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New record of crabs and lobsters from the Early Cretaceous (Albian) of Haute-Marne, France

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ABSTRACT
The present study documents eight new specimens of decapod crustaceans from the Early Cretaceous (Albian) of Haute-Marne (Grand Est, France), located on the eastern margin of the Paris Basin. They are assigned to *Eryma* Meyer, 1840, with *E. vocontii* Devillez, Charbonnier, Hyžný & Leroy, 2016 (Erymidae Van Straelen, 1925), *Rathbunopon* Stenzel, 1945, with *R. brisaci* n. sp. (Prosopidae Meyer, 1860), *Paranecrocarcinus* Van Straelen, 1936, with *P. perchati* n. sp. (Necrocarcinidae Förster, 1968), and *Joeranina* Van Bakel, Guinot, Artal, Jagt & Fraaije, 2012, with *J. scheitzi* n. sp. (Palaeocorystidae Lőrenthey *in* Lőrenthey & Beurlen, 1929). The lobster *Eryma vocontii* was previously known by a few fossils only found at the type locality, in the South-East Basin of France, 360 km southward. This new occurrence suggests a significantly broader distribution for this species. A notable aspect of one of the new specimens is the presence of an epibiontic mollusk fixed on the carapace, represent-

ing the first documented instance of such an association with an Early Cretaceous erymid lobster. *Rathbunopon brisaci* n. sp. represents the second record of this genus in France, after the record of *R. tuberculatum* (Van Straelen, 1936) from the Hauterivian of Auxerre (Yonne, Bourgogne-Franche-Comté). The new species confirms the stratigraphic range of the genus limited to the Early Cretaceous (Hauterivian-Albian)-early Late Cretaceous (Cenomanian). *Paranecrocarcinus perchati* n. sp. represents the second report of this genus from the Early Cretaceous of France, after the record of the type-species *P. hexagonalis* Van Straelen, 1936 from the Hauterivian of Auxerre (Yonne, Bourgogne-Franche-Comté). *Joeranina scheitzi* n. sp. represents the second species of *Joeranina* found in the Early Cretaceous of France.

KEY WORDS
Crustacea,
Decapoda,
Erymida,
Brachyura,
Podotremata,
Gymnopleura,
new species.

RÉSUMÉ
Nouveau signalement de crabes et de homards dans le Crétacé inférieur (Albien) de Haute-Marne, France.
La présente étude documente huit nouveaux spécimens de crustacés décapodes du Crétacé inférieur (Albien) de Haute-Marne (Grand Est, France), situé sur la marge orientale du bassin de Paris. Ils sont attribués à *Eryma* Meyer, 1840, avec *E. vocontii* Devillez, Charbonnier, Hyžný & Leroy, 2016 (Erymidae Van Straelen, 1925), *Rathbunopon* Stenzel, 1945, avec *R. brisaci* n. sp. (Prosopidae Meyer, 1860), *Paranecrocarcinus* Van Straelen, 1936, avec *P. perchati* n. sp. (Necrocarcinidae Förster, 1968), et *Joeranina* Van Bakel, Guinot, Artal, Jagt & Fraaije, 2012, avec *J. scheitzi* n. sp. (Palaeocorystidae Lőrenthey *in* Lőrenthey & Beurlen, 1929). Le homard *Eryma vocontii* n'était auparavant connu que par quelques fossiles trouvés uniquement dans la localité type, dans le bassin du Sud-Est de la France, à 360 km au sud. Cette nouvelle occurrence suggère une distribution significativement plus large pour l'espèce. L'un des nouveaux spécimens présente un mollusque épibionte fixé sur la carapace, ce qui constitue le premier cas documenté d'une telle association chez les érymides du Crétacé inférieur. *Rathbunopon brisaci* n. sp. représente le second signalement de ce genre en France, après celui de *R. tuberculatum* (Van Straelen, 1936) de l'Hauterivien d'Auxerre (Yonne, Bourgogne-Franche-Comté). La nouvelle espèce confirme une étendue stratigraphique du genre, limitée entre le Crétacé inférieur (Hauterivien-Albien) et le début du Crétacé supérieur (Cénomanien). *Paranecrocarcinus perchati* n. sp. représente le second signalement de ce genre dans le Crétacé inférieur de France, après l'espèce-type *P. hexagonalis* Van Straelen, 1936 de l'Hauterivien d'Auxerre (Yonne, Bourgogne-Franche-Comté). *Joeranina scheitzi* n. sp. est la seconde espèce de *Joeranina* trouvée dans le Crétacé inférieur de France.

MOTS CLÉS
Crustacea,
Decapoda,
Erymida,
Brachyura,
Podotremata,
Gymnopleura,
espèces nouvelles.

INTRODUCTION

The presence of Early Cretaceous decapod crustaceans in the Paris Basin has been documented since the mid-19th century, notably with the contributions of Robineau-Desvoidy (1849) who is widely regarded as a pioneering figure in this field. The exhaustive list of publications is long and beyond the scope of this study, although some landmark papers can be mentioned (Tribolet 1875, 1876; Van Straelen 1936; Devillez *et al.* 2016). The crustaceans from the Albian stratotype have been revised recently by Breton (2010, 2011) and Breton *et al.* (2015) who listed about 15 different species. In the Haute-Marne department, the Lac du Der-Chantecoq (often abbreviated to Lac du Der) is an artificial lake designed to protect Paris from flooding. This lake is periodically drained and the Albian deposits become accessible for fossil collecting (Fig. 1). We describe herein specimens recently collected in this area, including the lobster *Eryma vocontii* Devillez, Charbonnier, Hyžný & Leroy, 2016 (Erymidae Van Straelen, 1925), and three new species of brachyuran crabs belonging to the Prosopidae Meyer, 1860, Necrocarcinidae Förster, 1968, and Palaeocorystidae Lőrenthey *in* Lőrenthey & Beurlen, 1929, respectively.

MATERIAL AND GEOLOGICAL SETTING

The studied material consists of eight specimens collected by one of the co-authors (RB), who is an amateur palaeontologist and specialist of decapod crustaceans. They come from the Presqu'Île de Nemours, to the east of the Lac du Der, in the commune of Éclaron-Braucourt-Sainte Livière, Haute-Marne (Grand Est region). The fossils in question correspond to isolated carapaces, which were collected in clay marls and, on occasion, found to be embedded in phosphatic nodules. Based on the associated ammonites, the age of the fossils has been determined to be middle Albian (*Hoplites dentatus* ammonite biozone). Supplementary stratigraphical data concerning the Albian deposits from the Paris Basin can be found in Colleté (2010), Amédro & Matrion (2014), and Amédro *et al.* (2014). During the Albian, the Lac du Der outcrop was located in the eastern margin of the Paris Basin, which was occupied by a narrow epicontinental sea (strait) between different landmasses and connecting the Tethys Ocean, located to the south-east, to the Boreal realm, toward the north-west (see palaeogeographic maps in Amédro & Matrion 2014).

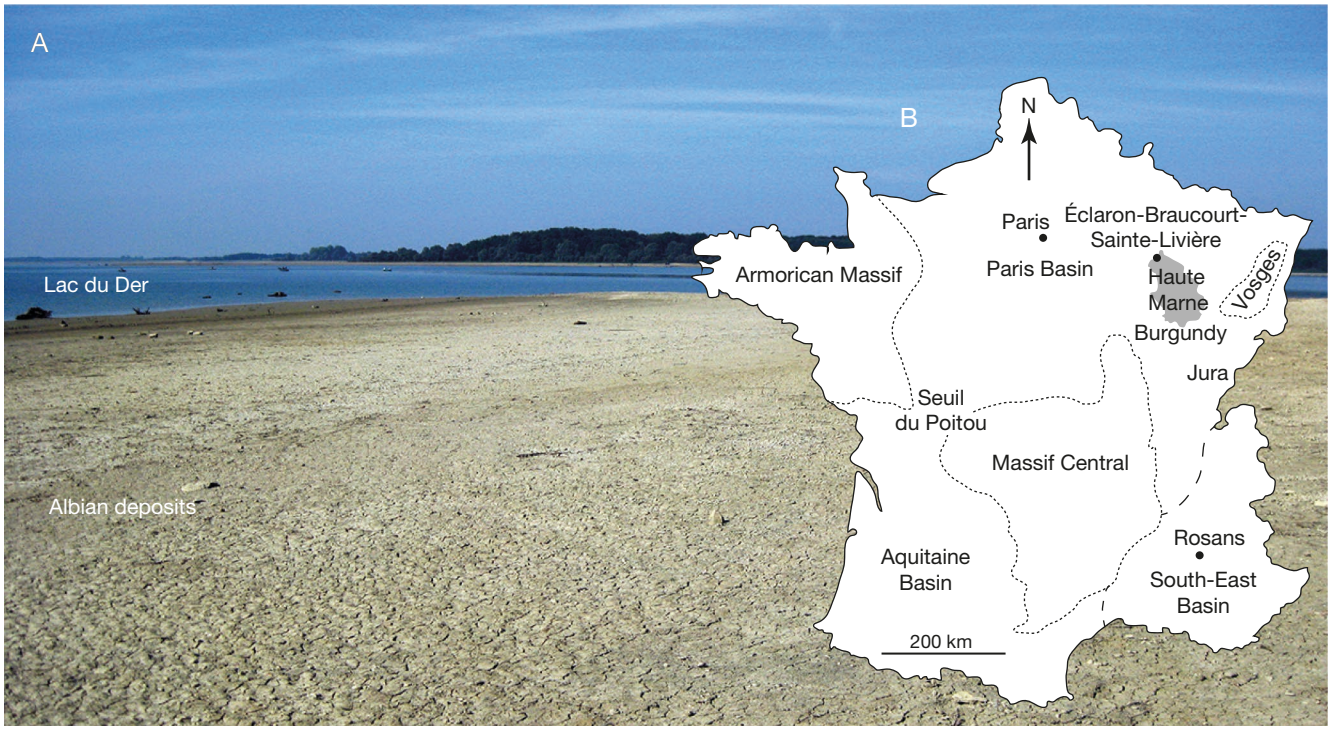

FIG. 1. — Location of the studied locality: Lac du Der, Presqu'Île de Nemours, Éclaron-Braucourt-Sainte Livière, Haute-Marne, Grand-Est: **A**, lake shore with Lower Cretaceous deposits (middle Albian, *Hoplites dentatus* ammonite biozone); **B**, map of France with the three main sedimentary basins. Photograph: Richard Brochet.

The studied specimens are currently housed in the palaeontological collection of the Muséum national d'Histoire naturelle, Paris, France.

ABBREVIATIONS

Institutional abbreviations

MNHN Muséum national d'Histoire naturelle, Paris;
MNHN.F Palaeontological collection, MNHN;
MHNAux Muséum d'histoire naturelle, Auxerre.

SYSTEMATIC PALAEONTOLOGY

Infraorder ASTACIDEA Latreille, 1802
Superfamily ERYMOIDEA Van Straelen, 1925
Family ERYMIDAE Van Straelen, 1925
Subfamily ERYMINAE Van Straelen, 1925

Genus *Eryma* Meyer, 1840

TYPE SPECIES. — *Macrourites modestiformis* Schlotheim, 1822, by subsequent designation by Glaessner (1929: 150).

INCLUDED SPECIES. — *E. antiquum* (Birshtein, 1958) (Changhsingian), *E. sinemurianum* (Garassino, 1996) (Sinemurian), *E. amalthei* (Quenstedt *in* Oppel, 1853) (Sinemurian-Pliensbachian), *E. birdi* Woods, 1930 (Toarcian), *E. compressum* (Eudes-Deslongchamps, 1842) (Toarcian-Bathonian), *E. osciensis* Garassino, Audo, Charbonnier & Schweigert *in* Bravi *et al.*, 2014 (Bajocian-Bathonian), *E. ventrosum* (Meyer, 1835) (Bathonian-Kimmeridgien), *E. ornatum* (Quenstedt, 1857) (Callovian), *E. mandelslohi* (Meyer, 1840) (Callovian-Oxfordian), *E. quadriverrucatum* Trautschold, 1866 (Callovian-Tithonian), *E. georgeii* Carter, 1886 (Oxfordian), *E. jungostrix* Feldmann & Titus, 2006 (Oxfordian), *E. major* Oppel, 1861 (Kimmeridgian), *E. punctatum* Oppel, 1861 (Kimmeridgian), *E. veltheimii* (Münster, 1839) (Kimmeridgian), *E. westphali* Schweigert, Dietl & Röper, 2000 (Kimmeridgian), *E. lerasi* (Étallon, 1861) (Kimmeridgian-Tithonian), *E. modestiforme* (Schlotheim, 1822) (Kimmeridgian-Tithonian), *E. nippon* Karasawa, Ohara & Kato, 2008 (Barremian), *E. glaessneri* (Van Straelen, 1936) (Hauterivian), *E. multicavatum* (Bell, 1863) (Hauterivian), *E. vocontii* Devillez, Charbonnier, Hyžný & Leroy, 2016 (Albian), *E. moriedaorum* Ando, Hirose, Ugai & Shimada, 2020 (Cenomanian), *E. oscari* Charbonnier, Audo, Garassino & Hyžný, 2017 (Cenomanian) (after Devillez *et al.* 2016, 2017, 2021; Devillez & Charbonnier 2017, 2019, 2021; Metodiev *et al.* 2021; Dadykin & Schmakov 2023).

PRELIMINARY REMARKS

Eryma was previously assigned to the infraorder Glypheidea Winkler, 1881 (Karasawa *et al.* 2013; Feldmann *et al.* 2015). However, the phylogenetic study provided by Charbonnier *et al.* (2015) on the glypheid lobsters resulted in the exclusion of *Eryma* from this infraorder. The following phylogenetic study by Devillez *et al.* (2019), focused on erymid lobsters, concurs with the result of Charbonnier *et al.* (2015), resulting in the assignation of *Eryma* into the infraorder Astacidea Latreille, 1802. Despite these studies, the recent additions to the Treatise online (Schweitzer & Feldmann 2024: 11-12) maintain the erymid lobsters (including *Eryma*) within Glypheidea. Considering that erymid lobsters, and so *Eryma*, are true chelate lobsters (glypheid pereiopod terminations are subchelate), we follow herein the systematic framework proposed in Devillez *et al.* (2019): *Eryma* is assigned to Astacidea, like other lobsters bearing true chelae.

Eryma vocontii
Devillez, Charbonnier, Hyžný & Leroy, 2016
(Fig. 2)

Eryma vocontii Devillez, Charbonnier, Hyžný & Leroy, 2016: 518, fig. 4a-f. — Devillez *et al.* 2017: 780. — Devillez & Charbonnier 2022: 282, fig. 13b, c.

TYPE MATERIAL. — **Holotype. France** • 1 specimen (carapace; adult); Rhône-Alpes Auvergne, Hautes-Alpes, Rosans; Early Cretaceous, Albian; Arnaud Clément leg.; MNHN.F.A57457.
Paratype. France • 1 specimen (P1 chela; adult); Rhône-Alpes Auvergne, Hautes-Alpes, Rosans; Early Cretaceous, Albian; Arnaud Clément leg.; MNHN.F.A57458.

EXAMINED MATERIAL. — **France** • 3 specimens (carapaces; adults); Grand-Est, Haute-Marne, Lac du Der, Presqu'Île de Nemours; Early Cretaceous, middle Albian, *Hoplites dentatus* zone; Richard Brochet leg.; MNHN.F.A98126, A98127, A98128.

DISCUSSION
The carapace groove pattern of the three specimens is typical of erymid lobsters: well-developed cervical, postcervical and branchiocardiac grooves, short gastro orbital groove and concavo-convex hepatic groove. Moreover, the junction between postcervical and branchiocardiac grooves at carapace midheight is diagnostic of *Eryma*. The assignation to *Eryma vocontii* is supported by: 1) the elongated "V" formed by the convergent postcervical and branchiocardiac grooves; 2) the very short ventral extension of the postcervical groove; 3) the ornamentation made of tubercles preceded by depressions; 4) with depressions deeper in branchial region; 5) the strongly inflated attachment sites of both mandibular and adductor testis muscles; and 6) the elongated, sub-rectangular outline of the attachment site of adductor testis muscles which is dorsally delimited by a narrow groove running between hepatic and branchiocardiac grooves (this last feature is typical of this species).

Early Cretaceous fossils attributed to *Eryma* are very uncommon and only four species are known to date (Karasawa *et al.* 2008; Devillez *et al.* 2016, 2021; Devillez & Charbonnier 2022; Ossó *et al.* 2024). *E. vocontii* was described based on only two specimens, a crushed carapace and a first pereiopod chela, both from the type locality (Fig. 2A-D). The three new specimens found about 360 km northward suggest a geographic distribution significantly broader than the French South-East Basin where the type locality is located (Devillez *et al.* 2016: fig. 2). These specimens are also more complete and less deformed than the holotype, with their attachment site of mandibular muscle and pterygostomial region entirely preserved. In addition, the specimen MNHN.F.A98128 (Fig. 2G) shows the basis of a strong antennal spine. This specimen also carries a fragment of an epibiontic bivalve shell fixed on its right flank, above the junction between postcervical and branchiocardiac grooves. Such an association is reported for the first time in Early Cretaceous erymid lobsters, but is well known, for instance, in mecochirid lobsters from the Aptian of the Isle of Wight, United Kingdom (see Robin *et al.* 2016).

Infraorder BRACHYURA Latreille, 1802
Section PODOTREMATA Guinot, 1977
Subsection DYNOMENIFORMIA
Guinot, Tavares & Castro, 2013
Superfamily HOMOLODROMIOIDEA Alcock, 1900
Family PROSOPIDAE Meyer, 1860

Genus *Rathbunopon* Stenzel, 1945

TYPE SPECIES. — *Rathbunopon polyakron* Stenzel, 1945, by original designation.

INCLUDED SPECIES. — *Rathbunopon brisaci* n. sp. (this study); *R. obesum* (Van Straelen, 1944) from the Albian-Cenomanian of Navarra (Spain; Van Straelen 1944; Klompmaker *et al.* 2011); *R. oblitum* (Carter, 1898) from the Cenomanian of the United Kingdom (Carter 1898); *R. polyakron* Stenzel, 1945 from the Cenomanian of USA (Stenzel 1945); *R. schrattenkalkensis* Klompmaker, Artal & Gulisano, 2011 from the Aptian of Germany-Austria (Klompmaker *et al.* 2011); *R. tarraconensis* Ossó, van Bakel, Ferratges-Kwekel & Moreno-Bedmar, 2018 from the Aptian of Catalonia (Spain; Ossó *et al.* 2018); *R. tuberculatum* (Van Straelen, 1936) from the Hauterivian of France (Van Straelen 1936); *R. viai* González-Léon, Ossó, Moreno-Bedmar & Vega, 2016 from the Aptian of Spain (González-León *et al.* 2016); *R. woodsi* Withers, 1951 from the Cenomanian of the United Kingdom (Withers 1951).

Rathbunopon brisaci n. sp.
(Fig. 3)

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DIAGNOSIS. — Carapace, subovoid almost pyriform in outline, longer than wide with maximum width in posterior third of carapace at level of metabranchial region; dorsal surface strongly sculptured, regions well defined by strong inflated tubercles and delimited by deep grooves; rostrum subtriangular, spatulate, with rounded tip; orbits large, deep, and complete; supraorbital margin with two tubercles, one bigger proximally and one smaller distally; infraorbital spine strong, dorsally visible; hook-shaped outer-orbital spine directed forward; anterolateral margins short, converging anteriorly; posterolateral margins strongly convex, converging posteriorly; posterior margin straight and rimmed; epi- and protogastric regions with one tubercle respectively; mesogastric region subtriangular elongate, with three tubercles; urogastric region with two parallel narrow transverse lobes; cardiac region inverted triangular, swollen; branchial regions separated by well-marked grooves; epibranchial region with one tubercle; meso- and metabranchial regions weakly inflated finely tuberculate; intestinal region narrow and weakly depressed; well-marked cervical, branchial, and branchiocardiac grooves.

ETYMOLOGY. — The specific epithet honours Patrick Brisac, collector of fossils and friend of one of the authors (RB).

TYPE MATERIAL. — **Holotype. France** • 1 specimen (carapace; adult); Grand-Est, Haute-Marne, Éclaron-Braucourt-Sainte Livière, Lac du Der, Presqu'Île de Nemours; Early Cretaceous, middle Albian, *Hoplites dentatus* ammonite biozone; Richard Brochet leg.; MNHN.F.A98122.
Paratype. France • 1 specimen (carapace; adult); Grand-Est, Haute-Marne, Éclaron-Braucourt-Sainte Livière, Lac du Der, Presqu'Île de Nemours; Early Cretaceous, middle Albian, *Hoplites dentatus* zone; Richard Brochet leg.; MNHN.F.A98121.

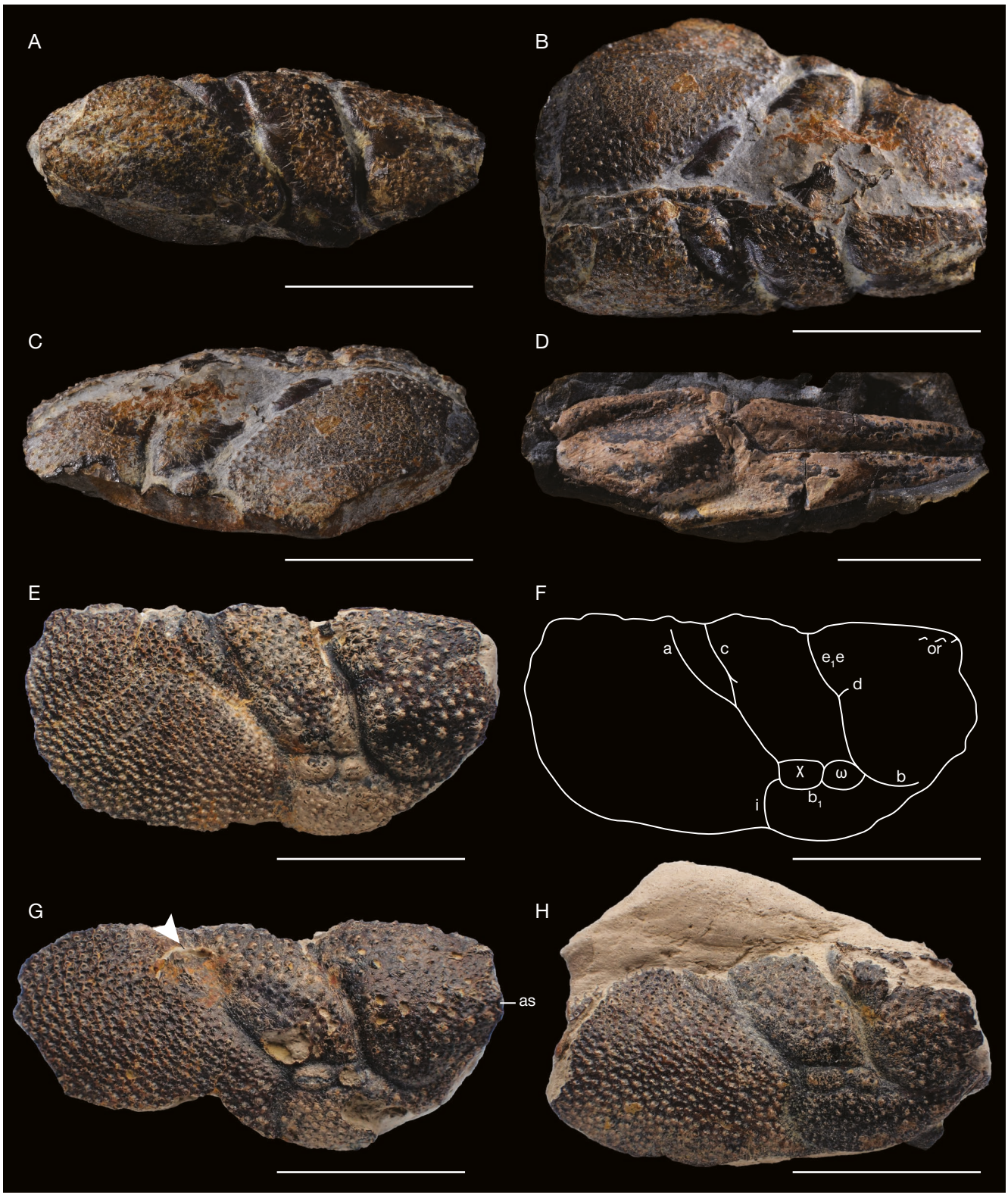

FIG. 2. — *Eryma vocontii* Devillez, Charbonnier, Hyžný & Leroy, 2016 (Erymidae) from the Albian of France: **A**-**D**, type material from Rosans (Hautes-Alpes, South-East Basin); **E**-**H**, new specimens from the Lac du Der (Presqu'Île de Nemours), Éclaron-Braucourt-Sainte Livière (Haute-Marne, Paris Basin); **A**-**C**, holotype MNHN.F.A57457, carapace, right lateral, dorsal, and left lateral views; **D**, paratype MNHN.F.A57458, P1 chela; **E**, **F**, carapace MNHN.F.A98126, right lateral view and line drawing; **G**, carapace MNHN.F.A98128, carapace showing the basis of a strong antennal spine and a fragment of an epibiontic mollusk bivalve shell fixed near the junction between postcervical and branchiocardiac grooves (white arrow); **H**, carapace MNHN.F.A98127, right lateral view. Abbreviations: **a**, branchiocardiac groove; **as**, antennal spine; **b**, antennal groove; $\mathbf{b}_1$, hepatic groove; **c**, postcervical groove; **d**, gastro-orbital groove; $\mathbf{e}_1\mathbf{e}$, cervical groove; **i**, inferior groove; **or**, orbital row; **ω**, attachment site of mandibular muscle; **χ**, attachment site of adductor testis muscle. Scale bars: 10 mm. Photographs: Lilian Cazes (A-D), Richard Brochet (E, G, H). Line drawing: Julien Devillez.

Fig. 3. — *Rathbunopon brisaci* n. sp. (Prosopidae) from the middle Albian of the Lac du Der (Presqu'Île de Nemours), Éclaron-Braucourt-Sainte Livière, Haute-Marne, France: **A**-**C**, holotype MNHN.F.A98122, carapace, dorsal, frontal, and ventro-frontal views; **D**-**F**, paratype MNHN.F.A98121, carapace, dorsal, frontal, and right lateral views. Abbreviations: **a**, branchiocardiac groove; **bg**, branchial groove; **e_1e**, cervical groove; **es**, epibranchial spine; **et**, epigastric tubercle; **iot**, infraorbital margin tooth; **mt**, mesogastric tubercle; **o**, orbit; **oos**, outer-orbital spine; **pt**, protogastric tubercle; **r**, rostrum; **sot**, supraorbital tubercle. Scale bars: 5 mm. Photographs: Richard Brochet.

TYPE LOCALITY. — Éclaron-Braucourt-Sainte-Livière, Presqu'Île de Nemours, Lac du Der (Haute-Marne, Grand-Est, France).

TYPE AGE. — Early Cretaceous (middle Albian), *Hoplites dentatus* ammonite zone.

ADDITIONAL EXAMINED MATERIAL. — *Rathbunopon tuberculatum* (Van Straelen, 1936): **Holotype**. **France** • 1 specimen (carapace; adult); Bourgogne Franche-Comté, Yonne, Auxerre; Early Cretaceous, Hauterivian; MHNAux.2012.0-11.

DESCRIPTION

Carapace, subovoid almost pyriform in outline, longer than wide with maximum width in posterior third of carapace at level of metabranchial region (holotype: carapace length: 16 mm; width: 12 mm; paratype: carapace length without rostrum: 13 mm; width: 12 mm); dorsal surface strongly sculptured, regions well defined by strong inflated tubercles and delimited by deep grooves; dorsal surface covered with small tubercles uniformly arranged; anterolateral margins short, converging anteriorly, medially divided by cervical groove and limited by a rounded epibranchial spine directed outward; hook-shaped outer-orbital spine directed forward; posterolateral margins strongly convex, converging posteriorly twice long anterolateral margins; posterior margin straight and rimmed; front with lateral folds forming inner-orbital spines; rostrum subtriangular, spatulate, with rounded tip, downturned, strongly sulcate axially, narrowing distally; lateral margins of axial groove, reinforced with a line of aligned small tubercles; orbits large, deep, and complete; supraorbital margin with two rounded and upwardly directed tubercles, bigger proximally and smaller distally; strong hook-shaped outer-orbital spine, directed forward, closing laterally the orbit; infraorbital margin with a strong subtriangular tooth, dorsally visible; hepatic regions small, defined by a transverse inflation, contiguous to the rearmost protogastric tubercle and ending below the outer-orbital spine; epigastric region with a pair of strong tubercles located at level of rostral base where the axial depression begins; protogastric regions, with a strong posterior tubercle close to median mesogastric tubercle; mesogastric region subtriangular elongate anteriorly, longer than wide, with three tubercles, two transversely contiguous at base and one bigger in the anterior part of the region; metagastric region not distinguishable from mesogastric region; urogastric region defined by two narrow transverse parallel lobes, bounded by grooves; first urogastric lobe, strongly inflated, connecting with epibranchial lobe laterally; second urogastric lobe, strongly flat, limited by branchiocardiac grooves laterally and separated by a depression from cardiac region posteriorly; cardiac region inverted triangular elongate, weakly inflated and well bounded laterally by deep branchiocardiac groove; epibranchial regions defined by a transverse lobe with an inner single tubercle; meso- and metabranchial regions weakly inflated covered with small tubercles uniformly arranged; intestinal region narrow and flat; cervical, postcervical, branchial, and branchiocardiac grooves well marked, deep, smooth; ventral carapace and appendages not preserved.

DISCUSSION

According to Klompmaker *et al.* (2011) and Ossó *et al.* (2018), the studied specimens can be assigned to *Rathbunopon* Stenzel, 1945 based on the following morphological characters: the subtriangular rostrum downturned, axially sulcate, the supraorbital margin with two tubercles, the hook-shaped outer-orbital spine directed forward, the mesogastric region with three tubercles, the epibranchial region with one tubercle, and the subtriangular cardiac region.

According to Ossó *et al.* (2018), *Rathbunopon* includes eight species (see included species paragraph), of which six are dated to the Early Cretaceous (Hauterivian-Albian).

Klompmaker *et al.* (2011) revised *Rathbunopon obesum* based on additional specimens from Koskobilo and Monte Orobe (northern Spain) since Van Straelen's original specimen was not encountered in the collection of Museo Geológico del Seminario de Barcelona nor in the collection of the Institut Royal des Sciences naturelles de Belgique in Brussels. The subtriangular, spatulate rostrum with rimmed axial depression of *R. brisaci* n. sp. (vs triangular rostrum with smooth axial depression in *R. obesum*), the strongly tuberculated dorsal surface (vs finely pustulate in *R. obesum*), and the strongly convex posterolateral margins (vs nearly straight posterolateral margins in *R. obesum*), and the mesogastric region subtriangular elongate anteriorly, longer than wide, with three tubercles, two transversely contiguous at base and one bigger in the anterior part of the region (vs mesogastric region divided in three raised parts in *R. obesum*) rule out the belonging of the studied specimens to the species from Navarra.

The poor state of preservation of the holotype of *R. schrattenkalkensis*, above all in the frontal region, does not allow a detailed comparison with the present specimens. However, based on the description provided by Klompmaker *et al.* (2011), the studied specimens differ from this species by the strongly tuberculated dorsal ornamentation (vs indented pustules in *R. schrattenkalkensis*) and by the mesogastric region which is subtriangular, elongate anteriorly, longer than wide, and with three tubercles (vs mesogastric region with two raised areas posteriorly, and one anteriorly instead of distinct tubercles in *R. schrattenkalkensis*).

The epigastric regions with one pair of strong tubercles and the epibranchial regions with one tubercle (vs epigastric regions with two pairs of tubercles and epibranchial regions with two tubercles in *R. tarraconensis*), the urogastric region with first lobe, strongly inflated, and second one, strongly flat (vs urogastric region with two short, narrow lobes similar to each other in *R. tarraconensis*), and dorsal regions with strong inflated tubercles uniformly arranged (vs strong tubercles limited to the branchial regions in *R. tarraconensis*) rules out the belonging of the studied specimens to *R. tarraconensis*.

Rathbunopon viai exhibits sinuous supraorbital margins, finely granulated, and bi-fissured, protogastric regions with two tubercles, and epibranchial regions without tubercles. This combination of characters rules out the belonging of the studied specimens to this species.

Rathbunopon tuberculatum is the oldest representative of the genus known to date. The holotype preserves only the

anterior portion of the carapace, making difficult a detailed comparison with the studied specimens. However, the smooth dorsal surface and the protogastric and epibranchial regions with two tubercles are clearly different from the studied specimens.

Three species are restricted to the Cenomanian (Late Cretaceous; see above-reported list). The smooth cardiac region (vs cardiac region with a pair of transverse median pits in *R. polyakron*) and the mesobranchial region with small tubercles uniformly arranged (vs mesobranchial region with one strong tubercle in *R. polyakron*) exclude the belonging of the studied specimens to the type species. The dorsal regions covered with tubercles uniformly arranged (vs tubercles limited to the branchial regions in *R. oblitum*) excludes the belonging of the studied specimens to *R. oblitum*. Finally, the dorsal regions with tubercles (vs smooth dorsal regions in *R. woodsi*) rules out the belonging of the studied specimens to *R. woodsi*.

In conclusion, based on these observations, we can attest that the subtriangular spatulate rostrum with rimmed axial depression, the epibranchial regions with an inner tubercle, and the dorsal surface strongly tuberculate are morphological characters justifying the description of *R. brisaci* n. sp. to accommodate the studied specimens. The recovery of *R. brisaci* n. sp. further confirms the stratigraphic range of *Rathbunopon* limited to the Early Cretaceous–early Late Cretaceous.

Subsection GYMNOPLEURA Bourne, 1922
Superfamily PALAEOCORYSTOIDEA
Lőrenthey *in* Lőrenthey & Beurlen, 1929
Family NECROCARCINIDAE Förster, 1968
Subfamily PARANECROCARCININAE
Fraaije, Van Bakel, Jagt & Artal, 2008

Genus *Paranecrocarcinus* Van Straelen, 1936

TYPE SPECIES. — *Paranecrocarcinus hexagonalis* Van Straelen, 1936, by monotypy.

INCLUDED SPECIES. — *Paranecrocarcinus balla* Van Bakel, Guinot, Artal, Fraaije & Jagt, 2012 (Cenomanian, France; Van Bakel *et al.* 2012); *P. hexagonalis* Van Straelen, 1936 (Hauterivian, France; Van Straelen 1936); *P. libanoticus* Förster, 1968 (Cenomanian, Lebanon, France, southern England; Förster 1968; Charbonnier *et al.* 2017); *P. mozambiquensis* Förster, 1970 (Cenomanian, Mozambique; Förster 1970); *P. perchati* n. sp. (this study); *P. xivertensis* Ossó, Charbonnier, Hyžný, van Bakel & Devillez *in* Ossó, Charbonnier, Hyžný, van Bakel, Devillez, Bover-Arnal & Moreno-Bedmar, 2024 (Aptian, Spain; Ossó *et al.* 2024).

Paranecrocarcinus perchati n. sp.
(Fig. 4)

urn:lsid:zoobank.org:act:70529EDC-FE01-45A7-9EE8-0EDFCD450FC6

DIAGNOSIS. — Carapace subhexagonal, moderately arched in both directions; spatulate-shaped rostrum, depressed axially, protruded beyond orbits, and strongly downturned; rostral lateral margins with one median strong swelling; supraorbital margin with two narrow fissures; anterolateral margins slightly convex, armed with small spines (4-5 as preserved); epibranchial angle strongly upturned with one well-developed rounded swelling; epigastric region flat with two post-frontal slits; protogastric regions with a pair of strong swellings and one contiguous smaller swelling, aligned transversely; cardiac region diamond shaped, slightly inflated, without tubercles; epibranchial regions with one inner small swelling close to branchiocardiac groove; mesobranchial regions with one marginal small swelling; cervical groove deep with gastric pits on either side of narrow medial gap; dorsal carapace surface from cervical groove to posterior margin covered with small granules uniformly arranged, gastric and hepatic regions scarcely granulate; granules more condensed on rostral, protogastric, epibranchial, and mesobranchial swellings.

ETYMOLOGY. — The specific epithet honours Mikael Perchat, president of the amateur palaeontological and geological club CMPG (Club Marnais en Paléontologie et Géologie).

TYPE MATERIAL. — **Holotype**. **France** • 1 specimen (carapace; adult); Grand-Est, Haute-Marne, Éclaron-Braucourt-Sainte Livière, Lac du Der, Presqu'Île de Nemours; Early Cretaceous, middle Albian, *Hoplites dentatus* ammonite biozone; Richard Brochet leg.; MNHN.F.A98123.

TYPE LOCALITY. — Éclaron-Braucourt-Sainte Livière, Presqu'Île de Nemours, Lac du Der (Haute-Marne, Grand-Est, France).

TYPE AGE. — Early Cretaceous (middle Albian), *Hoplites dentatus* ammonite zone.

DESCRIPTION

Carapace subhexagonal (length: *c.* 13 mm; width: *c.* 14 mm), moderately arched in both directions; front produced as spatulate-shaped rostrum, depressed axially, protruded beyond orbits, and strongly downturned; rostral lateral margins with one median strong swelling; orbits close together directed forwards; supraorbital margin with two narrow fissures; anterolateral margins slightly convex, armed with small spines (4-5 as preserved); posterolateral margins straight, backwards converging, defined by a fine rim of granules; epibranchial angle strongly upturned with a well-developed rounded swelling; posterior margin strongly concave, rimmed; regions moderately defined, generally swollen; hepatic regions small, flat; epigastric region flat with two post-frontal slits; protogastric regions with a pair of strong swellings and one contiguous smaller swelling, aligned transversely; meso- and metagastric regions indistinct; urogastric region slightly inflated; cardiac region diamond shaped, slightly inflated, without tubercles; intestinal region flat; epibranchial regions with one inner small swelling close to branchiocardiac groove; meso- and metabranchial regions fused, smooth; mesobranchial regions with one marginal small swelling; cervical groove deep with gastric pits on either side of narrow medial gap; branchiocardiac grooves deep; marked cardiac region laterally; dorsal carapace surface from cervical groove to posterior margin covered with small granules uniformly arranged, gastric and hepatic regions scarcely granulated; granules more condensed on rostral, protogastric, epibranchial, and mesobranchial swellings.

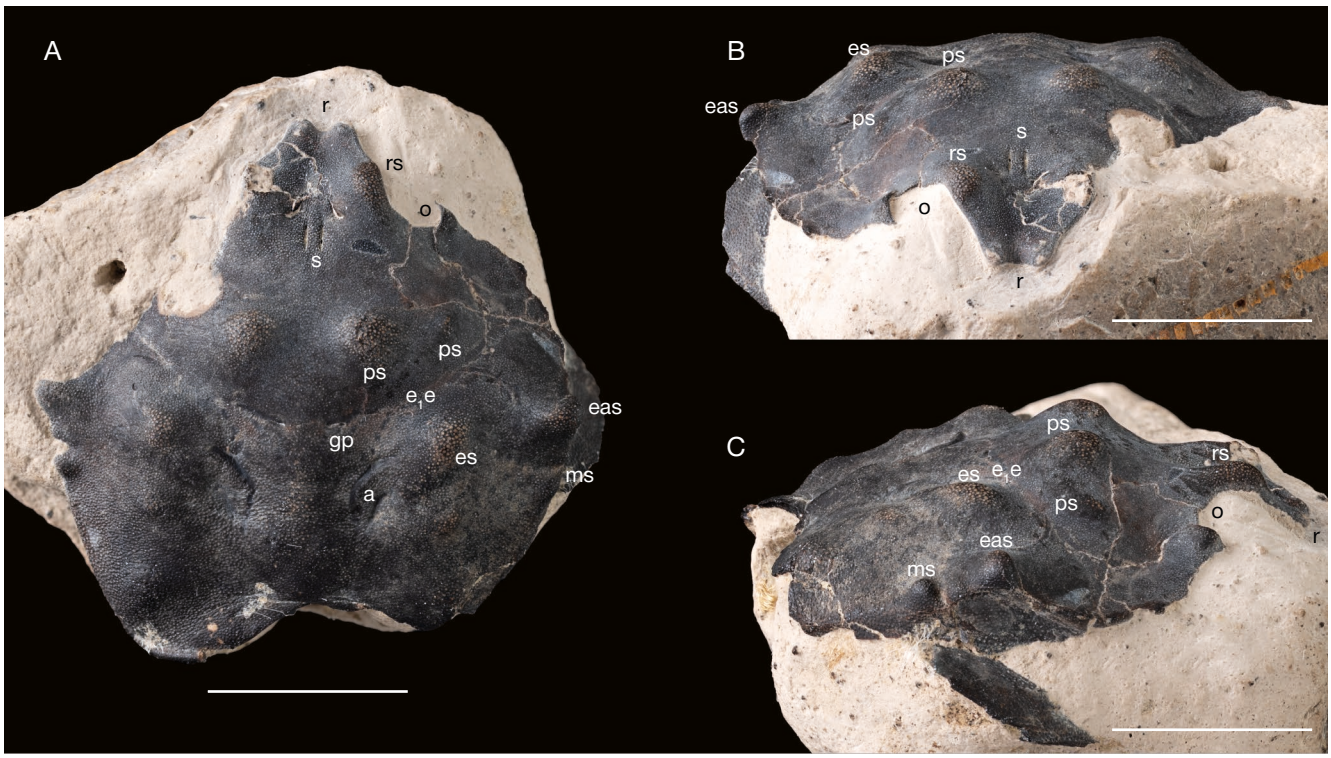

Fig. 4. — *Paranecrocarcinus perchati* n. sp. (Necrocarcinidae) from the middle Albian of the Lac du Der (Presqu'Île de Nemours), Éclaron-Braucourt-Sainte Livière, Haute-Marne, France: holotype MNHN.F.A98123, carapace, dorsal (**A**), frontal (**B**), and right lateral (**C**) views. Abbreviations: **a**, branchiocardiac groove; **e_1e**, cervical groove; **eas**, epibranchial angle swelling; **es**, epibranchial swelling; **gp**, gastric pit; **ms**, mesobranchial swelling; **o**, orbit; **ps**, protogastric swelling; **r**, rostrum; **rs**, rostral swelling; **s**, slits. Scale bars: 5 mm. Photographs: Lilian Cazes.

Discussion

Based on Van Bakel *et al.* (2012) and Schweitzer *et al.* (2018), some characters support the assignment of the studied specimen to *Paranecrocarcinus*, such as the carapace with protogastric and branchial swellings, orbits directed anteriorly, rostrum axially sulcate, and epigastric regions with a pair of elongate slits.

Ossó *et al.* (2024) provided an updated list of the species of *Paranecrocarcinus*. Among these, only three species are known to date from the Early–Late Cretaceous of Europe: *P. hexagonalis* (Hauterivian, France), *P. xivertensis* (Aptian, Spain), and *P. balla* (Cenomanian, France).

As reported by Van Straelen (1936), the urogastric region with one median tubercle and the cardiac region with a pair of medial tubercles exclude the specimen from belonging to *P. hexagonalis*.

The cardiac region with three tubercles (vs smooth cardiac region in the studied specimen) and the mesobranchial regions smooth (vs mesobranchial regions with one marginal small swelling in the studied specimen) exclude the belonging of the studied specimen to *P. xivertensis.*

We exclude the belonging of the studied specimen to *P. balla* for the different dorsal carapace ornamentation finely pitted between small and large tubercles in *P. balla* (vs small granules uniformly arranged posteriorly, gastric and hepatic regions scarcely granulated in the studied specimen). The same observations on the dorsal carapace (location and number of tubercles and ornamentation with pits or granules) can be made for *P. mozambiquensis* and *P. libanoticus*.

The spatulate-shaped rostrum strongly downturned, the rostral lateral margins with one median inflated swelling, the epibranchial angle strongly upturned, the cardiac region without swellings, the mesobranchial regions with one marginal swelling, the dorsal carapace surface covered posteriorly with small granules uniformly arranged, the gastric and hepatic regions scarcely granulated, and granules more thickened on rostral, protogastric epibranchial, and mesobranchial swellings are enough characters to justify the description of *P. perchati* n. sp. for the studied specimen. This is the second report of *Paranecrocarcinus* from the Early Cretaceous of France.

Family Palaeocorystidae
Lőrenthey *in* Lőrenthey & Beurlen, 1929

Genus *Joeranina*
Van Bakel, Guinot, Artal, Jagt & Fraaije, 2012

Type species. — *Corystes broderipii* Mantell, 1844, original designation by Van Bakel *et al.* (2012).

Included species. — *Joeranina broderipii* (Mantell, 1844) (middle-late Albian-?Cenomanian, England, France, Switzerland; Mantell 1844, Van Bakel *et al.* 2012); *J. colombiana* Bermúdez, Gómez-Cruz & Vega *in* Bermúdez, Gómez-Cruz, Hyžný, Moreno-Bedmar, Barragán, Sánchez & Vega, 2013 (Aptian-Albian, Colombia; Bermúdez *et al.* 2013); *J. gaspari* Van Bakel, Guinot, Artal, Jagt & Fraaije, 2012 (Aptian, Spain; Van Bakel *et al.* 2012); *J. goshourajimensis* Karasawa & Komatsu,

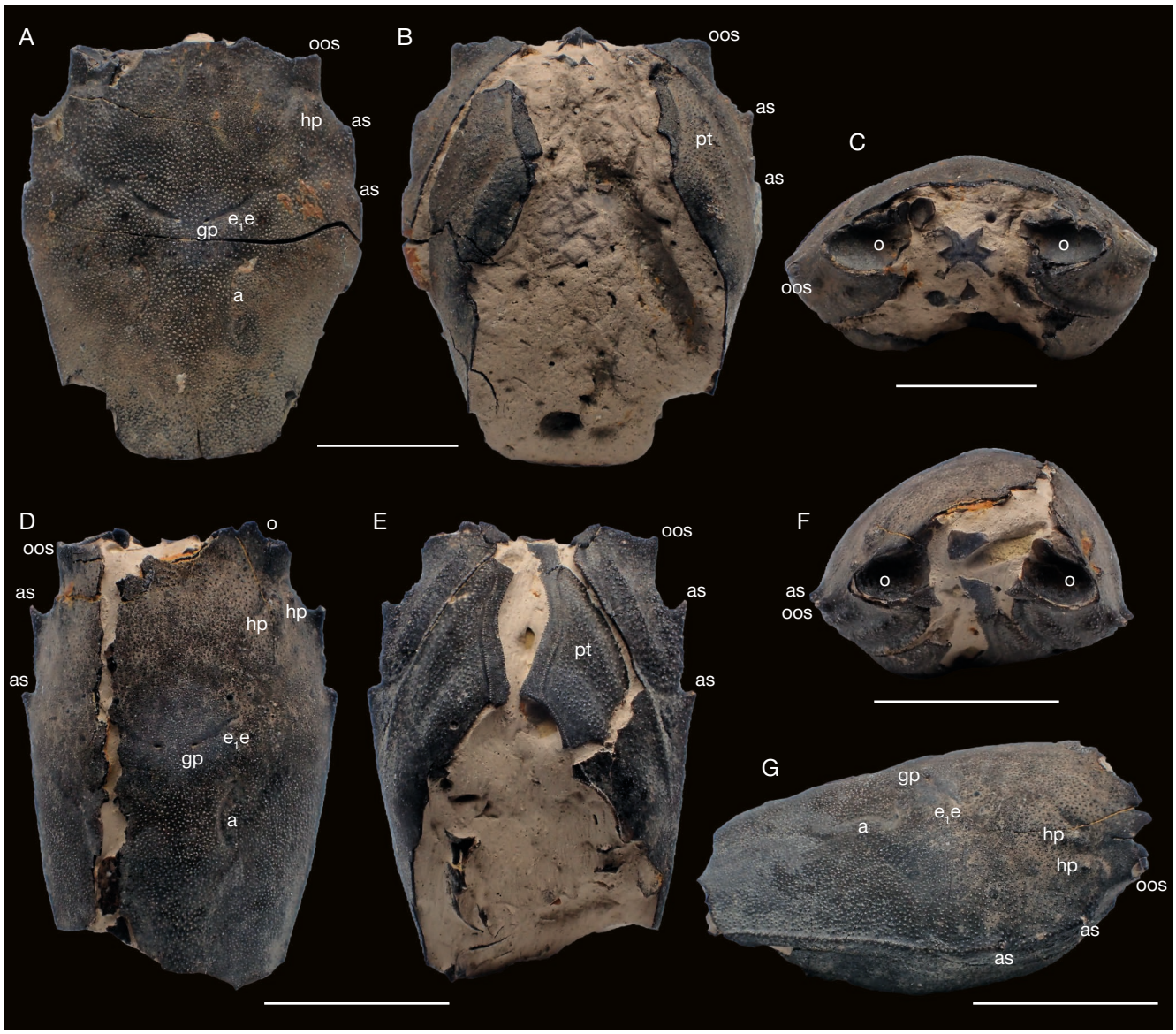

FIG. 5. — *Joeranina scheitzi* n. sp. (Palaeocorystidae) from the middle Albian of the Lac du Der (Presqu'Île de Nemours), Éclaron-Braucourt-Sainte Livière, Haute-Marne, France: **A**-**C**, holotype MNHN.F.A98124, carapace, dorsal, ventral, and frontal views; **D**-**G**, paratype MNHN.F.A98125, carapace, dorsal, ventral, frontal, and right lateral views. Abbreviations: **a**, branchiocardiac groove; **as**, anterolateral spine; **e$_1$e**, cervical groove; **gp**, gastric pit; **hp**, hepatic suborbital protuberance; **o**, orbit; **oos**, outer-orbital spine; **pt**, pterygostome. Scale bars: 5 mm. Photographs: Richard Brochet.

2013 (Middle Cretaceous, Japan; Karasawa & Komatsu 2013); *J. harveyi* (Woodward, 1896) (Cenomanian, British Columbia, Canada; Woodward 1896); *J. houssineaui* Van Bakel, 2013 (Cenomanian, France; Van Bakel 2013); *J. japonica* (Jimbô, 1894) (Cenomanian-Santonian, Japan; Jimbô 1894); *J. kerri* (Luque, Feldmann, Schweitzer, Jaramillo & Cameron, 2012) (Aptian, Columbia; Luque *et al.* 2012); *J. paututensis* (Collins & Rasmussen, 1992) (late Santonian or early Campania, West Greenland; Collins & Rasmussen 1992); *J. platys* (Schweitzer & Feldmann, 2002) (Albian, USA; Schweitzer & Feldmann 2002); *J. scheitzi* n. sp. (this study); *J. syriaca* (Withers, 1928) (Cenomanian, Syria; Withers 1928); *J. tausi* Ossó, Charbonnier, Hyžný, van Bakel & Devillez *in* Ossó, Charbonnier, Hyžný, van Bakel, Devillez, Bover-Arnal & Moreno-Bedmar, 2024 (Albian, Spain; Ossó *et al.* 2024).

Joeranina scheitzi n. sp.
(Fig. 5)

urn:lsid:zoobank.org:act:BD1690E5-B429-494D-96CF-80CD344D02A6

DIAGNOSIS. — Small carapace, longitudinally ovate, strongly convex transversely, flat longitudinally, longer than wide; fronto-orbital margin broad; orbits wide, deep; supraorbital margin with two narrow fissures, outer-orbital spines conical, acute, forwardly directed; anterolateral margins short with two spines; posterolateral margins longer, straight, rimmed; posterior margin very short, weakly concave; hepatic regions with a pair of small suborbital protuberances; cervical groove broadly U-shaped, deeper medially, almost indistinct laterally; gastric pits close together; branchio-

cardiac grooves deep; axial carina weakly marked for the entire length of the carapace; dorsal surface covered with small granules uniformly arranged.

ETYMOLOGY. — The specific epithet honours Martial Scheitz, vice-president of the amateur palaeontological and geological club CMPG (Club Marnais en Paléontologie et Géologie).

TYPE MATERIAL. — **Holotype**. **France** • 1 specimen (carapace; adult); Grand-Est, Haute-Marne, Éclaron-Braucourt-Sainte Livière, Lac du Der, Presqu'Île de Nemours; Early Cretaceous, middle Albian, *Hoplites dentatus* ammonite biozone; Richard Brochet leg.; MNHN.F.A98124.
Paratype. **France** • 1 specimen (carapace; adult); Grand-Est, Haute-Marne, Éclaron-Braucourt-Sainte Livière, Lac du Der, Presqu'Île de Nemours; Early Cretaceous, middle Albian, *Hoplites dentatus* ammonite biozone; Richard Brochet leg.; MNHN.F.A98125.

TYPE LOCALITY. — Éclaron-Braucourt-Sainte Livière, Presqu'Île de Nemours, Lac du Der (Haute-Marne, Grand-Est, France).

TYPE AGE. — Early Cretaceous (middle Albian), *Hoplites dentatus* ammonite zone.

DESCRIPTION

Subhexagonal carapace, longitudinally ovate, strongly convex transversely, flat longitudinally, longer than wide (holotype, length: 15 mm, width: 12 mm; paratype, length: 13 mm, width: 9 mm); fronto-orbital margin broad; rostrum no preserved; orbits broad and deep; supraorbital margins with two narrow fissures; outer-orbital spines conical, acute, forwardly directed; anterolateral margin short, slightly convex, with two spines, one at hepatic level and one at epibranchial level; posterolateral margins longer, straight, rimmed and narrowing posteriorly; posterior margin very short, weakly concave; dorsal regions indistinct; hepatic regions with a pair of small protuberances aligned transversely; cardiac region wide, well defined by deep branchiocardiac groove laterally; cervical groove, deeper medially and broadly U-shaped, laterally less marked; gastric pits distinct, close together; axial carina weakly marked; dorsal carapace surface covered with small granules uniformly arranged.

DISCUSSION

Based on Van Bakel *et al.* (2012) the assignment of the studied specimens to *Joeranina* rather than other palaeocorystid genera is supported by the following morphological characters: the presence of hepatic suborbital protuberances, a complete cervical groove, and a cuticle microstructure with granules.

Ossó *et al.* (2024) provided an updated list of the species of *Joeranina*. Among these, only four species are known to date from the Early-Late Cretaceous of Europe: *J. broderipii* (middle-late Albian-?Cenomanian, United Kingdom, France, Switzerland), *J. gaspari* (Albian, Spain), *J. tausi* (Albian, Spain), and *J. houssineaui* (Cenomanian, France) to which the studied specimens are compared.

The well-developed axial carina, the anterolateral margins with one spine, and the cervical groove well marked medially and laterally rule out the belonging of the studied specimens to *J. broderipii* (see Charbonnier & Garassino 2022).

The anterolateral margins with three spines exclude the belonging of the studied specimens to *J. gaspari* and *J. tausi* (Ossó *et al.* 2024).

Although *J. houssineaui* has the anterolateral margins with two spines, we exclude the belonging of the studied specimens to this species which has gastric pits well separated (vs close together in the studied specimens), hepatic region with one protuberance (vs a pair of protuberances in the studied specimens), and dorsal carapace surface with granules most prominent on axial carina, postfrontal area, anterolateral area, and posterolateral margins (vs small granules uniformly arranged in the studied specimens) (Van Bakel 2013).

In conclusion, based on the above comparisons restricted to the European species, some characters (anterolateral margins short with two spines, cervical groove broadly U-shaped, deeper medially, almost indistinct laterally, hepatic regions with a pair of small protuberances, gastric pits close together, and dorsal surface covered with small granules uniformly arranged) justify the description of *J. scheitzi* n. sp. to accommodate the studied specimens. It represents the second species of *Joeranina* in the Early Cretaceous of France.

CONCLUSION

Charbonnier *et al.* (2025) stipulated that only a general revision taking into account the historical collections and the new specimens collected by amateur palaeontologists can reveal the true richness of the Early Cretaceous crustacean diversity of France, which is clearly underestimated at present. The present study corroborates their hypothesis, with the description of three new species of brachyuran crabs and the discovery of a species of erymid lobster hitherto unrecorded in the Paris Basin, and which was previously known only from the South-East Basin of France. This study illustrates the strong link between academic research and amateur discoveries.

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