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Geodiversitas is a fast track journal published by the Museum Science Press, Paris

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Tél. : 33 (0)1 40 79 48 05 / Fax : 33 (0)1 40 79 38 40
diff.pub@mnhn.fr / <http://sciencepress.mnhn.fr>

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ISSN (imprimé / *print*) : 1280-9659/ ISSN (électronique / *electronic*) : 1638-9395

The decapod crustacean fauna from the Late Jurassic of Cricqueboeuf, Normandy (France)

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Submitted on 3 February 2023 | accepted on 15 May 2023 | published on 26 October 2023

[urn:lsid:zoobank.org:pub:C8248DDD-2BFE-4EA2-BA9E-92D5E09B9F53](https://zoobank.org/pub:C8248DDD-2BFE-4EA2-BA9E-92D5E09B9F53)

Charbonnier S., Garassino A., Gendry D., Devillez J. & Picot L. 2023. — The decapod crustacean fauna from the Late Jurassic of Cricqueboeuf, Normandy (France). *Geodiversitas* 45 (19): 573–588. <https://doi.org/10.5252/geodiversitas2023v45a19>. <http://geodiversitas.com/45/19>

ABSTRACT

The Late Jurassic (late Oxfordian) fauna from Cricqueboeuf (Normandy, France) is remarkable for its three-dimensionally fossilized crustaceans in carbonate and phosphate nodules, some even preserving eyes and ommatidia network. The crustacean fauna includes four species assigned to the Mecochiridae (*Meyeria hurtrelleorum* n. sp.), Glypheidae (*Glypheopsis trouvillensis*), and Erymidae (*Eryma ventrosum*, *Enoploclytia* sp.). A quantitative analysis based on 191 specimens shows that the fauna was dominated by *Eryma ventrosum* (46.6% of specimens) and *Meyeria hurtrelleorum* n. sp., (40.3%), which makes it unique in the fossil record of the Jurassic crustacean assemblages. *Meyeria hurtrelleorum* n. sp. is one of the oldest occurrences of the genus and its abundance at Cricqueboeuf is outstanding. The palaeoenvironment is interpreted as subtidal mud flats, where the soft substrate was favorable to the settlement and burrowing of both glypheid, mecochirid, and erymid lobsters. Most of the specimens may actually have been preserved directly inside their own burrow, ultimately infilled by reworking of the muddy bottom during detrital inputs.

KEY WORDS

Crustacea,
Decapoda,
Glypheoidea,
Glypheidae,
Mecochiridae,
Erymoidea,
Erymidae
Jurassic,
Normandy,
France,
new species.

RÉSUMÉ

La faune de crustacés décapodes du Jurassique supérieur de Cricqueboeuf, Normandie (France).

La faune du Jurassique supérieur (Oxfordien supérieur) de Cricqueboeuf (Normandie, France) est remarquable par ses crustacés fossilisés en trois dimensions dans des nodules carbonatés et phosphatés, certains conservant même leurs yeux avec le réseau d'ommatidies. La faune de crustacés comprend quatre espèces attribuées aux Mecoichiridae (*Meyeria hurtrelleorum* n. sp.), Glypheidae (*Glypheopsis trouillensis*) et Erymidae (*Eryma ventrosum*, *Enoploclytia* sp.). Une analyse quantitative basée sur 191 spécimens montre que la faune était dominée par *Eryma ventrosum* (46,6 % des spécimens) et *Meyeria hurtrelleorum* n. sp., (40,3 %), la rendant unique dans le registre fossilifère des assemblages de crustacés du Jurassique. *Meyeria hurtrelleorum* n. sp. est l'une des plus anciennes occurrences du genre et son abondance à Cricqueboeuf est remarquable. Le paléoenvironnement est interprété comme correspondant à des vasières subtidales, où le substrat mou était favorable à la colonisation et au creusement de terriers par les glyphéides, mécoichirides et érymides. La plupart des spécimens auraient été conservés directement à l'intérieur de leur propre terrier, comblé par le remaniement du fond boueux lors d'apports détritiques.

MOTS CLÉS

Crustacea,
Decapoda,
Glypheoidea,
Glypheidae,
Mecoichiridae,
Erymoidea,
Erymidae,
Jurassique,
Normandie,
France,
espèce nouvelle.

INTRODUCTION

The decapod crustaceans from the Jurassic deposits of Normandy were reported since the nineteenth century by some pioneers such as Eudes-Deslongchamps (1835, 1842) Morière (1864, 1882), Hée (1924), and Van Straelen (1925) (see historical synthesis by Gendry 2020). In the 2000s, new studies were carried out on occasional but important discoveries in the Early Jurassic (e.g., hermit crabs: Schweigert *et al.* 2013), Middle Jurassic (e.g., isopods: Guinot *et al.* 2005; homolodromioid crabs: Fraaije *et al.* 2013; galatheoid anomurans: Fraaije *et al.* 2019; erymid lobsters: Devillez & Charbonnier 2019), and Late Jurassic (e.g., erymid and glypheid lobsters: Devillez *et al.* 2018; Charbonnier *et al.* 2013; Chény *et al.* 2023). The littoral outcrops along the English Channel (e.g., Vaches Noires cliffs) are particularly favorable to collect fossil crustaceans by amateur palaeontologists and scientists. Herein we report for the first time a rich decapod crustacean fauna from the Late Jurassic (late Oxfordian) of Cricqueboeuf, a locality situated between the Vaches Noires cliffs and the Seine estuary. We describe these crustaceans and present the first faunal inventory. Based on new specimens, we present a precise anatomical description of the glypheid lobster *Glypheopsis trouillensis* Charbonnier, Garassino, Schweigert & Simpson, 2013. We confirm the occurrence of the cosmopolitan erymid lobster *Eryma ventrosum* (Meyer, 1835) at Cricqueboeuf. We describe one of the oldest occurrences of *Meyeria* M'Coy, 1849 in the fossil record. Finally, we present a quantitative analyze based on 191 specimens and we compare the assemblage of Cricqueboeuf to coeval faunas from the Middle Jurassic (late Callovian) of Normandy and from the Late Jurassic (early Oxfordian) of Haute-Saône.

GEOLOGICAL SETTING

The studied specimens were collected in the Late Jurassic deposits of Cricqueboeuf, Calvados Normandy, France (Fig. 1A). The Jurassic is here represented by upper Oxfordian and lower Kimmeridgian deposits (Guyader 1968; Guyader *et al.* 1970). In this area, the original monoclinical structure of the deposits is included within the landslide of the "Fosses du Macre" (Lissak 2012). Therefore, the deposits described herein are not really in situ and they were observed at the bottom of the slope, on the foreshore when it was not buried in sand (DG pers. obs.). The Oxfordian is represented by the Marnes de Villerville Formation, divided into two members. The youngest one corresponds to the Argiles brunes de Cricqueboeuf Member (*Ringsteadia pseudocordata* ammonite biozone), which is composed of clays and ferruginous sandstones. The most basal part corresponds to the Argiles grises de Villerville Member (*Decipia decipiens* ammonite biozone). We distinguish the inferior part made of fossiliferous black clays overlain by a marly limestone and by greenish sands. The sands are under fossiliferous silty black clays, including tree trunks covered by oysters. Above some pebble beds, the second half of Oxfordian deposits are dominated by an alternation of brown clays, beds of sandstones sometime oolitic and ferruginous, and a fossiliferous puddingstone. These terrigenous sediments correspond to the Argiles brunes de Cricqueboeuf Member and mark the end of the upper Oxfordian (Guyader 1968). The stratigraphic nomenclature follows Rioult (1980) and Rioult & Guyader (1980a, b).

The studied crustaceans come from the transition between the Argiles grises de Villerville and the Argiles brunes de Cricqueboeuf members, and where collected in slumped horizons on the foreshore. In addition, the outcrop is periodically partially covered by beach sand and therefore is not entirely visible at all times. The crustaceans enclosed in nodules mainly originate

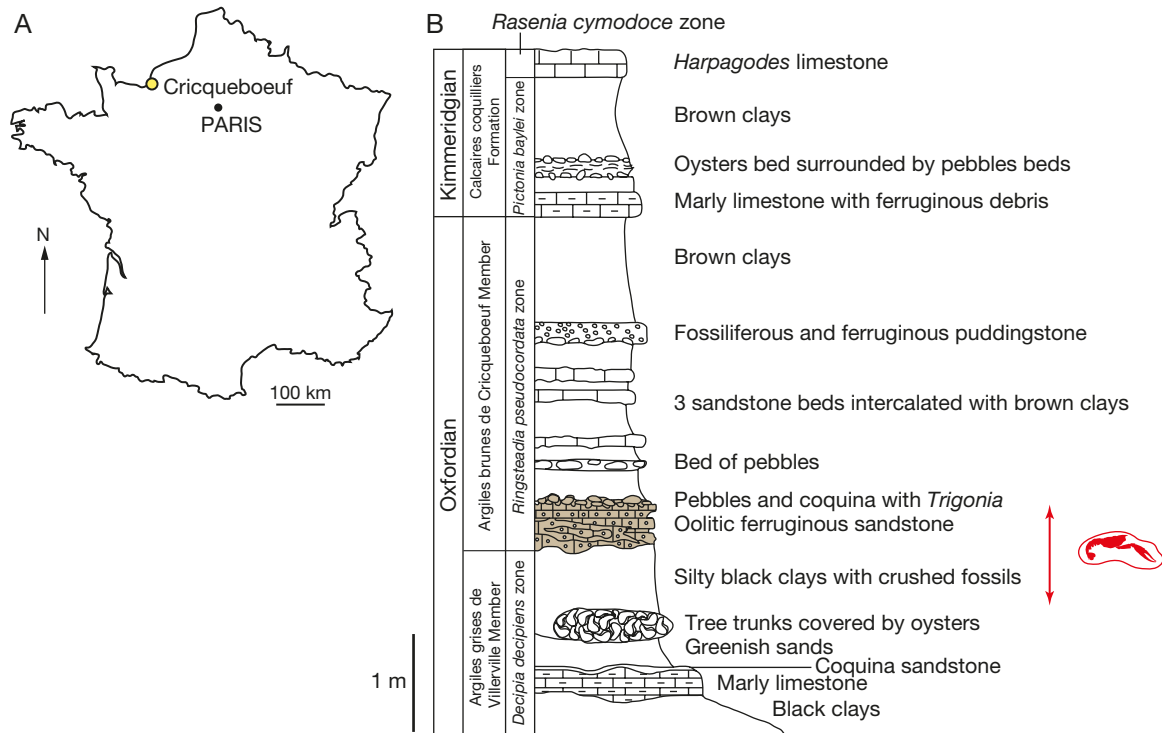


FIG. 1. — Geographic and geological settings: **A**, location of the Cricqueboeuf outcrop in Normandy; **B**, stratigraphic log of the upper Oxfordian-lower Kimmeridgian succession based on Guyader (1968) and modified after Devillez *et al.* (2018). The red arrow indicates the interval of beds yielding crustacean-bearing nodules.

from the black clays at the summit of the Argiles grises de Villerville Member, just below the oolitic ferruginous sandstone (thick bed reported in brown in Fig. 1B). This oolitic ferruginous sandstone, at the basis of the Argiles brunes de Cricqueboeuf Member, also yields some nodules, but the latter are clearly reworked. Indeed, some of these nodules show yellowish quartz grains at their surface indicating reworking of the sediment due to detritic inputs, well documented in the Upper Jurassic sedimentation of Normandy, which was at the boundary between the Paris Basin and the emerged Armorican Massif (Dugué 1989). The sedimentary facies and the associated fauna are indicators of subtidal mudflats characterized by low energy deposits (silt, shales), probable salinity variations linked to detritic inputs disturbing the sediments (Rioul & Guyader (1980a, b; Dugué 1989).

MATERIAL

LOCALITY

The studied material includes 191 specimens generally three-dimensionally preserved enclosed in small greyish to brownish carbonate and phosphate concretions. The majority of the samples was collected on the foreshore of Cricqueboeuf by Jacques and Françoise Hurtrelle, and housed since 2013 at the Paléospace Museum of Villers-sur-Mer, Normandy. The Hurtrelle collection is composed of about 800 vertebrate and invertebrate fossils mostly collected at Cricqueboeuf in the same stratigraphic beds (LP pers. comm. 2022). Other specimens

were collected at the same locality by one of the co-authors (DG) and his wife Coraline Bara, and are housed at the University of Rennes. All these specimens come from the upper Oxfordian beds emerging sporadically on Cricqueboeuf beach.

ABBREVIATIONS

Collection acronyms

FSL-EM	École nationale supérieure des Mines de Paris, collection housed at the Université Claude Bernard Lyon 1, France;
IGR	Musée de Géologie, Université de Rennes (<i>ex</i> Institut de Géologie de Rennes), France;
MNHN.F	Palaeontological collection of the Muséum national d'Histoire naturelle, Paris, France;
MPV	Paléospace-L'Odyssée, Villers-sur-Mer, France.

Crustacean anatomy

CL	carapace length (excluding rostrum);
CH	carapace height;
P1-P5	pereiopods 1 to 5;
s1-s6	pleonal somites 1 to 6.

SYSTEMATIC PALAEONTOLOGY

The systematic arrangement used in the present paper follows the classifications proposed by Charbonnier *et al.* (2015) for the glypheid lobsters and Devillez *et al.* (2019) for the erymid lobsters. We follow the most recent systematic reviews (Robin *et al.* 2016; Charbonnier *et al.* 2021) for the mecochirid lobsters.

Order DECAPODA Latreille, 1802
 Infraorder GLYPHEIDEA Winkler, 1881
 Superfamily GLYPHEOIDEA Winkler, 1881
 Family GLYPHEIDAE Winkler, 1881

Genus *Glypheopsis* Beurlen, 1928

TYPE SPECIES. — *Orphnea ornata* Quenstedt, 1858, subsequent designation by Glaessner (1929: 194).

EMENDED DIAGNOSIS (after Charbonnier *et al.* 2013). — Subcylindrical carapace, laterally compressed; spineless rostrum, elongate, narrow, slightly downward-directed; cephalic region with longitudinal spiny carinae; gastro-orbital groove absent; deep cervical groove, perpendicular to dorsal margin, forming strengthening between cephalic and branchial regions; ventral margin of antennal-ptyergostomial region strongly concave; antennal groove joined with ventral margin of cephalic region; antennal spine strongly developed; very narrow and elongate cephalic region; subparallel postcervical and branchiocardiac grooves; deep postcervical groove joined dorsally and ventrally to branchiocardiac groove, delimiting one elongate lobe; short, straight cardiac groove, forward-inclined and joined posteriorly to postcervical groove; cardiac groove joined to dorsal margin; short, straight intercervical groove, backward-inclined from postcervical to cervical grooves; deep straight branchiocardiac groove, strongly inclined, joined to dorsal margin; weak, straight hepatic groove; deep inferior groove, convex posteriorly, joined to hepatic groove.

INCLUDED FOSSIL SPECIES. — See Charbonnier *et al.* (2013: table 5).

Glypheopsis trouvillensis Charbonnier, Garassino,
 Schweigert & Simpson, 2013
 (Figs 2; 3)

Glypheopsis trouvillensis Charbonnier, Garassino, Schweigert & Simpson, 2013: 153, 154, fig. 331, table 5.

TYPE MATERIAL. — Holotype FSL-EM 80052.

TYPE LOCALITY. — Trouville-sur-Mer, Calvados, Normandy, France.

TYPE AGE. — Late Jurassic (late Oxfordian).

ADDITIONAL EXAMINED MATERIAL. — 24 specimens (MPV 2013.1.146.1-21, 2013.1.288.3, Hurtrelle coll.; IGR-PAL-153416, 153417, Bara coll.) from the Oxfordian of Cricqueboeuf, Calvados, France.

DESCRIPTION

See Charbonnier *et al.* (2013). *Glypheopsis trouvillensis* was described based upon one isolated carapace, which is probably a moulted specimen. Two new specimens (MPV 2013.1.146.1, 2) allow us to add some morphological details previously not provided in the original description.

Pleon

Subrectangular s1-s5 equal in size, with smooth tergum and pleuron; rounded s1-s5 pleura; s2-s5 pleura with marginal carina limited by a groove.

Thoracic appendages

Partially preserved P1 lacking distal extremities (carpus, propodus, and dactylus); P2 preserves only the subsquare

basis; P3-P5 preserve basis, ischium, and incomplete merus; dorsal margin of subsquare P1 basis with one spine at level of ischiobasal articulation; subtriangular P1 ischium strongly enlarged at level of ischiomeral articulation; subrectangular P1 merus; smooth outer surface of P1 ischium and merus; dorsal and ventral margins of P1 ischium and merus covered by spines arranged in parallel rows; elongate P3 merus with smooth outer surface and spiny dorsal and ventral margins.

Ornamentation of carapace

Charbonnier *et al.* (2013: 154) described the ornamentation of the branchial region of the carapace as made by pits dorsally and tubercles medially and ventrally and a tuberculate pterygostomial region. Some additional specimens (MPV 2013.1.146.1-9, 11, 13-15, 19-21, IGR-PAL-153416, 153417) show that the ornamentation of the branchial region is more complex with the ventral area covered by small pits, the median area by small tubercles located inside pits, and the dorsal area by large pits.

DISCUSSION

The postcervical groove joining dorsally and ventrally to branchiocardiac groove, the presence of the cardiac and intercervical grooves and the absence of the gastro-orbital groove in additional specimens are all diagnostic characters of *Glypheopsis*. They are assigned to *G. trouvillensis* because they share with the holotype the three spiny cephalic carinae and the ornamentation of cephalic, cardiac, and branchial regions. Mainly, the ornamentation of the branchial region with a progressive gradation from ventral tubercles to dorsal pits is very typical of *G. trouvillensis*. We add all additional specimens collected in a fossiliferous locality nearby the type locality.

Family MECOCHIRIDAE Van Straelen, 1925

Genus *Meyeria* M'Coy, 1849

TYPE SPECIES. — *Astacus ornatus* Phillips, 1829, original designation by M'Coy (1849: 333).

DIAGNOSIS (after Charbonnier *et al.* 2021). — Subcylindrical carapace, laterally compressed, with ogival-shaped cross-section; pointed rostrum; antennal-ptyergostomial region with strongly concave ventral margin; cervical groove strongly oblique, ventrally joined to antennal groove, delimiting narrow cephalic region; cephalic region with generally three longitudinal carinae; postcervical and branchiocardiac grooves parallel, straight, directed toward posterior margin; postcervical groove joined ventrally to branchiocardiac groove, forming one elongate lobe; elongate and wide cardiac groove, forward-inclined, joined to postcervical groove and to dorsal margin; deep hepatic groove, curved toward posterior; short inferior groove, joined to hepatic groove and interrupted before reaching ventral margin; pleon about twice the length of carapace; subrectangular telson; pseudochelate P1, strongly elongate; P2 shorter than first; pseudochelate P3-P5 with terminal dactylus.

INCLUDED FOSSIL SPECIES. — *Meyeria aragonensis* (Garassino, Artañ & Pasini, 2009) (Oxfordian, Spain); *M. bartholomaei* (Jell, Woods & Cook, 2017) (Aptian, Australia); *M. crofti* Ball, 1960

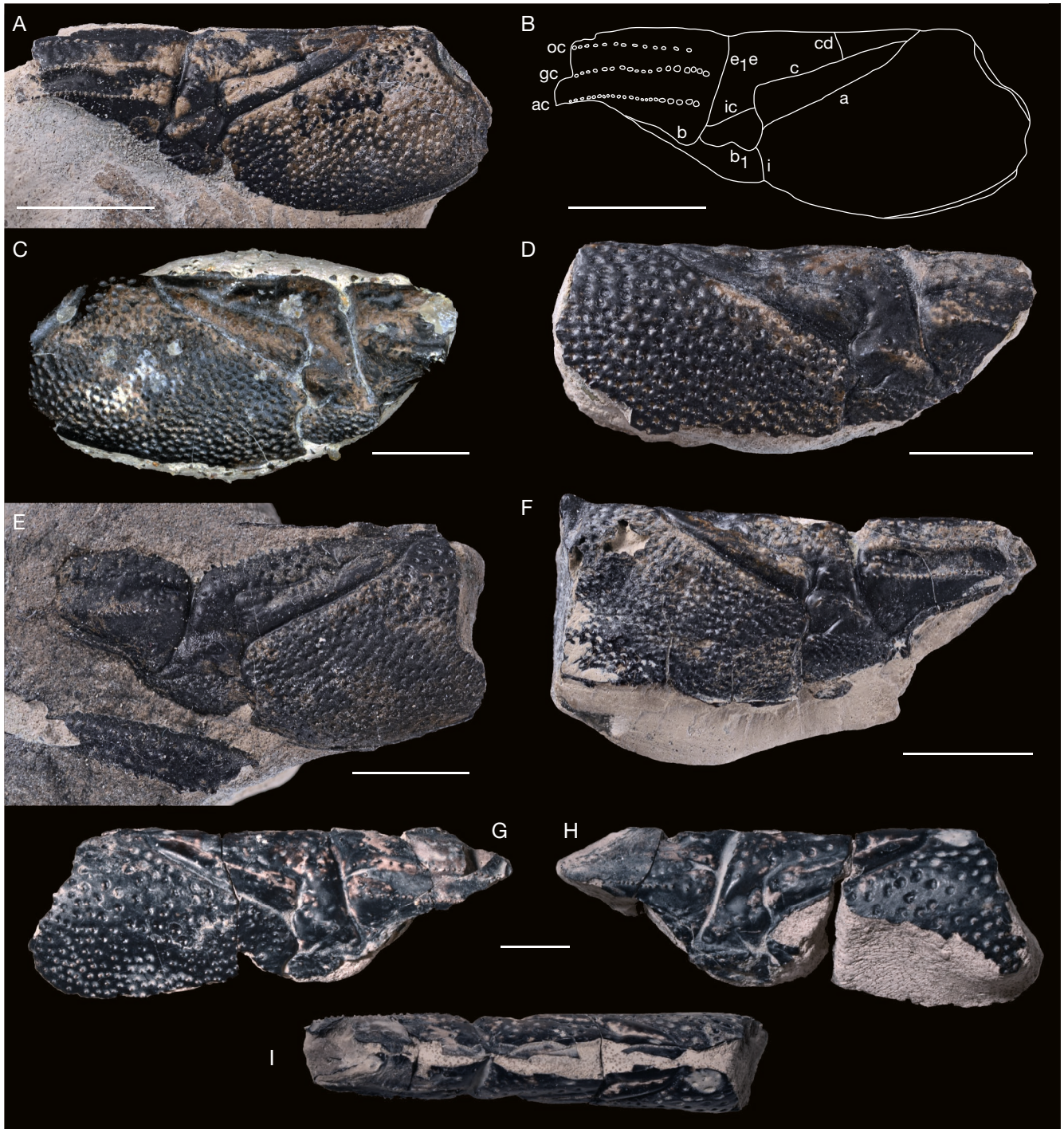


FIG. 2. — *Glypheopsis trouvillensis* Charbonnier, Garassino, Schweigert & Simpson, 2013 from the late Oxfordian of Cricqueboeuf, Normandy: **A, B**, carapace MPV 2023.1.146.5 and interpretative line drawing, left lateral view; **C**, carapace IGR-PAL-153416, right lateral view; **D**, carapace MPV 2013.1.146.3, right lateral view; **E**, carapace MPV 2013.1.146.4, left lateral view; **F**, carapace MPV 2013.1.146.6, right lateral view; **G-I**, carapace IGR-PAL-153417, right lateral, left lateral and dorsal views. Abbreviations: **a**, branchiocardiac groove; **ac**, antennal carina; **b**, antennal groove; **b₁**, hepatic groove; **c**, postcervical groove; **cd**, cardiac groove; **e₁e**, cervical groove; **gc**, gastro-orbital carina; **i**, inferior groove; **ic**, intercervical groove; **oc**, orbital carina; Photographs: L. Cazes, except (C): D. Gendry. Line drawing: S. Charbonnier. Scale bars: 5 mm.

(Campanian, Antarctic); *M. gracilis* Glaessner, 1932 (Hauterivian, Germany); *M. houdardi* (Van Straelen, 1936) (Albian, France); *M. libanotica* Charbonnier, Audo, Garassino in Charbonnier, Audo, Garassino, Simpson, Gèze & Azar, 2021 (Barremian, Lebanon); *M. ornata* (M'Coy, 1849) (Hauterivian: United Kingdom, France,

Germany, The Netherlands, Switzerland; Aptian: United Kingdom); *M. hurtrelleorum* n. sp. (Oxfordian, France; this work); *M. rostrata* (Collins & Rasmussen, 1992) (late Campanian and Maastrichtian, West Greenland); *M. serratosae* (Dupuy de Lôme & de La Revilla, 1956) (Jurassic, Spain).



FIG. 3. — *Glypheopsis trouvillensis* Charbonnier, Garassino, Schweigert & Simpson, 2013 from the Oxfordian of Cricqueboeuf (A–C, E, F) and Trouville-sur-Mer (D), Normandy, France: A–C, subcomplete specimen MPV 2013.1.146.1 (carapace and disconnected pleon), interpretative line drawing of carapace (B), left lateral view (A), and dorsal view of pleon and posterior margin of carapace (C); D, holotype FSL-EM 80052; E, F, carapace and fragments of pereopods MPV 2013.1.146.2, left lateral and ventral views. Abbreviations: a, branchiocardiac groove; ac, antennal carina; b, antennal groove; b₁, hepatic groove; c, postcervical groove; cd, cardiac groove; e₁e, cervical groove; gc, gastro-orbital carina; i, inferior groove; ic, intercervical groove; oc, orbital carina; r, rostrum. Photographs: L. Cazes, except: D, C. Lemzaouda. Line drawing: S. Charbonnier. Scale bars: 5 mm.

Meyeria hurtrelleorum n. sp.
(Figs 4–6)

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ETYMOLOGY. — The specific epithet honors the amateur palaeontologists Jacques and Françoise Hurtrelle who collected the studied specimens.

TYPE MATERIAL. — Holotype MPV 2013.1.289.1; 18 paratypes MPV 2013.1.289.2–17, 2013.1.289.74 (Hurtrelle coll.); one paratype IGR-PAL-153418 (Bara coll.).

TYPE LOCALITY. — Cricqueboeuf (Calvados Department, Basse-Normandie, France).

TYPE AGE. — Late Jurassic (late Oxfordian).

ADDITIONAL EXAMINED MATERIAL. — 59 specimens (MPV 2013.1.289.18–73; 2013.1.302.1, 2, Hurtrelle coll.) from the Oxfordian of Cricqueboeuf, Calvados, France.

DESCRIPTION

Carapace

Subcylindrical carapace, laterally compressed, with ogival cross-section (holotype: CL = 20 mm, CH = 10 mm); short, pointed rostrum, unarmed, with median dorsal depression; straight dorsal margin; rimmed posterior margin; convex ventral margin until antennal-ptyergostomial region with slightly concave ventral margin; shallow orbit; short antennal spine; deep cervical groove strongly oblique, intercepting dorsal margin at angle of *c.* 45°, ventrally joined to antennal groove, delimiting narrow cephalic region; cephalic region with three longitudinal carinae: strongly raised and tuberculate orbital and gastro-orbital carinae; orbital carina shorter than gastro-orbital one, extending along the whole length of the cephalic region; raised tuberculate antennal carina, shortest among the cephalic carinae and slightly concave; equal space among the carinae; strong dorsal carina extending along the whole length of the carapace until rostral base; shallow postcervi-

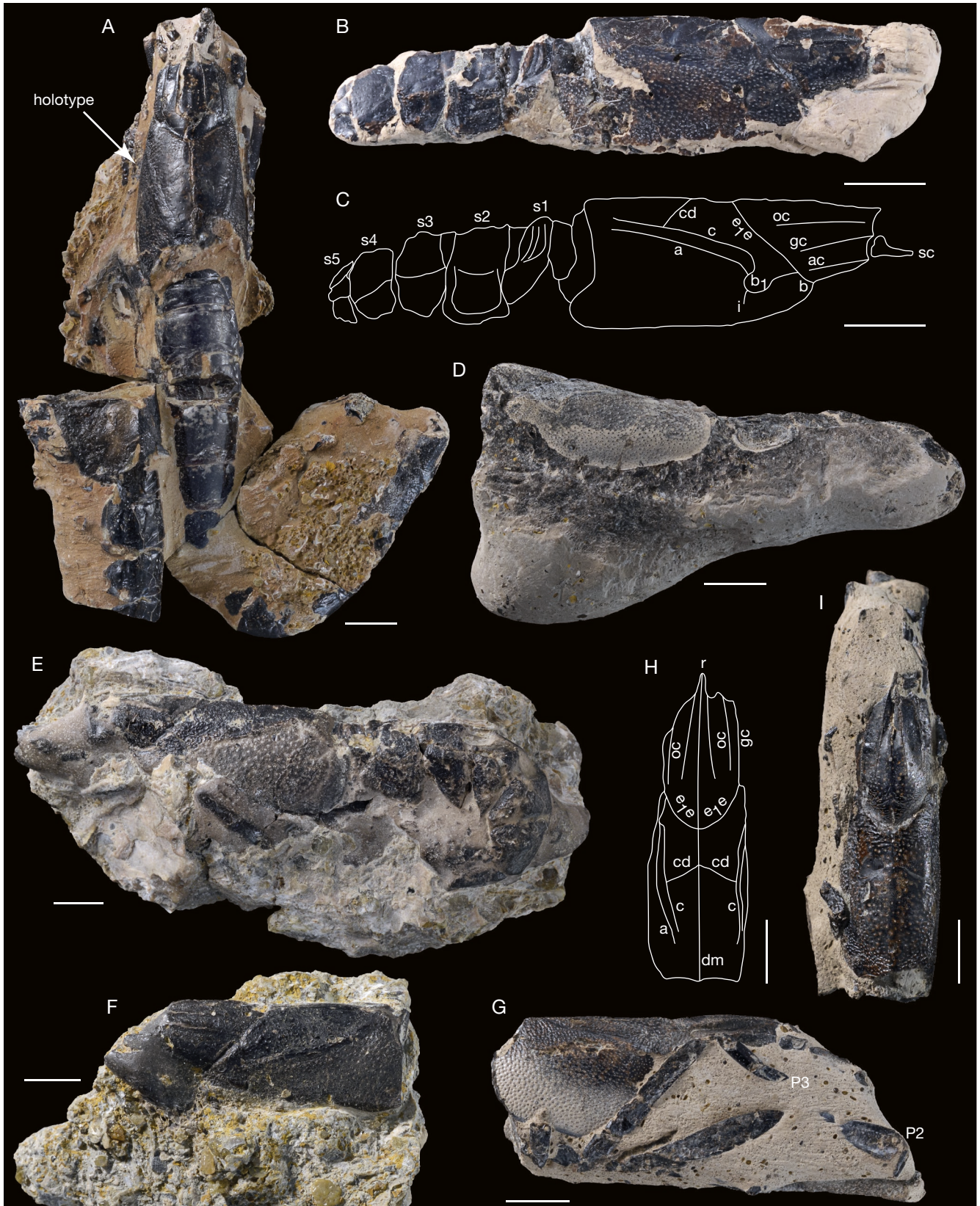


FIG. 4. — *Meyeria hurtrelleorum* n. sp. from the late Oxfordian of Cricqueboeuf, Normandy: **A**, holotype MPV 2013.1.289.1, dorsal view; **B**, **C**, paratype MPV 2013.1.289.11, carapace and pleon, right lateral view and interpretative line drawing; **D**, paratype MPV 2013.289.14, subcomplete specimen always enclosed into a carbonate concretion, left lateral view; **E**, paratype 2013.289.10, subcomplete specimen, left lateral view; **F**, paratype 2013.289.15, isolated carapace, left lateral view, note the coarse matrix with yellowish quartz grains; **G-I**, paratype 2013.289.15, carapace and pereiopods, right lateral and dorsal views, and interpretative line drawing, note the well-preserved subchelate pereiopod 2. Abbreviations: **a**, branchiocardiac groove; **ac**, antennal carina; **b**, antennal groove; **b₁**, hepatic groove; **c**, postcervical groove; **cd**, cardiac groove; **dm**, dorsal midline; **e, e₁**, cervical groove; **gc**, gastro-orbital carina; **i**, inferior groove; **oc**, orbital carina; **r**, rostrum; **sc**, scaphocerite; **s1-s5**, pleonal somites 1 to 5. Photographs: L. Cazes. Line drawings: S. Charbonnier. Scale bars: 5 mm.

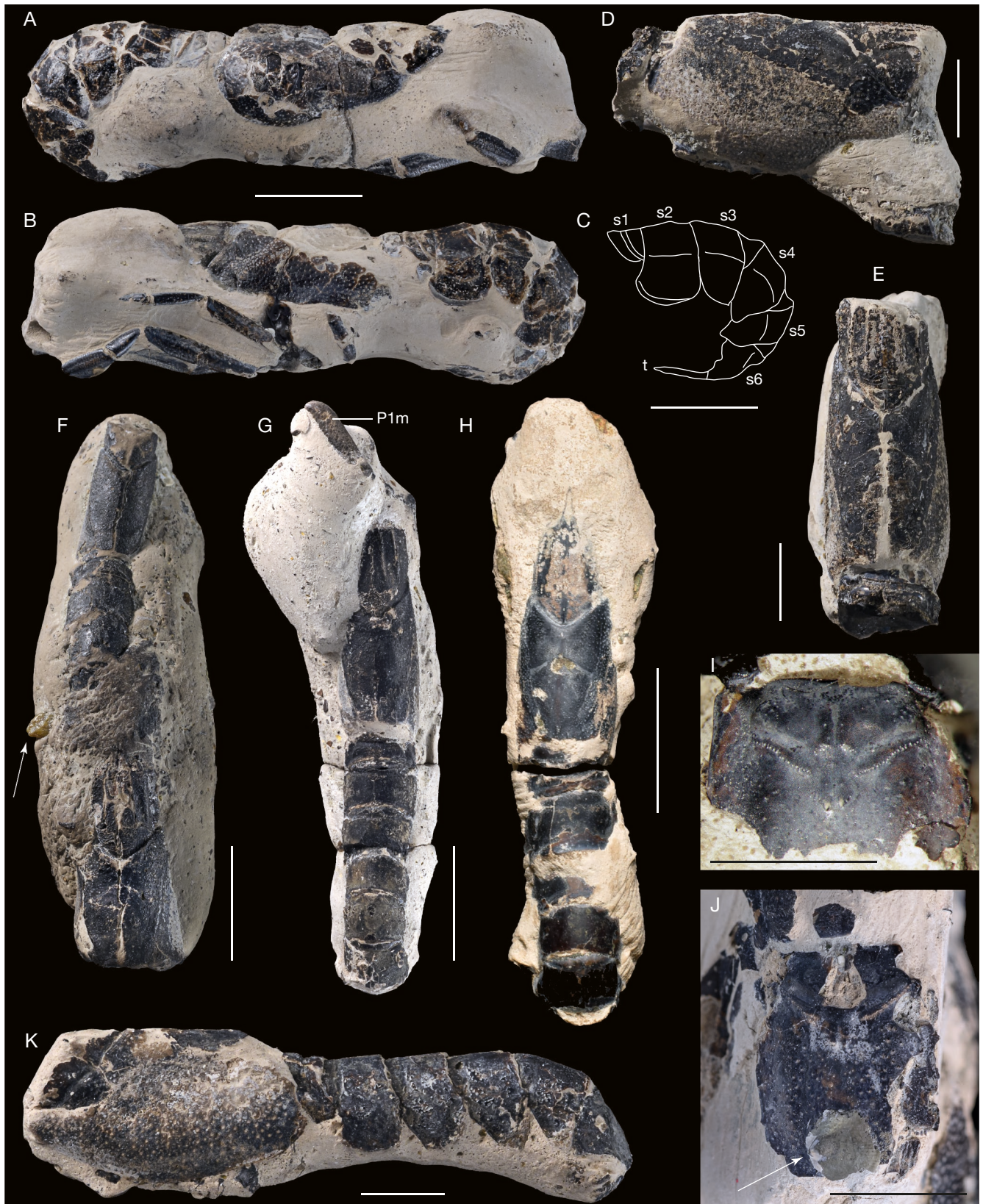


FIG. 5. — *Meyeria hurtrelleorum* n. sp. from the late Oxfordian of Cricqueboeuf, Normandy: **A–C**, paratype MPV 2013.1.289.5, subcomplete specimen showing carapace, pleon, and fragments of pereopods, right lateral and left lateral views, and interpretative line drawing of pleon; **D, E**, paratype MPV 2013.1.289.74, carapace in right lateral and dorsal views; **F**, paratype MPV 2013.1.289.6, two specimens enclosed into the same nodule, dorsal view, note one large yellowish quartz grain (**white arrow**); **G**, paratype MPV 2013.1.289.9, subcomplete specimen, dorsal view; **H–I**, paratype IGR-PAL-153418, subcomplete specimen, dorsal view (**H**) and close-up of telson (**I**); **J**, paratype MPV 2013.1.289.12, close-up of telson, note epibiotic mollusc bivalve fixed on distal part (**white arrow**); **K**, paratype MPV 2013.1.289.16, carapace and pleon, left lateral view. Abbreviations: **P1m**, merus of first pereopod; **s1–s6**, pleonal somites 1 to 6; **t**, telson. Photographs: L. Cazes, except: I, D. Gendry. Line drawing: S. Charbonnier. Scale bars: 5 mm.

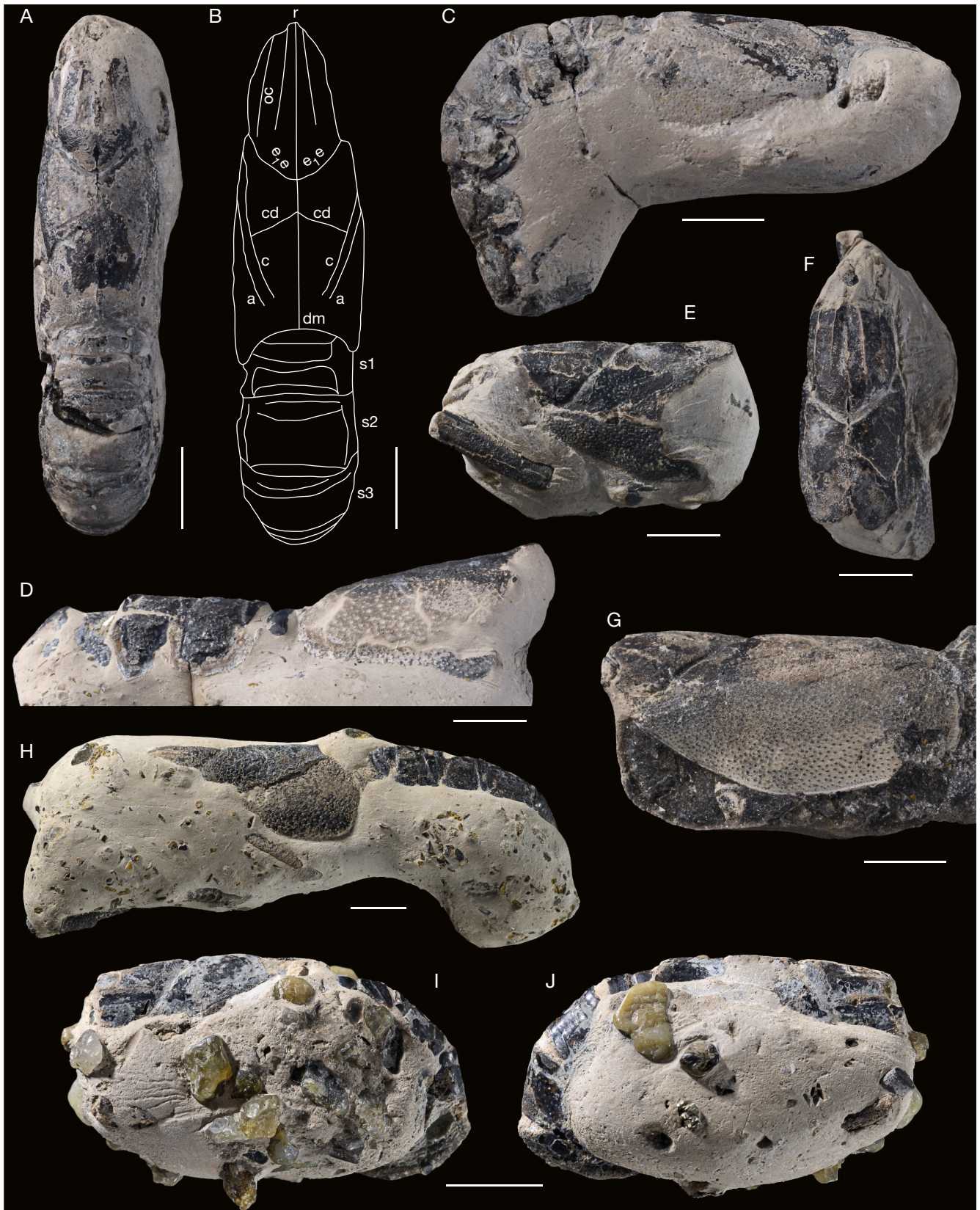


FIG. 6. — *Meyeria hurtrelleorum* n. sp. from the late Oxfordian of Cricqueboeuf, Normandy: **A–C**, paratype MPV 2013.1.289.2, carapace and pleon in connection, dorsal and right lateral views, and interpretative line drawing; **D**, paratype MPV 2013.1.289.2, carapace and close-up of pleonal somites 2 and 3, right lateral view; **E, F**, paratype MPV 2013.1.289.4, fragment of carapace and P1 merus, left lateral and dorsal views; **G**, paratype MPV 2013.1.289.4, close-up of carapace, left lateral view; **H**, subcomplete specimen MPV 2013.1.289.18, almost totally enclosed in carbonate nodule showing yellowish quartz grains and ferruginous oolites; **I, J**, specimen MPV 2013.1.289.58 always enclosed in carbonate nodule showing large, yellowish quartz grains. Abbreviations: **a**, branchio-cardiac groove; **c**, postcervical groove; **cd**, cardiac groove; **dm**, dorsal midline; **e**, cervical groove; **oc**, orbital carina; **r**, rostrum; **sc**, scaphocerite; **s1–s3**, pleonal somites 1 to 3. Photographs: L. Cazès. Line drawing: S. Charbonnier. Scale bars: 5 mm.

cal and branchiocardiac grooves parallel, strongly inclined, directed toward posterior margin; postcervical groove joined ventrally to branchiocardiac groove, forming one elongate, straight lobe; elongate, wide cardiac groove, forward-inclined, joined to postcervical groove and to dorsal margin; deep hepatic groove, curved toward posterior, surrounding weak subcircular hepatic lobe; very short inferior groove, joined to hepatic groove and interrupted before reaching ventral margin; regions uniformly covered by tubercles.

Pleon

Pleon (including telson) about one-third longer than carapace; short s1; very large s2 with rounded anterior and ventral margins and straight posterior margin; s2 pleuron with longitudinal carina on middle portion; s3-s5 almost same in shape and size, with subtriangular pleura; s3-s5 pleura with longitudinal carina on middle portion; s2-s5 pleura with rimmed ventral margins; short subsquare s6 with triangular pleuron; s1-s6 terga and pleura uniformly covered by small tubercles; subrectangular telson with subovate distal extremity and median part limited by lateral longitudinal carinae; proximal part with a pair of short carinae (formed by aligned setal pits) inclined downward and an axial pair of tubercles; tuberculate dorsal surface.

Thoracic appendages

P1 very poorly preserved (e.g., only P1 merus visible in specimen MPV 2013.1.289.9); elongate subchelate P2; subtriangular P2 ischium narrowing proximally; P2 merus twice longer than carpus with spiny lateral margins; P2 propodus with a tuberculate carina extending close to the upper margin; short smooth P2 dactylus, slightly incurved distally; elongate P3 incomplete distally; subrectangular P3 ischium; P3 merus twice longer than carpus; only P4 ischium preserved; P2-P3 meri, carpi, and propodi uniformly covered by small tubercles.

Pleonal appendages

Pleopods of s1-s5 not preserved; left uropodal exopod only preserved in specimen MPV 2013.1.289.12; uropodal exopod slightly longer than telson, with straight spiny diaeresis.

DISCUSSION

The mecochirid lobsters include four genera, *Atherfieldastacus* Simpson *in* Robin *et al.*, 2016, *Huhatanka* Feldmann & West, 1978, *Mecochirus* Germar, 1827, and *Meyeria* M'Coy, 1849 (junior synonym: *Jabaloya* Garassino, Artal & Pasini, 2009). Based on Robin *et al.* (2016) and Charbonnier *et al.* (2021: 4), the studied specimens show morphological characters typical of *Meyeria*: carapace groove pattern with elongate and wide cardiac groove joined to dorsal margin (short cardiac groove joined to dorsal margin in *Atherfieldastacus*; extremely short and not joined to dorsal margin in *Mecochirus*), subcircular hepatic groove, and short inferior groove not joined to ventral margin (joined to ventral margin in *Atherfieldastacus*; absent in *Mecochirus*); carapace with ogival cross section (bevelled sublanceolate in *Atherfieldastacus*; ogival in *Mecochirus*). *Huhatanka* exhibits a very simple carapace groove pattern and a

carapace without branchial carinae, very different from the Cricqueboeuf specimens. Finally, the absence of the branchial carinae, diagnostic character of *Atherfieldastacus* (e.g. González-León *et al.* 2014), allow us to assign confidently the studied specimens to *Meyeria*.

Based on Charbonnier *et al.* (2021: 4), *Meyeria* includes nine species (see above-mentioned list), mostly restricted to the Early and Late Cretaceous. Only *M. aragonensis* (Garassino, Artal & Pasini, 2009) is known to date from the Oxfordian of Jabaloyas (Teruel, Aragón, Spain). Based on Garassino *et al.* (2009: 200, 201), the cephalic region with just one carina (gastro-orbital carina), regions of carapace covered by pits, the spiny ventral margins of s2-s5 pleura, and the spiny outer margin of the uropodal exopod rule out the belonging of the studied specimens of this species.

Charbonnier *et al.* (2013: 278) assigned *Glypheia serratosae* from the Jurassic of Buñol (Valencia, Spain) to *Meyeria* for the absence of the gastro-orbital groove and the elongate wide cardiac groove. As discussed by these authors, the age of this species is still controversial. Dupuy de Lôme & de la Revilla (1956) reported an indeterminate Jurassic age for the fossiliferous locality, whereas Vía (1976) proposed a Middle Jurassic age. Later, Solé & Vía (1989) proposed a Late Jurassic age. Finally, Artal *et al.* (2008) returned to the Jurassic *sensu lato*. Though the age could be controversial, *M. serratosae* represented the only second species of the genus known to date from the Jurassic. Based on Dupuy de Lôme & de la Revilla (1956: 6), the subtriangular s2 pleuron rule out the assignment of the studied specimens to this species.

In conclusion, *M. hurtrelleorum* n. sp. is described to accommodate the studied specimens, representing for the genus the third report from the Jurassic and the second one from the Late Jurassic.

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, subsequent designation by Glaessner (1929: 150).

DIAGNOSIS (after Devillez & Charbonnier 2019). — Fusiform intercalated plate; deep cervical groove, strongly inclined dorsally, joined to dorsal margin and to antennal groove; short gastro-orbital groove, originating as a slight median inflexion of the cervical groove; postcervical groove joined to branchiocardiac groove at carapace mid-height; branchiocardiac groove usually strongly inclined, joined to the posterior extremity of hepatic groove; hepatic groove concavo-convex, joined to cervical groove; inferior groove convex posteriorly, joined to hepatic groove and to ventral margin; v area usually inflated; cephalic region usually with an orbital row and with strong orbital and antennal spines; chelate P1-P3; P1 chelae without prominent spines and with an homogeneous ornamentation; P1 propodus compressed dorso-ventrally with narrow inner and outer margins, with a narrow dactylar bulge; P1 fingers usually longer than propodus, equal in length, progressively narrowing to their

TABLE 1. — Decapod crustaceans from Cricqueboeuf, Normandy, France (late Oxfordian): number of specimens and percentages.

Taxa	Collections			Total of specimens	Percentages
	MPV	IGR	MNHN.F		
<i>Eryma ventrosum</i> (Meyer, 1835)	89	0	0	89	46.6%
<i>Meyeria hurtrelleorum</i> n. sp.	76	1	0	77	40.3%
<i>Glypheopsis trouvillensis</i> Charbonnier, Garassino, Schweigert & Simpson, 2013	22	2	0	24	12.6%
<i>Enoploclytia</i> sp.	0	0	1	1	0.5%
Total	187	3	1	191	100.0%

distal extremity; index wider than dactylus; P1 chelae (form I) with a short rectangular propodus, straight fingers, slightly longer than propodus; P1 chelae (form II) with an elongated subrectangular or trapezoidal propodus, bearing fingers quite longer than propodus, usually curved inward.

Eryma ventrosum (Meyer, 1835)
(Figs 7; 8)

Glypheo ventrosa Meyer, 1835: 329.

Eryma ventrosum – Devillez & Charbonnier 2021: 32, 33–35, figs 3–5 [cum syn.].

TYPE MATERIAL. — Holotype housed at the University of Strasbourg and destroyed by fire in 1967, cast MNHN.F.B12484.

TYPE LOCALITY. — Fréteigny, Haute-Saône, Burgundy, France.

TYPE AGE. — Late Jurassic (Oxfordian).

ADDITIONAL EXAMINED MATERIAL. — 89 specimens including nine articulated specimens with partially preserved pereopods (MPV 2013.1.288.34, 43, 45, 47, 52, 55, 56, 60, 61). — 46 isolated, more or less complete carapaces (MPV 2013.1.164.1, 2013.1.288.1, 2, 4–16, 18, 19, 22–24, 27–33, 37, 38, 41, 42, 46, 49, 53, 54, 57–59, 77–83). — Eight pleons with or without telson or tail fan (MPV 2013.1.288.20, 25, 48, 50, 51, 74, 87, 88). — 16 isolated P1 chelae more or less complete (MPV 2013.1.288.17, 21, 26, 35, 36, 39, 40, 44, 63, 64, 68, 71, 73, 76, 86, 89). — Five isolated P1 dactylus and index (MPV 2013.1.288.62, 66, 67, 69, 85). — Five isolated P1 carpopomer articulations (MPV 2013.1.288. 65, 70, 72, 75, 84). All the samples are from the Oxfordian of Cricqueboeuf, Calvados, Normandy, France.

DESCRIPTION AND DISCUSSION

Devillez & Charbonnier (2021: 34, 36) provided an updated and very complete description of *Eryma ventrosum*. The specimens from Cricqueboeuf show the fusiform intercalated plate typical of the erymid lobsters and a carapace groove pattern typical of *Eryma*: cervical groove, strongly inclined dorsally, joined to dorsal margin and to antennal groove; short gastro-orbital groove, originating as a slight median inflexion of the cervical groove; postcervical groove joined to branchiocardiac groove at carapace mid-height; branchiocardiac groove usually strongly inclined, joined to the posterior extremity of hepatic groove; hepatic groove concavo-convex, joined to cervical groove; inferior groove convex posteriorly, joined to hepatic groove and to ventral margin, inflated pleural basis.

The specimens from Cricqueboeuf have a cervical groove slightly inflected, a short gastro-orbital groove, slightly curved postcervical and branchiocardiac grooves, joined at carapace mid-height, a ventral extension of the postcervical groove, an inflated ω area, a dense, fine ornamentation made of tubercles and crescent-shaped depressions, orbital and antennal rows of tubercles, elongated P1 chelae with a subrectangular propodus which is compressed dorso-ventrally, bearing long thin fingers, progressively curved inward, and armed with numerous teeth. In addition, some specimens show rounded stalked eyes with a well-preserved framework of subsquare ommatidia (Fig. 8B, D–F). All these morphological characters are typical of *E. ventrosum*, which is well-known in the Callovian–Oxfordian deposits of Normandy (Devillez & Charbonnier 2021).

DISCUSSION AND CONCLUSIONS

DIVERSITY AND RELATIVE ABUNDANCE (Table 1; Fig. 9)

The Cricqueboeuf fauna includes four different species of decapod crustaceans assigned to the glypheid lobsters (one species), mecochirid lobsters (one species), and erymid lobsters (two species) (Table 1). The quantitative analysis based on 191 specimens shows two dominant species: *Eryma ventrosum* (46.6% of specimens) and *Meyeria hurtrelleorum* n. sp. (40.3%). The third component of the fauna, *Glypheopsis trouvillensis* (12.6%) is less abundant, however the 24 new specimens confirm that the species was not as rare than expected in the Oxfordian deposits of Normandy. *Enoploclytia* sp. (0.5%) is very rare and only represented by a single specimen reported to date (Devillez *et al.* 2018). It was not recovered in the present rich studied sample, and this confirms its rarity.

By comparison with other Middle–Late Jurassic crustacean faunas (Fig. 9) from the late Callovian of Ste-Scolasse, Calvados, France (Chény *et al.* 2023), and the early Oxfordian of Haute-Saône, France (Charbonnier *et al.* 2012), the Cricqueboeuf fauna is less diversified (four species *versus* five at Ste-Scolasse, and nine in Haute-Saône). However, the samplings are not similar (191 specimens *versus* 149 specimens at Ste-Scolasse, and 424 in Haute-Saône) and the sizes of the study areas are very different (about 1 km² *versus* 12 km² at Ste-Scolasse and 550 km² in Haute-Saône). Thus, the Cricqueboeuf fauna is remarkable, especially by the abundance of *Eryma ventrosum* and *Meyeria hurtrelleorum* n. sp., which is so far unique in the fossil record of the Jurassic crustacean assemblages.

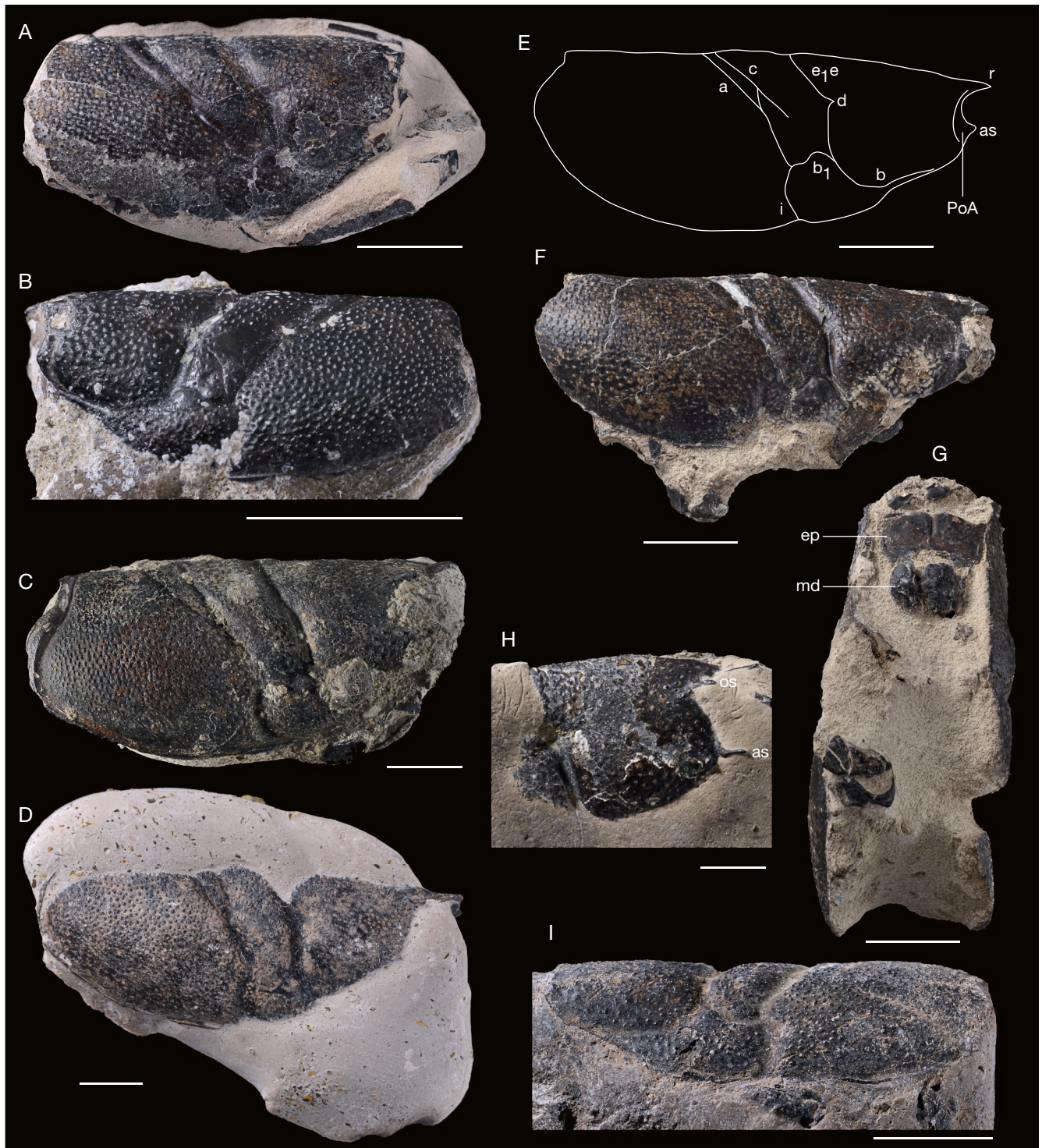


FIG. 7. — *Eryma ventrosum* (Meyer, 1835) from the late Oxfordian of Cricqueboeuf, Normandy: **A**, carapace MPV 2013.1.288.2, right lateral view; **B**, carapace MPV 2013.1.288.13, left lateral view; **C**, carapace MPV 2013.1.288.54, right lateral view; **D**, carapace MPV 2013.1.288.28, partially enclosed in carbonate nodule, right lateral view; **E–G**, carapace MPV 2013.1.288.57, interpretative line drawing, right lateral and ventral views; **H**, carapace MPV 2013.1.288.49, close-up of cephalic region, note the strong orbital and antennal spines; **I**, carapace MPV 2013.1.288.8, close-up of antennal-ptyergostomial and ventral regions. Abbreviations: **a**, branchiocardiac groove; **as**, antennal spine; **b**, antennal groove; **b₁**, hepatic groove; **c**, postcervical groove; **d**, gastro-orbital groove; **ep**, epistome; **e₁e**, cervical groove; **i**, inferior groove; **md**, mandible; **os**, orbital spine; **PoA**, postorbital area; **r**, rostrum. Photographs: L. Cazes. Line drawings: S. Charbonnier. Scale bars: 5 mm.

PALAEOENVIRONMENT & PALAEOECOLOGY

The absence of glypheid species (e.g., *Glyphea regleyana*, *G. muensteri*, *G. dressieri*), which are emblematic of Callo-

vian-Oxfordian deposits in France could support that the Cricqueboeuf assemblage probably reflects differences in palaeoenvironmental conditions. For instance, the Haute-



FIG. 8. — *Eryma ventrosus* (Meyer, 1835) from the late Oxfordian of Cricqueboeuf, Normandy: **A–C**, subcomplete specimen MPV 2013.1.288.61, right lateral, dorsal, and ventral views; **D–F**, specimen MPV 2013.1.288.56, cephalic region showing the eyes, dorsal view (**D**), close-up of stalked-eye (**E**), close-up of ommatidia network (**F**); **G**, specimen MPV 2013.1.288.8, P1 chela, outer view; **H**, specimen MPV 2013.1.288.39, P1 chela, index and propodus, inner view; **I, J**, isolated pleon MPV 2013.1.288.50, dorsal and right lateral views; **K**, specimen MPV 2013.1.288.60, close-up of tail fan. Abbreviations: **ip**, intercalated plate; **o**, eye; **os**, orbital spine; **r**, rostrum. Photographs: L. Cazes, except (E–F): D. Audo. Scale bars: A–C, G–K, 1 cm; D, 5 mm; E, 1 mm; F, 200 µm.

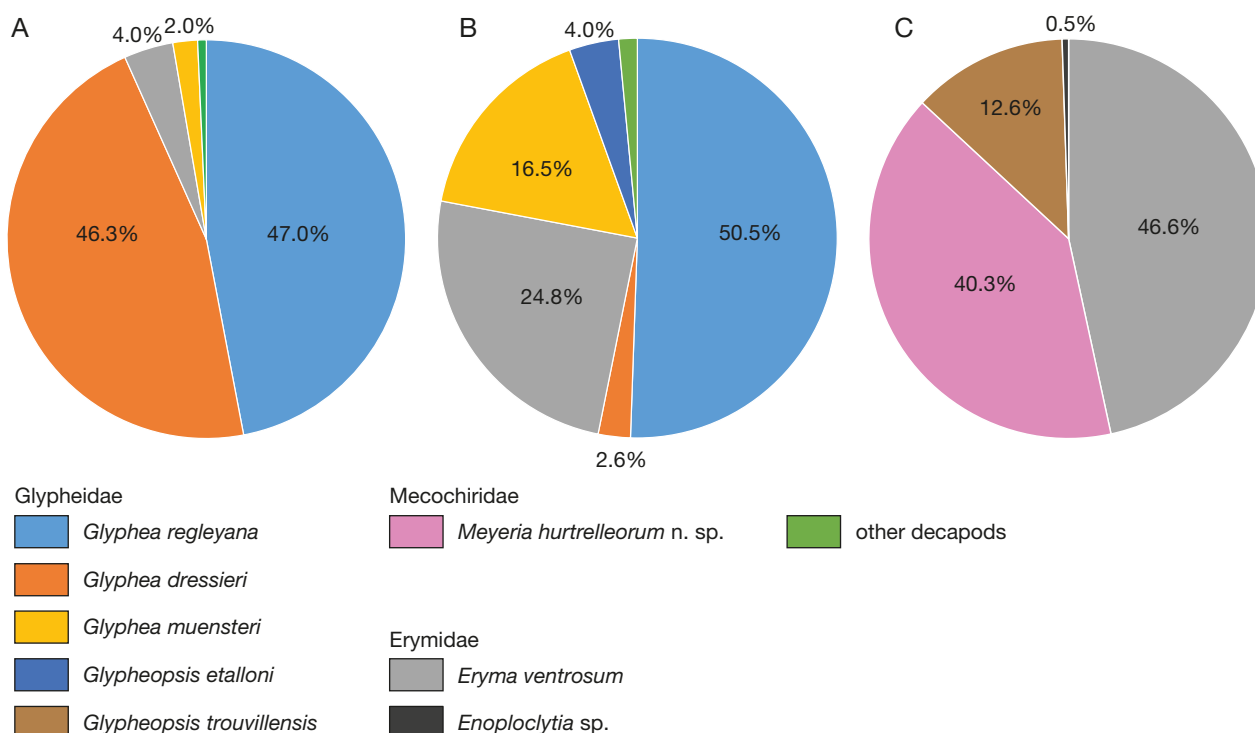


FIG. 9. — Pie charts showing the relative abundances of the crustacean communities from: **A**, Sainte-Scolasse-sur-Sarthe (late Callovian, Normandy, France; after Chény *et al.* 2023); **B**, Haute-Saône (early Oxfordian, east France; after Charbonnier *et al.* 2012); and **C**, Cricqueboeuf (late Oxfordian, Normandy, France; present work).

Saône crustaceans inhabited a moderately deep water setting probably about 100-150 m (lower circalittoral zone), where light intensity was even sensitive (Charbonnier *et al.* 2012). In the Ste-Scolasse area, the palaeoenvironment is interpreted as subtidal mud flats, however, largely open to offshore conditions (upper circalittoral zone). At Cricqueboeuf, the palaeoenvironment is also interpreted as subtidal mud flats by the rarity of nektonic fauna (e.g., ammonites). These conditions were probably suitable for the settlement of mecochirid lobsters, which need soft substrate for burrowing. Indeed, a burrowing habit has already been suggested for mecochirids, as these are often found in burrow-like nodules (see McKerrow 1978; Neto de Carvalho *et al.* 2007; Robin *et al.* 2016). All the studied specimens of *Meyeria hurtrelleorum* n. sp. are three-dimensionally preserved probably directly inside their own burrow infilled by reworking of the muddy bottom during detrital input. The same interpretation is valid for *Glypheopsis trouvillensis* because a burrowing habit is also frequently cited among other Jurassic glypheid lobsters (see *Glyphea regleyana* in Whicher *et al.* [2016]; *Glyphea dressieri* in Sellwood [1971]). It could be also valid for *Eryma ventrosum*, even if there is scarce direct evidence to confirm the burrowing behaviour of erymid lobsters (see *Eryma sinemuriana* [Garassino, 1996] in Monaco & Garassino, 2001). Alternatively, erymids could have used the burrows of other lobsters as shelter for moulting. The preservation of eyes with ommatidia of some Cricqueboeuf specimens suggests they are corpses, not exuviae.

We also notice that *E. ventrosum* is the sole species reported from the three discussed assemblages, suggesting a higher environmental tolerance compared to other species.

Acknowledgements

We thank Torrey Nyborg (Loma Linda University, California, United States of America) and Günter Schweigert (State Museum of Natural History Stuttgart, Germany) for their careful reviews. We are grateful to Karine Boutillier (director of Paléospace Museum, Villers-sur-Mer, Normandy, France) for access and loan of the studied specimens. We thank Jacques and Françoise Hurtrelle for the donation of their collection to the Paléospace Museum of Villers-sur-Mer. We thank Coraline Bara for the donation of her specimens to the geological museum of the University of Rennes. We warmly thank the photographers Lilian Cazes (MNHN, CR2P) and Denis Audo (MNHN, CR2P).

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*Submitted on 3 February 2023;
accepted on 15 May 2023;
published on 26 October 2023.*