulia* und *Vetoplautus latimarginus*. Folgende neue Kombination werden vorgeschlagen: *Gastrosacus ubaghshi* (PELSENEER, 1886) und *Cracensigillatus acutirostrus* (MOERICKE, 1889). Aufgrund der vorliegenden Daten wird die Gattung *Galatheites* BALSS, 1913 wieder als valide Form eingeführt. Für die Arten *Cracensigillatus acutirostrus*, *Galatheites zitteli*, *Gastrosacus meyeri*, *Gastrosacus wetzleri* und *Paragalathea verrucosa* werden Lectotypen designiert. Die früher den Munidopsiden zugeordnete Gattung *Munitheites* LÖRENTHEY (in LÖRENTHEY & BEURLEN, 1929) wird hier den Pylochelidae innerhalb der Paguroidea zugewiesen. Um die Beschreibungen und Diagnosen der verschiedenen Formen besser vergleichen zu können, wird eine vereinheitlichte Terminologie für fossile Munidopsidae vorgeschlagen. Zwei neue Bestimmungsschlüssel erlauben es, die Familien innerhalb der Galatheoidea und die Gattungen innerhalb der Munidopsidae anhand von fossilisationsfähigen Merkmalen des dorsalen Carapax zu unterscheiden.

**Schlüsselworte:** Munidopsidae, Galatheoidea, Ernstbrunner Kalk, Tithonium, Neue Taxa, Pylochelidae, Springkrebse

### Introduction

The diversity of the Ernstbrunn Limestone with respect to decapods is well established (see FELDMANN & SCHWEITZER, 2009; SCHWEITZER & FELDMANN, 2009a, 2009b, 2010). Thousands of decapods from the Ernstbrunn Limestone are found within the BACHMAYER Collection, housed in the Natural History Museum of Wien, Austria. The decapods within the BACHMAYER Collection were collected by BACHMAYER and his associates during the 1950s and were apparently intended to be published as a monograph at a later date (BACHMAYER 1959). Although several small studies were completed by BACHMAYER (1947, 1955, 1959), the vast majority of the specimens within his collection remained unpublished. This paper details the members of Munidopsidae found within the Ernstbrunn Limestone, and addresses some of the confusion surrounding classification of the Jurassic galatheoids.

### Study Area

The Ernstbrunn Limestone is Tithonian in age, and crops out in several locations in Lower Austria (ZEISS 2001; ADÁMEK 2005). The BACHMAYER Collection was sourced from five quarries in the vicinity surrounding the town of Ernstbrunn (Fig. 1). Exact stratigraphic positions and faunal associations of the decapods within the Ernstbrunn Limestone are unknown.

Fig. 1. Map showing the location of Ernstbrunn, Austria, as well as Štramberk, Czech Republic, another fossil locality with a very similar decapod fauna.



## Terminology

In order to effectively describe the numerous new species, as well as to clearly differentiate between members of Galatheidae, Munididae, and the more complex Munidopsidae, a standard terminology has been adopted for both the regions of the dorsal carapace and the ornamentation. Currently there is no widely available, accurate definition of munidopsid groove patterns that works well for fossil taxa. ZARIQUIEY ALVAREZ (1952) attempted to define the regions and spines of the galatheids, specifically, for the genus *Munida* LEACH 1820. BABA (2005) expanded on the various regional definitions of ZARIQUIEY ALVAREZ.

The terminology of ZARIQUIEY ALVAREZ does not take into account the complex nature of the carapace grooves of the fossil munidopsids; it is limited to only the simpler pattern of galatheids and munidids. The terminology proposed herein uses the same terminology as ZARIQUIEY ALVAREZ (1952) and BABA (2005) whenever possible and adds new terms to differentiate the more complex carapace groove structure of many fossil munidopsids. This terminology will allow for more consistent and accurate classification of these heavily ornamented galatheoids as well as provide a firmer basis for any future coding of traits for phylogenetic analysis.

Regions and morphological features of the carapace on three Munidopsidae are denoted in Figures 2.1–2.3. Figure 2.4 is a schematic drawing of a galatheoid showing the same regions as depicted in Figures 2.1–2.3. The numbers used in Figure 2 will be used as reference points in the discussion below. Typical fossil members of the family Galatheidae can be seen throughout the work of DE ANGELI & GARASSINO (2002).

**Grooves:** One of the defining characteristics of fossil munidopsids is the large number of grooves and regions, reflecting the complex architecture of the carapace. Traditionally, munidopsids have been described as possessing a cervical groove, which follows the outline of the base of 16a, and continues in a smooth arc to the lateral margin, following 16b. In fossil munidopsids, there are two main grooves: the circumgastric (16a, b, c), which partially follows the route of the traditional cervical groove, and the

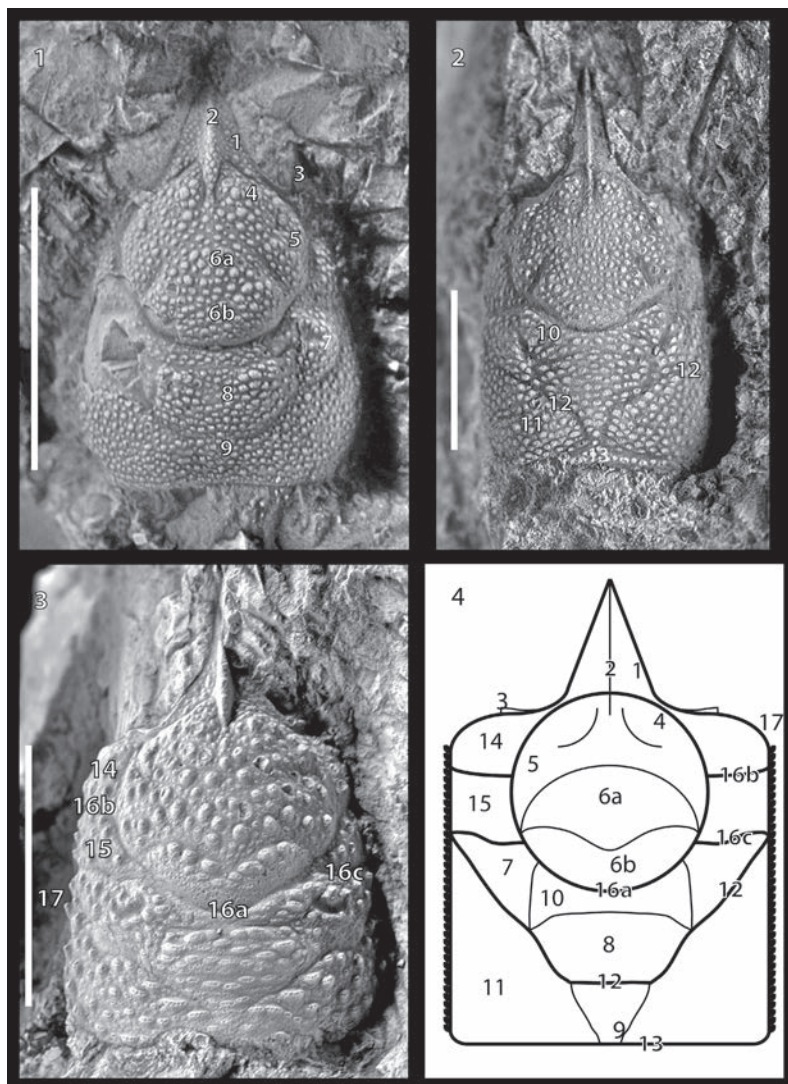


Fig. 2. Munidopsidae illustrating different regions. Numerous regions were present on multiple taxa; not all were labeled to increase visibility. **1:** *Bullariscus arcuatorus* nov. gen., nov. spec., NHMW 2007z0149/0105, ornamented with tubercles of varying sizes. Scale bar equals 5 mm. **2:** *Cracensigillatus gracilirostrus* nov. gen., nov. spec., NHMW 2007z0149/0345, ornamented with small tubercles. Scale bar equals 2 mm. **3:** *Gastrosacus eminens* (BLASCHKE, 1911), NHMW 2007z0149/0233, ornamented with pustules. Granules can be seen interspersed with the pustules. Scale bar equals 10 mm. **4:** Schematic of the idealized member of family Munidopsidae.

Regions are keyed as follows: 1. Rostrum; 2. Keel; 3. Outer-orbital spine; 4. Epigastric; 5. Protogastric; 6a. Mesogastric; 6b. Metagastric; 7. Mesobranchial; 8. Cardiac; 9. Intestinal; 10. Urogastric; 11. Branchial; 12. Branchiocardiac; 13. Posterior margin (rimmed); 14. Hepatic; 15. Epibranchial; 16a. Circumgastric groove (CG); 16b. CG hepatic branch; 16c. CG epibranchial branch; 17. Lateral margin spines.

branchiocardiac (12). The circumgastric groove surrounds the gastric region, which is divided into subregions (4, 5, 6a, b) and has two sub-branches (16b, 16c). The epibranchial branch (16c) separates the epibranchial (15) and either the mesobranchial (if present; 7) or branchial (11) regions; the hepatic branch (16b) separates the epibranchial and the hepatic region (14).

The second major groove is the branchiocardiac groove (12). This groove marks the anterior border of the branchial region and the posterior border of the cardiac region (8). It usually intersects the epibranchial branch of the circumgastric groove at the lateral margin. Often, the branchiocardiac groove branches at the base of the cardiac region, with one small branch continuing to separate the branchial regions and intestinal region (9) until it terminates at the posterior margin (13). The other branch (the main branchiocardiac groove) continues to outline the posterior margin of the cardiac region. Usually the segment of the branchiocardiac groove defining the cardiac region is weakly developed when an intestinal region is present.

The anterior part of the carapace is composed of all regions anterior to the circumgastric and epibranchial branches of the circumgastric groove (i.e. gastric, epibranchial, and hepatic regions). The posterior part of the carapace is composed of all regions posterior to the circumgastric groove.

**Regions:** A second unique characteristic of these fossil munidopsids is the extensive regional definition present. They all have well defined gastric, hepatic, epibranchial, and branchial regions. Most have moderately defined metagastric and urogastric regions, and many have mesobranchial and intestinal regions present.

The gastric region in fossil munidopsids is defined so well that it is appropriate and useful to divide it into four different subregions: the epigastric (4), protogastric (5), mesogastric (6a), and metagastric (6b). There will occasionally be no differentiation between the mesogastric and metagastric areas. However, when both are present, the metagastric is the most clearly defined; usually it is elevated slightly above the remainder of the carapace as well. The epigastric is usually marked with short grooves or depressions that can take several different forms. The epigastric markings usually diverge from the circumgastric groove and approach the mesogastric area at an angle from the anterior, but they do not merge with any discernible structure within the gastric area.

**Spines:** Orbits are usually obscured on fossil munidopsids, but most are marked by small outer orbital spines (3). They are usually located close to the hepatic region. Additionally, some taxa have a large anteriorly directed spine at the tip of the hepatic region. On some species, these seem to be the outer-orbital spine. Occasionally, an anteriorly projecting spine at the anterior of the epigastric region is present. The lateral margins of the carapace are usually spined (17). The spines often seem to be equal in size along the lateral margin; however, some lateral margin spines increase in size posteriorly.

**Degree of Definition:** The degree of definition of regions varies among species, from very well defined to subtly marked. A region that is well defined is usually bounded



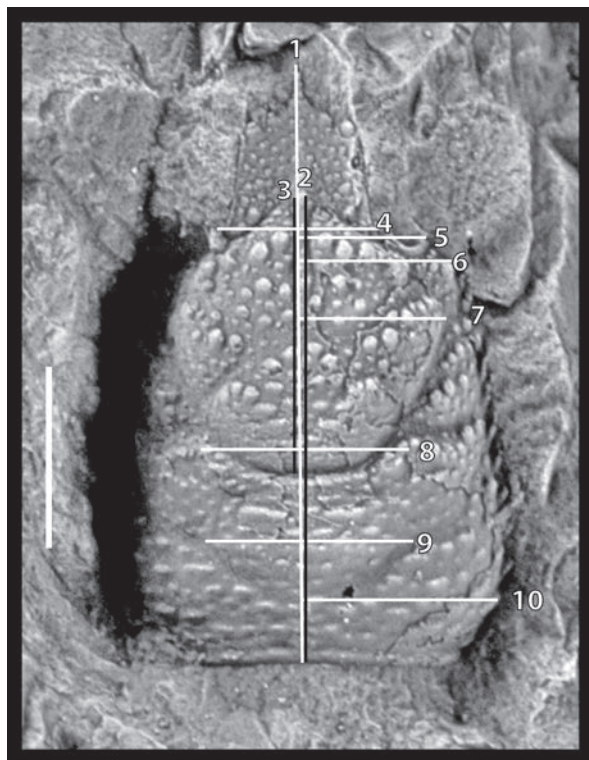


Fig. 3. *Culmenformosa glaessneri* nov. gen., nov. spec., NHMW 2007z0149/0184, showing the location of measurements taken on the carapace. This figure is a composite of all measurement locations, as not every genus was measured this extensively. In instances where only half the munidopsid is preserved, the specimen was measured to the midpoint, then doubled. Abbreviations for the measurements used in the tables and on the figure are as follows: Total length of carapace including rostrum (LR, 1), length of carapace excluding rostrum (L, 2), length of rostrum (R, not indicated), length of the gastric region (GH, 3), rostral width (RW, 4), orbital width (OW, 5), total width of anterior margin (TW, 6), width of the gastric region (GW, 7), width of urogastric region (UW, 8), width of cardiac region (CW, 9), and maximum width (MW, 10).

by moderately deep depressions on all sides or is raised from the carapace. A weakly defined region is usually bounded by extremely shallow depressions or is very faintly raised from the surface. The depression may deepen or shallow as it surrounds or marks the particular region. Moderately defined regions fall anywhere between the two. Usually moderately defined means that the region is apparent, but not as well defined as other regions, or, the region is well defined on two sides but weakly defined on a third. When a region is described as marked or indicated it means the region is present but boundaries are not complete or clear. Ornamentational differences often distinguish regions.

**Degree of ornamentation:** The fossil munidopsids studied in this work all display similar styles of rounded protrusions as ornamentation. In order to help differentiate between the types, they have been divided into categories by size. Admittedly, part of the division is subjective. The size of the ornamentation is usually proportional to the size of the carapace; i.e. within the same species smaller specimens have proportionately smaller ornamentation than larger specimens.

The largest type of ornamentation is termed pustular (Fig. 2.3); some original definitions translate more readily to the term “warty.” Tubercles constitute the moderately-sized ornamentation (Fig. 2.1). Granules are the smallest type of ornamentation, usually resembling granules of sugar or salt in size (Fig. 2.2).

In addition to size, ornamentation can also vary in shape. The majority of the ornamentation is round, especially on the anterior of the carapace. Often, the ornamentation is slightly transversely ovate, appearing more oval in shape than round, perpendicular to the lateral margin (Fig. 2.3). A third, much less common shape, is scabrous. This ornamentation is raised from the carapace, slightly transversely ovate, and angled slightly relative to the lateral margin. Measurements were taken of the studied specimens whenever possible. The measurement locations are featured in Fig. 3.

### Abbreviations and Notes

Synonymies are listed below the relevant species and were verified by comparison with the holotype or a plaster replica of the holotype whenever possible. Synonymy sections are limited to previously illustrated specimens and published descriptions or occurrences that the authors have been able to visually verify.

This paper predominantly details species from within BACHMAYER's Late Jurassic (Tithonian) collection. In several cases, discussion was needed about existing species that were not found within BACHMAYER's collection. The discussions about those species are located under discussion sections for the respective genera.

Unless otherwise noted, all illustrated specimens were dyed with removable blue dye and subsequently coated with ammonium chloride powder prior to photography. Genera denoted with the single symbol § indicates taxa known from the extant and fossil record; a double §§ indicates taxa known solely from the fossil record. No symbol indicates an extant genus without a fossil record. All species detailed within are exclusively fossil. Where possible, average ratios are provided of carapace length excluding rostrum (L) and width of anterior margin (TW) and maximum width of specimens (MW).

### Institutional abbreviations:

BSP – Bayerische Staatssammlung für Paläontologie und historische Geologie München (Munich), Germany

IRSNB – Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium

KSU – Kent State University, Kent, Ohio, USA

MFSN – Museo Friulano di Storia Naturale, Udine, Italy

MGSB – Museo Geológico del Seminario de Barcelona, Spain

MGUH – Type Collection, Museum Geologicum Universitatis Hauniensis (Geological Museum), University of Copenhagen, Denmark

MNHN – Muséum National d'Histoire Naturelle, Paris, France

NHMM – Natuurhistorisch Museum Maastricht, the Netherlands

NHMW – Naturhistorisches Museum Wien, Austria

NMB – Národní museum Praha, Czech Republic (Prague National Museum)

UJ – Collections of the Geological Museum of the Institute of Geological Sciences, Jagiellonian University, Kraków, Poland

USNM – National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA

## Systematic Paleontology

Order Decapoda LATREILLE, 1802

Infraorder Anomura H. MILNE-EDWARDS, 1832

Superfamily Galatheoidea SAMOUELLE, 1819

Included families: Galatheidae SAMOUELLE, 1819, Munididae AHYONG et al., 2010, Munidopsidae ORTMANN, 1898, Porcellanidae HAWORTH, 1825, Retrorsichelidae FELDMANN et al., 1993.

Key to families within Galatheoidea using exclusively dorsal carapace characteristics:

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1a. Circumgastric groove (Fig. 2.4, 16a) present .....	Munidopsidae
1b. Circumgastric groove absent; cervical groove (Fig. 2.4, base of 16a + 16b) present.....	2
2a. Carapace flattened; rostrum may be absent or projects only slightly beyond orbits.....	3
2b. Carapace usually convex; rostrum projects significantly beyond orbits.....	4
3a. Carapace carcinized, of variable shape, generally less than 40 mm in length .....	Porcellanidae
3b. Carapace ovate, almost egg shaped, narrowing appreciably anteriorly, generally greater than 40 mm in length. ....	Retrorsichelidae
4a. Rostrum needle-like or composed of narrow spines .....	Munididae
4b. Rostrum broad, usually sub-triangular.....	Galatheidae

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**Discussion:** The above key uses carapace characteristics that can easily be found in the fossil record to distinguish between the galatheoid families, whereas biological keys often use features that are infrequently or never fossilized. Included in this key is the exclusively fossil Retrorsichelidae.

Family Munidopsidae ORTMANN, 1898

Type genus: *Munidopsis*<sup>§</sup> WHITEAVES, 1874

Other included genera: *Ambulocapsa*<sup>§§</sup> nov. gen.; *Ankylokypha*<sup>§§</sup> nov. gen.; *Aulavescus*<sup>§§</sup> nov. gen.; *Brazilomunida*<sup>§§</sup> MARTINS-NETO, 2001; *Bullariscus*<sup>§§</sup> nov. gen.; *Calteagalathea*<sup>§§</sup> DE ANGELI & GARASSINO, 2006; *Cracensigillatus*<sup>§§</sup> nov. gen.; *Culmenformosa*<sup>§§</sup> nov. gen.; *Faxegalathea*<sup>§§</sup> JAKOBSEN & COLLINS, 1997; *Galacantha* A. MILNE-EDWARDS, 1880; *Gastrosacus*<sup>§§</sup> VON MEYER, 1851; *Leiogalathea* BABA, 1969; *Nykteripteryx*<sup>§§</sup> KLÖMPMAKER et al., 2012; *Octoeurax*<sup>§§</sup> nov. gen.; *Palaeomunidopsis*<sup>§§</sup> VAN STRAELEN, 1925; *Pegomyrmekella*<sup>§§</sup> nov. gen.; *Shinkaia*<sup>§</sup> BABA & WILLIAMS, 1998, *Vetoplautus*<sup>§§</sup> nov. gen.



**Diagnosis:** Carapace longer than wide; rostrum strong; typically keeled. One small outer-orbital spine usually present. Circumgastric groove strongest groove on dorsal carapace; surrounds gastric region. Branchiocardiac groove always present. Lateral margins usually spined; ornamentation usually consists of pustules or tubercles of varying shapes. Gastric area extremely well defined; epibranchial, metabranchial, and cardiac regions moderately well to extremely well defined.

**Discussion:** Munidopsidae was recently elevated from subfamily to family level by AHYONG et al. (2010) to reflect the huge diversity found within the Galatheoidea. The Munidopsidae are the oldest family within the Galatheoidea; their range extends from the Middle Jurassic to the Recent. Munidopsidae currently embraces 15 exclusively fossil genera, 9 of which are newly described in this paper. *Munidopsis* and *Shinkaia* have both a fossil and extant record, and two genera, *Galacantha* and *Leiogalathea*, are exclusively found in the modern record.

*Munidopsis* is a speciose genus, including over 225 mostly extant species (SCHWEITZER et al. 2010), with extremely variable characteristics and no clear diagnosis, making differentiation between *Munidopsis* and all other genera difficult. There are six junior synonyms of *Munidopsis*, all of which were defined using extant material. The junior synonyms are: *Anoplonotus* SMITH, 1883; *Bathyankeystes* ALCOCK & ANDERSON, 1894; *Elasmonotus* A. MILNE-EDWARDS, 1880; *Galathodes* A. MILNE-EDWARDS, 1880; *Galathopsis* HENDERSON, 1885; and *Orophorhynchus* A. MILNE-EDWARDS, 1880. These junior synonyms were treated as full genera, subgenera, or junior synonyms by various authors until CHACE (1942) synonymized them all with *Munidopsis*. However, recent molecular work by AHYONG et al. (2011) revealed that several of the previously synonymized genera possibly correspond to genetic divisions within *Munidopsis*. Differences listed between *Munidopsis* and the fossil genera were determined by comparison with the type species, *Munidopsis curvirostra* WHITEAVES, 1874.

BEURLIN (1930) tried to separate the fossil Munidopsidae genera (then the Munidopsinae) into a separate subfamily, the Galatheitinae, based on the presumed well-developed eyes of the fossil forms. Though GLAESSNER (1969) rejected this subfamily based on insufficient information about other differences, it bears noting that all the species found at Ernstbrunn lived in a coralgal reef environment. Extant muniopsids are predominantly found on outer slopes, abyssal plains, and near hydrothermal vents (BABA et al. 2008), and all modern species of *Munidopsis*, including the subgenera listed above, have reduced eyes (SCHNABEL et al. 2011).

AHYONG et al. (2010) expressed concern that the diagnoses of *Calteagalathea*, *Paragalathea* PATRULIUS, 1959, and *Eomunidopsis* VÍA BOADA, 1981, could be accommodated within the current diagnosis of *Munidopsis*, and that “further refinement of the generic classification is required to harmonize neontological and palaeontological taxonomies” (Ahyong et al. 2010, p. 63). These three exclusively fossil genera mentioned by AHYONG et al. (2010), the type species of which are shown in Fig. 4, are readily differentiated from one another, with *Calteagalathea* the only genus similar to *Munidopsis*. *Calteagalathea*,

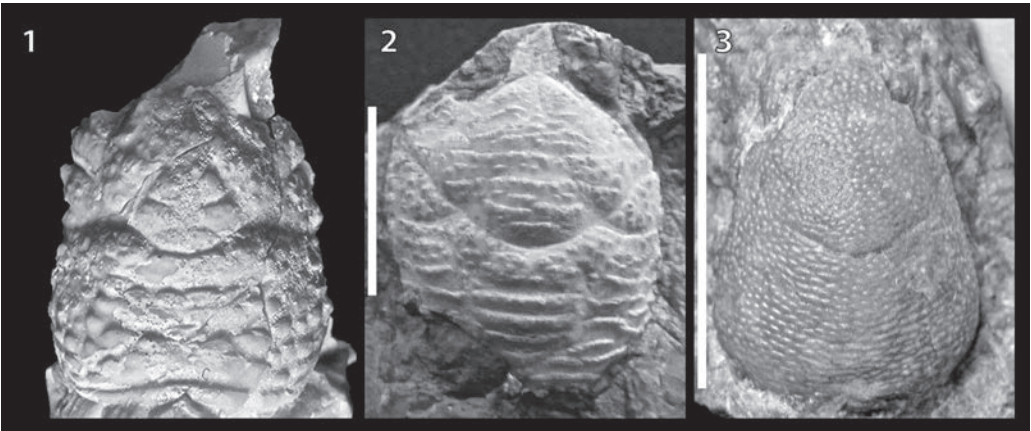
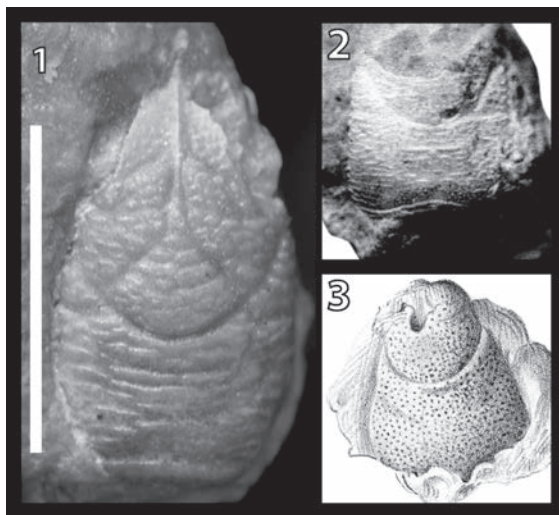


Fig. 4. **1:** *Calteagalathea friulana* DE ANGELI & GARASSINO, 2006, holotype, MFSN 19969. Image of specimen also published in DE ANGELI & GARASSINO (2006: p. 275, Fig. 4b). Carapace length excluding rostrum 17.2 mm. Photo by A. DE ANGELI. **2:** *Eomunidopsis orobensis* (RUIZ DE GAONA, 1943), neotype, MGSB 28120. Scale bar equals 5 mm. Photo by A. KLONPMMAKER. **3:** *Paragalathea verrucosa* (MOERICKE, 1889), lectotype, BSP AS III 313. Scale bar equals 5 mm.

*Eomunidopsis*, and *Paragalathea* have different groove structures, with *Calteagalathea* (Fig. 4.1) possessing a circumgastric groove, squamous ornamentation, and an extremely broad rostrum, a characteristic not exhibited by *Munidopsis curvirostra*, the type species, which has an almost needle-like rostrum. *Calteagalathea* also has distinctly squamous ornamentation, a feature not commonly found on members of *Munidopsis* sensu lato. *Eomunidopsis* and *Paragalathea* do not belong to the Munidopsidae, since they do not have the diagnostic circumgastric groove. Members of *Eomunidopsis* (Fig. 4.2) have transverse ornamentation and a narrow rostrum, as well as extensive regional definition. Members of *Paragalathea* (Fig. 4.3) sensu stricto have a broad rostrum, tuberculate ornamentation, and virtually no regional definition other than a U-shaped cervical groove. The specimen illustrated in Fig. 4.3 was identified by MOERICKE (1889) as *Paragalathea verrucosa*, and is herein declared the lectotype. *Paragalathea* and *Eomunidopsis* are the subject of a future study (CR, in progress).

Many species currently within the genus *Gastrosacus* have previously been referred to *Galatheites* BALSS, 1913. BALSS (1913) chose *Galathea zitteli* MOERICKE, 1889, illustrated herein as Fig. 5.1, as the type species of *Galatheites*. The individual illustrated (BSP AS III 308) is the specimen illustrated by MOERICKE (1889) and is herein declared the lectotype. As originally described, *Galatheites* was indistinguishable from *Gastrosacus*, and the members of *Galatheites* were assimilated into *Gastrosacus*, including *Galathea zitteli*. Various authors have since assigned *Galathea zitteli* to several very different genera without a clearly given reason, including *Palaeomunida* LÖRENTHEY, 1902 (PATRULIUS, 1959), *Eomunidopsis* VÍA BOADA, 1981 (DE ANGELI & GARASSINO, 2002; KLONPMMAKER et al., 2012), and *Gastrosacus* (SCHWEITZER et al., 2010). *Galathea zitteli* does not belong

Fig. 5. 1: *Galatheites zitteli* (MOERICKE, 1889), lectotype, BSP AS III 308. Scale bar equals 5 mm. 2: *Galatheites royoi* VAN STRAELEN, 1927, reprinted from VAN STRAELEN (1927: Pl. 2, Fig. 1–2). Originally illustrated with a magnification factor; preserved portion of specimen approximately 5 mm in length. 3: *Galatheites? robineau*i (DE TRIBOLET, 1874), reprinted from ROBINEAU-DESVOIDY (1849: Pl. 5, Fig. 15) of). Scale unknown.



within *Gastrosacus* as it is missing the distinctive circumgastric groove, narrow rostrum, and pustular ornamentation. Instead, it has a typical galatheid groove pattern, broad rostrum, and both squamous and transverse ornamentation. Since the type species of *Galatheites* does not fit within the parameters of *Gastrosacus*, the genus *Galatheites* is re-established within the Galatheidae to encompass *Galatheites zitteli* and *Galatheites royoi* VAN STRAELEN 1927. A forthcoming study by the authors will redescribe *Galatheites*, as well as the remaining non-munidopsid galatheoids in the BACHMAYER Collection.

*Galatheites royoi* from the Aptian of Spain, was described based on a partial carapace of one specimen (VAN STRAELEN, 1927, Pl. 2, Fig. 1 – 2; reprinted herein as Fig. 5.2). The anterior of the specimen is missing, but it seems that there is no circumgastric groove, and the mesogastric region is undefined. Until the holotype or a more complete specimen can be located, it remains within *Galatheites*.

*Galatheites? robineau*i (DE TRIBOLET, 1874, as *Aeglea*) (? added by GLAESSNER, 1929) was first described and illustrated by ROBINEAU-DESVOIDY (1849; Pl. 5, Fig. 15, reprinted herein as Fig. 5.3) as a possible new species of *Aeglea*, which was a common misspelling of *Aegla* LEACH, 1820 (MARTIN & ABELE 1988). DE TRIBOLET (1874) defined the species as *Aeglea? robineau*i (1874), and declared that the figure was true to the specimen. The species is reported to be from Neocomian age rocks in north-central France. The species was transferred to the genus *Galatheites* as *Galatheites? robineau*i by GLAESSNER in 1929. Most details about the specimen were either not preserved or were embedded within the rock. The holotype is presumed lost. It is declared incertae superfamiliae.

*Munitheites* LÖRENTHEY (in LÖRENTHEY & BEURLEN, 1929) had long been considered a galatheoid; however, its general carapace shape, small rostrum, and its groove structure align it more with the members of the Paguroidea, specifically the genus *Jurapylocheles* VAN BAKEL et al., 2008, within the Pylochelidae. Members of the Galatheoidea



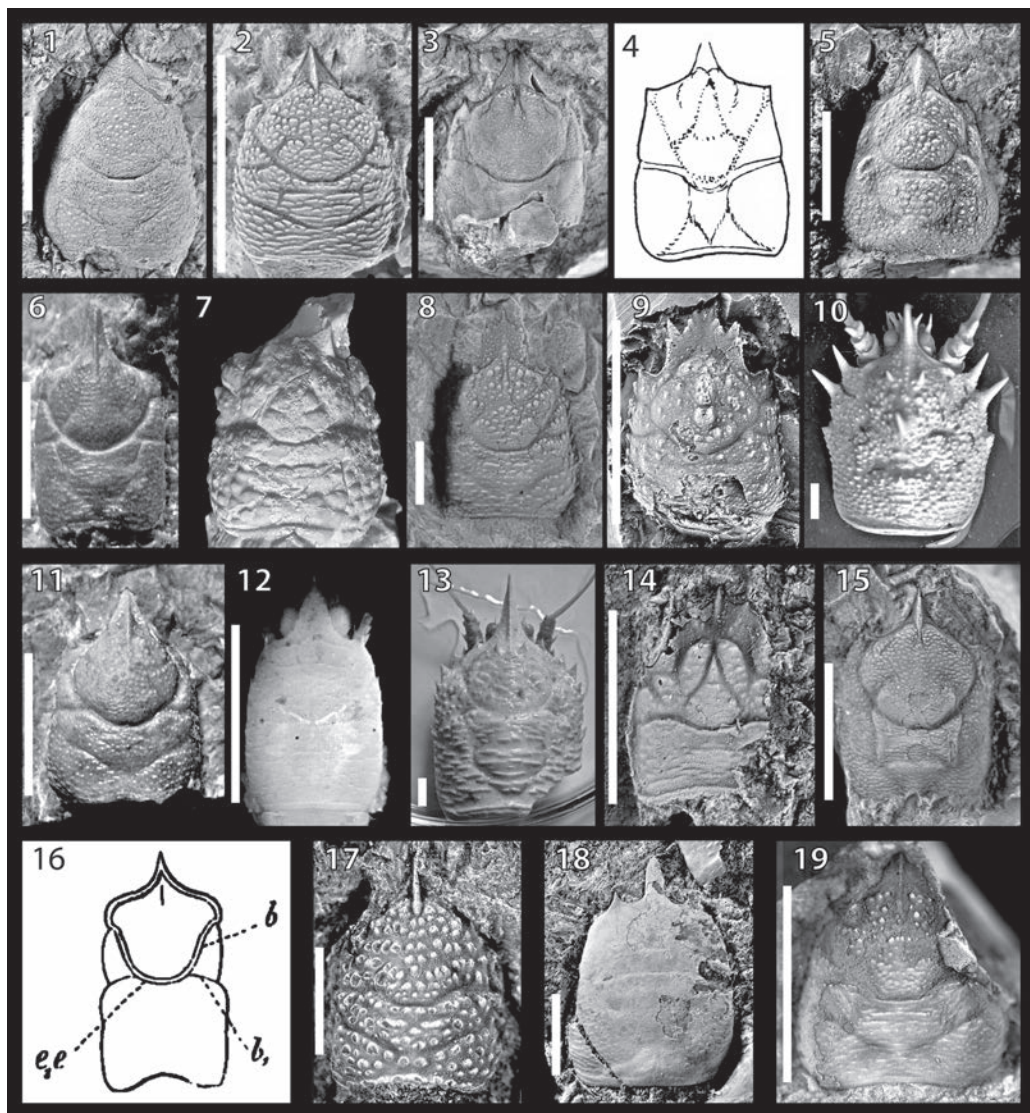


Fig. 6. 1: *Ambulocapsa altilis* nov. gen., nov. spec., holotype, NHMW 2007z0149/0130. Scale bar equals 5 mm. 2: *Ankylokypha parabola* nov. gen., nov. spec., holotype, NHMW 2007z0149/0119. Scale bar equals 5 mm. 3: *Aulavescus exutus* nov. gen., nov. spec., holotype, NHMW 2007z0149/0117. Scale bar equals 5 mm. 4: *Brazilomunida brasiliensis* (BEURLEN, 1965), reprinted from BEURLEN (1965: p. 267, Fig. 2). Attempts to procure a photo of the holotype, believed to be housed in Recife, Brazil, were unsuccessful. 5: *Bullariscus patruliusi* nov. gen., nov. spec., holotype, NHMW 2007z0149/0089. Scale bar equals 5 mm. 6: *Cracensigillatus acutirostrus* (MOERICKE, 1889) nov. comb., lectotype, BSP AS III 332. Scale bar equals 5 mm. 7: *Calteagalathea friulana* DE ANGELI & GARASSINO, 2006, holotype, MFSN 19969. Image of specimen also published in DE ANGELI & GARASSINO, 2006, p. 275, Fig. 4b. Carapace length excluding rostrum 17.2 mm. Photo by A. DE ANGELI. 8: *Culmenformosa glaessneri* nov. gen., nov. spec., holotype,

(excluding Porcellanidae) have a pronounced, strong rostrum, whereas the rostra on members of the Paguroidea are reduced or absent. *Munitheites* has a very diminutive rostrum, and does not appear to have the carcinized body of a porcellanid. The flat, depressed, wider-than-long region that is present on the anterior of the carapace in *Munitheites* is also much more commonly found within the Paguroidea, but remains undocumented within the Galatheaidea. Several paguroids have been found within the Ernstbrunn Limestone; they will be detailed in a future work. Thus, we refer *Munitheites* to the Pylochelidae.

Differences between genera and species are listed below the relevant discussion sections. *Palaeomunidopsis* is not considered in the differences sections because not enough is known about it. The holotype is lost, and the only photo known to exist is of poor quality of a partial specimen (VAN STRAELEN 1925; Pl. 9, Fig. 8). The only other known illustration is a simplified sketch by VAN STRAELEN (1925; p. 308, Fig. 141). It is included within Munidopsidae based on the presence of what appears to be a circumgastric groove in both the image and the sketch. Differences between *Palaeomunidopsis* and the other genera are therefore unknown.

*Leiogalathea* is an extant genus that plots closely with the other extant members of *Munidopsis*, based on molecular data (AHYONG et al., 2010); however, it is a closer match morphologically to the Galatheaidea. It is the only genus within the Munidopsidae that does not possess a circumgastric groove.

Below is the key to genera within the Munidopsidae, using dorsal carapace characteristics; *Palaeomunidopsis* and *Leiogalathea* have been excluded from the key for reasons enumerated above. An example from each genus is illustrated alphabetically in Figs 6.1 – 6.19.

- ◀ NHMW 2007z0149/0184. Scale bar equals 2 mm. **9:** *Faxegalathea platyspinosa* JAKOBSEN & COLLINS, 1997, holotype, MGUH 24372. Scale bar equals 5 mm. Photo provided by S. JAKOBSEN. **10:** *Galacantha rostrata* A. Milne-Edwards, 1880, USNM 4927. This is a member of the type species of *Galacantha*, but is not itself type material. Scale bar equals 5 mm. **11:** *Gastrosacus wetzleri* VON MEYER, 1854 [1856], lectotype, BSP IX 683. Scale bar equals 5 mm. **12:** *Leiogalathea imperialis* (MIYAKE & BABA, 1967). USNM 150498. This is one of two species in the genus *Leiogalathea*; it is not, however, the type species. Scale bar equal to 5 mm. **13:** *Munidopsis starmer* BABA & DE SAINT LAURENT, 1992, paratype, NHMN 2358. This is not the type species of *Munidopsis*. Scale bar equals 5 mm. **14:** *Nykteripteryx rostrata* KLOMPMAKER et al., 2012, holotype, MGSB 77719. Scale equals 2 mm. Specimen also illustrated in KLOMPMAKER et al. 2012, p. 142, Fig. 11A. **15:** *Octoeurax acaresprora* nov. gen., nov. spec., holotype, NHMW 2007z0149/0126. Scale bar equals 5 mm. **16:** *Palaeomunidopsis moutieri* VAN STRAELEN, 1925, reprinted from VAN STRAELEN (1925: p. 308, Fig. 141). **17:** *Pegomyrmekella chaulia* nov. gen., nov. spec., holotype, NHMW 2007z0149/118. Scale bar equals 5 mm. **18:** *Shinkaia katapsyxis* SCHWEITZER & FELDMANN, 2008, paratype, USNM 536287; image was also published in SCHWEITZER & FELDMANN (2008, p. 1024, Fig. 2.3). Scale bar equals 5 mm. It should be noted that this is not the type species of *Shinkaia*; however, it is the only known fossil species. **19:** *Vetoplautus latimarginus* nov. gen., nov. spec., holotype, NHMW 2007z0149/0151. Scale bar equals 5 mm.



1a. Carapace oval in outline .....	<i>Shinkaia</i>
1b. Carapace not oval in outline .....	2
2a. Rostrum triangular, broadly triangular or spatulate .....	3
2a. Rostrum narrowly triangular, styliiform .....	10
3a. Single keel or no keel on rostrum .....	4
3b. Multiple keels on rostrum .....	<i>Nykteripteryx</i>
4a. Rostral keel absent or, if present, does not extend full length of rostrum .....	5
4b. Rostral keel present full length of rostrum .....	7
5a. Rostral keel present; does not extend full length of rostrum .....	<i>Culmeniformosa</i>
5b. Rostral keel absent .....	6
6a. Carapace has large anteriorly directed spine protruding from gastric region .....	<i>Faxegalathea</i>
6b. Carapace does not have large anteriorly directed spine protruding from gastric region.....	<i>Calteagalathea</i>
7a. Rostral keel weak crease or fold .....	8
7b. Rostral keel moderately strong to very strong ridge .....	9
8a. Carapace very vaulted/convex .....	<i>Ambulocapsa</i>
8b. Carapace not vaulted, weakly to moderately convex .....	16
9a. Carapace regions swollen; inflated.....	<i>Bullariscus</i>
9b. Carapace regions not swollen, not inflated .....	<i>Ankylokypha</i>
10a. Carapace with very large mesobranchial regions; mesobranchial regions extend to posterior margin .....	<i>Brazilomunida</i>
10b. Carapace with mesobranchial regions undefined or mesobranchial regions do not extend to posterior margin .....	11
11a. Cardiac region very wide transversely; extends across 60 % of dorsal carapace surface .....	<i>Pegomyrmekella</i>
11b. Cardiac region extends across less than 60 % of dorsal carapace surface .....	12
12a. Rostrum more than 25 % total carapace length .....	13
12b. Rostrum less than 25 % total carapace length.....	<i>Octoeurax</i>
13a. Rostral keel moderately strong.....	<i>Cracensigillatus</i>
13b. Rostral keel extremely strong .....	14

14a. Carapace has large spine protruding from both mesogastric region and cardiac region.....	<i>Galacantha</i>
14b. Carapace may or may not be spined; if spined, spines not exclusively on both mesogastric and cardiac regions .....	15
15a. Rostrum deflected upward.....	<i>Munidopsis</i>
15b. Rostrum deflected downward, or in same plane as carapace.....	<i>Gastrosacus</i>
16a. Regions well defined, especially gastric regions.....	<i>Vetoplautus</i>
16b. Regions poorly defined, especially gastric regions.....	<i>Aulavescus</i>

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### Genus *Gastrosacus* VON MEYER, 1851

Type species: *Gastrosacus wetzleri* VON MEYER, 1854 [1856], by monotypy.

Other included species: *Gastrosacus carteri* VAN STRAELEN, 1925; *G. eminens* (BLASCHKE, 1911), as *Galathea*; *G. ernstbrunnensis* BACHMAYER, 1947; *G.? latirostrus* (BEURLEN, 1929), as *Gastrosacus*; *G. levocardiacus* nov. spec.; *G. meyeri* (MOERICKE, 1889), as *Galathea*; *G. pisinnus* nov. spec.; *G. torosus* nov. spec.; *G. tuberosiformus* (LÖRENTHEY, in LÖRENTHEY & BEURLEN, 1929) as *Galatheites*; *G. tuberosus* (REMEŠ, 1895), as *Galathea*; *Gastrosacus ubaghsi* (PELSENEER, 1886) nov. comb., as *Galathea*.

Emended diagnosis: Carapace sub-rectangular; usually widens posteriorly, average L/TW 1.4, L/MW 1.1. Carapace moderately convex transversely. Rostrum narrowly triangular, styliform; strongly keeled. Carapace strongly ornamented with large tubercular or pustular spines anteriorly; grading to transversely ovate pustules posteriorly, increasing in size approaching lateral metabranchial margin. Metagastric region extraordinarily well defined; raised above remainder of gastric region.

Discussion: Above is an emended diagnosis for the genus *Gastrosacus*. It is geographically the widest-ranging and most speciose extinct genus within this family. Most of the species are known only from the Late Jurassic; however, the genus ranges from the Middle Jurassic to the Late Cretaceous. Not all of the species listed above were found within BACHMAYER's collection; however, some observations, clarifications, and discussion of various species are needed.

VON MEYER erected the genus *Gastrosacus* in 1851, and described the single species within it, *Gastrosacus wetzleri*, in 1854 [1856]. Figure 7.1 shows a specimen identified by VON MEYER as *Gastrosacus wetzleri* that is housed in the BSP, and is herein designated the lectotype.

In 1889, MOERICKE named a new species, *Galathea acutirostris*. He suggested in his description that it may be a subspecies of *Gastrosacus wetzleri*. The specimen MOERICKE illustrated as *Galathea acutirostris*, shown in Fig. 7.2 and herein declared the

lectotype, shows significant differences from *Gastrosacus wetzleri*; however, with few exceptions, this species is listed in literature as synonymous with *Gastrosacus wetzleri* (BALSS, 1913; VAN STRAELEN, 1925; numerous others). Several authors (notably PATRULIUS, 1959; 1966) differentiated between *Gastrosacus wetzleri* and *Galathea acutirostris* by listing *Galathea acutirostris* as the subspecies *Gastrosacus wetzleri acutirostris*, but most authors did not make that distinction.

*Galathea acutirostris* is considered distinct from *Gastrosacus wetzleri* and is now the type species of *Cracensigillatus*. The lectotype of *Cracensigillatus acutirostris* (MOERICKE, 1889) nov. comb. is housed in the BSP in München. A specimen showing the range of variation within the species is shown in Figure 7.3.

BACHMAYER (1947) reported multiple occurrences of *Gastrosacus wetzleri* from both Ernstbrunn and Štramberg. It is unclear how many of the specimens were *G. wetzleri* (Fig. 7.1) and how many were *Cracensigillatus acutirostris* nov. comb. (Figs 7.2–7.3). Specific differences between *G. wetzleri* and the former *G. wetzleri acutirostris* are discussed under *Cracensigillatus acutirostris*. None of the munidopsids studied thus far from BACHMAYER's collection appear to be *G. wetzleri*.

Upon studying the two specimens considered to be syntypes of *Gastrosacus meyeri* (MOERICKE 1889; Fig. 7.4 and 7.5), it was quite clear that the two syntypes, an anterior of a carapace (Fig. 7.5), and a carapace that is complete except for the anterior-most portion (Fig. 7.4), represent two separate galatheid taxa. The areas where the galatheids overlap are dissimilar. Unfortunately, both carry the same catalog number, BSP AS III 314. The drawing with which MOERICKE illustrated the original description (1889, Pl. 30, Fig. 3; reillustrated herein as Fig. 7.6) appears to be a combination of both halves. According to MOERICKE's original description, a distinguishing feature of *G. meyeri* was the presence of a branchiocardiac groove, so the nearly-complete specimen featuring that groove is herein designated as the lectotype of *G. meyeri* (Fig. 7.4). The anterior portion that does not represent *G. meyeri* is too fragmentary for genus or species identification; however, it does belong to the Galatheidae, not the Munidopsidae, due to the lack of a circumgastric groove on the anterior portion. Although BACHMAYER (1947, 1948) reported occurrences of *G. meyeri* within the Ernstbrunn Limestone, examination of his collection has yet to yield any specimens of *G. meyeri*.

*Gastrosacus? latirostris* was illustrated with a schematic figure in BEURLEN (1929; p. 134, Fig. 5; reprinted herein as Fig. 7.7). A similar schematic figure is shown in BEURLEN & GLAESSNER (1930; p. 66, Fig. 14). The schematic drawing is not very detailed, but it shows three lateral spines protruding from what should be the epibranchial and hepatic areas (they are not differentiated in the drawing). None of the new species listed within any of the genera herein exhibit this morphology. The description of *G.? latirostris* could fit most members of *Gastrosacus*. Of note, BEURLEN (1929) stated that the rostrum was quite large on *G.? latirostris*, comparable in size to that of *G. meyeri* and larger than that of *G. wetzleri*. These comparisons were apparently made with the illustrations

of VON MEYER (1860) and MOERICKE (1889), as BEURLEN refers to parts of illustrations of the specimens that are not faithful to the actual specimens. The material that BEURLEN described came from a World War I-era disorganized collection of material in the Geological Museum of the Bavarian State. BEURLEN believed the material to be Oxfordian in age from the Saint Mihiel region of Lorraine, France. The holotype seems to have since been lost. Without the holotype or topotype material, comparisons between this species and others within the genus cannot be made with any confidence.

VAN STRAELEN (1925) asserted that *Gastrosacus tuberosus* (REMEŠ, 1895) was not a galatheid based on the relatively incomplete composite drawing and description provided by REMEŠ (1895; Pl. 1, Fig. 4; reprinted here as Fig. 7.8). He placed *G. tuberosus* within what was then the genus *Avihomeola* VAN STRAELEN, 1925. LÖRENTHEY (in LÖRENTHEY & BEURLEN, 1929) disputed this, and reassigned it to the Galatheidae, into the genus *Galatheites*. LÖRENTHEY (in LÖRENTHEY & BEURLEN, 1929) also described *Gastrosacus tuberosiformus* (as *Galatheites*) in the same paper, ostensibly due to the extensive similarities he saw between *Gastrosacus tuberosiformus* and *Gastrosacus tuberosus*. *Gastrosacus tuberosiformus* and *Gastrosacus eminens* are remarkably similar. Since REMEŠ used several large specimens to make a composite drawing, it is more than likely that *G. tuberosus* and *Gastrosacus eminens* are synonymous; however, this may be impossible to test. REMEŠ' holotypes appear to have been lost or assimilated into other collections, and the drawing provided does not explicitly match *G. eminens*, especially in the carapace shape and the very long branchial areas. This may be due to the composite nature of the drawing. Unless the holotype of *G. tuberosus* is found and can be compared to *G. eminens*, the two should remain separate species.

*Gastrosacus carteri* was described by VAN STRAELEN (1925), apparently based solely on the drawing and description of J. CARTER (1898), not examination of the actual specimen. CARTER's figure (1898, Pl. 1, Fig. 3; shown as Fig. 7.9 herein) and VAN STRAELEN's figure (1925, p. 299, Fig. 135) are quite different. VAN STRAELEN's drawing did not show any detail of the ornamentation, and he included parts of the carapace that were not preserved, such as the posterior margin, that do not appear to be proportional to the rest of the specimen. Comparisons of *G. carteri* to other species within *Gastrosacus* will be made using CARTER's original figure and description, not that of VAN STRAELEN.

The *Gastrosacus* sp. reported by MUTIU & BĂDĂLUTĂ, 1969, has been identified based on the photographic illustration (MUTIU & BĂDĂLUTĂ 1969, Pl. 1, Fig. 1) as likely a member of the genus *Paragalathea* PATRULIUS, 1959. HOUŠA (1963) reported the occurrence of a new species of *Gastrosacus*, but did not describe it, other than to say it was infested with an isopod.

*Faxegalathea* has a much wider rostrum, without a keel, as well as a large spine protruding from its gastric area. *Culmenformosa* is very similar to *Gastrosacus*; however, *Culmenformosa* has a broader rostrum, with the keel only extending half of the rostral length. *Culmenformosa* typically has less regional definition than the species of



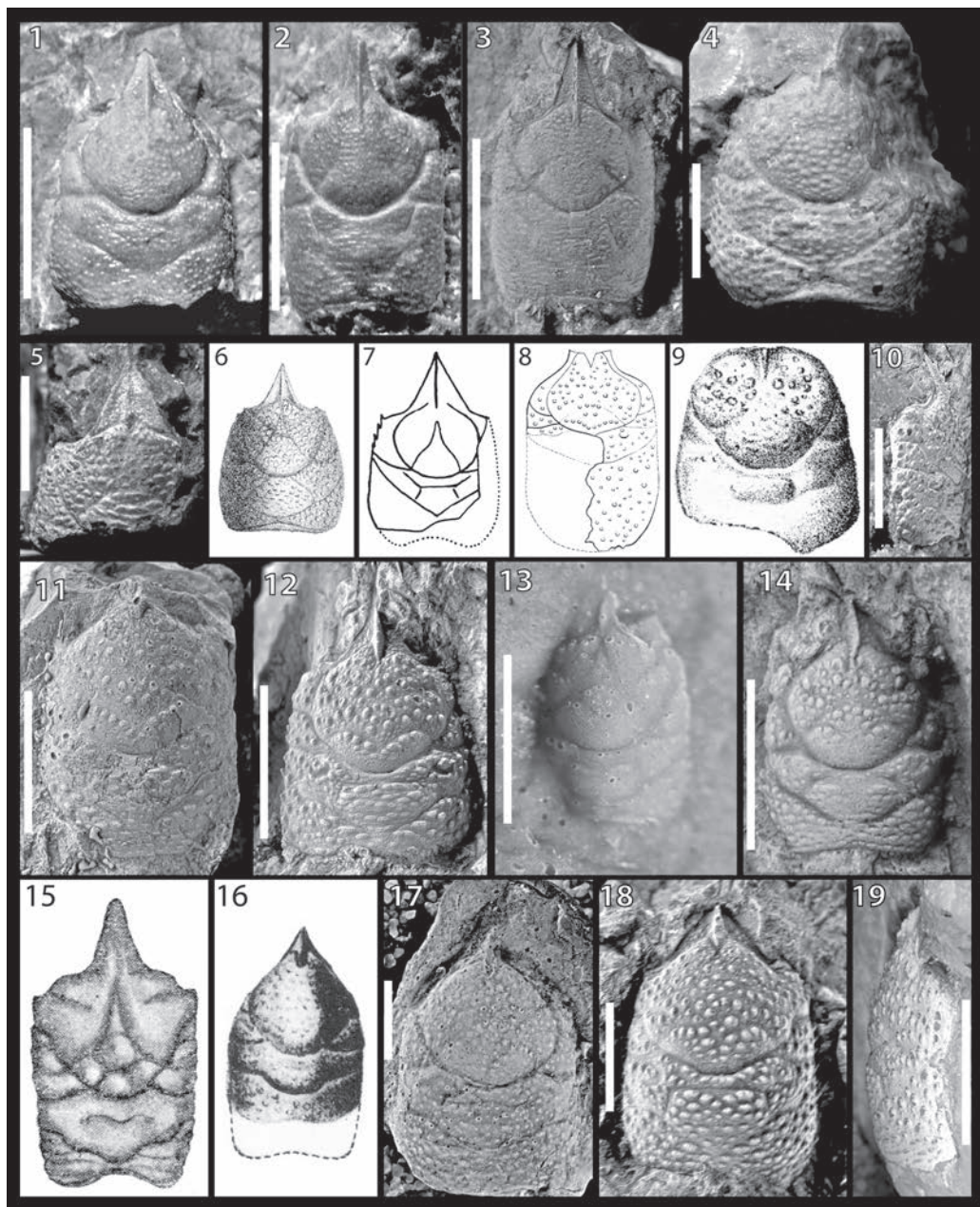


Fig. 7. 1: *Gastroscus wetzleri* VON MEYER, 1854 [1856], lectotype, BSP IX 683. Scale bar equals 5 mm. This specimen is the one VON MEYER illustrated in his 1860 paper. 2: *Cracensigillatus acutirostrus* (MOERICKE, 1889) nov. comb., lectotype, BSP AS III 332. Scale bar equals 5 mm. 3: *Cracensigillatus acutirostrus* (MOERICKE, 1889) nov. comb., NHMW 2007z0149/0314, showing the range of variation of regional definition. This species shows a range of characteristics further elaborated in the text. Scale bar equals 5 mm. 4: *Gastroscus meyeri* (MOERICKE, 1889),



*Gastrosacus*, as well as less densely spaced ornamentation. *Ambulocapsa* is much more transversely convex with a broader rostrum and weaker keel. *Ankylokypha* is much more transversely convex and lacks pustular ornamentation. *Cracensigillatus* is much smaller than most species of *Gastrosacus*; it does not widen posteriorly; and it has smaller, more uniform ornamentation and a lesser degree of gastric definition. *Bullariscus* is much more convex with much better regional definition than *Gastrosacus*; the rostrum is also slightly wider. *Octoeurax* has a much shorter rostrum, much larger urogastric area, and a triangular cardiac region. *Aulavescus* has a different carapace shape, narrowing abruptly anterior to the hepatic region; a much weaker keel; and finer, less pronounced ornamentation. *Pegomyrmekella* has a much broader cardiac region. *Munidopsis curvirostra* has an almost diamond-shaped gastric region in contrast to the round gastric region of *Gastrosacus*. *Vetoplautus* is sub-pentagonal in shape and has an area between the protogastric and epigastric regions that is absent on *Gastrosacus*.

- ◀ lectotype, BSP AS III 314. Scale bar equals 5 mm. **5:** Galatheidae indet., paralectotype of *G. meyeri*, BSP AS III 314 (same lot as the lectotype). This specimen cannot be identified other than to family level and is likely not conspecific with *G. meyeri*. Scale bar equals 5 mm. **6:** *Gastrosacus meyeri* (MOERICKE, 1889), reprinted from MOERICKE (1889: Pl. 30, Fig. 3). **7:** *Gastrosacus? latirostrus* BEURLEN, 1929, reprinted from BEURLEN (1929: p. 134, Fig. 5). **8:** *Gastrosacus tuberosus* (REMEŠ, 1895), reprinted from REMEŠ (1895: Pl. 1, Fig. 4). The illustration is based on three different specimens; no scale was given. **9:** *Gastrosacus carteri* VAN STRAELEN, 1925, reprinted from CARTER (1898, Pl. 1, Fig. 3). CARTER describes the length of the carapace from the base of the rostrum as 11 mm. **10:** *Gastrosacus eminens* (BLASCHKE, 1911), NHMW 2007z0149/0233, side view, showing the forward-directed spines on the rostrum. Scale bar equals 10 mm. **11:** *Gastrosacus eminens* (BLASCHKE, 1911), cast of holotype, KSU D1001 (Original: NHMW 1912/0006/0691). Scale bar equals 10 mm. **12:** *Gastrosacus eminens* (BLASCHKE, 1911), NHMW 2007z0149/0233, upon which the emended description was based. Scale bar equals 10 mm. **13:** *Gastrosacus ernstbrunnensis* BACHMAYER, 1947, silicone cast of holotype, KSU D1002 (Original: NHMW 1990/0041/3012). The small size of the specimen precluded a high quality cast, despite multiple attempts. Scale bar equals 2 mm. **14:** *Gastrosacus ernstbrunnensis* BACHMAYER, 1947, NHMW 2007z0149/0257. Scale bar equals 2 mm. **15:** *Gastrosacus ernstbrunnensis* BACHMAYER, 1947, reprinted from BACHMAYER (1947: p. 37, Fig. 2). **16:** *Gastrosacus tuberosiformus* LÖRENTHEY in LÖRENTHEY & BEURLEN, 1929, reprinted from LÖRENTHEY & BEURLEN (1929, Pl. 3, Fig. 13). Total carapace length is listed as 17 mm. **17:** *Gastrosacus tuberosiformus* (LÖRENTHEY in LÖRENTHEY & BEURLEN, 1929), photo of KSU D1134, which is cast of MGSB 32287, which in turn is a cast of the holotype of *Gastrosacus tuberosiformus*. The location of the actual holotype is unknown. Scale bar equals 5 mm. **18:** *Gastrosacus tuberosiformus* (LÖRENTHEY in LÖRENTHEY & BEURLEN, 1929). NHMW 2007z0149/0206. Scale bar equals 5 mm. **19:** *Gastrosacus tuberosiformus* (LÖRENTHEY in LÖRENTHEY & BEURLEN, 1929), NHMW 2007z0149/0207, side view showing a similar rostral keel as *Gastrosacus eminens*. This specimen was neither dyed nor whitened with ammonium chloride.

***Gastrosacus eminens* (BLASCHKE, 1911)**  
(Figs 7.10–7.12)

1911 *Galathea eminens* nov. spec. – BLASCHKE, p. 149, Pl. 1, Fig. 1.

**Emended diagnosis:** Carapace sub-rectangular; may widen slightly posteriorly, average L/TW 1.5, L/MW 1.25. Carapace moderately convex transversely, weakly convex longitudinally. Rostrum arcs downward; triangular in shape, strong rostral keel bears well defined dorsal serrations. Lateral margin straight with small anteriorly directed spines. Both circumgastric and branchiocardiac grooves strong. Metagastric, mesogastric, urogastric, cardiac, hepatic, and epibranchial regions well defined. Metagastric region inflated; very strongly ornamented. Carapace anteriorly ornamented with anteriorly directed, pustule-sized triangular spines; posteriorly ornamented with transversely ovate pustules and tubercles; ornamentation most transversely ovate on cardiac region. All coarse ornamentation interspersed with granules. Size of ornamentation increases toward lateral margins of metabranchial regions. Posterior margin weakly rimmed.

**Measurements:** See Table 1.

**Holotype:** NHMW 1912/0006/0691.

**Other material examined:** NHMW 2007z0149/0225 to NHMW 2007z0149/0230; NHMW 2007z0149/0232 to NHMW 2007z0149/0244; NHMW 2007z0149/0250; NHMW 2007z0149/0251.

**Type Locality:** Štramberg Limestones of Wischlitz (Wiślica, near Skoczów, Poland).

**Type Stratum:** Štramberg Limestones, Tithonian, Upper Jurassic.

**Other known occurrences:** Ernstbrunn Limestones, Ernstbrunn, Austria.

**Discussion:** *Gastrosacus eminens* is one of the largest munidopsids that has been found within the Ernstbrunn Limestone. It is usually fairly well preserved, despite its protruding pustular ornamentation, which can be prone to breakage. The spines on the rostrum are rarely preserved, but when present, appear quite strong but narrow. It is probable that several other members of the genus *Gastrosacus* possess these spines; however, the only other species where they have been found intact is *Gastrosacus tuberosiformis*. There is also a possibility that *G. eminens* is synonymous with *Gastrosacus tuberosus* (REMEŠ, 1895), previously detailed in the discussion section of the genus.

*Gastrosacus meyeri*, *Gastrosacus tuberosus*, *Gastrosacus ubaghsi*, and *Gastrosacus tuberosiformis* are the closest species to *Gastrosacus eminens*. *Gastrosacus meyeri* has a less well defined metagastric area. *Gastrosacus tuberosus* has a longer branchial region and a narrower frontal margin. *Gastrosacus ubaghsi* has larger pustular ornamentation, a wider, less well-defined cardiac area, and larger urogastric area. *Gastrosacus tuberosiformis* has a narrower cardiac region, with less transversely ovate ornamentation. Its

Table 1. Measurements of studied *Gastrosacus* specimens. Abbreviations for the measurements are as follows: Total length of carapace excluding rostrum (L), length of carapace including rostrum (LR), length of rostrum (R), maximum width (MW), orbital width (OW), rostral width (RW), total width of anterior margin (TW), length of the gastric region (GH), width of the gastric region (GW), width of urogastric region (UW), width of cardiac region (CW).

Number	L	LR	R	MW	OW	RW	TW	GH	GW	L/MW	L/TW
<b><i>Gastrosacus eminens</i> (BLASCHKE, 1911)</b>											
NHMW 2007z0149/0227	-	-	-	4.2	-	-	3.2	-	3.2	-	-
NHMW 2007z0149/0229	-	-	-	-	8.1	4.2	-	9.0	10.0	-	-
NHMW 2007z0149/0230	-	-	1.8	5.3	3.0	1.4	4.9	3.7	4.0	-	-
NHMW 2007z0149/0232a	-	-	1.9	-	-	2.5	-	5.5	5.6	-	-
NHMW 2007z0149/0232b	-	-	-	14.8	-	-	9.6	8.2	8.5	-	-
NHMW 2007z0149/0233	-	-	4.8	15.0	8.2	4.6	11.2	10.5	11.1	-	-
NHMW 2007z0149/0234	-	-	2.8	-	-	3.0	-	6.8	6.4	-	-
NHMW 2007z0149/0235	13.6	17.1	3.5	11.6	7.2	4.0	9.2	7.8	8.5	1.2	1.5
NHMW 2007z0149/0236	-	-	2.9	-	5.6	3.0	7.5	6.8	7.7	-	-
NHMW 2007z0149/0237	-	-	3.1	-	6.6	2.9	9.4	8.4	8.7	-	-
NHMW 2007z0149/0239	15.6	-	-	-	3.5	3.6	9.8	8.9	9.8	-	1.6
NHMW 2007z0149/0240	14.6	18.1	3.5	11.2	-	3.2	9.6	8.0	9.3	1.3	-
NHMW 2007z0149/0241	-	-	3.9	-	6.4	2.5	8.4	7.0	8.1	-	-
NHMW 2007z0149/0251	-	-	-	-	-	3.6	8.4	7.7	8.0	-	-
NHMW 1912/0006/0691	16.0	-	-	-	-	-	11.3	9.4	10.4	-	1.4
<b><i>G. ernstbrunnensis</i> BACHMAYER, 1947</b>											
NHMW 2007z0149/271	2.5	3.0	0.5	2.3	1.5	0.8	1.9	1.5	1.7	1.1	1.3
NHMW 2007z0149/272	4.3	-	-	3.7	-	-	3.4	2.4	2.8	1.2	1.3
NHMW 1990/0041/3012	2.2	-	-	2.1	-	-	1.7	1.4	1.6	1.0	1.3
<b><i>G. tuberosiformus</i> (LÖRENTHEY in LÖRENTHEY &amp; BEURLEN, 1929)</b>											
NHMW 2007z0149/0206	9.5	-	-	8.9	5.0	3.1	6.6	5.3	6.2	1.1	1.4
NHMW 2007z0149/0207	15.2	-	-	14.7	8.0	4.6	10.6	7.7	10.3	1.0	1.4
NHMW 2007z0149/0208a	12.3	15.6	3.3	-	6.4	3.6	8.6	7.2	8.0	-	1.4
NHMW 2007z0149/0209	12.0	-	-	11.2	-	-	-	6.3	6.6	1.1	-
NHMW 2007z0149/0210	7.0	8.9	1.9	6.6	-	1.6	4.9	4.2	5.0	1.1	1.4
NHMW 2007z0149/0211	7.0	-	-	6.0	-	2.0	4.5	4.1	4.6	1.2	1.6
NHMW 2007z0149/0212	-	-	-	10.2	5.5	2.8	8.7	6.0	6.8	-	-
NHMW 2007z0149/0214	-	-	-	4.8	3.6	-	4.3	-	3.7	-	-
NHMW 2007z0149/0217	-	-	-	-	-	1.6	-	3.3	3.5	-	-
NHMW 2007z0149/0218	10.0	-	-	8.9	-	-	-	-	-	1.1	-
NHMW 2007z0149/0221	3.1	-	-	3.0	-	0.8	2.6	1.9	2.3	1.0	1.2

carapace is also slightly more convex than *G. eminens*. *Gastrosacus eminens* has much stronger and coarser ornamentation, especially on the metabranchial regions, than *Gastrosacus carteri*, *G. meyeri*, *Gastrosacus wetzleri*, *Gastrosacus torosus*, and *Gastrosacus ernstbrunnensis*. *Gastrosacus levocardiacus* has a cardiac region with the central portion elevated above the remainder of the cardiac region; *G. eminens* does not. *Gastrosacus pisinnus* is much smaller than *G. eminens*, with less prominent ornamentation and a non-serrated rostral keel.

*Gastrosacus eminens* has been found in the Upper Jurassic strata of Austria, Czech Republic, Poland, and Romania.

***Gastrosacus ernstbrunnensis* BACHMAYER, 1947**

(Figs 7.13–7.15)

1947 *Gastrosacus ernstbrunnensis* BACHMAYER, p. 37, Fig. 2.

**Emended diagnosis:** Carapace subrectangular in shape; narrows slightly approaching anterior and posterior margins, average L/TW 1.3, L/MW 1.1. Rostrum triangular, deflected, bears strong keel. Circumgastric and branchiocardiac grooves strong. Branchiocardiac groove interrupted by intestinal region at extreme posterior of cardiac region.

Ornamentation composed of varying sizes of tubercles and granules. Metagastric, mesogastric, protogastric, epigastric, cardiac, hepatic, epibranchial, mesobranchial, and metabranchial regions well defined. Urogastric region moderately defined; intestinal region weakly defined. Cardiac region ornamented with slightly transversely ovate tubercles; anterior margin of cardiac region inflected concave forward. Metabranchial regions small. Posterior margin slightly rimmed; ornamentation continues on rim.

**Measurements:** See Table 1.

**Holotype:** NHMW 1990/0041/3012.

**Other material examined:** Cast of the holotype NHMW 1990/0041/3012 (KSU D1002); NHMW 2007z0149/0270; NHMW 2007z0149/0271.

**Type Locality:** Ernstbrunn Quarries.

**Type Stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace subrectangular in shape; narrows slightly approaching anterior and posterior margins, L/TW 1.3; L/MW ranges from 1.1 to 1.2. Carapace moderately convex transversely, weakly convex longitudinally. Rostrum triangular with smooth lateral margins. Rostrum deflected; bears strong keel. Orbital margin present; upper orbital margin weakly rimmed. Small outer orbital spine present. Lateral margin straight. Circumgastric groove strongest groove on dorsal carapace. Two strong grooves diverge from circumgastric groove anterior and posterior to epibranchial region. Strong branchiocardiac groove outlines base of cardiac and mesobranchial regions and joins

groove outlining posterior of epibranchial region at lateral margin. Branchiocardiac groove interrupted by intestinal region at extreme posterior of cardiac region.

Ornamentation composed of varying sizes of tubercles and granules. Metagastric, mesogastric, protogastric, epigastric, cardiac, hepatic, epibranchial, mesobranchial, and metabranchial regions well defined. Urogastric region moderately defined; intestinal region weakly defined.

Metagastric region outlined by shallow groove; deepest posteriorly, weakening anteriorly. Metagastric region slightly raised above remainder of gastric region. All gastric regions ornamented with tubercles and granules. Epigastric and protogastric regions separated by shallow groove that extends posteriorly from circumgastric groove, terminating at metagastric groove. Cardiac region ornamented with slightly transversely ovate tubercles; anterior margin of cardiac region inflected concave forward. Hepatic, epibranchial, mesobranchial, and metabranchial regions ornamented with tubercles and granules. Urogastric region very narrow; lies just anterior to cardiac region posterior to circumgastric groove; not clearly separated from mesobranchial region. Intestinal region small, ornamented similar to metabranchial regions; not well separated from cardiac region. Posterior margin weakly rimmed; ornamentation continues onto rim.

**Discussion:** Above is an emended diagnosis and description for *Gastrosacus ernstbrunnensis*. The holotype is currently housed with the remainder of BACHMAYER's collection at the NHMW, not the Palaeontology-Palaeobiology Institute of the Universität-Wien as BACHMAYER indicated in his 1947 paper. When BACHMAYER originally described *G. ernstbrunnensis*, the only known specimen was the holotype, an exterior mold, which is incomplete. The low-quality of the mold obfuscates some of the detail of the specimen. Multiple attempts to cast this specimen were not successful in producing a high-quality cast, most likely due to its extraordinarily small size and odd angle within the source rock. Unfortunately, the original diagnosis does not match the holotype (Fig. 7.13) or BACHMAYER's hand-drawn illustration (1947, p. 37, Fig. 2; reprinted herein as Fig. 7.15). BACHMAYER described the branchial regions as "large", yet the holotype has quite small branchial regions. It is possible that he used "branchial regions" as the equivalent of the total area posterior to the circumgastric groove. Additionally, BACHMAYER claimed that the rostrum was complete and lacking a median keel, and illustrated it as such; however, on the holotype the rostrum is not complete, but does have a keel. The emended diagnosis and description were made using the specimen illustrated in Fig. 7.14, NHMW 2007z0149/0257.

The main differences between this species and others within *Gastrosacus* is its shape and size. Several new species, including *Gastrosacus pisinnus*, *Gastrosacus levocardiacus*, *Gastrosacus limacurvus*, and *Gastrosacus torosus* are similar in size, but do show some differences. *Gastrosacus pisinnus* has a differently shaped cardiac region; *G. pisinnus* has a straight anterior edge, while *G. ernstbrunnensis* has a concave forward arc along the anterior edge of the cardiac region. *Gastrosacus levocardiacus* has a cardiac region with the central portion elevated above the remainder of the cardiac region, while the cardiac



region on *G. ernstbrunnensis* is only one level. *Gastrosacus limacurvus* does not narrow at the extreme posterior like *G. ernstbrunnensis*, *G. limacurvus* also has a smoother circumgastric groove passing seamlessly from outlining the gastric region to separating the epibranchial and hepatic regions, while the junction between the groove branch and the main groove is much more abrupt in *G. ernstbrunnensis*. *Gastrosacus torosus* has stronger grooves and larger metabranchial regions than *G. ernstbrunnensis*. All other known members of *Gastrosacus* are at least twice the size of *G. ernstbrunnensis*.

***Gastrosacus tuberosiformis* (LÖRENTHEY in LÖRENTHEY & BEURLEN, 1929)**  
(Figs 7.16–7.19)

1929 *Galatheites tuberosiformis* LÖRENTHEY in LÖRENTHEY & BEURLEN, p. 75 – 77, Pl. 3, Fig. 13.

1966 *Gastrosacus eminens* – PATRULIUS, p. 502–503, Text-fig. 3; Pl. 30, Fig. 1, 2.

**Emended diagnosis:** Carapace sub-rectangular; maximum width at posterior of preserved specimen, average L/TW 1.4, L/MW 1.1. Carapace strongly convex transversely, weakly convex longitudinally. Rostrum triangular with smooth lateral margins, deflected, bears keel with well defined serrations. Lateral margin straight with small anteriorly directed spines. Both circumgastric and branchiocardiac grooves strong. Metagastric, mesogastric, urogastric, cardiac, hepatic, and epibranchial regions very well defined. Mesogastric ornamented with triangular spines pointed forward; metagastric region inflated, strongly ornamented with very slightly transversely ovate pustules. Both spines and pustules interspersed with granular ornamentation. Urogastric, cardiac and metabranchial regions ornamented with very slightly transversely ovate pustules directed anteriorly. Posterior margin weakly rimmed.

**Measurements:** See Table 1.

**Holotype:** Location of the holotype is unknown; a cast of the holotype, MGSB 32287, is in Barcelona, Spain. A cast of the cast of the holotype (KSU D1134) was examined and illustrated as Fig. 7.17.

**Additional material examined:** NHMW 2007z0149/0206 to .../0212, NHMW 2007z0149/0214, NHMW 2007z0149/0216 to .../0223.

**Type locality and type stratum:** Reported by LÖRENTHEY (in LÖRENTHEY & BEURLEN 1929) as the white Tithonian Limestones of Abrud, Romania.

**Other known occurrences:** Ernstbrunn, Austria and Štramberk, Czech Republic.

**Description:** Carapace sub-rectangular; maximum width at posterior of preserved specimen; L/TW ranges from 1.2 to 1.6, L/MW ranges from 1.0 to 1.2. Carapace strongly convex transversely, weakly convex longitudinally. Rostrum triangular with smooth lateral margins. Rostrum arcs downward; bears keel with well defined serrations. Upper orbital margin weakly flared with granular ornamentation; terminates in small orbital spine. Anterior third of upper orbital margin straight; directed posteriorly and laterally. Posterior part of upper orbital margin curves in slight concave forward arc.

Lateral margin straight with ornamentation continuing onto flanks. Strongest groove on dorsal carapace surrounds the gastric region. Two grooves diverge from circumgastric groove anterior and posterior to epibranchial region. Strong branchiocardiac groove outlines base of cardiac region and extends to lateral margin.

Metagastric, mesogastric, urogastric, cardiac, hepatic, and epibranchial regions very well defined. Metagastric region inflated; strongly ornamented with very slightly transversely ovate pustules; mesogastric ornamented with triangular spines pointed forward. Both spines and pustules interspersed with granular ornamentation. Epigastric region weakly defined; ornamented similar to mesogastric region. Hepatic and epibranchial regions ornamented similar to epigastric region. Urogastric and cardiac region ornamented with very slightly transversely ovate pustules directed anteriorly, largest at the anterior of cardiac region, grading smaller posteriorly. Ornamentation of metabranchial region nodular at edges; grades to slightly transversely ovate pustules towards center. Ventral surface and appendages not preserved.

**Discussion:** *Gastrosacus tuberosiformus* was described by LÖRENTHEY (in LÖRENTHEY & BEURLEN 1929) as *Galattheites*, and illustrated with a drawing of the single, incomplete specimen found in the white Tithonian limestone of Dobogókő, near Abrudbánya, Alsó-Fehér, which is now the city of Abrud, in Transylvania, Romania (Pl. 3, Fig. 13; reprinted herein as Fig. 7.16). Although LÖRENTHEY did not explicitly state the etymology of *G. tuberosiformus*, he gave extensive comparisons with *Gastrosacus tuberosus* REMES, 1895, indicating their similarities. The characteristics exhibited by *Gastrosacus tuberosiformus* were used by LÖRENTHEY (in LÖRENTHEY & BEURLEN 1929) as justification for returning *G. tuberosus* to the Galatheididae (now Munidopsidae), specifically noting the similarities in rostrum structure with the modern genus, *Munidopsis*. Unfortunately, the holotype has not been located; however, a cast of the holotype is housed in Barcelona, Spain. A cast of that cast is illustrated in Fig. 7.17. While the cast is less than perfect, it does closely match the specimen illustrated in Fig. 7.18. The groove structure, shape, and type of ornamentation parallel each other well. The only difference is the size of the ornamentation. The ornamentation on the specimen in Fig. 7.17 is smaller than that of Fig. 7.18. Although the ornamentation is different in size, the pustules and tubercles are arranged in a similar pattern. The size of the ornamentation may be a factor of carapace condition, as internal molds may show finer ornamentation than the original carapace surface. The difference in sizes may also reflect different growth stages. Other, incomplete specimens of *G. tuberosiformus* show a range of ornamentation sizes. While the ornamentation size may vary between specimens, the ornamentation is a fairly consistent size on each individual. The specimen illustrated in Fig. 7.18 was used to make the emended diagnosis and description.

In his original description, LÖRENTHEY (in LÖRENTHEY & BEURLEN 1929) commented on the rostrum of his specimen. The rostrum was strongly keeled, forward pointed, and downturned, all of which match the rostrum of the specimen illustrated in Fig. 7.18. During preparation, the rostrum of the holotype was destroyed, so LÖRENTHEY was describing it from memory. Unfortunately, during preparation of the specimen in Fig. 7.18, the keel was broken, but the rostrum itself is intact. The photograph of Fig. 7.18 was taken

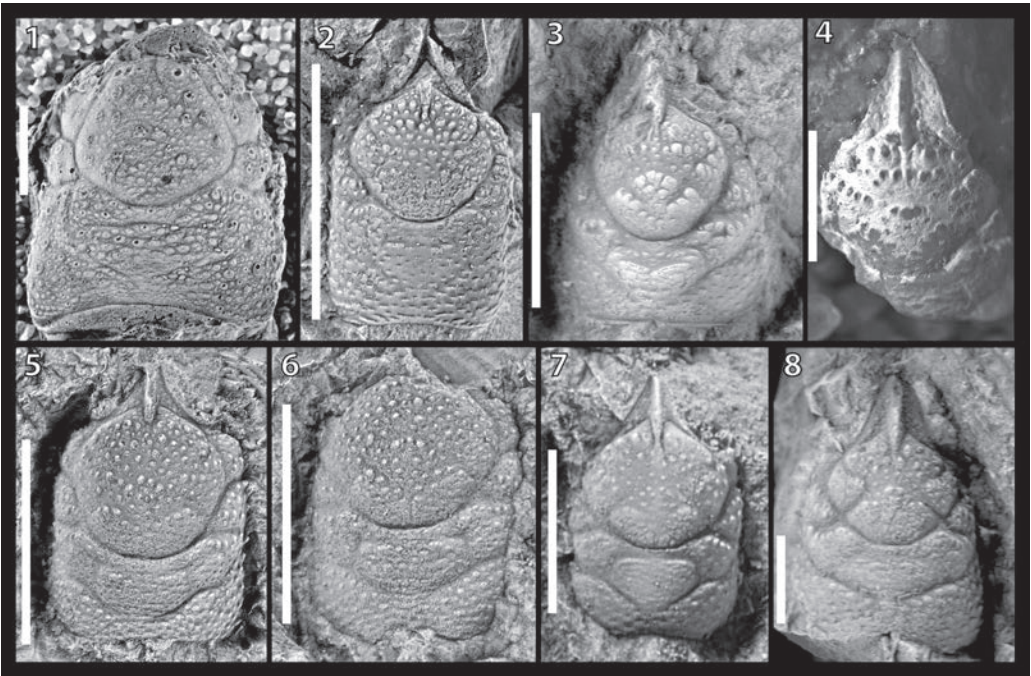


Fig. 8. 1: *Gastrosacus ubaghsi* (PELSENEER, 1886) nov. comb., cast, KSU D2068. (Original: NHMM 1991030). Scale bar equals 5 mm. 2: *Gastrosacus aequabus* nov. spec., holotype, NHMW 2007z0149/0231. Scale bar equals 5 mm. 3: *Gastrosacus levocardiacus* nov. spec., holotype, NHMW 2007z0149/0153. Scale bar equals 5 mm. 4: *Gastrosacus levocardiacus* nov. spec., paratype, NHMW 2007z0149/0159. Scale bar equals 2 mm. This specimen was neither dyed nor whitened with ammonium chloride. 5: *Gastrosacus limacurvus* nov. spec., holotype, NHMW 2007z0149/0259. Scale bar equals 5 mm. 6: *Gastrosacus limacurvus* nov. spec., paratype, NHMW 2007z0149/0245. Scale bar equals 5 mm. 7: *Gastrosacus pisinnus* nov. spec., holotype, NHMW 2007z0149/0205. Scale bar equals 2 mm. 8: *Gastrosacus torosus* nov. spec., holotype, NHMW 2007z0149/0161. Scale bar equals 2 mm.

before the damage occurred. Figure 7.19 shows a side view of a partial keel, showing similar forward-directed serrations found on *Gastrosacus eminens*.

This species is morphologically the most similar to *Gastrosacus eminens*, *Gastrosacus meyeri*, and *Gastrosacus tuberosus*. PATRULIUS (1966) described and illustrated two specimens and identified them as *Gastrosacus eminens* (p. 502–503, Text-fig. 3; Pl. 30, Fig. 1, 2). Examination of those specimens reveals that they are better identified as the very similar *G. tuberosiformus*. *Gastrosacus tuberosiformus* is more transversely convex, and has a narrower cardiac region than *G. eminens*. The ornamentation, while strong, is less transversely ovate than *G. eminens*, especially in the cardiac region. *Gastrosacus meyeri* has a much less developed metagastric region than *Gastrosacus tuberosiformus*. *Gastrosacus tuberosus* has a longer branchial region and a narrower frontal margin. *Gastrosacus tuberosiformus* has much stronger, more protruding ornamentation

than *Gastrosacus carteri*, *Gastrosacus wetzleri*, and *Gastrosacus torosus*. *Gastrosacus ernstbrunnensis* is much smaller, with smaller metabranchial regions than *Gastrosacus tuberosiformus*. *Gastrosacus levocardiacus* has a cardiac region with the central portion elevated above the remainder of the cardiac region; *Gastrosacus tuberosiformus* does not. *Gastrosacus tuberosiformus* has ornamentation of a consistent size across the carapace, not varied as found on *Gastrosacus ubaghsi*. *Gastrosacus pisinnus* is much smaller with less prominent ornamentation than *G. tuberosiformus*.

***Gastrosacus ubaghsi* (PELSENEER, 1886) nov. comb.**

(Fig. 8.1)

1886 *Galathea Ubaghsi* PELSENEER, p. 167, Fig. 5.

1886 *Galathea Ubaghsi* PELSENEER, p. 173.

1995 *Paragalathea ubaghsi* in COLLINS, FRAAYE, & JAGT, p. 174–175.

**Diagnosis:** COLLINS, FRAAYE, & JAGT (1995, p. 174) described a recently discovered specimen of *G. ubaghsi* in detail, and it need not be repeated here.

**Holotype:** IRSNB T 10651 (IG 6521); not examined by the authors.

**Other material examined:** KSU D2068, which is a cast of NHMM 1991030.

**Type locality and type stratum:** Saint-Pierre, Limbourg (Sint Piersberg, Limburg), the Netherlands; Maastricht Formation, late Maastrichtian, Cretaceous (as reported by PELSENEER, 1886). COLLINS, FRAAYE, & JAGT (1995) added that it is found in the lower Meerssen Member of the Maastricht Formation.

**Discussion:** The holotype of *Gastrosacus ubaghsi* was not examined here; a figure of the holotype *G. ubaghsi* published by COLLINS, FRAAYE, & JAGT (1995, p. 175 Fig. 4E–G), as well as a cast of a specimen of *G. ubaghsi* as identified by COLLINS, FRAAYE, & JAGT (1995, p. 175, Fig. 4H) was used for the generic placement of this species. A photo of the cast of *G. ubaghsi* is shown in Fig. 8.1. The presence of a circumgastric groove and high degree of regional definition precludes this genus from being placed within *Paragalathea*. These characteristics, as well as the pustular and tubercular ornamentation, fit in well with other species of *Gastrosacus*. This Late Cretaceous species shows a strong similarity to the Late Jurassic *Gastrosacus eminens* in regional definition and ornamentation. Although numerous species within *Gastrosacus* have pustular spines, the spines on *G. ubaghsi*, found on the gastric region and along the lateral edges of the carapace, are larger than those of all other known members of *Gastrosacus*.

***Gastrosacus aequabus* nov. spec.**

(Fig. 8.2)

**Diagnosis:** Carapace rectangular; strongly convex transversely, weakly convex longitudinally, L/TW 1.6, L/MW 1.4. Rostrum narrow, appears to bear keel. Circumgastric groove strong; weak branchiocardiac groove outlines base of cardiac region and extends to lateral margin.

Metagastric, mesogastric, epigastric, urogastric, cardiac, hepatic, and epibranchial regions moderately well defined. Anterior of carapace ornamented with tubercles. Posterior of carapace ornamented with transversely ovate tubercles; largest, most transversely ovate tubercles located at the anterior of cardiac region. Remainder of cardiac region

Table 2. Measurements of studied *Gastrosacus* specimens. Abbreviations as in Tab. 1.

NHMW	L	LR	R	MW	OW	RW	TW	GH	GW	L/MW	L/TW
<b><i>Gastrosacus aequabus</i> nov. spec.</b>											
NHMW 2007z0149/0231	5.0	-	-	3.6	2.4	1.1	3.1	2.9	3.2	1.4	1.6
<b><i>Gastrosacus levocardiacus</i> nov. spec.</b>											
NHMW 2007z0149/0153	5.7	-	-	5.7	3.0	1.2	4.5	3.5	3.7	1.0	1.3
NHMW 2007z0149/0154	-	-	1.1	3.7	2.3	1.2	3.0	2.1	2.5	-	-
NHMW 2007z0149/0156	3.2	4.4	1.2	2.9	2.0	1.2	-	1.9	2.0	1.1	
NHMW 2007z0149/0157	-	-	-	3.3	2.3	-	3.1	-	2.7	-	-
NHMW 2007z0149/0158	3.4	4.3	0.9	3.4	1.8	1.0	2.6	2.1	2.2	1.0	1.3
NHMW 2007z0149/0159	-	-	1.5	-	-	-	-	2.4	-		
<b><i>Gastrosacus limacurvus</i> nov. spec.</b>											
NHMW 2007z0149/0245	5.5	-	-	-	-	1.6	4.3	-	3.6		1.3
NHMW 2007z0149/0247	4.2	-	-	3.9	2.5		3.2	2.6	2.6	1.1	1.3
NHMW 2007z0149/0273	5.9	-	-	4.9	3.4	1.6	4.3	3.7	3.8	1.2	1.4
NHMW 2007z0149/0274	-	-	-	5.2	3.2	-	4.1	-	3.6	-	-
<b><i>Gastrosacus pisinnus</i> nov. spec.</b>											
NHMW 2007z0149/0205	2.6	3.2	0.6	2.0	1.5	0.9	1.9	1.6	1.8	1.3	1.4
<b><i>Gastrosacus torosus</i> nov. spec.</b>											
NHMW 2007z0149/0160	4.2	5.8	1.6	3.4	2.4	1.3	2.9	2.3	2.7	1.2	1.4
NHMW 2007z0149/0161	5.0	6.5	1.5	4.5	3.3	1.8	3.3	2.7	3.1	1.1	1.5
NHMW 2007z0149/0162	2.8	-	-	2.6	1.7	-	2.4	1.6	1.8	1.1	1.2
NHMW 2007z0149/0163	2.4	3.2	0.8	2.6	1.7	1.1	2.1	1.4	2.0	0.9	1.1
NHMW 2007z0149/0165	4.4	-	-	-	-	2.0	-	2.3	2.7	-	-
NHMW 2007z0149/0166	3.6	-	-	3.4	-	-	-	2.0	-	1.1	-
NHMW 2007z0149/0167	-	-	1.0	-	-	0.8	2.0	1.4	1.7	-	-
NHMW 2007z0149/0168	5.1	-	-	4.8	2.8	1.6	3.5	2.9	3.4	1.1	1.5
NHMW 2007z0149/0169	3.7	-	-	4.0	2.5	-	3.2	2.0	2.6	0.9	1.2
NHMW 2007z0149/0172	-	-	-	-	1.8	1.1	2.4	1.6	2.1	-	-
NHMW 2007z0149/0173	-	-	1.0	-	-	1.4	-	1.7	1.9	-	-
NHMW 2007z0149/0174	-	-	1.1	3.7	2.4	1.6	3.0	2.2	2.5	-	-
NHMW 2007z0149/0176	3.3	4.5	1.2	3.1	-	1.2	2.8	1.7	2.2	1.1	1.2



ornamented with much smaller, more widely spaced transversely ovate tubercles than found on remainder of carapace.

**Etymology:** From the Latin *aequabus*, meaning without knots or smooth. The species name refers to the posterior of the carapace that exhibits weak groove structure.

**Measurements:** See Table 2.

**Holotype and sole specimen:** NHMW 2007z0149/0231.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace rectangular; strongly convex transversely, weakly convex longitudinally; L/TW 1.6, L/MW 1.4. Rostrum narrow; incompletely preserved; appears to bear keel. Upper orbital margin terminates in small orbital spine.

Lateral margin straight with ornamentation continuing onto flanks. Strongest groove on dorsal carapace surrounds the gastric region. Two grooves diverge from circumgastric groove anterior and posterior to epibranchial region. Weak branchiocardiac groove outlines base of cardiac region and extends to lateral margin.

Metagastric, mesogastric, epigastric, urogastric, cardiac, hepatic, and epibranchial regions moderately well defined. Urogastric and cardiac region ornamented with transversely ovate pustules; largest, most transversely ovate pustules located at the anterior of cardiac region. Remainder of cardiac region ornamented with much smaller, more widely spaced transversely ovate tubercles than found on remainder of carapace. Metabranhial regions ornamented with transversely ovate tubercles; tubercles become more transversely ovate approaching posterior margin. Ventral surface and appendages not preserved.

**Discussion:** Only one incomplete specimen of this species has been found. It differs significantly from all other members of *Gastrosacus* due to the weak to moderately developed branchiocardiac groove, whereas all other members have very pronounced branchiocardiac grooves. Although this species has some similarities to *Cracensigillatus* in carapace shape, the lack of a well-developed urogastric region makes *Gastrosacus* a better generic fit. The metagastric region, which is extremely developed within members of *Gastrosacus*, is unfortunately damaged in this specimen. The metagastric region, while less inflated than in other species, is still pronounced.

### ***Gastrosacus levocardiacus* nov. spec.**

(Figs 8.3–8.4)

**Diagnosis:** Carapace widens posteriorly, trapezoidal in shape, moderately convex transversely, weakly convex longitudinally, average L/TW 1.3, L/MW 1.0. Rostrum triangular, deflected, bears strong keel decreasing slightly in height along length of rostrum. Lateral margin straight with small anteriorly directed spines. Both circumgastric

and branchiocardiac grooves strong. Ornamentation composed of varying sizes of tubercles and granules. Mesogastric, metagastric, epigastric, protogastric, cardiac, hepatic, epibranchial, and metabranchial regions well defined. Mesobranchial and urogastric regions moderately defined. Epigastric region and protogastric region separated by shallow groove that extends posteriorly from circumgastric groove, terminating at metagastric groove. Ornamentation strongest and largest at anterior of regions. Cardiac region ornamented with rows of transversely ovate tubercles; central part of region elevated and ornamented with larger transversely ovate tubercles. Metabranchial region ornamented with anteriorly directed tubercular spines, increasing in size to pustules approaching lateral margin. Pustules appear imbricated at lateral margin. Posterior margin weakly rimmed.

**Etymology:** The species name is a combination of the Latin *levo*, meaning raised, and *cardiacus*. This combination refers to the cardiac region appearing to have two separate levels.

**Measurements:** See Table 2.

**Holotype:** NHMW 2007z0149/0153.

**Paratypes:** NHMW 2007z0149/0154, 2007z0149/0158, 2007z0149/0159.

**Additional material examined:** NHMW 2007z0149/0156, 2007z0149/0157.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace widens posteriorly, trapezoidal in shape, moderately convex transversely, weakly convex longitudinally; L/TW 1.3; L/MW ranges from 1.0 to 1.1. Rostrum triangular with slightly blunted tip and smooth lateral margins, deflected, bears strong keel decreasing slightly in height along length, ornamented with granules and small tubercles.

Orbital margin present; upper orbital margin weakly rimmed, small outer orbital spine present. Lateral margin straight with small anteriorly directed spines. Circumgastric groove strongest groove on dorsal carapace. Two strong grooves diverge from circumgastric groove anterior and posterior to epibranchial region. Strong branchiocardiac groove outlines base of cardiac and mesobranchial regions and joins groove outlining posterior of epibranchial region at lateral margin.

Ornamentation composed of varying sizes of tubercles and granules. Mesogastric, metagastric, epigastric, protogastric, cardiac, hepatic, epibranchial, and metabranchial regions well defined. Mesobranchial and urogastric regions moderately defined.

Mesogastric region outlined by shallow groove; strongly ornamented posteriorly with large tubercular spines, points directed anteriorly; anteriorly with small tubercles. Metagastric region ornamented anteriorly by large tubercular spines, points directed anteriorly; grading posteriorly to smaller tubercles and transversely ovate tubercles. Epigastric

region and protogastric region separated by shallow groove that extends posteriorly from circumgastric groove, terminating at metagastric groove. Both regions ornamented anteriorly by anteriorly directed pustular spines, posteriorly by tubercles and granules. Cardiac region ornamented with rows of transversely ovate tubercles; central part of region elevated and ornamented with larger transversely ovate tubercles. Hepatic region comparatively flatter than gastric region; ornamented anteriorly with one large anteriorly directed tubercle spine; posteriorly with smaller anteriorly directed tubercular spines with interspersed granules. Epibranchial region ornamented with anteriorly directed tubercular spines. Metabranhial region ornamented with anteriorly directed tubercular spines, increasing in size to pustules approaching lateral margin. Pustules appear imbricated at lateral margin.

Mesobranhial and metabranhial regions ornamented anteriorly with anteriorly directed tubercular spines, posteriorly with transversely ovate tubercles. Urogastric region very narrow; lies just anterior to cardiac region posterior to circumgastric groove; widens at edges. Left and right anteriormost points of urogastric region ornamented with small anteriorly directed tubercular spines; remainder ornamented with small, transversely ovate tubercles. Posterior margin weakly rimmed. Ventral surface and appendages not preserved.

**Discussion:** This species, along with *Gastrosacus torosus* and *Gastrosacus pisinnus* are placed within *Gastrosacus* with reservation. They are much smaller than the majority of species in *Gastrosacus*, and have a slightly different gastric area as well as a slightly wider rostrum. *Gastrosacus levocardiacus* differs from all other species within *Gastrosacus* by its cardiac region that has the central portion elevated above the remainder of the cardiac region.

### ***Gastrosacus limacurvus* nov. spec.**

(Figs 8.5–8.6)

**Diagnosis:** Carapace subrectangular in shape; moderately convex transversely, weakly convex longitudinally, L/TW 1.3, L/MW 1.15. Rostrum narrow, very strongly keeled. Circumgastric groove strong; strongest part of circumgastric groove continues seamlessly between epibranchial and hepatic region. Strong branchiocardiac groove outlines base of cardiac and mesobranhial regions. Ornamentation composed of varying sizes of anteriorly directed tubercles and granules. Metagastric, cardiac, hepatic, epibranchial, mesobranhial, and metabranhial regions well defined. Epigastric, mesogastric, protogastric, and urogastric regions weakly defined. Epigastric and protogastric regions separated by very shallow groove that extends posteriorly from circumgastric groove. Cardiac region ornamented with slightly transversely ovate tubercles.

**Etymology:** From the Latin *lima*, meaning smoothed or polished, and *curvus*, referring to a portion of the circumgastric groove. The groove arcs smoothly across the carapace, continuing without interruption between the epibranchial and hepatic regions.

Measurements: See Table 2.

Holotype: NHMW 2007z0149/0259.

Paratype: NHMW 2007z0149/0245.

Other material examined: NHMW 2007z0149/0247; NHMW 2007z0149/0260.

Type locality: Ernstbrunn Quarries.

Type stratum: Ernstbrunn Limestones, Tithonian, Upper Jurassic.

Description: Carapace subrectangular in shape, moderately convex transversely, weakly convex longitudinally, L/TW ranges from 1.3 to 1.4; L/MW ranges from 1.1 to 1.3. Rostrum narrow, very strongly keeled, ornamented with granules and small tubercles, rostral termination unknown.

Orbital margin present; upper orbital margin weakly rimmed. Small outer orbital spine present. Lateral margin straight. Circumgastric groove strongest groove on dorsal carapace. Two strong grooves diverge from circumgastric groove anterior and posterior to epibranchial region. Strongest part of circumgastric groove continues seamlessly between epibranchial and hepatic region. Strong branchiocardiac groove outlines base of cardiac and mesobranchial regions and joins groove outlining posterior of epibranchial region at lateral margin.

Ornamentation composed of varying sizes of tubercles and granules. Metagastric, cardiac, hepatic, epibranchial, mesobranchial, and metabranchial regions well defined. Epigastric, mesogastric, protogastric, and urogastric regions weakly defined.

Metagastric region outlined by shallow groove; metagastric region slightly raised above remainder of gastric region. All gastric regions ornamented with small, anteriorly directed tubercles and granules. Epigastric and protogastric regions separated by very shallow groove that extends posteriorly from circumgastric groove. Cardiac region ornamented with slightly transversely ovate tubercles. Hepatic and epibranchial regions ornamented with small anteriorly directed tubercle spines and granules. Mesobranchial and metabranchial region ornamented with anteriorly directed tubercles. Urogastric region very narrow; lies just anterior to cardiac region posterior to circumgastric groove; not clearly separated from mesobranchial region. Posterior margin very weakly rimmed. Ventral surface and appendages not preserved.

Discussion: Four individuals of this species were found, none of which were complete. They differ from all other *Gastrosacus* species with the smoothly arcing groove defining the gastric region as well as the smooth branch separating the epibranchial and hepatic region.

***Gastrosacus pisinnus* nov. spec.**

(Fig. 8.7)

Diagnosis: Carapace subrectangular in shape, moderately convex transversely, weakly convex longitudinally, L/TW 1.4, L/MW 1.3. Rostrum triangular with sharp tip,



deflected; bears very strong keel decreasing slightly in height along length. Lateral margin straight. Both circumgastric and branchiocardiac grooves strong. Metagastric, protogastric, cardiac, hepatic, epibranchial, mesobranchial and metabranchial regions well defined. Mesogastric, epigastric, and urogastric regions moderately defined. Epigastric region and protogastric region separated by very shallow groove that extends posteriorly from circumgastric groove, terminating at metagastric groove. Metagastric region slightly raised above remainder of gastric region. Ornamentation on carapace of species composed of varying sizes of tubercles and granules. Posterior margin weakly rimmed.

**Etymology:** The species name *pisinnus* is from Latin, meaning small or little. The species name refers to the minuteness of the specimen.

**Measurements:** See Table 2.

**Holotype and sole specimen:** NHMW 2007z0149/0205.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace subrectangular in shape; L/TW 1.4, L/MW 1.3. Carapace moderately convex transversely, weakly convex longitudinally. Rostrum triangular with sharp tip and smooth lateral margins. Rostrum deflected; bears strong keel decreasing slightly in height along length of rostrum. Rostrum ornamented with granules and small tubercles.

Orbital margin present; upper orbital margin weakly rimmed. Small outer orbital spine present. Lateral margin straight. Circumgastric groove strongest groove on dorsal carapace. Two strong grooves diverge from circumgastric groove anterior and posterior to epibranchial region. Strong branchiocardiac groove outlines base of cardiac and mesobranchial regions and joins groove outlining posterior of epibranchial region at lateral margin.

Ornamentation composed of varying sizes of tubercles and granules. Metagastric, protogastric, cardiac, hepatic, epibranchial, mesobranchial, and metabranchial regions well defined. Epigastric and urogastric regions moderately defined.

Metagastric region outlined by shallow groove; deepest posteriorly, weakening anteriorly. Metagastric region slightly raised above remainder of gastric region. All gastric regions ornamented with small, anteriorly directed tubercles and granules. Epigastric and protogastric regions separated by shallow groove that extends posteriorly from circumgastric groove, terminating at metagastric groove. Cardiac region ornamented with slightly transversely ovate tubercles. Hepatic region ornamented anteriorly with one large anteriorly directed tubercle spine; posteriorly with small tubercles and granules. Epibranchial region ornamented with anteriorly directed tubercular spines. Metabranchial region ornamented with anteriorly directed tubercles, slightly increasing in size approaching lateral margin. Mesobranchial and metabranchial regions ornamented anteriorly with large, anteriorly directed tubercles, posteriorly with transversely ovate tubercles. Urogastric region very narrow; lies just anterior to cardiac region posterior to

circumgastric groove; not clearly separated from mesobranchial region. Posterior margin weakly rimmed. Ventral surface and appendages not preserved.

**Discussion:** Only one specimen of this species has been found. At 2.75 mm maximum length (rostrum – posterior margin), it is the smallest known member of *Gastrosacus*. It is most similar to *Gastrosacus ernstbrunnensis*, *Gastrosacus torosus*, and *Gastrosacus levocardiacus*. *Gastrosacus pisinnus* has a differently shaped cardiac region; the anterior edge of the cardiac region on *G. pisinnus* is straight, whereas the anterior edge of the cardiac region on *G. torosus*, *G. ernstbrunnensis*, and *G. levocardiacus* is arced concave forward.

***Gastrosacus torosus* nov. spec.**

(Fig. 8.8)

**Diagnosis:** Carapace widens slightly posteriorly; trapezoidal in shape, moderately convex transversely, weakly convex longitudinally, L/TW 1.3, L/MW 1.1. Rostrum triangular with sharp tip, deflected; bears very strong keel decreasing slightly in height along length. Lateral margin straight with small anteriorly directed spines. Both circumgastric and branchiocardiac grooves strong. Metagastric, epigastric, protogastric, cardiac, hepatic, epibranchial, and metabranchial regions well defined. Mesogastric, mesobranchial, urogastric, and intestinal regions moderately defined. Epigastric region and protogastric region separated by shallow groove that extends posteriorly from circumgastric groove, terminating at metagastric groove. Ornamentation on anterior carapace of species composed of varying sizes of tubercles and granules; grading smaller from anterior of regions to posterior of regions. Cardiac region ornamented with rows of transversely ovate tubercles. Metabranchial region ornamented with anteriorly directed tubercles, increasing in size approaching lateral margin. Tubercles appear imbricated at lateral margin. Posterior margin weakly rimmed.

**Etymology:** The species name *torosus* refers to the extremely strong keel on the rostrum, one of the most prominent features on this species.

**Measurements:** See Table 2.

**Holotype:** NHMW 2007z0149/0161.

**Paratypes:** NHMW 2007z0149/0160, NHMW 2007z0149/0162, NHMW 2007z0149/0164.

**Additional material examined:** NHMW 2007z0149/0165 to NHMW 2007z0149/0178.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace widens slightly posteriorly, trapezoidal in shape, moderately convex transversely, weakly convex longitudinally, L/TW ranges from 1.1 to 1.5; L/MW

ranges from 0.9 to 1.3. Rostrum triangular with sharp tip and smooth lateral margins, deflected, bears strong keel decreasing slightly in height along length, ornamented with granules and small tubercles.

Orbital margin present; upper orbital margin weakly rimmed. Small outer orbital spine present. Lateral margin straight with small anteriorly directed spines. Circumgastric groove strongest groove on dorsal carapace. Two strong grooves diverge from circumgastric groove anterior and posterior to epibranchial region. Strong branchiocardiac groove outlines base of cardiac and mesobranchial regions and joins groove outlining posterior of epibranchial region at lateral margin.

Ornamentation composed of varying sizes of tubercles and granules. Metagastric, epigastric, protogastric, cardiac, hepatic, epibranchial, and metabranchial regions well defined. Mesobranchial, urogastric, and intestinal regions moderately defined.

Metagastric region outlined by shallow groove; deepest posteriorly, weakening anteriorly. Mesogastric region strongly ornamented anteriorly with large tubercles, centrally with small tubercles and granules. Metagastric region ornamented anteriorly by large tubercles grading posteriorly to smaller tubercles. Epigastric region and protogastric region separated by shallow groove that extends posteriorly from circumgastric groove, terminating at metagastric groove. Both regions ornamented anteriorly by large anteriorly directed tubercles, posteriorly by small tubercles and granules. Cardiac region ornamented with rows of transversely ovate tubercles. Hepatic region ornamented anteriorly with one large anteriorly directed tubercle spine; posteriorly with small tubercles and granules. Epibranchial region ornamented with anteriorly directed tubercular spines. Metabranchial region ornamented with anteriorly directed tubercles, increasing in size approaching lateral margin. Tubercles appear imbricated at lateral margin. Mesobranchial and metabranchial regions ornamented anteriorly with large, anteriorly directed tubercles, posteriorly with transversely ovate tubercles. Urogastric region very narrow; lies just anterior to cardiac region posterior to circumgastric groove; widens at edges. Left and right anteriormost points of urogastric region ornamented with small anteriorly directed tubercles; remainder ornamented with small, transversely ovate tubercles. Intestinal region bounded by shallow grooves laterally; weak depression anteriorly. Intestinal region ornamented with tubercles. Posterior margin weakly rimmed. Ventral surface and appendages not preserved.

**Discussion:** *Gastrosacus torosus* has a triangular shaped rostrum with an extremely strong keel, much like that of members of the genus *Bullaris*. However, *Gastrosacus torosus* lacks the extreme convexity that is diagnostic of the genus *Bullaris*. The keel, along with an extremely well defined gastric region, where the protogastric, epigastric, and metagastric are all separated by grooves, separates it from all other *Gastrosacus* species except for *Gastrosacus levocardiacus*. *Gastrosacus levocardiacus* has a cardiac region with the central portion elevated above the remainder of the cardiac region, whereas *Gastrosacus torosus* has a single level cardiac region.

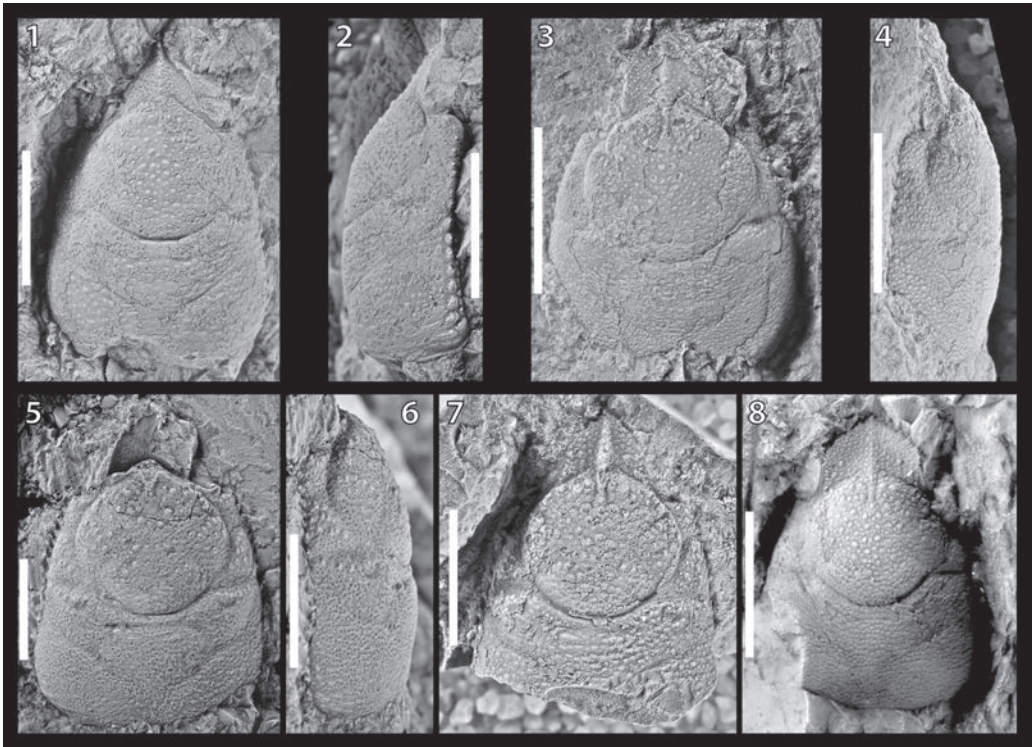


Fig. 9. 1: *Ambulocapsa altilis* nov. gen., nov. spec., holotype, NHMW 2007z0149/0130. Scale bar equals 5 mm. 2: *Ambulocapsa altilis* nov. gen., nov. spec. NHMW 2007z0149/0401, side view. 3–4: *Ambulocapsa bachmayeri* nov. gen., nov. spec., holotype, NHMW 2007z0149/0139, 3: dorsal view, 4: side view. Scale bar equals 5 mm. 5–6: *Ambulocapsa novacula* nov. gen., nov. spec., holotype, NHMW 2007z0149/0144. 5: dorsal view, 6: side view. Scale bar equals 5 mm. 7: *Ambulocapsa novacula* nov. gen., nov. spec., paratype, NHMW 2007z0149/0146. Scale bar equals 5 mm. 8: *Ambulocapsa sentosa* nov. gen., nov. spec., holotype, NHMW 2007z0149/0140a. Scale bar equals 5 mm.

#### Genus *Ambulocapsa* nov. gen.

Type species: *Ambulocapsa altilis* nov. spec.

Other included species: *Ambulocapsa bachmayeri* nov. spec., *Ambulocapsa novacula* nov. spec., *Ambulocapsa sentosa* nov. spec.

Diagnosis: Carapace widens posteriorly; extremely convex transversely; vaulted anteriorly, average L/TW 1.5, L/MW 1.1. Rostrum deflected downward; broadly triangular to spatulate in shape; may be spined at tip; keel continuous, extends full length of rostrum, composed of nodes, or starts as nodes then changes to small ridge or crease distally. Small outer orbital spine present. Small spines on lateral margins. Circumgastric



groove strong; branchiocardiac groove weakly defined. Gastric regions (mesogastric, metagastric, epigastric, protogastric) weakly defined.

**Etymology:** *Ambulocapsa* is a combination of the Latin *ambulo*, meaning ambulatory, and *capsa*, meaning box. The carapace convexity displayed by members of this genus give them the appearance of walking boxes. Feminine gender.

**Discussion:** This new genus is closest to *Gastrosacus* and *Ankylokypha* but is significantly different from both. *Gastrosacus* has a much less convex carapace, has more clearly defined gastric regions, has a narrower, more styliform rostrum with a much larger keel, and coarser ornamentation than *Ambulocapsa*. *Ankylokypha* has a much more convex carapace, has a much stronger rostral keel, and has more well-defined regions. *Culmenformosa* has a much less convex carapace, has coarser ornamentation, especially posteriorly, and has a keel that only extends half the length of its rostrum. *Bullariscus* has a much stronger rostral keel, and has inflated regions. *Cracensigillatus* has a less convex carapace, has a narrower rostrum, and a greater carapace L/W ratio. *Octoeurax* has a much less convex carapace and has a triangular cardiac region. *Aulavescus* is much less convex, and has much less regional definition than *Ambulocapsa*. *Pegomyrmekella* has a much broader cardiac region, a much stronger rostral keel, and has much coarser ornamentation. *Munidopsis curvirostra* has a less convex dorsal carapace, with much deeper grooves, and a less rounded gastric region. *Vetoplautus* has a less convex carapace, with an additional gastric area defined between the protogastric and epigastric regions.

Members of *Ambulocapsa* have been found in both the Ernstbrunn Limestones of Austria and in the Štramperk Limestones of the Czech Republic.

***Ambulocapsa altilis* nov. spec.**

(Figs 9.1, 9.2)

**Diagnosis:** Carapace widens posteriorly, extremely convex transversely, vaulted anteriorly, average L/TW 1.4, L/MW 1.1. Rostrum deflected downward, overall broadly triangular in shape; rostral keel moderately strong, extending full length of rostrum, completely composed of nodes. Anteriormost part of hepatic region located anteriorly beyond orbital margin edge. Small spines on lateral margins. Circumgastric groove moderately strong; branchiocardiac groove weakly, but distinctly, defined. Gastric, hepatic, epibranchial, and branchial regions moderately defined. Cardiac and metabranchial regions weakly to moderately defined. Epigastric, mesogastric, and metagastric regions very weakly defined. Grooves on carapace all very shallow; regions not swollen or inflated. Carapace ornamented with tubercles of varying sizes. Posterior margin appears unrimmed.

**Etymology:** The specific name *altilis*, Latin for well-nourished, reflects the robust appearance of the carapace.

**Measurements:** See Table 3.

**Holotype:** NHMW 2007z0149/0130.

Paratypes: NHMW 2007z0149/0131, NHMW 2007z0149/0132.

Other material examined: NHMW 2007z0149/0133 to NHMW 2007z0149/0137; NHMW 2007z0149/0401.

Type locality: Ernstbrunn Quarries.

Type stratum: Ernstbrunn Limestones, Tithonian, Upper Jurassic.

Description: Carapace widens posteriorly, extremely convex transversely, vaulted anteriorly; L/TW ranges from 1.3 to 1.7; L/MW ranges from 1.0 to 1.2. Rostrum deflected, overall broadly triangular in shape, begins with sides slightly converging toward one another; half-way along the length, sides narrow and converge at a steeper angle; rostral keel moderately strong and extends full length of rostrum; keel completely composed of nodes. Small outer orbital spine present. Anteriormost part of hepatic region located anteriorly beyond orbital margin edge. Small spines on lateral margins. Circumgastric groove moderately strong; branchiocardiac groove weakly, but distinctly, defined. Gastric, hepatic, epibranchial, and branchial regions moderately defined. Cardiac and metabranchial regions weakly to moderately defined. Epigastric, mesogastric,

NHMW	L	LR	R	MW	OW	RW	TW	GH	GW	L/MW	L/TW
<b><i>Ambulocapsa altilis</i> nov. spec.</b>											
NHMW 2007z0149/0130	9.0	11.3	2.3	7.4	4.4	2.8	5.3	5.0	5.2	1.2	1.7
NHMW 2007z0149/0131	9.1	11.1	2.0	8.8	5.2	3.2	6.2	5.4	6.1	1.0	1.5
NHMW 2007z0149/0132	7.4	9.6	2.2	7.1	4.4	3.0	5.1	4.5	4.8	1.0	1.5
NHMW 2007z0149/0133	7.5	-	-	6.8	4.4	2.9	5.1	4.3	4.8	1.1	1.5
NHMW 2007z0149/0136	3.6	4.6	1.0	3.0	2.2	1.0	2.7	2.4	2.2	1.2	1.3
NHMW 2007z0149/0137	-	-	2.1	-	4.3	2.9	4.9	4.5	5.0	-	-
NHMW 2007z0149/0369	5.1	6.2	1.1	4.7	-	2.1	3.7	2.9	3.1	1.1	1.4
NHMW 2007z0149/0371	5.0	6.1	1.1	4.7	-	1.9	3.9	3.0	3.7	1.1	1.3
NHMW 1912/0006/0688	7.8	-	-	6.7	4.1	2.7	5.5	4.8	4.8	1.2	1.4
<b><i>Ambulocapsa bachmayeri</i> nov. spec.</b>											
NHMW 2007z0149/0139	9.1	11.6	2.5	8.9	2.5	3.3	6.2	4.7	5.2	1.0	1.5
<b><i>Ambulocapsa novacula</i> nov. spec.</b>											
NHMW 2007z0149/0144	11.8	14.2	2.4	10.0	5.9	3.6	7.4	6.6	6.4	1.2	1.6
NHMW 2007z0149/0145	-	-	2.1	-	-	3.0	5.7	5.4	5.1	-	-
NHMW 2007z0149/0146	-	-	2.0	6.5	3.6	2.8	4.7	4.2	4.5	-	-
NHMW 2007z0149/0147	-	-	2.2	-	-	-	-	-	-	-	-
<b><i>Ambulocapsa sentosa</i> nov. spec.</b>											
NHMW 2007z0149/0140a	8.1	10.0	1.9	8.1	4.9	3.8	5.4	4.5	5.0	1.0	1.5
NHMW 2007z0149/0141	-	-	2.0	-	5.2	3.9	6.5	-	6.2	-	-
NHMW 2007z0149/0142	-	-	2.2	-	-	4.3	-	5.2	-	-	-
NHMW 2007z0162/0008	-	-	-	5.8	-	-	-	3.4	4.1	-	-

and metagastric regions very weakly defined. Grooves on carapace all very shallow; regions not swollen or inflated. Carapace ornamented with tubercles of varying sizes. Tubercles most pronounced at anterior of regions. Tubercles become transversely ovate posteriorly, especially on cardiac region. Tubercles become larger approaching lateral margin of branchial region. Posterior margin appears unrimmed. Ventral surface and appendages not preserved.

**Discussion:** This species can easily be differentiated from others within the genus. *Ambulocapsa bachmayeri* has a rostrum that is less triangular in shape and a carapace that is slightly less convex and widens more posteriorly. Its grooves are also slightly deeper and its ornamentation finer than *Ambulocapsa altilis*. *Ambulocapsa sentosa* does not have a triangular rostrum and has a carapace that is less convex and widens posteriorly so that it is near triangular in shape. *Ambulocapsa novacula* has a serrate rostrum and better defined regions than *A. altilis*. This species has also been found in material from the Štramberg Limestones of the Czech Republic, also Tithonian in age.

Table 3. Measurements of studied *Ambulocapsa* specimens. Abbreviations as in Tab. 1.

***Ambulocapsa bachmayeri* nov. spec.**

(Fig. 9.3)

**Diagnosis:** Carapace widens posteriorly, extremely convex transversely, vaulted anteriorly, L/TW 1.5, L/MW 1.0. Rostrum deflected downward; sub-triangular in shape; rostral keel moderately strong, extending full length of rostrum; proximal half of keel completely composed of nodes, distal half of keel composed of crease. Anteriormost part of hepatic region projected beyond orbital margin edge. Small spines on lateral margins. Circumgastric groove moderately strong, branchiocardiac groove very weakly defined; both grooves shallow. Mesogastric, hepatic, and epibranchial regions moderately defined. Cardiac and branchial regions weakly to moderately defined. Epigastic and protogastric regions very weakly defined. Carapace grooves shallow. Carapace ornamented with tubercles of varying sizes with small, very slightly transversely ovate tubercles interspersed with granules ornament posterior of carapace. Ornamentation most transversely ovate on cardiac region.

**Etymology:** The species name is in honor of Friedrich BACHMAYER, whose extensive decapod collection, housed at the NHMW, was studied for this work.

**Measurements:** See Table 3.

**Holotype and sole specimen:** NHMW 2007z0149/0139.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace incomplete; missing most of posterior margin. Carapace widens posteriorly; extremely convex transversely, vaulted anteriorly, L/TW 1.5, L/MW

1.0. Rostrum deflected downward; sub-triangular in shape; begins with sides subparallel, slightly converging toward one another; at mid-length, sides narrow and converge at much steeper angle and very slight arc. Rostrum ornamented with granules. Rostral keel moderately strong, extending full length of rostrum; proximal half of keel completely composed of nodes, distal half of keel composed of crease. Small outer orbital spine present. Anteriormost part of hepatic region located anteriorly beyond orbital margin edge. Small spines on lateral margins. Circumgastric groove moderately strong; branchiocardiac groove very weakly defined. Mesogastric, hepatic, and epibranchial regions moderately defined. Cardiac and branchial regions weakly to moderately defined. Epigastric and protogastric regions very weakly defined. Grooves on carapace shallow. Carapace ornamented with tubercles of varying sizes. Tubercles most pronounced at anterior of regions; tubercles largest on anterior part of carapace. Small, very slightly transversely ovate tubercles interspersed with granules ornament posterior of carapace. Ornamentation most transversely ovate on cardiac region. Ventral surface and appendages not preserved.

**Discussion:** Although there is only one specimen studied for this new species, it is clearly different than the others within the genus. It is closest in appearance to *Ambulocapsa altilis*; however, *A. altilis* has coarser ornamentation, shallower grooves, and a triangular rostrum. *Ambulocapsa sentosa* has a spatulate rostrum, a less convex carapace, and widens more posteriorly than *A. bachmayeri*. *Ambulocapsa novacula* has a serrate rostrum, stronger branchiocardiac groove, and more regional swelling.

***Ambulocapsa novacula* nov. spec.**

(Figs 9.4, 9.5)

**Diagnosis:** Carapace widens posteriorly, extremely convex transversely, moderately vaulted anteriorly, L/TW 1.6, L/MW 1.2. Rostrum deflected downward; overall broadly triangular in shape; distal half of rostrum serrate, ornamented with 7 spines; rostral keel moderately strong extending full length of rostrum, completely composed of nodes. Small spines on lateral margins. Circumgastric groove strong; branchiocardiac groove shallow. Epigastric, protogastric, mesogastric, metagastric, hepatic, epibranchial, cardiac, and branchial regions moderately defined. Carapace ornamented with tubercles of varying sizes. Tubercles largest on anterior part of carapace; tubercles directed anteriorly. Carapace ornamented posteriorly with small, slightly transversely ovate tubercles and granules. Tubercles slightly larger and more transversely ovate on cardiac region. All regions appear slightly swollen, especially cardiac region.

**Etymology:** From the Latin *novacula*, meaning sharp knife. The name refers to the triangular rostrum with the sharp spines.

**Measurements:** See Table 3.

**Holotype:** NHMW 2007z0149/0144.

**Paratypes:** NHMW 2007z0149/0145, NHMW 2007z0149/0146.

Other material examined: NHMW 2007z0149/0147.

Type locality: Ernstbrunn Quarries.

Type stratum: Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace widens posteriorly, extremely convex transversely, moderately vaulted anteriorly, L/TW 1.6, L/MW 1.2. Rostrum deflected downward; overall broadly triangular in shape, proximally with sides converging weakly toward one another, at mid-length, sides narrow and converge at steeper angle; distal half of rostrum serrate, ornamented with 7 spines; rostral keel moderately strong, extending full length of rostrum, completely composed of nodes. Small outer orbital spine present.

Small spines on lateral margins. Circumgastric groove strong; branchiocardiac groove shallow, but distinctly defined. Epigastric, protogastric, mesogastric, metagastric, hepatic, epibranchial, cardiac, and branchial regions moderately defined.

Carapace ornamented with tubercles of varying sizes. Tubercles largest on anterior part of carapace; tubercles directed anteriorly. Regions on anterior part of carapace lined anteriorly with row of tubercles. Carapace ornamented posteriorly with small, slightly transversely ovate tubercles and granules. Tubercles slightly larger and more transversely ovate on cardiac region. All regions appear slightly swollen, especially cardiac region. Ventral surface and appendages not preserved.

**Discussion:** The specimen primarily used for the description is missing the rostrum; however, the rostral outline is intact (Fig. 9.4). The description of the rostral keel is from the three other specimens that are all comparatively less complete (Fig. 9.5). This species is distinctly different from the others within this genus. It has a less convex carapace, has slightly swollen regions, better regional definition, and deeper grooves. *Ambulocapsa altilis* does not have a serrate rostrum, has a more convex carapace, and has shallower grooves. *Ambulocapsa bachmayeri* does not have a serrate rostrum, has a more convex carapace, and widens posteriorly to a greater degree. *Ambulocapsa sentosa* has a broader rostrum, weaker rostral keel, and has less regional definition.

***Ambulocapsa sentosa* nov. spec.**

(Fig. 9.6)

**Diagnosis:** Carapace widens significantly posteriorly, extremely convex transversely; vaulted anteriorly, L/TW 1.5, L/MW 1.0. Rostrum deflected downward, spatulate, broadly pentagonal, distal half of rostrum serrate, tipped with 13 spines, rostral keel weak, extending full length of rostrum, proximally composed of small nodes but becomes weak crease distally. Anteriormost part of hepatic region located anteriorly beyond orbital margin termination. Small spines on lateral margins. Circumgastric groove moderately strong; branchiocardiac groove weakly defined; both grooves shallow. Gastric, hepatic, epibranchial, and branchial regions moderately defined. Cardiac region weakly defined. Epigastric and metagastric regions very weakly indicated. Carapace ornamented



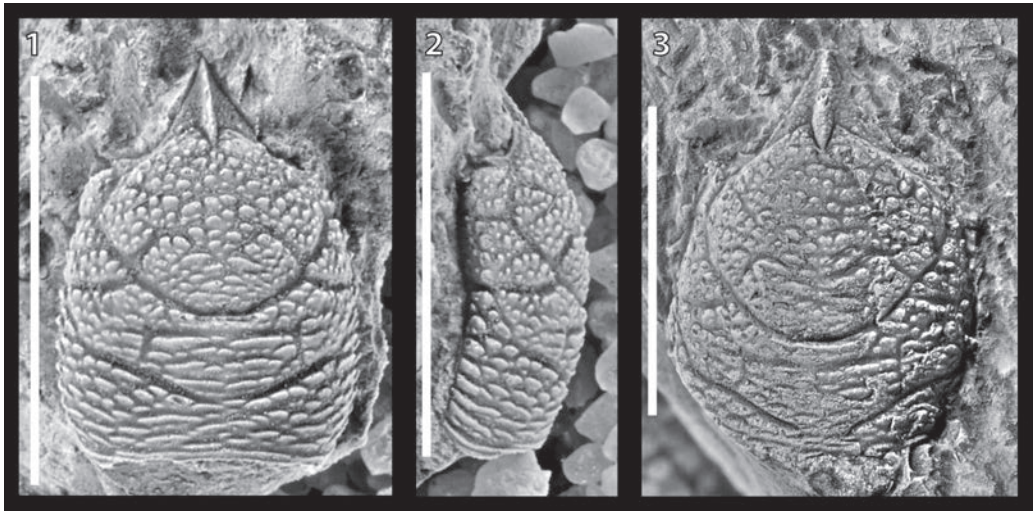


Fig. 10. 1–2: *Ankylokypha parabola* nov. gen., nov. spec., holotype, NHMW 2007z0149/0119. 1: dorsal view; 2: side view. Scale bar equals 5 mm. 3: *Ankylokypha parabola* nov. gen., nov. spec., paratype, NHMW 2007z0149/0120. Scale bar equals 5 mm.

with tubercles of varying sizes; tubercles largest on anterior part of carapace. Tubercles most pronounced on anterior half of gastric region. Tubercles become transversely ovate posteriorly; tubercles very closely spaced. Posterior margin very weakly rimmed.

**Etymology:** From the Latin *sentosus*, meaning thorny. The name refers to the 13 spines on the rostrum.

**Measurements:** See Table 3.

**Holotype:** NHMW 2007z0149/0140.

**Paratype:** NHMW 2007z0149/0142.

**Other material examined:** NHMW 2007z0149/0141; NHMW 2007z0149/0143; NHMW 2007z0162/0008.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace incomplete; left branchial region mostly absent; possible bopyrid infestation in left branchial region, carapace widens significantly posteriorly, extremely convex transversely; vaulted anteriorly, L/TW 1.5, L/MW 1.0. Rostrum deflected downward; spatulate; proximally with sides subparallel, slightly converging toward one another; at mid-length, sides converge more steeply, joining at tip, ornamented with large granules; distal half of rostrum serrate; tipped with 13 spines, rostral keel weak, extending full length of rostrum, proximally composed of small nodes but becomes weak crease distally. Small outer orbital spine present. Anteriormost part of

hepatic region located anteriorly beyond orbital margin termination. Small spines on lateral margins.

Circumgastric groove moderately strong; branchiocardiac groove weakly defined. Gastric, hepatic, epibranchial, and branchial regions moderately defined. Cardiac region weakly defined. Epigastric and metagastric regions very weakly indicated. Grooves on carapace all very shallow.

Carapace ornamented with tubercles of varying sizes; tubercles largest on anterior part of carapace. Tubercles most pronounced on anterior half of gastric region. Tubercles become transversely ovate posteriorly; tubercles very closely spaced.

Posterior margin very weakly rimmed. Ventral surface and appendages not preserved.

Discussion: Although there are five specimens studied here, two are composed only of the rostrum and part of the gastric area. One of these, however, appears to have a pereopod segment associated with it. Two other specimens are not well preserved and incomplete. The fifth, upon which this description is based (NHMW1990z0041/0140) is almost complete, although most of the left branchial region is missing. The portion that remains seems slightly swollen from a bopyrid infestation. *Ambulocapsa sentosa* is significantly different from the other three members of this genus. *Ambulocapsa altilis* has a triangular, non-serrate rostrum, has a more convex carapace, has larger ornamentation anteriorly, and does not widen as much posteriorly. *Ambulocapsa bachmayeri* does not have a serrate rostrum, has a slightly more convex carapace, has larger ornamentation anteriorly, and does not widen as much posteriorly. *Ambulocapsa novacula* has better regional definition, a triangular rostrum, and does not widen as much posteriorly. This species has also been found in the Štramberg Limestones of the Czech Republic.

### Genus *Ankylokypha* nov. gen.

Type species: *Ankylokypha parabola* nov. spec.

Diagnosis: Carapace sub-rectangular in shape; extremely convex transversely; moderately convex longitudinally, L/TW 1.4, L/MW 1.2. Rostrum triangular; strongly deflected downward; ends in sharp point and bears strong keel. Circumgastric and branchiocardiac deep, well defined. Metagastric, hepatic, epibranchial, cardiac, and meta-branchial regions well defined; mesogastric, protogastric, urogastric, and mesobranchial regions moderately defined. Epigastric area very weakly indicated. All regions separated by distinct grooves.

Hepatic, epibranchial, epigastric, mesogastric, and protogastric ornamented with tubercles of varying sizes. Metagastric region ornamented with transversely ovate tubercles of varying shapes and sizes. Posteriorly, ornamentation consistently transversely ovate tubercles of varying sizes; tubercles much larger and more transversely ovate than anteriorly. Tubercles bounded by anastomosing depressions; tubercles evenly spaced, but not arranged in definite rows.

**Etymology:** A combination of the Greek *ankylos*, meaning crooked, and *kyphos*, meaning humpbacked. The name is a combination of its anastomosing ornamentation and high degree of convexity. Both Greek terms are neuter in gender, but the name is here constructed as feminine.

**Discussion:** This genus was erected to embrace one species, which is substantially different from all other genera. The two closest genera to *Ankylokypha* nov. gen. are *Ambulocapsa* and *Bullariscus*. The strength of the rostral keel, increased regional definition, and strong ornamentation separate *Ankylokypha* from *Ambulocapsa*. Absence of swelling of regions readily separate *Ankylokypha* from *Bullariscus*. The shape of the rostrum, strength of the rostral keel, ornamentation, and extreme carapace convexity separate *Ankylokypha* from all other genera within the family.

*Faxegalathea* has no keel on its rostrum and a large spine protruding from its gastric region. *Gastrosacus* has much larger, protruding ornamentation, and has a less convex carapace. *Culmenformosa* has much larger, protruding ornamentation, a weaker rostral keel, and has a much less convex carapace. *Cracensigillatus* has a less convex carapace, has a narrower rostrum with a weaker keel, and more discrete, rounded ornamentation. *Pegomyrmekella* has a much broader cardiac region and much larger, pustular ornamentation. *Munidopsis curvirostra* has a less convex carapace, and its gastric region is less circular in shape. *Vetoplautus* has a less convex carapace, and has an extra defined area of the gastric region between the epigastric and protogastric regions. This genus has also been found in the Štramberg Limestones of the Czech Republic.

***Ankylokypha parabola* nov. spec.**

(Figs 10.1–10.3)

**Diagnosis:** As for genus.

**Etymology:** The species name comes from the Greek *parabole*, meaning parabola. The species name refers to the carapace shape appearing parabolic when viewed from the posterior edge of the specimen.

**Measurements:** See Table 4.

**Holotype:** NHMW 2007z0149/0119.

**Paratype:** NHMW 2007z0149/0120.

**Other material examined:** NHMW 2007z0149/0121 to NHMW 2007z0149/0125; NMP T132 akc kat 36907.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace sub-rectangular in shape, extremely convex transversely, moderately convex longitudinally, L/TW 1.4, L/MW 1.2. Rostrum triangular; strongly deflected downward; ends in sharp point and bears strong keel, keel decreasing in breadth

and height along length of rostrum, rostrum ornamented with granules extending onto side of keel. Orbital margin weakly rimmed; terminates in small outer-orbital spine.

Circumgastric and branchiocardiac deep, well defined. Metagastric, hepatic, epibranchial, cardiac, and metabranchial regions well defined; mesogastric, protogastric, urogastric, and mesobranchial regions moderately defined. Epigastric area marked, not defined. All regions separated by distinct grooves.

Epigastric, mesogastric, and protogastric ornamented with tubercles of varying sizes. Metagastric region ornamented with transversely ovate tubercles of varying shapes and sizes. Epigastric area marked; separated from rest of gastric area by slight indentation. Hepatic and epibranchial regions ornamented similar to protogastric.

Posteriorly, ornamentation consistently transversely ovate tubercles of varying sizes; tubercles much larger and more transversely ovate than anteriorly. Cardiac region bears longest transversely ovate tubercles. Ornamentation becomes coarser approaching lateral margins of metabranchial regions. Transversely ovate tubercles bounded by anastomosing depressions; tubercles evenly spaced, but not arranged in definite rows.

Posterior margin slightly rimmed; ornamentation does not continue onto posterior margin. Ventral surface and appendages not preserved.

**Discussion:** Several individuals within this species are incomplete and show wear on the carapace cuticle. That wear enhances the anastomosing depressions that are characteristic of this species. This species has also been found in the Štramperk Limestones of the Czech Republic.

### Genus *Aulavescus* nov. gen.

Type species: *Aulavescus exutus* nov. spec.

Other included species: *Aulavescus tectus*, nov. spec.

**Diagnosis:** Carapace widens posteriorly, moderately to strongly convex transversely, moderately convex longitudinally. Rostrum long; sub-triangular in shape; bears very weak keel, keel almost disappears approaching tip of rostrum; rostral tip may appear sulcate, rostrum narrows at anterior to form blunted or tridentate point, ornamented with small granules. Circumgastric groove moderately strong; branchiocardiac groove weak. Hepatic, epibranchial, and gastric regions moderately defined; mesogastric, epigastric, metagastric, urogastric, and cardiac regions weakly to moderately defined. Lateral margin of hepatic region angled anteriorly toward rostrum; not parallel with lateral margin of remainder of carapace. Metagastric region slightly raised above remainder of gastric area; anterior segment of mesogastric region well defined. Urogastric region large; clearly defined laterally by depressions; not clearly delimited from cardiac region. Epigastric, mesobranchial, and cardiac region slightly swollen. Ornamentation consists of squamous or slightly elongated tubercles.

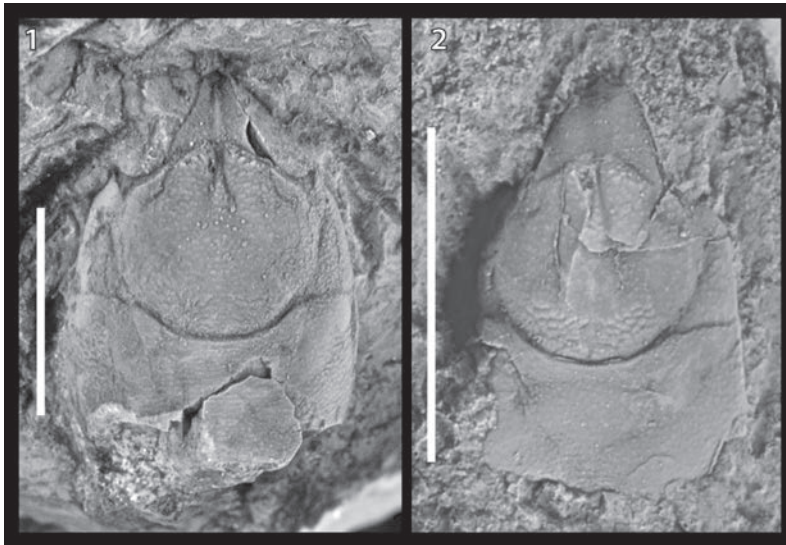


Fig. 11. 1: *Aulavescus exutus* nov. gen., nov. spec., holotype, NHMW 2007z0149/0117. Scale bar equals 5 mm. 2: *Aulavescus tectus* nov. gen., nov. spec., holotype, NHMW 2007z0149/0368. Scale bar equals 5 mm.

**Etymology:** From the Latin *aulax*, meaning furrow, and *vescus*, meaning weak. The generic name refers to the weak ornamentation and groove structure on the carapace. Masculine gender.

**Discussion:** Unfortunately, there is only one specimen of each of the two species within this genus, and neither specimen is complete. Many of the ornamental marks on the carapace have been eroded; one can only speculate on the strength of the ornamentation. Where cuticle remains, the ornamentation is quite apparent. Were the specimens in better condition, it is likely the regions would be easier to separate.

Given all the condition problems, this genus is still readily differentiated from other genera. It has a carapace that narrows abruptly at the hepatic region, as opposed to remaining straight or gently rounding, as in all the other genera, as well as a broadly triangular rostrum with a very weak keel. The only other genus with a weak rostral keel, *Ambulocapsa*, has a much broader rostrum and a much higher degree of convexity and better regional definition. *Faxegalathea* has a large spine protruding from the gastric region, as well as no rostral keel. *Gastrosacus* has much coarser ornamentation, a stronger rostral keel, and better regional definition. *Cracensigillatus* does not widen posteriorly and has a narrower rostrum with a stronger keel. *Bullariscus* has a much more convex carapace, with deeper grooves and inflated regions. *Culmenformosa* has much coarser ornamentation, a spatulate rostrum, and a keel that only extends half the length of the rostrum. *Ankylokypha* has a much more convex carapace, has stronger regional definition, a much stronger keel, and different ornamentation. *Munidopsis curvirostra* has much deeper grooves, clearer regional definition, and a much narrower rostrum. *Pegomyrmekella* has a much broader cardiac region and much larger ornamentation. *Octoeurax* has a much shorter rostrum and larger urogastric area. *Vetoplautus* has much better defined regions, with a much better defined gastric area.



***Aulavescus exutus* nov. spec.**

(Fig. 11.4)

**Diagnosis:** Carapace appears to widen posteriorly. Carapace very convex transversely; moderately convex longitudinally. Rostrum long with blunted tip; triangular in shape; bears very weak keel. Circumgastric groove moderately defined; branchiocardiac groove extremely weak. Hepatic, epibranchial, and gastric regions moderately defined; mesogastric, metagastric, epigastric, urogastric, and cardiac regions weakly to moderately defined. Mesobranchial region slightly marked. Large outer orbital spine present on anterior of hepatic region. Lateral margin of hepatic region angled anteriorly toward rostrum; not parallel with lateral margin of remainder of carapace. Urogastric region large; clearly defined laterally by depressions; not clearly delimited from cardiac region. Mesobranchial region and cardiac regions slightly swollen. Ornamentation consists of small tubercles interspersed with granules anteriorly; transversely ovate tubercles posteriorly. Ventral surface and appendages not preserved.

**Etymology:** From the Latin *exutus*, meaning bare. The species name is referring to the weak ornamentation on the carapace.

**Measurements:** See Table 4.

**Holotype and sole specimen:** NHMW 2007z0149/0117.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Specimen incomplete; missing posteriormost part. Carapace appears to widen posteriorly, very convex transversely; moderately convex longitudinally. Rostrum

Table 4. Measurements of studied *Ankylokypha* and *Aulavescus* specimens. Abbreviations as in Tab. 1.

	L	LR	R	MW	OW	RW	TW	GH	GW	L/MW	L/TW
<b><i>Ankylokypha parabola</i> nov. spec.</b>											
NHMW 2007z0149/0120	-	-	1.2	4.9	3.0	1.9	4.0	3.4	4.1	-	-
NHMW 2007z0149/0122	-	-	-	4.5	-	-	-	-	3.4	-	-
NHMW 2007z0149/0121	-	-	-	4.5	2.7	1.7	3.4	3.2	3.5	-	-
NHMW 2007z0149/0123	-	-	-	3.8	2.2	1.4	3.2	2.4	2.8	-	-
NHMW 2007z0149/0124	-	-	-	4.6		1.8	4.0	2.9	3.6	-	-
NHMW 2007z0149/0119	4.2	5.1	0.9	3.7	2.4	1.3	3.1	2.4	2.9	1.2	1.4
<b><i>Aulavescus exutus</i> nov. spec.</b>											
NHMW 2007z0149/0117	-	-	2.0	-	-	2.7	5.8	4.8	5.1	-	-
<b><i>Aulavescus tectus</i> nov. spec.</b>											
NHMW 2007z0149/0368	-	-	1.2	-	-	1.8	4.2	3.4	3.4	-	-

long, triangular in shape, narrows at tip to form blunted point, bears very weak keel. Keel almost disappears approaching tip of rostrum; rostrum tip sulcate, ornamented with small granules.

Circumgastric groove moderately defined; branchiocardiac groove extremely weak. Hepatic, epibranchial, and gastric regions moderately defined; mesogastric, metagastric, epigastric, urogastric, and cardiac regions weakly to moderately defined. Mesobranchial region slightly marked. Metabranial regions not clear due to condition of specimen. Large outer orbital spine present on anterior of hepatic region. Lateral margin of hepatic region angled anteriorly toward rostrum; not parallel with lateral margin of remainder of carapace. Small spine present on anterior of epibranchial region. Metagastric region slightly raised above remainder of gastric area; mesogastric region well defined anteriorly; definition weakens posteriorly approaching metagastric region. Epigastric region very slightly raised. Urogastric region large; clearly defined laterally by depressions; not clearly delimited from cardiac region. Mesobranchial region and cardiac regions slightly swollen.

Ornamentation consists of slightly squamous tubercles interspersed with granules anteriorly; slightly transversely ovate tubercles posteriorly. Transversely ovate tubercles largest approaching lateral margins of metabranial regions and on cardiac region. Approaching lateral margins, transversely ovate tubercles directed anteriorly; seem imbricated. Ventral surface and appendages not preserved.

**Discussion:** Unfortunately, there is only one specimen of this species, and it is not complete. Many of the ornamental marks on the carapace have been eroded. Where cuticle is left, the ornamentation is quite apparent. Were the specimen in better condition, it is likely the regions would be easier to differentiate. Despite the poor condition of the specimen, it is easy to differentiate from the other species of this genus, *Aulavescus tectus*. *Aulavescus exutus* has a narrower rostrum with a stronger keel than *A. tectus*. *Aulavescus tectus* also is ornamented with squamous tubercles, whereas *A. exutus* is ornamented with round to transversely elongate tubercles.

***Aulavescus tectus* nov. spec.**

(Fig. 11.5)

**Diagnosis:** Carapace widens slightly posteriorly, very convex transversely, moderately convex longitudinally. Rostrum broadly triangular in shape; bears extremely weak keel, rostral tip tridentate. Circumgastric groove moderately well defined; branchiocardiac groove weak. Hepatic, epibranchial, and gastric regions moderately defined; mesogastric, metagastric, epigastric, urogastric, cardiac, and metabranial regions weakly to moderately defined. Mesobranchial region slightly marked. Outer orbital spine present on anterior of hepatic region. Lateral margin of hepatic region angled anteriorly toward rostrum. Metagastric region raised above remainder of gastric area; mesogastric region well defined anteriorly. Urogastric region large; clearly defined on all sides by depressions. Urogastric, mesobranchial, metabranial, and cardiac regions slightly swollen. Ornamentation consists of squamous tubercles interspersed with granules.

**Etymology:** From the Latin *tectus*, meaning secret or concealed. The species name refers to the weakness of the carapace ornamentation, and the ease with which it seems to have eroded.

**Measurements:** See Table 4.

**Holotype and sole specimen:** NHMW 2007z0149/0368.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Specimen incomplete; posteriormost part of metabranchial regions absent. Carapace appears to widen slightly posteriorly, very convex transversely; moderately convex longitudinally. Rostrum broadly triangular in shape; bears extremely weak keel, tip tridentate; central tooth projects slightly more anteriorly than lateral teeth, ornamented with small granules.

Circumgastric groove moderately defined; branchiocardiac groove weak. Hepatic, epibranchial, and gastric regions moderately defined; mesogastric, metagastric, epigastric, urogastric, cardiac, and metabranchial regions weakly to moderately defined. Mesobranchial region slightly marked. Outer orbital spine present on anterior of hepatic region. Lateral margin of hepatic region angled anteriorly toward rostrum; not parallel with lateral margin of remainder of carapace. Metagastric region raised above remainder of gastric area; mesogastric region well defined anteriorly; definition weakens slightly posteriorly approaching metagastric region. Epigastric region slightly raised. Urogastric region large; clearly defined laterally by depressions; delimited from cardiac region by slight depression. Urogastric, mesobranchial, metabranchial, and cardiac regions slightly swollen. Ornamentation consists of squamous tubercles interspersed with granules. Ornamentation grades larger approaching lateral margins posteriorly; anteriorly, ornamentation largest in metagastric area. Ventral surface and appendages not preserved.

**Discussion:** Unfortunately, there is only one specimen of this species, and it is not complete. It is easily separated from the other species within this genus. *Aulavescus exutus* has a narrower rostrum with a stronger keel than *A. tectus*. *Aulavescus tectus* also is ornamented with squamous tubercles, whereas *A. exutus* is ornamented with round to transversely elongate tubercles.

### Genus *Bullariscus* nov. gen.

**Type species:** *Bullariscus patruliusi* nov. spec.

**Other included species:** *Bullariscus arcuotorus* nov. spec., *Bullariscus gibbernodus* nov. spec., *Bullariscus triquetrus* nov. spec.

**Diagnosis:** Carapace ranges in shape from triangular to widening slightly posteriorly; very strongly convex transversely, moderately convex longitudinally, average L/

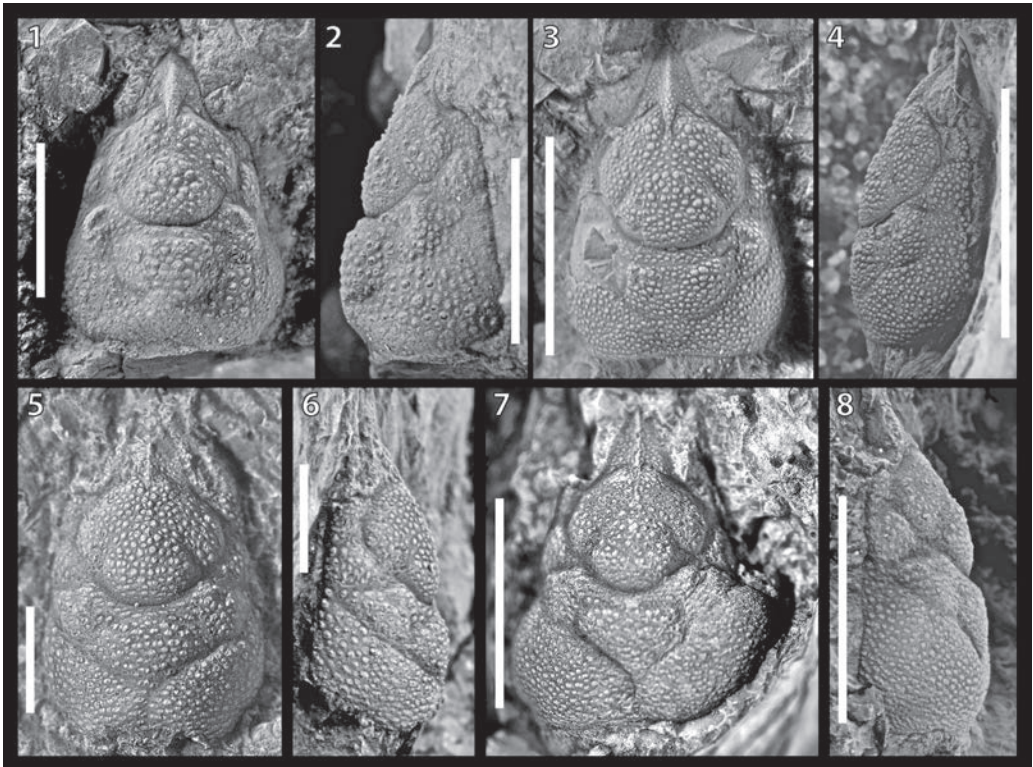


Fig. 12. 1–2: *Bullariscus patruliusi* nov. gen., nov. spec., holotype, NHMW 2007z0149/0089. 1: dorsal view, 2: side view. Scale bar equals 5 mm. 3–4: *Bullariscus arcuatorus* nov. gen., nov. spec., holotype, NHMW 2007z0149/0105. 3: dorsal view, 4: side view. Scale bar equals 5 mm. 5–6: *Bullariscus gibbernodus* nov. gen., nov. spec., holotype, NHMW 2007z0149/0103. 5: dorsal view, 6: side view. Scale bar equals 2 mm. 7–8: *Bullariscus triquetrus* nov. gen., nov. spec., holotype, NHMW 2007z0149/0101a. 7: dorsal view, 8: side view. Scale bar equals 5 mm.

TW 1.6, L/MW 1.1. Rostrum triangular with blunted tip and smooth lateral margins, arcs downward; bears extremely strong keel decreasing in both breadth and height over entire length of rostrum. Small outer orbital spine present. Circumgastric and branchiocardiac grooves very strong; mesogastric, metagastric, hepatic, epibranchial, mesobranchial, cardiac, and metabranchial regions well defined. Intestinal region weakly to moderately defined. Ornamentation consists of tubercles.

**Etymology:** *Bullariscus* is a combination of the Latin *bulla*, meaning bubble, and *riscus*, meaning box. The various regions of the carapace look like individual bubbles stuck together. Masculine gender.

**Discussion:** *Bullariscus* is easily the most distinctive genus within this family and differs from all other genera due to its extreme carapace convexity and large amount of regional inflation and definition. Members of this genus have been found in Upper Jurassic deposits in both Austria and Poland.

***Bullariscus patruliusi* nov. spec.**  
(Figs 12.1, 12.2)

1966 *Gastrosacus meyeri* PATRULIUS, p. 504, Pl. 30, Fig. 3.

**Diagnosis:** Carapace widens posteriorly, triangular in shape, extremely strongly convex transversely, weakly convex longitudinally, average L/TW 1.6, L/MW 1.1. Rostrum deflected; triangular with blunted tip, bears very strong keel decreasing in both breadth and height over entire length of rostrum. Lateral margin straight with small, anteriorly directed spines. Circumgastric and branchiocardiac grooves very strong. Mesogastric, metagastric, cardiac, hepatic, epibranchial, mesobranchial, and metabranchial regions well defined. Epigastric, protogastric, urogastric, and intestinal regions weakly defined. All defined regions of carapace except hepatic extremely strongly inflated. Metagastric and mesogastric regions strongly inflated relative to entire gastric region; mesogastric strongly ornamented with large tubercular spines, points directed anteriorly. Metagastric region ornamented anteriorly with large tubercular spines, grading to smaller tubercles posteriorly. Ornamentation varies slightly among individual specimens; generally composed of large and small tubercles. Cardiac region highest part of carapace; ornamented with concentric rows of anteriorly directed tubercular spines. Posterior margin weakly rimmed; weakly indented.

**Etymology:** Named in honor of D. PATRULIUS, who first published an image of *B. patruliusi* (PATRULIUS 1966, p. 504, Pl. 30, Fig. 3), but identified it as *Gastrosacus meyeri* (MOERICKE, 1889).

**Measurements:** See Table 5.

**Holotype:** NHMW 2007z0149/0089.

**Paratypes:** NHMW 2007z0149/0090, NHMW 2007z0149/0091.

**Other material examined:** NHMW 2007z0149/0092 to NHMW 2007z0149/0099.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace widens posteriorly, triangular in shape, extremely strongly convex transversely, weakly convex longitudinally, L/TW ranges from 1.4 to 2.0; L/MW ranges from 0.9 to 1.2. Rostrum triangular with blunted tip and smooth lateral margins, arcs downward; bears very strong keel decreasing in both breadth and height over entire length, ornamented with granules and small tubercles.

Orbital margin present; upper orbital margin weakly rimmed. Lateral margin straight with small, anteriorly directed spines. Circumgastric and branchiocardiac grooves strong.

All defined regions of carapace extremely strongly inflated. Ornamentation varies slightly among individual specimens; generally composed of both large and small tubercles. Mesogastric, metagastric, cardiac, hepatic, epibranchial, mesobranchial, and metabranchial regions well defined. Mesogastric and metagastric regions strongly inflated



relative to entire gastric region; mesogastric region strongly ornamented posteriorly with large tubercular spines, points directed anteriorly; grading to smaller tubercles anteriorly. Metagastric region ornamented anteriorly by large tubercular spines, points directed anteriorly; grading posteriorly to smaller tubercles and transversely ovate tubercles. Cardiac region highest part of carapace; ornamented with concentric rows of anteriorly directed tubercular spines. Hepatic region comparatively less inflated than rest of carapace; ornamented with granules with one large anteriorly directed tubercle spine at anterior of hepatic region. Epibranchial region ornamented with small, anteriorly directed tubercular spines. Mesobranchial and metabranchial regions ornamented similarly to epibranchial region. Epigastric, protogastric, urogastric, and intestinal regions weakly defined. Epigastric region and protogastric regions ornamented similarly to epibranchial; also interspersed with granular ornamentation. Epigastric and protogastric regions separated by slight indentation in carapace. Urogastric region very narrow; lies just anterior to cardiac region posterior to circumgastric groove. Ornamented with small, transversely ovate tubercles. Posterior margin weakly rimmed; slightly concavely indented. Ventral surface and appendages not preserved.

Table 5. Measurements of studied *Bullariscus* specimens. Abbreviations as in Tab. 1.

NHMW	L	LR	R	MW	OW	RW	TW	GH	GW	L/MW	L/TW
<b><i>Bullariscus patrulei</i> nov. spec.</b>											
NHMW 2007z0149/0089	7.5	9.6	2.1	8.2	4.0	2.3	4.8	4.1	4.0	0.9	1.6
NHMW 2007z0149/0090	5.2	6.2	1.0	4.9	-	1.6	-	2.7	-	1.1	-
NHMW 2007z0149/0091	7.8	9.6	1.8	6.7	3.9	2.1	4.6	4.0	4.1	1.2	1.7
NHMW 2007z0149/0092	7.1	8.6	1.5	-	3.6	1.9	4.3	3.6	4.0	-	1.7
NHMW 2007z0149/0093	-	-	-	-	3.5	1.9	4.8	3.9	4.0	-	-
NHMW 2007z0149/0094	5.9	-	-	5.2	-	1.6	3.8	3.3	3.2	1.1	1.6
NHMW 2007z0149/0095	6.8	8.1	1.3	5.6	3.0	2.4	3.4	3.7	3.7	1.2	2.0
NHMW 2007z0149/0096	-	-	-	-	-	2.2	-	3.4	3.3	-	-
NHMW 2007z0149/0097	9.4	11.6	2.2	8.0	4.5	2.6	5.6	4.9	4.7	1.2	1.7
NHMW 2007z0149/0098	4.2	-	-	4.0	2.3	1.0	3.1	2.3	2.5	1.1	1.4
<b><i>Bullariscus arcuotus</i> nov. spec.</b>											
NHMW 2007z0149/0105	5.6	7.0	1.4	4.7	2.8	2.0	3.5	3.2	3.2	1.2	1.6
NHMW 2007z0149/0106	4.4	-	-	3.9	-	1.6	-	2.5	2.7	1.1	-
<b><i>Bullariscus gibbernodus</i> nov. spec.</b>											
NHMW 2007z0149/0103	4.9	-	-	4.2	2.6	1.6	3.1	2.5	2.9	1.2	1.6
NHMW 2007z0149/0104	3.0	-	-	2.4	-	-	2.3	1.7	2.0	1.3	1.3
<b><i>Bullariscus triquetrus</i> nov. spec.</b>											
NHMW 2007z0149/0101a	5.9	7.5	1.6	5.2	3.2	1.9	3.4	2.9	3.3	1.1	1.7
NHMW 2007z0149/0102a	5.4	7.0	1.6	-	-	1.7	-	2.8	3.3	-	-

**Discussion:** PATRULIUS (1966) identified a specimen of *Bullariscus patruliusi* found in Woźniki, Poland, as *Gastrosacus meyeri*. The misidentification most likely resulted from PATRULIUS comparing his specimen to the illustration drawn by MOERICKE (1889, Pl. 30, Fig. 3; reillustrated herein as Fig. 5.6), which was the composite drawing previously referred to in the discussion section of the genus *Gastrosacus*. In fact, PATRULIUS emended MOERICKE's original description based on this specimen, in order to facilitate a better match. A visual comparison of PATRULIUS' photo illustration with that of *Bullariscus patruliusi* shows a clear match between the two.

The smallest measured specimen of *B. patruliusi* has a much closer L/TW and L/MW ratio. This may indicate that the triangular shape becomes more pronounced as the individuals grow. *Bullariscus triquetrus* has less regional swelling and smaller ornamentation. *Bullariscus gibbernodus* is less triangular in shape, has less regional swelling, and smaller ornamentation. *Bullariscus arcuatorus* is less triangular in shape, has less regional swelling, a larger intestinal region, and finer ornamentation.

***Bullariscus arcuatorus* nov. spec.**

(Figs 12.3, 12.4)

**Diagnosis:** Carapace sub-rectangular in shape; strongly convex transversely, weakly convex longitudinally, average L/TW 1.6, L/MW 1.15. Rostrum deflected; triangular with blunted tip, bears strong keel decreasing in both breadth and height along length of rostrum. Lateral margin has small, anteriorly directed spines. Circumgastric and branchiocardiac grooves strong. Ornamentation of carapace composed of both large and small tubercles and granules, some slightly transversely ovate. Mesogastric, metagastric, cardiac, hepatic, epibranchial, mesobranchial, and metabranchial regions well defined; intestinal region moderately defined. Urogastric regions weakly defined. Gastric, cardiac, and mesobranchial regions moderately inflated; epibranchial region slightly inflated. Metagastric region inflated relative to entire gastric region; strongly ornamented with large and small tubercles; interspersed with few granules. Cardiac region ornamented with rows of slightly transversely ovate tubercles largest at margins of cardiac region, grade to smaller tubercles posteriorly. Posterior margin very weakly rimmed; very slightly concavely indented.

**Etymology:** A combination of the Latin *arcus*, meaning arc, and *torus*, meaning strength. Refers to the strong convexity of the carapace.

**Measurements:** See Table 5.

**Holotype:** NHMW 2007z0149/0105.

**Paratype:** NHMW 2007z0149/0106.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace sub-rectangular in shape; reaches maximum width at anterior of metabranchial regions; strongly convex transversely, weakly convex longitudinally, L/TW 1.6, L/MW ranges from 1.1 to 1.2.

Rostrum triangular with blunted tip and smooth lateral margins; rostrum strongly deflected; bears strong keel decreasing in both breadth and height along length of rostrum, ornamented with granules and small tubercles.

Orbital margin present; upper orbital margin weakly rimmed. Small outer orbital spine present. Lateral margin has small, anteriorly directed spines. Circumgastric groove strongest groove on dorsal carapace. Two strong grooves diverge from circumgastric groove anterior and posterior to epibranchial region. Groove posterior to epibranchial region arcs posteriorly to lateral margin. Strong branchiocardiac groove outlines base of cardiac and mesobranchial regions and joins with branch of circumgastric groove posterior to epibranchial region at lateral margin. At base of cardiac region, groove branches off; one branch continues outlining cardiac region; second branch continues outlining metabranchial regions.

Ornamentation of carapace composed of both small and large tubercles, and granules, some slightly transversely ovate. Mesogastric, metagastric, cardiac, hepatic, epibranchial, mesobranchial, and metabranchial regions well defined; intestinal region moderately defined. Urogastric regions weakly defined. Gastric, cardiac, and mesobranchial regions moderately inflated; epibranchial region slightly inflated. Metagastric and mesogastric regions inflated relative to entire gastric region; both strongly ornamented with large and small tubercles; interspersed with few granules. Metagastric region inflated above mesogastric region. Cardiac region ornamented with rows of slightly transversely ovate tubercles largest at margins of cardiac region, grading to smaller tubercles centrally. Hepatic region ornamented with granules; one large anteriorly directed tubercle spine at anterior of hepatic region. Epibranchial region ornamented similarly to gastric region. Mesobranchial, intestinal, and metabranchial regions ornamented similarly to metagastric region, with some tubercles slightly transversely ovate. Urogastric region narrow; lies just anterior to cardiac region posterior to circumgastric groove. Ornamented with small, slightly transversely ovate tubercles. Posterior margin very weakly rimmed; very weakly indented. Ventral surface and appendages not preserved.

**Discussion:** *Bullariscus patruliusi* has a more triangular shape, much more regional swelling, larger ornamentation, and a larger rostral keel than *Bullariscus arcuatorus*. *Bullariscus triquetrus* is more triangular in shape and has a smaller intestinal region than *B. arcuatorus*. *Bullariscus gibbernodus* lacks a defined intestinal region and has a smaller urogastric region than *B. arcuatorus*.

***Bullariscus gibbernodus* nov. spec.**

(Figs 12.5, 12.6)

**Diagnosis:** Carapace sub-triangular in shape, extremely strongly convex transversely, weakly convex longitudinally, average L/TW 1.45, L/MW 1.25. Rostrum long, deflected,

triangular in shape with blunted tip, bears strong keel decreasing in both breadth and height along length of rostrum. Small outer orbital spine present. Lateral margin has small, anteriorly directed spines. Circumgastric groove and branchiocardiac groove strong. Ornamentation of carapace composed of large and small tubercles and granules. Mesogastric, metagastric, cardiac, hepatic, epibranchial, mesobranchial, and metabranchial regions well defined; epigastric, protogastric, and urogastric regions weakly defined. Intestinal region weakly defined; reduced. Gastric, cardiac, and mesobranchial regions moderately inflated. Metagastric region inflated relative to entire gastric region; strongly ornamented with large tubercles, interspersed with small tubercles. Cardiac region highest part of carapace; ornamented with rows of tubercles largest at anterior of cardiac region, becoming smaller posteriorly. Posterior margin weakly rimmed; weakly indented.

**Etymology:** A combination of the Latin *gibberus*, meaning protuberances, and *nodus*, meaning swelling. Refers to the protuberant, swollen regions of the carapace.

**Measurements:** See Table 5.

**Holotype:** NHMW 2007z0149/0103.

**Paratype:** NHMW 2007z0149/0104.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace widens posteriorly; sub-triangular in shape, extremely strongly convex transversely, weakly convex longitudinally, L/TW ranges from 1.3 to 1.6; L/MW ranges from 1.2 to 1.3. Rostrum long; triangular in shape with blunted tip and smooth lateral margins; strongly deflected downward; bears strong keel decreasing in both breadth and height along length of rostrum, ornamented with granules and small tubercles.

Orbital margin present; upper orbital margin weakly rimmed. Small outer orbital spine present. Lateral margin has small, anteriorly directed spines. Circumgastric groove strongest groove on dorsal carapace. Two strong grooves diverge from circumgastric groove anterior and posterior to epibranchial region. Groove posterior to epibranchial region arcs posteriorly to lateral margin. Strong branchiocardiac groove outlines base of cardiac and mesobranchial regions and joins with branch of circumgastric groove posterior to epibranchial region at lateral margin.

Ornamentation of carapace composed of small pustules, tubercles, and granules. Mesogastric, metagastric, cardiac, hepatic, epibranchial, mesobranchial, and metabranchial regions well defined; gastric, cardiac, and mesobranchial regions moderately inflated. Mesogastric and metagastric region inflated relative to entire gastric region; both strongly ornamented with small pustules, interspersed with small tubercles. Cardiac region highest part of carapace; ornamented with rows of tubercles largest at anterior of cardiac region, becoming smaller posteriorly. Hepatic region ornamented with granules; one large anteriorly directed tubercle spine at anterior of hepatic region.

Epibranchial region ornamented with small tubercles, interspersed with granules. Mesobranchial and metabranchial regions ornamented similarly to epibranchial region. Epigastric, protogastric, and urogastric regions weakly defined; intestinal region extremely weakly defined; reduced. Epigastric region and protogastric regions ornamented similarly to epibranchial. Protogastric region slightly swollen compared to epigastric region. Urogastric region narrow; lies just anterior to cardiac region posterior to circumgastric groove. Ornamented with small, slightly transversely ovate tubercles. Posterior margin weakly rimmed; weakly indented. Ventral surface and appendages not preserved.

**Discussion:** Only two individuals of this species were found. The larger specimen exhibits a large difference between the L/TW and L/MW ratios. This may indicate a change in proportions as members of the species grow, similar to *B. patruliusi*. *Bullariscus patruliusi* has a more triangular shape, larger ornamentation, a larger intestinal region, and more pronounced regional swelling than *Bullariscus gibbernodus*. *Bullariscus triquetrus* has a more triangular shape and a larger intestinal region than *B. gibbernodus*. *Bullariscus arcuatorus* has a large intestinal region and larger metagastric area than *B. gibbernodus*.

***Bullariscus triquetrus* nov. spec.**

(Figs 12.7, 12.8)

**Diagnosis:** Carapace widens posteriorly, triangular in shape, strongly convex transversely, weakly convex longitudinally, L/TW 1.7, L/MW 1.1. Rostrum deflected, triangular, bears keel decreasing in both breadth and height along length of rostrum. Lateral margin straight with small, anteriorly directed spines. Circumgastric groove and branchiocardiac groove strong. Mesogastric, metagastric, cardiac, hepatic, epibranchial, mesobranchial, and metabranchial regions well defined. Epigastric, protogastric, urogastric, and intestinal regions weakly defined. All defined regions except hepatic moderately inflated. Ornamentation close spaced; uniformly distributed; composed of small tubercles varying slightly in size and shape; some slightly transversely ovate. Mesogastric and metagastric regions inflated relative to entire gastric region; mesogastric region ornamented with tubercular spines, points directed anteriorly. Metagastric region ornamented anteriorly with tubercular spines, points directed anteriorly, grading to smaller tubercles posteriorly. Cardiac region ornamented anteriorly with rows of anteriorly directed tubercular spines; posteriorly with smaller transversely ovate tubercles. Posterior margin very slightly rimmed; weakly indented.

**Etymology:** From Latin *triquetrus*, meaning three sided, referring to the triangular shape of the carapace.

**Measurements:** See Table 5.

**Holotype:** NHMW 2007z0149/0101a.

**Paratype:** NHMW 2007z0149/0102a.

**Type locality:** Ernstbrunn Quarries.



**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace widens posteriorly; carapace triangular in shape, strongly convex transversely, weakly convex longitudinally, L/TW 1.7, L/MW 1.1. Rostrum triangular with smooth lateral margins; tip of rostrum obscured, arcs downward; bears keel decreasing in both breadth and height along length of rostrum; rostrum ornamented uniformly with flat, small tubercles.

Orbital margin present; upper orbital margin weakly rimmed. Very small outer orbital spine present. Lateral margin straight with small, anteriorly directed spines. Circumgastric groove strongest groove on dorsal carapace. Two grooves diverge from circumgastric groove anterior and posterior to epibranchial region. Groove posterior to epibranchial region arcs posteriorly to lateral margin. Strong branchiocardiac groove outlines base of cardiac and mesobranchial regions and joins with branch of circumgastric groove posterior to epibranchial region at lateral margin. At base of cardiac region, groove branches off, separating metabranchial regions and defining very small intestinal region. Mesogastric, metagastric, cardiac, hepatic, epibranchial, mesobranchial, and metabranchial regions well defined. All defined regions except hepatic moderately inflated. Ornamentation composed of small tubercles varying slightly in size and shape; some slightly transversely ovate. Ornamentation closely spaced, uniformly distributed. Mesogastric and metagastric regions inflated relative to entire gastric region; mesogastric region ornamented with tubercular spines, points directed anteriorly. Metagastric region ornamented anteriorly by tubercular spines, points directed anteriorly; grading posteriorly to small tubercles and transversely ovate tubercles. Cardiac region ornamented anteriorly with rows of anteriorly directed tubercular spines; posteriorly with smaller transversely ovate tubercles. Hepatic region not inflated; ornamented with small tubercles; one anteriorly directed tubercle spine at anterior of hepatic region. Epibranchial region ornamented with small, anteriorly directed tubercular spines. Anterior of mesobranchial ornamented similarly to epibranchial region; grades posteriorly to slightly transversely ovate tubercles. Metabranchial region ornamented anteriorly with tubercles; grades posteriorly to slightly transversely ovate tubercles. Epigastric, protogastric, urogastric, and intestinal regions weakly defined. Epigastric region and protogastric regions ornamented similarly to epibranchial. Epigastric and protogastric regions separated by slight indentation in carapace. Urogastric region very narrow; diminishes into small lobes on both sides of cardiac region, ornamented with small, slightly transversely ovate tubercles. Intestinal region ornamented with slightly transversely ovate tubercles. Posterior margin very slightly rimmed; weakly indented. Ventral surface and appendages not preserved.

**Discussion:** Unfortunately, the only two specimens found have large bopyrid swellings in their metabranchial regions, which distort their actual shape, and made calculating the L/MW ratio difficult. *Bullariscus triquetrus* has much less regional inflation, more uniform ornamentation, and less carapace convexity than *Bullariscus patruliusi*. *Bullariscus gibbernodus* has a less triangular shape and has a much reduced intestinal region than *B. triquetrus*. *Bullariscus arcuatorus* has a less triangular shape and a much

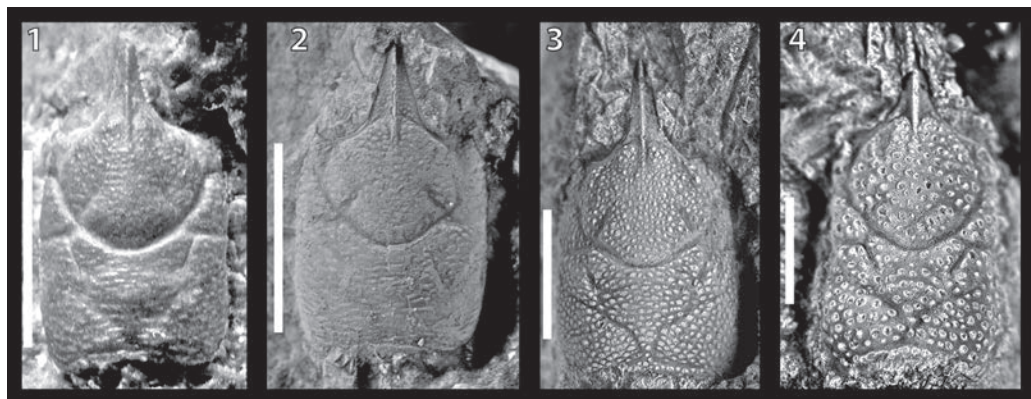


Fig. 13. 1: *Cracensigillatus acutirostrus* (MOERICKE, 1889) nov. comb., lectotype, BSPAS III 332. Scale bar equals 5 mm. 2: *Cracensigillatus acutirostrus* (MOERICKE, 1889) nov. comb., NHMW 2007z0149/0314, showing the range of variation of regional definition. Scale bar equals 5 mm. 3: *Cracensigillatus gracilirostrus* nov. gen., nov. spec., holotype, NHMW 2007z0149/0345. Scale bar equals 5 mm. 4: *Cracensigillatus prolatus* nov. gen., nov. spec., holotype, NHMW 2007z0149/0362a. Scale bar equals 5 mm.

larger intestinal region than *B. triquetrus*. The triangular shape of *B. triquetrus* may be enhanced by the bopyridal swellings; however, the undeformed half of the carapace also seems triangularly shaped.

#### Genus *Cracensigillatus* nov. gen.

Type species: *Galathea acutirostris* MOERICKE, 1889.

Other included species: *Cracensigillatus gracilirostrus* nov. spec., *Cracensigillatus prolatus* nov. spec.

Diagnosis: Carapace sub-rectangular; moderately to strongly convex transversely, weakly convex longitudinally, average L/TW 1.5, L/MW 1.25. Rostrum long, narrow, terminates in single point; moderately to strongly keeled along length. Carapace bears small triangular outer orbital spine. Lateral margin straight with very small spines. Circumgastric groove strong; weakens slightly anteriorly. Branchiocardiac groove slightly marked to moderately-well defined. Carapace ornamented uniformly with round tubercles to moderately transversely ovate tubercles. Urogastric region usually exceptionally well defined. Posterior margin strongly rimmed with concave inflection posterior.

Etymology: The generic name is a combination of the Latin *cracens*, meaning slender, and *sigillatus*, meaning adorned with little marks. The name refers to the graceful rostrum and small tubercles ornamenting the carapace. Masculine gender.

Discussion: This genus exhibits a wide variety, but all species have the same basic carapace shape and can be accommodated within the generic definition. It is most similar

to *Gastrosacus*, but members of *Gastrosacus* have a smaller L/W ratio; larger, more protruding ornamentation; and generally a larger total carapace size. *Faxegalathea* has a wider, unkeeled rostrum, along with a large spine protruding from the gastric region. *Culmenformosa* has a wider rostrum with only a partial keel; larger, more protruding ornamentation, and a smaller carapace L/W ratio. *Ambulocapsa* has a much more convex and vaulted carapace than *Cracensigillatus*, with a wider rostrum. *Bullariscus* has much stronger regional definition and swelling, along with deeper grooves. *Ankylokypha* has a much more convex and vaulted carapace than *Cracensigillatus* and has a wider rostrum with a much stronger rostral keel. *Octoeurax* has a much shorter rostrum and a triangular cardiac region. *Aulavescus* has a wider rostrum and has a different carapace shape, widening posteriorly and narrowing abruptly at the hepatic region, whereas *Cracensigillatus* has a sub-rectangular shape. *Munidopsis curvirostra* has a less circular gastric region than *Cracensigillatus*. *Pegomyrmekella* has a much broader cardiac region and smaller L/W ratio. *Vetoplautus* has a sub-pentagonal carapace shape with a much smaller L/W ratio.

Members of this genus have been found in Upper Jurassic rocks in Austria, the Czech Republic, Poland, and Romania.

***Cracensigillatus acutirostris* (MOERICKE, 1889) nov. comb.**

(Figs 13.1, 13.2)

1889 *Galathea acutirostris* MOERICKE, p. 53, Pl. 6, Fig. 7.

1959 *Gastrosacus wetzleri* MEYER – PATRULIUS, p. 251.

1966 *Gastrosacus wetzleri* MEYER – PATRULIUS, p. 504, p. 499, Fig. 2b, Pl. 30, Fig. 4.

2008 *Gastrosacus wetzleri* von MEYER, 1851 – WEINBERG RASMUSSEN, JAKOBSEN, & COLLINS, p. 36–38, Pl. 3 Fig. 11.

2008 *Gastrosacus wetzleri* von MEYER, 1851 – VAN BAKEL et al., p. 144–145, Fig. 4F, p. 147, Fig. 6H.

**Emended diagnosis:** Carapace sub-rectangular; rostrum long and narrow; moderately strong keel extends along entire length, average L/TW 1.4, L/MW 1.25. Lateral margin straight with small spines. Circumgastric groove strong; branchiocardiac groove very weakly to moderately defined. Hepatic and epibranchial regions well defined; urogastric, intestinal, metabranchial, and cardiac regions weakly to moderately defined. Urogastric region large. Carapace ornamented uniformly with small tubercles and granules anteriorly, grading to small transversely ovate tubercles posteriorly. Posterior margin rimmed with concave inflection; rim not ornamented.

**Measurements:** See Table 6.

**Lectotype:** BSP AS III 332 is identified as illustrated by MOERICKE as *Galathea acutirostris* (1889, p. 53, Pl. 6, Fig. 7, as a drawing; photograph of specimen herein as Fig. 13.1). MOERICKE did not designate a type specimen, but indicated that he had six total specimens; thus, the specimen shown in Fig. 13.1 is a syntype of *Cracensigillatus acutirostris*, and was previously designated herein as the lectotype.

**Other material examined:** NHMW 2007z0149/0276 to NHMW 2007z0149/0286; NHMW 2007z0149/0298 to NHMW 2007z0149/0321; NHMW 2007z0149/0323 to

NHMW 2007z0149/0330; NHMW 2007z0149/0332 to NHMW 2007z0149/0340; NHMW 2007z0149/0364.

**Type locality:** MOERICKE (1899) reported six occurrences of *C. acutirostrus* from four different localities: Stramberk (Štramberk, Czech Republic), Willamowitz (Wilamowice near Oświęcim, Poland), Kotzobenz (Chotěbuz near Český Těšín, Czech Republic), and Wischlitz (Wiślica, near Skoczów, Poland). The specimen in Fig. 13.1 is from Wischlitz.

**Type stratum:** Štramberk Limestones, Tithonian, Upper Jurassic.

**Emended description:** Carapace sub-rectangular; rostrum long and narrow; moderately strong keel extends along entire length, L/TW ranges from 1.3 to 1.6, L/MW ranges from 1.2 to 1.4. Rostral base ornamented with very small granules; ornamentation continues along entire rostrum.

Carapace bears triangular outer orbital spine at anterior of hepatic region. Lateral margin straight with small spines. Strongest groove on carapace surrounds gastric area; one groove diverges from circumgastric groove posterior to epibranchial region; second groove diverges from circumgastric groove posterior to hepatic region. Branchiocardiac groove weak to moderately strong; groove between lateral edge of carapace and cardiac region often very difficult to discern. At base of cardiac region, branchiocardiac groove diverges, with stronger groove continuing to outline metabranchial region and intestinal region. Very weak branch continues to outline base of cardiac region, rejoining stronger branch at edge of posterior of cardiac region.

Carapace ornamented uniformly with small tubercles and granules anteriorly, grading to small transversely ovate tubercles posteriorly. Hepatic and epibranchial regions well defined; urogastric, intestinal, metabranchial, and cardiac regions weakly to moderately defined. Mesogastric and metagastric area weakly defined. Urogastric region large; terminates in a groove that joins circumgastric groove where the first branch diverges at the posterior of epibranchial region. Posterior margin rimmed with concave inflection; rim not ornamented. Ventral surface and appendages not preserved.

**Discussion:** *Cracensigillatus acutirostrus* was first proposed as a possible sub-species of *Gastrosacus wetzleri* VON MEYER, 1854, by MOERICKE (1889), and was considered synonymous with *G. wetzleri* by most subsequent authors. PATRULIUS (1959, 1966) reported finding *G. wetzleri*, but specified that it was the subspecies, *Gastrosacus wetzleri acutirostris*. Other authors did not make this distinction. *Gastrosacus wetzleri* and *Cracensigillatus acutirostrus* are easily distinguished from one another. *Gastrosacus wetzleri* widens posteriorly, has coarser ornamentation, has better defined regions, and is generally larger than *Cracensigillatus acutirostrus*. It is likely that most, if not all, of the specimens of *G. wetzleri* from Ernstbrunn, reported by BACHMAYER (1947), were, in fact, *Cracensigillatus acutirostrus*, given the large numbers of *Cracensigillatus acutirostrus* within his collection. *Gastrosacus wetzleri* has yet to be found within BACHMAYER's collection.

Table 6. Measurements of studied *Cracensigillatus* specimens. Abbreviations as in Tab. 1.

NHMW	L	LR	R	MW	OW	RW	TW	L/MW	L/TW
<b><i>Cracensigillatus acutirostrus</i> (MOERCKE, 1889) nov. comb.</b>									
NHMW 2007z0149/0305	-	-	2.4	7.7	4.6	2.2	-	-	-
NHMW 2007z0149/0306	-	-	-	2.3	-	1.8	2.2	-	-
NHMW 2007z0149/0307	5.8	7.8	2.0	4.6	-	1.5	-	1.3	-
NHMW 2007z0149/0308	5.5	-	-	4.5	3.1	1.4	4.0	1.2	1.4
NHMW 2007z0149/0309	-	-	-	-	-	1.2	-	-	-
NHMW 2007z0149/0310	2.3	-	-	1.9	1.4	0.6	1.8	1.2	1.3
NHMW 2007z0149/0311	4.4	5.9	1.5	3.8	-	1.5	-	1.2	-
NHMW 2007z0149/0312	4.6	6.4	1.8	3.8	2.6	1.2	3.1	1.2	1.5
NHMW 2007z0149/0313	-	-	1.9	4.4	-	-	-	-	-
NHMW 2007z0149/0314	6.8	9.3	2.5	5.1	-	1.8	4.6	1.3	1.5
NHMW 2007z0149/0315a	7.2	-	-	6.1	4.3	-	-	1.2	-
NHMW 2007z0149/0316	6.6	8.7	2.1	5.6	3.9	1.7	-	1.2	-
NHMW 2007z0149/0318	-	-	2.0	-	-	1.4	3.5	-	-
NHMW 2007z0149/0319	4.2	-	-	-	-	-	-	-	-
NHMW 2007z0149/0324	4.3	-	-	-	-	-	-	-	-
NHMW 2007z0149/0325	3.0	4.0	1.0	2.1	-	0.9	-	1.4	-
NHMW 2007z0149/0326	6.2	-	-	-	3.9	1.4	-	-	-
NHMW 2007z0149/0327	4.3	-	-	3.5	-	1.2	-	1.2	-
NHMW 2007z0149/0328	5.9	8.3	2.4	4.6	2.9	1.7	3.6	1.3	1.6
NHMW 2007z0149/0329a	4.7	6.2	1.5	-	2.9	1.3	3.3	-	1.4
NHMW 2007z0149/0330	7.4	-	-	6.3	4.2	2.1	5.2	1.2	1.4
NHMW 2007z0149/0332	-	-	2.0	-	3.2	1.7	3.9	-	-
NHMW 2007z0149/0334a	-	-	-	6.8	-	-	-	-	-
NHMW 2007z0149/0364	5.3	-	-	3.9	3.0	1.5	3.7	1.4	1.4
<b><i>Cracensigillatus gracilirostrus</i> nov. spec.</b>									
NHMW 2007z0149/0345	3.6	4.9	1.3	3.0	1.7	0.7	2.5	1.2	1.4
NHMW 2007z0149/0347	4.1	-	-	3.6	-	1.0	-	1.1	-
NHMW 2007z0149/0348	3.4	5.7	1.8	3.0	1.8	0.9	2.5	1.1	1.4
NHMW 2007z0149/0349	3.2	4.5	1.3	3.0	-	0.8	-	1.1	-
NHMW 2007z0149/0350	3.8	-	-	-	1.8	0.7	-	-	-
NHMW 2007z0149/0351	-	-	1.2	-	-	-	-	-	-
NHMW 2007z0149/0352	-	-	1.8	3.2	-	1.0	-	-	-
NHMW 2007z0149/0353	4.5	-	-	3.6	-	-	-	1.3	-
NHMW 2007z0149/0355	3.7	-	-	3.1	1.9	-	2.4	1.2	1.5
NHMW 2007z0149/0357	2.9	-	-	2.4	1.5	0.6	1.8	1.2	1.6
NHMW 2007z0149/0359	3.7	5.7	2.0	3.3	1.9	-	-	1.1	-
<b><i>Cracensigillatus prolatus</i> nov. spec.</b>									
NHMW 2007z0149/0362	4.0	-	-	3.0	-	1.0	2.8	1.3	1.5
NHMW 2007z0149/0363	7.2	-	-	4.8	3.1	1.5	4.7	1.5	1.5
NHMW 2007z0149/0366	5.9	-	-	3.9	-	1.5	3.7	1.5	1.6



There are two morphs included within *Cracensigillatus acutirostrus*; however, separating the two has proven extremely difficult. The two morphs consistently have very slight differences, but the boundary between the two seems to be gradational. Most of the variation occurs in the amount of regional definition of the posterior part of the carapace. In some specimens, such as Fig. 13.1, the branchiocardiac groove is strong, and regions are clearly defined. Others, represented by the specimen in Fig. 13.2, have a very weak branchiocardiac groove and very little regional definition. Most of the specimens show an intermediate amount of regional development between the extremes shown in Figs 13.1 and 13.2.

*Cracensigillatus gracilirostrus* has much better defined regions and stronger, less transversely ovate ornamentation than *C. acutirostrus*. *Cracensigillatus prolatus* has a larger L/W ratio, better defined regions, and stronger ornamentation than *C. acutirostrus*.

***Cracensigillatus gracilirostrus* nov. spec.**

(Fig. 13.3)

**Diagnosis:** Carapace sub-rectangular; strongly convex transversely, weakly convex longitudinally, average L/TW 1.5, L/MW 1.2. Rostrum narrow and very long in proportion to body, slightly deflected downward, strongly keeled along entire length. Lateral margin straight with very small spines. Circumgastric groove strong; branchiocardiac groove moderately strong. Carapace ornamented uniformly with round tubercles anteriorly, grading to moderately transversely ovate tubercles posteriorly. Epibranchial, urogastric, intestinal, and metabranchial regions well defined; hepatic, mesogastric, metagastric, metabranchial, and cardiac regions moderately defined. Urogastric region large. No ornamentational changes apparent between regions. Posterior margin strongly rimmed with large concave inflection; ornamentation similar to that of carapace.

**Etymology:** The species name is from the Latin *gracilis*, meaning slender. It refers to the narrowness of the rostrum.

**Measurements:** See Table 6.

**Holotype:** NHMW 2007z0149/0345.

**Paratypes:** NHMW 2007z0149/0347, NHMW 2007z0149/0348.

**Other material examined:** NHMW 2007z0149/0349 to NHMW 2007z0149/0355; NHMW 2007z0149/0357; NHMW 2007z0149/0359.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace sub-rectangular; strongly convex transversely, weakly convex longitudinally, L/TW ranges from 1.4 to 1.6, L/MW ranges from 1.1 to 1.2. Rostrum narrow and very long in proportion to carapace; slightly deflected downward, very lightly ornamented with extremely small granulations, strongly keeled along entire length, lateral edges of rostrum angle slightly toward each other and converge to a point.

Orbital margin moderately rimmed. Carapace bears triangular outer orbital spine. Possible spine present on anterior part of epigastric region. Lateral margin straight with very small spines. Strongest groove on carapace surrounds gastric area; one groove diverges from circumgastric groove posterior to epibranchial region; very weak groove diverges from circumgastric groove posterior to hepatic region. Branchiocardiac groove moderately defined. At base of cardiac region, branchiocardiac groove diverges, with stronger groove continuing to outline metabranchial region and intestinal region. Very weak branch of branchiocardiac groove continues to outline base of cardiac region, rejoining stronger branch at edge of posterior of cardiac region.

Carapace ornamented uniformly with round tubercles anteriorly, grading to moderately transversely ovate tubercles posteriorly. Epibranchial, urogastric, intestinal, and metabranchial regions well defined; hepatic, mesogastric, metagastric, metabranchial, and cardiac regions moderately defined. No ornamental changes apparent between regions.

Hepatic region extremely flat in comparison to rest of carapace. Urogastric region large; terminates in a groove that joins circumgastric groove where first branch diverges at posterior of epibranchial region. Groove continues onto gastric region, partially outlining metagastric area. Posterior margin strongly rimmed with large concave inflection; ornamentation similar to that of carapace. Ventral surface and appendages not preserved.

**Discussion:** *Cracensigillatus gracilirostrus* has a long, narrow rostrum that almost seems disproportionate to its relatively small carapace. However, the average rostral length is not significantly longer than the rostrum of *Cracensigillatus acutirostrus*. *Cracensigillatus acutirostrus* has less regional definition and more transversely ovate ornamentation. *Cracensigillatus prolatus* has larger ornamentation and a larger length/width ratio. *Cracensigillatus gracilirostrus* has also been found in material sourced from the Štramberk Limestones.

***Cracensigillatus prolatus* nov. spec.**

(Fig. 13.4)

**Diagnosis:** Carapace sub-rectangular; narrows slightly at extreme posterior, average L/TW 1.5, L/MW 1.45. Rostrum incomplete; appears long and very narrow; strong keel presumably extends along entire length. Possible spine present on anterior parts of both hepatic and epigastric regions. Lateral margin straight with small spines. Circumgastric groove strong; branchiocardiac groove moderately strong. Carapace ornamented uniformly with large round pustules interspaced with smaller pustules. Hepatic, epibranchial, mesobranchial, urogastric, intestinal, and metabranchial regions well defined; cardiac region moderately defined. Metagastric area weakly defined. No ornamental changes apparent between regions. Urogastric region large. Posterior margin strongly rimmed with large concave inflection; ornamentation similar to that of carapace.

**Etymology:** The species name *prolatus* is Latin for elongated, referring to the elongated body of the species.

Measurements: See Table 6.

Holotype: NHMW 2007z0149/0362a.

Paratype: NHMW 2007z0149/0363.

Other material examined: NHMW 2007z0149/0365 to NHMW 2007z0149/0366.

Type locality: Ernstbrunn Quarries.

Type stratum: Ernstbrunn Limestones, Tithonian, Upper Jurassic.

Description: Carapace sub-rectangular; narrows slightly at extreme posterior, L/TW ranges from 1.3 to 1.5; L/MW ranges from 1.5 to 1.6. Rostrum incomplete; appears long and very narrow; strong keel presumably extends along entire length, base ornamented with large granules; ornamentation probably continues along entire rostrum.

Orbital margin moderately rimmed. Carapace bears triangular outer orbital spine. Possible orbital spine present on anterior part of hepatic region.

Lateral margin straight with small spines. Strongest groove on carapace surrounds gastric area; one groove diverges from circumgastric groove posterior to epibranchial region; second groove diverges from circumgastric groove posterior to hepatic region. Branchiocardiac groove weak; at base of cardiac region, branchiocardiac groove diverges, with stronger groove continuing to outline metabranchial region and intestinal region. Very weak branch continues to outline base of cardiac region, rejoining stronger branch at edge of posterior of cardiac region.

Carapace ornamented uniformly with very large round pustules interspaced with smaller pustules. Hepatic, epibranchial, mesobranchial, metagastric, intestinal, and metabranchial regions well defined; cardiac region moderately defined. Metagastric area weakly defined. No ornamental changes apparent between regions. Urogastric region large; terminates in a groove that joins circumgastric groove where the first branch diverges at the posterior of epibranchial region. Weak groove continues onto gastric region, partially outlining metagastric area. Posterior margin strongly rimmed with large concave inflection; ornamentation similar to that of carapace. Ventral surface and appendages not preserved.

Discussion: Unfortunately, no complete specimens of *Cracensigillatus prolatus* were found within BACHMAYER's collection. It appears quite similar to *Cracensigillatus gracilirostrus*, with a larger L/TW ratio and coarser ornamentation. *Cracensigillatus acutirostrus* has less well-defined regions, has less pronounced, more transversely ovate ornamentation, and a smaller L/TW ratio.

### Genus *Culmenformosa* nov. gen.

Type species: *Culmenformosa glaessneri* nov. spec.

Other included species: *Culmenformosa nephelepera* nov. spec., *Culmenformosa triastrixosa* nov. spec.

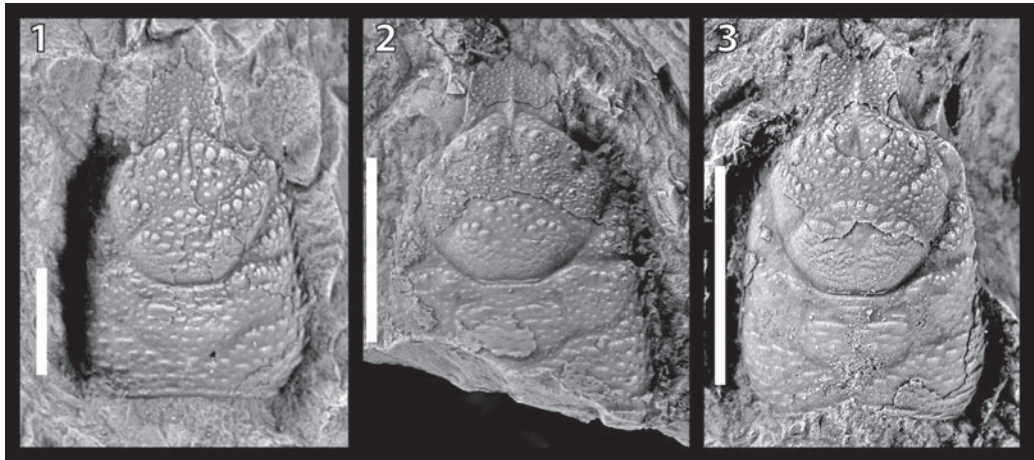


Fig. 14. 1: *Culmenformosa glaessneri* nov. gen., nov. spec., holotype, NHMW 2007z0149/0184. Scale bar equals 2 mm. 2: *Culmenformosa nephelepera* nov. gen., nov. spec., holotype, NHMW 2007z0149/0179. Scale bar equals 5 mm. 3: *Culmenformosa triastrixosa* nov. gen., nov. spec., holotype, NHMW 2007z0149/0181. Scale bar equals 5 mm.

**Diagnosis:** Carapace rectangular; may broaden very slightly posteriorly, moderately convex transversely, average L/TW 1.5, L/MW 1.2. Rostrum spatulate, with keel which extends along half rostral length; may appear as small nodes; tip of rostrum bears 7 or 9 spines or lobes. Small outer orbital spines usually present. Lateral margins have small, forward directed spines; spines largest in metabranchial regions. Circumgastric groove strong; usually weakens anteriorly. Branchiocardiac groove weakly, but always, defined. Gastric region extremely well defined. Carapace ornamented with distinct lines of tubercles of varying shapes and sizes; spherical anteriorly, becoming scabrous posteriorly. Tubercles largest at anterior of regions. Posterior margin weakly rimmed.

**Etymology:** The name comes from a combination of the Latin *formosus*, meaning well formed, and *culmen*, meaning summit or apex. The name refers to the ornate rostrum members of this genus possess. Feminine gender.

**Discussion:** The species within this genus are remarkably similar in terms of carapace ornamentation. The main difference is the rostral shape. As is true for most of the galatheoids, but especially pronounced within this genus, the ornamentation weakens with an increase in carapace size. The smallest specimens have the strongest, best defined ornamentation. The larger individuals widen posteriorly, whereas the smaller individuals have a more uniform L/TW and L/MW ratio, and thus, a more rectangular shape. *Culmenformosa glaessneri* seems to be the most common species in this genus. *Culmenformosa* is separated from all other genera in the family by having a rostral keel that extends only half the total rostral length. *Faxegalathea* has no keel on its rostrum and has a large spine protruding from the gastric region. *Gastrosacus* is the closest genus to *Culmenformosa*. *Gastrosacus* has a much narrower rostrum with a stronger keel that

extends the full length of the rostrum. *Ambulocapsa* has much more convex carapace with less regional definition. It also has finer ornamentation. *Ankylokypha* has a much more convex carapace with less regional definition and less protruding ornamentation. Its rostral keel is also much stronger than *Culmenformosa*. *Cracensigillatus* has much less protruding ornamentation, a much narrower rostrum, and generally the carapace does not widen posteriorly. *Bullariscus* has much more regional definition, deeper grooves, and a triangular rostrum. *Octoeurax* has a much shorter, triangularly shaped rostrum and a triangularly shaped cardiac area, whereas *Culmenformosa* has a cardiac region that is sub-pentagonal in shape. *Aulavescus* has a triangular rostrum, and much finer ornamentation than *Culmenformosa*. *Pegomyrmekella* has a much broader cardiac region and much larger ornamentation than *Culmenformosa*. *Vetoplautus* has a sub-pentagonal carapace shape with a circular shaped region between the protogastric and epigastric areas that is absent from *Culmenformosa*. *Munidopsis curvirostra* has a much narrower rostrum and a less circular gastric area than *Culmenformosa*.

Members of this genus can be found in both the Ernstbrunn Limestones of Austria and the Štramperk Limestones of the Czech Republic.

***Culmenformosa glaessneri* nov. spec.**

(Fig. 14.1)

1947 *Galatheites becki* GLAESSNER, in BACHMAYER, p. 38. [*nomen nudum*]

**Diagnosis:** Carapace subrectangular, average L/TW 1.5, L/MW 1.2. Rostrum spatulate, terminates in nine spines; lateral edges of rostrum parallel. Outermost pair of spines shortest; second and third pair of spines, working toward axis, slightly larger. Fourth pair of spines much smaller; borders central, largest spine. Median keel extends half of length of rostrum.

**Etymology:** In honor of M. F. GLAESSNER, who first identified this species in notes he left at the NHMW. No description written by GLAESSNER of this species has been found.

**Measurements:** See Table 7.

**Holotype:** NHMW 2007z0149/0184.

**Paratype:** NHMW 2007z0149/0185a.

**Other material examined:** NHMW 2007z0149/0186 to NHMW 2007z0149/0202.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace subrectangular; moderately convex transversely, L/TW ranges from 1.4 to 1.7; L/MW ranges from 1.1 to 1.3. Rostrum spatulate with smooth lateral margins and granular ornamentation; terminates in nine spines. Lateral edges of rostrum parallel; portion bearing spines angles to a slight point. Outermost pair of



spines shortest; second and third pair of spines slightly larger. Fourth pair of spines much smaller; borders central, largest spine. Rostrum bears median keel along majority of length. Orbital margin weakly rimmed. Small outer orbital spine present.

Lateral margin straight with small, forward directed spines. Lateral flanks appear quite narrow. Circumgastric groove strongest groove on dorsal carapace. One groove diverges from circumgastric groove posterior to epibranchial region; a separate very weak groove diverges at posterior of hepatic region. Circumgastric groove weakens after two grooves diverge. Weak branchiocardiac groove outlines base of cardiac region and extends to lateral margin.

Table 7. Measurements of studied *Culmenformosa* specimens. Abbreviations as in Tab. 1.

NHMW	L	LR	R	MW	OW	RW	TW	GH	GW	L/MW	L/TW
<b><i>Culmenformosa glaessneri</i> nov. spec.</b>											
NHMW 2007z0149/0184	4.9	6.5	1.4	4.2	2.8	1.6	3.2	2.9	3.1	1.2	1.5
NHMW 2007z0149/0185a	-	-	1.9	7.2	4.0	2.5	5.3	4.1	4.5	-	-
NHMW 2007z0149/0186	8.8	11.1	2.3	7.5	-	3.4	6.1	5.1	5.4	1.2	1.4
NHMW 2007z0149/0187	-	-	2.1	-	-	3.5	6.7	5.9	6.3	-	-
NHMW 2007z0149/0188	-	-	2.3	9.3	5.7	3.8	6.9	6.4	6.6	-	-
NHMW 2007z0149/0189	10.0	11.9	1.9	7.9	4.7	3.3	6.4	-	6.1	1.3	1.6
NHMW 2007z0149/0191	-	-	3.4	8.3	6.2	4.2	7.5	7.0	7.3	-	-
NHMW 2007z0149/0192	-	-	1.7	-	3.9	2.7	4.4	4.2	4.3	-	-
NHMW 2007z0149/0193	-	-	1.3	-	3.2	2.1	-	3.5	3.5	-	-
NHMW 2007z0149/0194	-	-	2.3	-	-	-	-	-	6.1	-	-
NHMW 2007z0149/0195	-	-	2.1	-	5.0	3.2	5.2	5.0	5.2	-	-
NHMW 2007z0149/0196	-	-	2.6	9.7	5.7	4.0	7.1	6.5	6.7	-	-
NHMW 2007z0149/0197	7.5	-	-	6.7	3.9	2.8	4.5	4.6	4.7	1.1	1.7
NHMW 2007z0149/0198	-	-	-	-	-	-	-	6.1	6.1	-	-
NHMW 2007z0149/0199	-	-	2.4	-	4.8	3.8	6.1	5.6	5.7	-	-
NHMW 2007z0149/0200	7.6	-	-	-	4.1	2.9	5.3	4.5	4.6	-	1.4
NHMW 2007z0149/0201	-	-	1.7	-	-	2.8	-	4.8	4.8	-	-
NHMW 2007z0149/0202	5.7	6.9	1.2	4.3	3.4	2.0	4.0	3.2	3.4	1.3	1.4
<b><i>Culmenformosa nephelepera</i> nov. spec.</b>											
NHMW 2007z0149/0179	-	-	1.9	7.3	5.6	2.9	6.6	5.2	5.6	-	-
NHMW 2007z0149/0180	9.3	11.0	1.7	7.9	5.1	3.0	5.7	5.4	5.9	1.2	1.6
<b><i>Culmenformosa triastrixosa</i> nov. spec.</b>											
NHMW 2007z0149/0181	-	-	2.8	-	-	4.5	-	7.2	-	-	-
NHMW 2007z0149/0182	8.2	9.9	1.7	7.1	4.3	2.9	5.2	5.0	5.7	1.2	1.6
NHMW 2007z0149/0183	4.0	4.8	0.8	3.3	2.2	1.5	2.6	2.4	2.6	1.2	1.5

Carapace ornamented anteriorly with lines of large and small tubercles, interspersed with granules, posteriorly with scabrous lines of tubercles. Epigastric and hepatic regions weakly defined; protogastric, mesogastric, metagastric, epibranchial, and cardiac regions moderately defined. Epigastric region ornamented with several rows of tubercles; hepatic region extremely small; lined by several tubercles and some granules. Epibranchial region ornamented similarly to hepatic region. Mesogastric region arched in wide V-shape; metagastric area appears slightly raised; both ornamented anteriorly by tubercles, granules; posteriorly by transversely ovate tubercles. Cardiac area slightly raised; ornamented with granules and transversely ovate tubercles decreasing in size posteriorly. Metabranhial regions bordered laterally by large tubercles, grading to smaller, ovate tubercles centrally. Entire carapace ornamentation interspersed with small granules. Posterior margin rimmed. Ventral surface and appendages not preserved.

Discussion: BACHMAYER (1947) published a photo of *Culmenformosa glaessneri* as *Galattheites becki* GLAESSNER. He also tabulated the number of occurrences for *G. becki* in the same paper. A search through the papers written by GLAESSNER has not yielded a description of *G. becki*. Although a specimen labeled *Galattheites becki* is present in the NHMW BACHMAYER collection, with no associated published description, the name is nomen nudum. This species is also found in the Štramperk Limestones of the Czech Republic.

*Culmenformosa nephelepera* has seven rounded points at the tip of its rostrum, not nine sharp ones as seen in *C. glaessneri*. *Culmenformosa triastrixosa* has three sections of three spines at the tip of its rostrum, whereas in *C. glaessneri*, no subgroupings of spines are seen.

### ***Culmenformosa nephelepera* nov. spec.**

(Fig. 14.2)

Diagnosis: Carapace subrectangular; moderately convex transversely, L/TW 1.6; L/MW 1.2. Rostrum spatulate; terminates in seven rounded spines; bears median keel extending half of length, lateral edges of rostrum straight; edges terminate at same length as median keel, coinciding with first rounded spine, portion bearing rounded spines converges at central point. Outermost pair of rounded spines shortest; second pair of rounded spines slightly larger. Third pair of rounded spines much smaller; borders central, largest rounded spine.

Etymology: A combination of the Greek *nephele*, meaning cloud, and *peras*, meaning end. The name refers to the rounded points on the rostrum.

Measurements: See Table 7.

Holotype: NHMW 2007z0149/0179.

Paratype: NHMW 2007z0149/0180.

Type locality: Ernstbrunn Quarries.

Type stratum: Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace incomplete; majority of metabranchial regions absent, appears rectangular; moderately convex transversely, L/TW 1.6, L/MW 1.2. Rostrum spatulate with smooth lateral margins and granular ornamentation, increasing in size to slightly imbricated squamous ornamentation approaching carapace, terminates in seven rounded spines, bears median keel extending half of length; lateral edges of rostrum straight; edges terminate at same length as median keel, coinciding with first rounded spine, portion bearing rounded spines converges at central point. Outermost pair of rounded spines shortest; second pair of rounded spines slightly larger. Third pair of rounded spines much smaller; borders central, largest rounded spine. Orbital margin weakly rimmed. Small outer orbital spine present.

Lateral margin straight with small, forward directed spines. Circumgastric groove strong; weakens anteriorly, immediately posterior to hepatic region. Weak branchiocardiac groove outlines metabranchial and cardiac regions; joins branch of circumgastric groove at lateral margin, immediately posterior to epibranchial region.

Carapace ornamented anteriorly with lines of tubercles, interspersed with granules, posteriorly with scabrous lines of tubercles. Hepatic region weakly defined; epigastric, protogastric, mesogastric, metagastric, epibranchial, and cardiac regions moderately defined. Hepatic region extremely small; lined by several tubercles and some granules. Epibranchial region ornamented similar to hepatic region. Epigastric region ornamented with several rows of tubercles; bordered posteriorly by small depression. Mesogastric region arched in wide V-shape; metagastric area appears slightly raised at base of V; both ornamented anteriorly by tubercles, granules; posteriorly by transversely ovate tubercles. Cardiac area slightly raised; ornamented with granules and transversely ovate tubercles decreasing in size posteriorly. Metabranchial regions bordered laterally by large tubercles, grading to smaller, ovate tubercles centrally. Entire carapace ornamentation interspersed with small granules. Ventral surface and appendages not preserved.

**Discussion:** Only two specimens of this species have been found; neither is complete. *Culmenformosa glaessneri* and *Culmenformosa triastrixosa* have nine points on the tip of their rostra; *Culmenformosa nephelepera* has seven rounded points.

***Culmenformosa triastrixosa* nov. spec.**

(Fig. 14.3)

**Diagnosis:** Carapace rectangular; moderately convex transversely, average L/TW 1.55, L/MW 1.2. Rostrum spatulate; terminates in three separate tridentate points, median keel extends half rostral length, left lateral edge of rostrum terminates in first of three equally sized small spines that form left-most trident; small v-shaped notch present between left-most trident and central trident. Central trident has two small spines with one larger axial spine, central trident slightly longer than left-most trident, right trident mirror-image of left-most trident.

**Etymology:** The name is a combination of the Greek *trias*, meaning in threes, and *trixosa*, meaning threefold. The name refers to the species having three groups of three spines on its rostrum.

**Measurements:** See Table 7.

**Holotype:** NHMW 2007z0149/0181.

**Paratypes:** NHMW 2007z0149/0182, NHMW 2007z0149/0183.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace rectangular; moderately convex transversely, L/TW 1.55, L/MW ranges from 1.15 to 1.2. Rostrum spatulate with smooth lateral margins and granular ornamentation; terminates in three separate tridentate points. Rostrum bears median keel along half of length. Lateral edges of rostrum straight; may widen anteriorly very slightly. Right trident symmetrical to left trident. Left lateral edge terminates in first of three equally sized small spines that form left-most trident. Small v-shaped notch present between left-most trident and central trident. Central trident longest trident; has two small spines with one larger axial spine. Orbital margin weakly rimmed. Small outer orbital spine present.

Lateral margin straight with small, forward directed spines. Circumgastric groove strongest groove on dorsal carapace. One groove diverges from circumgastric groove posterior to epibranchial region; a separate very weak groove diverges at posterior of hepatic region. Circumgastric groove weakens after two grooves diverge. Weak branchiocardiac groove outlines base of cardiac region and extends anteriorly, joining branch of circumgastric groove at lateral margin, posterior to epibranchial region.

Carapace ornamented anteriorly with lines of large and small tubercles, interspersed with granules, posteriorly with scabrous lines of small and large tubercles. Hepatic region weakly defined; epigastric, protogastric, mesogastric, metagastric, epibranchial, and cardiac regions moderately defined. Hepatic region extremely small; ornamented by several tubercles and some granules. Epibranchial region ornamented similarly to hepatic region. Epigastric region ornamented with rows of tubercles; bordered posteriorly by short, deep depression. Mesogastric region arched in wide V-shape; metagastric area appears slightly raised at base of V; both ornamented anteriorly by tubercles, granules; posteriorly by transversely ovate tubercles. Cardiac area slightly raised; ornamented with granules and transversely ovate tubercles decreasing in size posteriorly. Metabranial regions bordered laterally by large tubercles, grading to smaller, ovate tubercles centrally. Entire carapace ornamentation interspersed with small granules. Posterior margin rimmed. Ventral surface and appendages not preserved.

**Discussion:** This species appears to exhibit less pronounced ornamentation than the other two species within this genus; this can most likely be attributed to both its larger

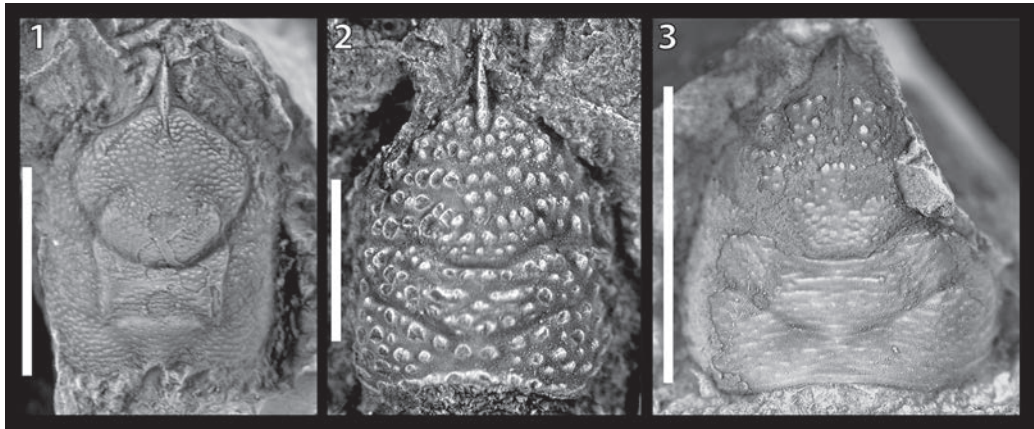


Fig. 15. 1: *Octoeurax acaesprora* nov. gen., nov. spec., holotype, NHMW 2007z0149/0126. Scale bar equals 5 mm. 2: *Pegomyrmekella chaulia* nov. gen., nov. spec., holotype, NHMW 2007z0149/118. Scale bar equals 5 mm. 3: *Vetoplautus latimarginus* nov. gen., nov. spec., holotype, NHMW 2007z0149/0151. Scale bar equals 5 mm.

size, as ornamentation is not as pronounced on larger specimens, as well as general condition factors; the specimens of *Culmenformosa triastrixosa* all seemed to be in poorer condition than those of the other species within this genus. *Culmenformosa glaessneri* has nine equally spaced spines on the anterior part of its rostrum, not three groups of three spines, as seen in *C. triastrixosa*. *Culmenformosa nephelepera* has only seven spines on the anterior part of its rostrum.

#### Genus *Octoeurax* nov. gen.

Type species: *Octoeurax acaesprora* nov. spec.

**Diagnosis:** Carapace sub-rectangular in shape; moderately convex transversely, weakly convex longitudinally, L/TW 1.6, L/MW 1.2. Rostrum short, narrow, unidentate, strongly keeled. Circumgastric groove well defined; branchiocardiac groove moderately defined. Mesogastric, hepatic, epibranchial, metagastric, urogastric, cardiac, and metabranchial regions well defined. Epigastric and mesobranchial regions weakly defined. Metagastric region slightly raised from remainder of gastric region. Urogastric region narrowest anterior to cardiac region, widens approaching mesobranchial regions. Lateral edges of urogastric region subparallel; edges arc slightly toward each other, concave to mesobranchial region. Urogastric region very large in comparison to other galatheoids. Cardiac region triangular. Carapace ornamented with slightly transversely ovate tubercles. Tubercles vary slightly in size. Ornamentation consistent across regions of carapace.



**Etymology:** The name is taken from the Greek *eurax*, meaning sideways, and *octo*, meaning eight. The name refers to the shape of the incredibly large urogastric region, which looks like the sideways numeral eight. Feminine gender.

**Discussion:** This new genus was relatively rare within BACHMAYER's collection. Only five specimens were found; unfortunately, none were complete. Despite the paucity of specimens, it merits a new genus. The size and shape of the urogastric region, as well as the shape of the cardiac region, are not encompassed by any currently erected genus within the Munidopsidae.

The impressive size of the urogastric region, as well as the triangular cardiac regions, easily distinguish *Octoeurax* from all other genera.

***Octoeurax acaresprora* nov. spec.**

(Fig. 15.1)

**Diagnosis:** As for genus.

**Etymology:** The species name is a combination of the Greek *akares*, meaning little, and *prora*, meaning face. The name refers to diminutive appearance of the rostrum.

**Measurements:** See Table 8.

**Holotype:** NHMW 2007z0149/0126.

**Other material examined:** NHMW 2007z0149/0127 to NHMW 2007z0149/0129; NHMW 2007z0149/0373.

Table 8. Measurements of studied *Octoeurax*, *Vetoplautus* and *Pegomyrmekella* specimens. Abbreviations as in Tab. 1.

	L	LR	R	MW	OW	RW	TW	UG	GH	GW	L/MW	L/TW
<b><i>Octoeurax acaresprora</i> nov. spec.</b>												
NHMW 2007z0149/0126	6.4	7.7	1.3	5.2	3.4	1.2	4.1	3.3	3.8	4.4	1.2	1.6
NHMW 2007z0149/0127	-	-	1.3	-	-	1.3	4.2	-	-	-	-	-
NHMW 2007z0149/0128	-	-	0.8	-	2.1	0.8	2.9	-	-	2.7	-	-
NHMW 2007z0149/0129	-	-	-	3.9	2.6	-	3.6	2.1	2.4	2.8	-	-
<b><i>Vetoplautus latimarginus</i> nov. spec.</b>												
NHMW 2007z0149/151	4.4	-	-	5.2	-	-	-	-	3	3.7	0.8	-
NHMW 2007z0149/152	-	-	-	-	-	-	-	-	2.2	2.7	-	-
	L	LR	R	MW	OW	RW	TW	CW	GH	GW	L/MW	L/TW
<b><i>Pegomyrmekella chaulia</i> nov. spec.</b>												
NHMW 2007z0149/0118	3.7	-	-	3.7	-	-	-	2.4	2.2	2.6	1.0	-

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace incomplete, posterior margin absent, sub-rectangular in shape; narrows slightly at both extreme anterior and posterior ends, moderately convex transversely, weakly convex longitudinally, L/TW 1.6, L/MW 1.2. Rostrum short, narrow, unidentate, strongly keeled. Orbital margin rimmed; small outer orbital spine present.

Circumgastric groove well defined; branchiocardiac groove moderately defined. Mesogastric, hepatic, epibranchial, metagastric, urogastric, cardiac, and metabranchial regions well defined. Epigastric and mesobranchial regions weakly defined. Metagastric region slightly raised from remainder of gastric region. Urogastric region narrowest anterior to cardiac region, widens approaching mesobranchial regions. Lateral edges of urogastric region subparallel; edges arc slightly toward each other, concave to mesobranchial region. Urogastric region very large in comparison to other galatheoids. Cardiac region isosceles triangle; apex of triangle directed toward posterior margin. Gastric, urogastric, and cardiac regions slightly inflated. Carapace ornamented with slightly transversely ovate tubercles. Tubercles vary slightly in size. Ornamentation consistent across regions of carapace. Ventral surface and appendages not preserved.

**Discussion:** None of the specimens studied are complete; however, all bear the characteristic urogastric region and short rostrum.

### Genus *Pegomyrmekella* nov. gen.

**Type species:** *Pegomyrmekella chaulia* nov. spec.

**Diagnosis:** Carapace subrectangular; moderately convex transversely, L/MW 1.0. Rostrum narrow; bears strong keel. Posteriormost part of circumgastric groove strong; weakens anteriorly. Branchiocardiac groove strong. Epibranchial, metagastric, urogastric, cardiac, and branchial regions well defined. Epigastric, protogastric, mesogastric and mesobranchial regions moderately defined. Carapace ornamented with extremely large pustules and pustular spines directed anteriorly; pustules not proportional to size of galatheoid. Cardiac region extremely wide; four times as wide as long. Lateral margins spined; posterior margin rimmed with ornamentation continuing onto rim.

**Etymology:** The name comes from a combination of the Greek *pegos*, meaning strong, and *myrmekia*, meaning wart. The name describes the huge warts ornamenting the carapace. Feminine gender.

**Discussion:** Only one incomplete specimen of this new genus and species was found within BACHMAYER's collection. Its differences from all other genera, however, are striking enough that it merits its own genus. This new genus differs from all others by having an extremely broad cardiac region, much broader than any other species examined, and very large pustules comprising its carapace ornamentation. These pustules are not

proportional to the size of the specimen; they are much larger than all those in the other genera studied in this work.

***Pegomyrmekella chaulia* nov. spec.**

(Fig. 15.2)

**Diagnosis:** As for genus.

**Etymology:** The name comes from the Greek word *chaulios*, meaning prominent. The species name refers to the prominent ornamentation exhibited by the species.

**Measurements:** See Table 8.

**Holotype and sole specimen:** NHMW 2007z0149/0118.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace incomplete; anterolateral margin and anteriormost part of rostrum absent, L/MW 1.0. Carapace subrectangular; moderately convex transversely. Rostrum appears narrow; bears strong keel. Posteriormost part of circumgastric groove strong; weakens anteriorly. Branchiocardiac groove strong. Epibranchial, metagastric, urogastric, cardiac, and branchial regions well defined. Epigastric, protogastric, mesogastric and mesobranchial regions moderately defined. Carapace ornamented with extremely large pustules and pustular spines directed anteriorly; pustules not proportional to size of galatheoid. Cardiac region extremely wide; four times as wide as long. Ornamentation of cardiac region consists of three very transversely ovate pustules placed axially; remainder of cardiac region ornamented similar to rest of carapace. Metabran- chial regions appear small; ornamentation increases in size approaching lateral margin of metabran- chial region. Lateral margins spined; posterior margin rimmed with orna- mentation continuing onto rim. Ventral surface and appendages not preserved.

**Discussion:** See discussion under *Pegomyrmekella* heading.

**Genus *Vetoplautus* nov. gen.**

**Type species:** *Vetoplautus latimarginus* nov. spec.

**Diagnosis:** Carapace sub-pentagonal in shape, widens posteriorly; moderately convex transversely, moderately convex longitudinally, L/MW 0.8. Carapace, excluding rostrum, slightly wider than long. Rostrum incompletely preserved; appears broad with keel composed of strong nodes or broken spines. Lateral margins spined; posterolateral margin rounded approaching posterior margin. Circumgastric groove strong; branchio- cardiac groove moderately strong. Epigastric, protogastric, metagastric, mesogastric, hepatic, epibranchial, mesobranchial, cardiac, and branchial regions well defined. Uro- gastric and intestinal regions moderately defined. Small, circular region present between epigastric and protogastric regions; separated from remainder of gastric region by

shallow grooves. Anterior regions ornamented with row of tubercles on anterior borders; remaining parts of anterior regions ornamented with less defined tubercles. Posterior regions ornamented with transversely ovate tubercles; most ridge-like. Posterior margin very slightly rimmed.

**Etymology:** *Vetoplautus* is a combination of the Latin *veto*, meaning forbidden, and *plautus*, meaning broad. The name refers to the genus having wider than long proportions, an uncommon feature among galatheoids. Masculine gender.

**Discussion:** The sub-pentagonal shape, as well as the extra region between the epigastric and protogastric regions, separate this genus from all others.

***Vetoplautus latimarginus* nov. spec.**

(Fig. 15.3)

**Diagnosis:** As for genus.

**Etymology:** The species name is a combination of the Latin *latus*, meaning wide, and *marginus*, meaning margins, referring to the wide lateral margins found on this species.

**Measurements:** See Table 8.

**Holotype:** NHMW 2007z0149/0151.

**Paratype:** NHMW 2007z0149/0152.

**Type locality:** Ernstbrunn Quarries.

**Type stratum:** Ernstbrunn Limestones, Tithonian, Upper Jurassic.

**Description:** Carapace incompletely preserved; right hepatic and epibranchial regions missing. Frontal margin incomplete. Carapace sub-pentagonal in shape; widens posteriorly; moderately convex transversely, moderately convex longitudinally, especially anteriorly. Carapace slightly wider than long, discounting rostrum, L/MW 0.8. Rostrum incompletely preserved; appears broad with keel composed of strong nodes or broken spines. Rostrum bears granular ornamentation. Lateral margins spined; posterolateral margin rounded approaching posterior margin.

Circumgastric groove strong; branchiocardiac groove moderately strong. Epigastric, protogastric, mesogastric, metagastric, hepatic, epibranchial, mesobranchial, cardiac, and branchial regions well defined. Urogastric and intestinal regions moderately defined.

Epigastric region ornamented with pustules; remaining anterior regions ornamented with row of tubercles on anterior borders; remaining parts of anterior regions ornamented with less defined tubercles. Posterior regions ornamented with transversely ovate tubercles; most ridge-like. Ornamentation largest and strongest approaching lateral margins of branchial regions. Posterior margin very slightly rimmed. Ventral surface and appendages not preserved.

**Discussion:** Unfortunately, there are currently only two known specimens within this species, and both are incomplete. Neither has a complete rostrum, but the shape of

Table 9. List of known fossil munidopsid species and localities where they have been found. Localities reported are either type localities or have been verified by the authors. The only species with multiple localities unable to be verified was *Gastrosacus wetzleri* VON MEYER, 1854 [1856]. The two localities reported by VON MEYER (1854 [1856], 1860) are included.

Species	Author	Erstbrunn	Stamberg*	Romania	Polish Carpathians	Other	Age
<i>Ambulocapsa altilis</i>	nov. spec.	X	X				Tithonian
<i>Ambulocapsa bachmayeri</i>	nov. spec.	X					Tithonian
<i>Ambulocapsa novacula</i>	nov. spec.	X					Tithonian
<i>Ambulocapsa sentosa</i>	nov. spec.	X	X				Tithonian
<i>Ankylokypha parabola</i>	nov. spec.	X	X				Tithonian
<i>Aulavescus exutus</i>	nov. spec.	X					Tithonian
<i>Aulavescus tectus</i>	nov. spec.	X					Tithonian
<i>Brazilomunida brasiliensis</i>	(BEURLIN, 1965)					Estado do Sergipe, Brazil	Lower Cretaceous
<i>Bullariscus patrulei</i>	nov. spec.	X			X		Tithonian
<i>Bullariscus arcuatorus</i>	nov. spec.	X					Tithonian
<i>Bullariscus gibbernodus</i>	nov. spec.	X					Tithonian
<i>Bullariscus triquetrus</i>	nov. spec.	X					Tithonian
<i>Culmenformosa glaessneri</i>	nov. spec.	X	X				Tithonian
<i>Culmenformosa nephelepera</i>	nov. spec.	X					Tithonian
<i>Culmenformosa triastrixosa</i>	nov. spec.	X					Tithonian
<i>Calteagalathea friulana</i>	DE ANGELI & GARASSINO, 2006					Val Caltea (Pordenone), Italy	Maastrichtian
<i>Cracensigillatus acutirostrus</i>	(MOERICKE, 1889)	X	X	X	X		Tithonian
<i>Cracensigillatus gracilirostrus</i>	nov. spec.	X	X				Tithonian
<i>Cracensigillatus prolatus</i>	nov. spec.	X					Tithonian
<i>Faxegalathea platyspinosa</i>	JAKOBSEN & COLLINS, 1997					Zealand, Denmark	Paleocene
<i>Gastrosacus wetzleri**</i>	VON MEYER, 1854 [1856]					Oerlinger-Tal and Nieder-Stotzingen, Germany	Upper Jurassic
<i>Gastrosacus aequabus</i>	nov. spec.	X					Tithonian
<i>Gastrosacus carteri</i>	VAN STRAELEN, 1925					Coral Rag at Upware, England	Oxfordian
<i>Gastrosacus eminens</i>	(BLASCHKE, 1911)	X	X	X			Tithonian
<i>Gastrosacus ernstbrunnensis</i>	BACHMAYER, 1947	X					Tithonian
<i>Gastrosacus? latirostrus</i>	(BEURLIN, 1929)					Côtes Lorraines, France	Oxfordian
<i>Gastrosacus levocardiacus</i>	nov. spec.	X					Tithonian
<i>Gastrosacus limacurvus</i>	nov. spec.	X					Tithonian



Species	Author	Ernstbrunn	Štramberk*	Romania	Polish Carpathians	Other	Age
<i>Gastrosacus meyeri</i>	(MOERICKE, 1889)		X				Tithonian
<i>Gastrosacus pisinnus</i>	nov. spec.	X					Tithonian
<i>Gastrosacus torosus</i>	nov. spec.	X					Tithonian
<i>Gastrosacus tuberosiformus</i>	(LÖRENTHEY, in LÖRENTHEY & BEURLEN, 1929)	X	X	X	X		Tithonian
<i>Gastrosacus tuberosus</i>	(REMES, 1895)		X				Tithonian
<i>Gastrosacus ubaghsi</i>	(PELSENER, 1886) nov. comb.					Southern Limburg, The Netherlands	Maastrichtian
<i>Munidopsis foersteri</i>	FELDMANN, TSHUDY & THOMSON, 1993					James Ross Basin, Antarctica	Campanian
<i>Munidopsis lieskovensis</i>	HYŽNÝ & SCHLÖGL, 2011					Cerová-Lieskové (Vienna Basin), Slovakia	Miocene
<i>Munidopsis scabrosa</i>	FELDMANN & WILSON, 1988					Seymour Island, Antarctica	Eocene
<i>Nykteripteryx rostrata</i>	KLOMPMAKER et al., 2012					Navarra, Spain	Albian
<i>Octoeurax acaresprora</i>	nov. spec.	X					Tithonian
<i>Palaeomunidopsis moutieri</i>	VAN STRAELEN, 1925					Giberville (Calvados), France	Bathonian
<i>Pegomyrmekella chaulia</i>	nov. spec.	X					Tithonian
<i>Shinkaia katapsyxis</i>	SCHWEITZER & FELDMANN, 2008					Washington, USA	Eocene
<i>Vetoplautus latimarginus</i>	nov. spec.	X					Tithonian

\* Multiple localities were reported as the Štramberk Limestones; data from all localities were combined.

\*\* *Gastrosacus wetzleri* has been reported from Štramberk, Ernstbrunn, and Romanian localities. None of these could be verified by the authors.

the partially preserved rostrum seems wide, with a weak keel. The keel does seem to extend the full length of the rostrum, as it is a consistent strength as it extends along the preserved portion of the rostra of both specimens.

## Discussion

The diversity of the munidopsids as well as other galatheoids found within the Ernstbrunn Limestone is astounding (see SCHWEITZER & FELDMANN 2010; ROBINS et al. 2012). Table 9 shows all the known fossil munidopsids and their type localities. Additional specimen localities verified by the authors are also noted. With 28 of the 43 known fossil munidopsid species found within the Ernstbrunn Limestone, it is easily the most diverse

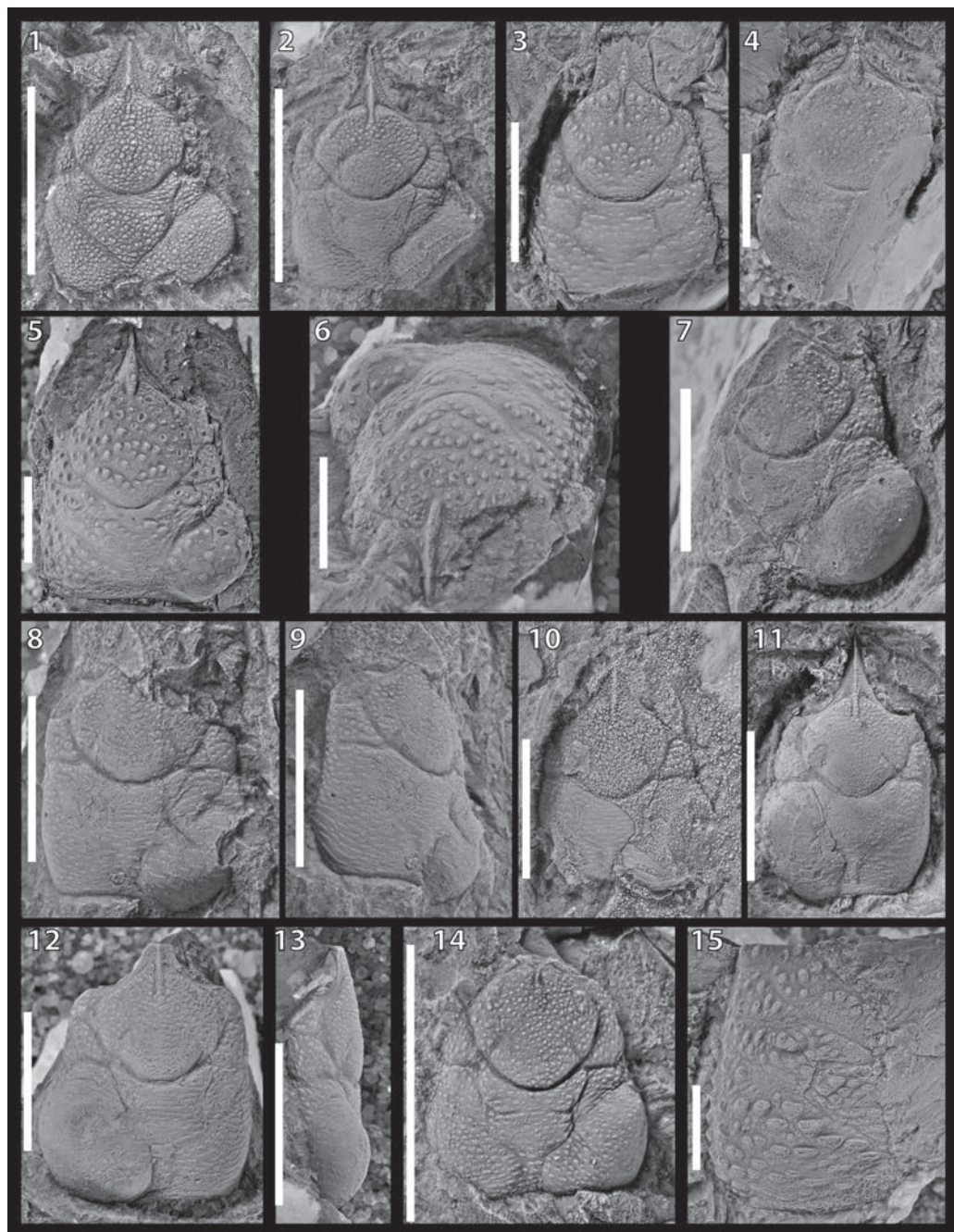


Fig. 16. **1:** *Bullariscus triquetrus* nov. gen., nov. spec., paratype, NHMW 2007z0149/0102; Swelling attributed to bopyrid infestation in right branchial region. **2:** *Cracensigillatus acutirostrus* (MOERICKE, 1889) nov. comb., NHMW 2007z0149/0329. **3:** *Culmenformosa glaessneri* nov. gen., nov. spec., paratype, NHMW 2007z0149/0185. Very slight swelling of the right branchial

fossil munidopsid locality worldwide. The Štramberg Limestones of the Czech Republic and Poland, also Tithonian corallgal reef-type deposits, most likely contained similar levels of munidopsid diversity; BACHMAYER (1947) commented on the similarities of decapod species found within the Štramberg and Ernstbrunn localities. Unfortunately, many specimens from the Štramberg localities were lost, and the limestones have since been extensively quarried, with many localities currently inaccessible or no longer in existence. It may be impossible to determine the true munidopsid diversity of the Štramberg Limestones. From the limited museum collections studied, as well as type localities from original descriptions, nine total munidopsid species have been verified by the authors as being found in the Štramberg Limestones. This total includes the Štramberg localities in the Czech Republic and Poland. Both Ernstbrunn and Štramberg also have a large number of galatheids; those will be studied in a future work.

Of the taxa described within this paper, seven species in four genera are found in both the Štramberg and Ernstbrunn limestones. Several species have an even larger distribution, as *Cracensigillatus acutirostrus*, *Gastrosacus eminens*, and *G. tuberosiformus* have been previously reported from Upper Jurassic strata in Romania (LÖRENTHEY in LÖRENTHEY & BEURLIN 1929; PATRULIUS 1966). Preliminary study of the material from Romania indicates a higher diversity of species than previously reported in literature, but not to the level of diversity found in the Štramberg and Ernstbrunn Limestones.

BACHMAYER (1948) reported that the occurrence of bopyrids was not rare within the Ernstbrunn decapod fauna, and the galatheids seemed to be particularly vulnerable. In a later work (1955), BACHMAYER specified that 60 out of less than 3,000, or around 2 % of decapods, from the Ernstbrunn Limestones were found with bopyrid swellings, a higher percentage than that of Štramberg. Figures 16.1–16.14 shows various examples of carapace distortions attributed to bopyrid infestations. Additional afflicted specimens have been illustrated above (*Ambulocapsa sentosa*, Fig. 9.6; *Bullariscus triquetrus*, Figs 12.7, 12.8; *Cracensigillatus prolatus*, Fig. 13.4). The swellings range from

- ◀ region. 4: *Gastrosacus eminens* (BLASCHKE, 1911). NHMW 2007z0149/0244. The specimen is poorly preserved, but there is moderate swelling of the left branchial region. 5–6: *Gastrosacus tuberosiformus* (LÖRENTHEY in LÖRENTHEY & BEURLIN, 1929). 5: dorsal view, 6: oblique view. NHMW 2007z0149/0208. 7: *Cracensigillatus acutirostrus* (MOERICKE, 1889) nov. comb., NHMW 2007z0149/0294. 8: *Cracensigillatus acutirostrus* (MOERICKE, 1889) nov. comb., NHMW 2007z0149/0334. 9: Oblique view of *Cracensigillatus acutirostrus* (MOERICKE, 1889) nov. comb., NHMW 2007z0149/0334. 10: *Cracensigillatus acutirostrus* (MOERICKE, 1889) nov. comb., NHMW 2007z0149/0340. Poorly preserved specimen, the majority of the carapace exhibits secondary crystal growth. 11: *Cracensigillatus acutirostrus* (MOERICKE, 1889) nov. comb., NHMW 2007z0149/0316. 12–13: *Cracensigillatus acutirostrus* (MOERICKE, 1889) nov. comb., NHMW 2007z0149/0315. 12: dorsal view, 13: side view. 14: *Cracensigillatus gracilirostrus* nov. gen., nov. spec. NHMW 2007z0149/0354. 15: *Gastrosacus eminens* (BLASCHKE, 1911), large specimen, NHMW 2007z0149/0238. All scale bars for Fig. 16.1–16.15 equal 5 mm. On specimens 16.1–16.14, swellings in the left or right branchial regions are attributed to bopyrid infestations.

barely discernable enlargements of one branchial region (Fig. 16.3) to huge protuberances (Fig. 16.12). The majority of the specimens affected belong to the genus *Cracensigillatus*. It should be noted, however, that *Cracensigillatus acutirostrus* is one of the most common species within the BACHMAYER Collection, so the number of infested individuals is more likely a reflection of population dynamics and not preference of the parasites or particular susceptibility of the hosts. The infestations have been found on 5 munidopsid genera and 8 munidopsid species from Ernstbrunn. Since this study is only on selected specimens from BACHMAYER's Collection, a true statistical test can not be performed without including the hundreds of other galatheoid specimens within his collection.

BACHMAYER (1947) commented on the size of the decapod specimens in Ernstbrunn in comparison to the ones from Štramberg, with the observation that the individuals from Štramberg seemed much larger, with some approaching twice the size of the Ernstbrunn fauna. He hypothesized an environmental difference, supported by the size difference and the color of the rock. The Ernstbrunn Limestones are white to slightly yellow, while the Štramberg Limestones are often dark grey. Individuals within the Štramberg area may have attained a larger size than that of Ernstbrunn more regularly, but examination of the limited amount of specimens accessible to the authors has not yielded a noticeable size difference between the two localities. More Štramberg specimens will need to be examined for this to be any more than an anecdotal observation. Unfortunately, there is no sizable collection of Štramberg material to compare the BACHMAYER Collection with. Many of the Štramberg quarries are inaccessible today, so finding more material is not feasible. Most of the Štramberg material within museums has a strong size bias, and the small species were ignored.

The largest partial galatheoid found within the Ernstbrunn material of the BACHMAYER Collection is *Gastrosacus eminens*, illustrated in Fig. 16.15. A rough estimate of the total length of that individual (rostrum included) would be approximately 3 cm, which is similar in size to the largest specimen, also *G. eminens*, found within material from Štramberg.

Further study on the remaining galatheoids from the BACHMAYER Collection is ongoing, and preliminary work indicates that a similar level of diversity among members of the Galatheidae is present.

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