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A new stenochirid lobster (Crustacea, Decapoda, Stenochiridae) from the Early Jurassic of France

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KEY WORDS
France,
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Astacidea,
Stenochiridae,
new species.

ABSTRACT
The marine clawed lobster genus *Pseudastacus* Oppel, 1861, previously known mainly from the Late Jurassic lithographic limestones of Bavaria (Germany), is herein recorded from the Early Jurassic (Sinemurian, *c.* 190-199 Ma) of France. A new species, *Pseudastacus lemovices* n. sp., is introduced. It is the oldest representative of the genus and of the family Stenochiridae Beurlen, 1828.

MOTS CLÉS
France,
Jurassique,
Sinémurien,
Crustacea,
Decapoda,
Astacidea,
Stenochiridae,
espèce nouvelle.

RÉSUMÉ
Une nouvelle langoustine sténochiride (Crustacea, Decapoda, Stenochiridae) du Jurassique inférieur de France.
Pseudastacus Oppel, 1861, un genre de langoustine connu jusqu'à présent principalement dans les calcaires lithographiques du Jurassique supérieur de Bavière (Allemagne) est ici découvert dans le Jurassique inférieur (Sinémurien, *c.* 190-199 Ma) de France. Une nouvelle espèce, *Pseudastacus lemovices* n. sp., est décrite. Il s'agit du plus ancien représentant du genre et de la famille des Stenochiridae Beurlen, 1928.

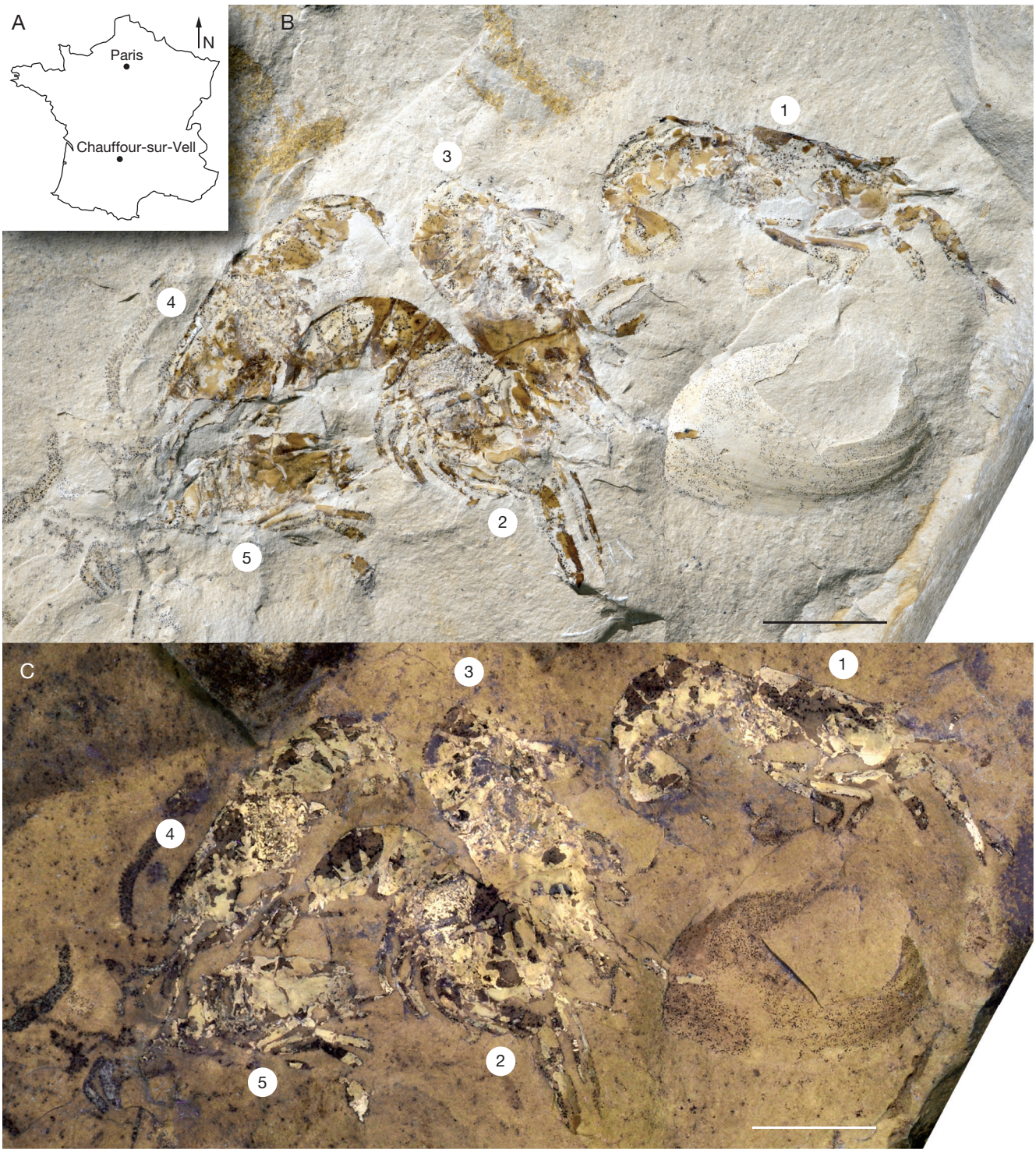

Fig. 1. — *Pseudastacus lemovices* n. sp. from the Sinemurian of Chauffour-sur-Vell, France: **A**, map of France with location of the type locality; **B**-**C**, slab CN-NMP-130 with the association of five preserved specimens, natural light (**B**) and UV light (**C**). Abbreviations: **1**, holotype CN-NMP-130-1; **2**-**5**, paratypes CN-NMP-130-2 to 130-5. Photographs: P. Loubry. Scale bars: 10 mm.

INTRODUCTION

Stenochirid lobsters (Astacidea, Stenochiroidea, Stenochiridae) are a group of exclusively fossil marine clawed lobsters which members are relatively rare and limited to some Jurassic and Cretaceous outcrops (Table 1). Following the phylogeny and systematics of lobsters proposed by Karasawa *et al.* (2013), the historical composition of the family evolved including five genera (*Stenochirus* Oppel, 1861a, *Pseudastacus* Oppel, 1861b, *Palaeophoberus* Glaessner, 1932, *Tillocheles* Woods, 1957, *Chilenophoberus* Chong & Förster, 1976). The inclusion of *Pseudastacus* within the stenochirids is recent and any discovery

TABLE 1. — List of the members of the family Stenochiridae Beurlen, 1928.

Taxa	Outcrops		Ages		References
Stenochirus Oppel, 1861					
Stenochirus angutus (Münster, 1839)	Solnhofen	Germany	Tithonian	Late Jurassic	Münster (1839); Oppel (1861a, 1862); Garassino & Schweigert (2006)
Stenochirus mayeri Oppel, 1862	Solnhofen	Germany	Tithonian	Late Jurassic	Oppel (1862); Garassino & Schweigert (2006)
Stenochirus vahldieki Schweigert, Garassino & Riou, 2006	La Voulte-sur-Rhône	France	Callovian	Middle Jurassic	Schweigert *et al.* (2006); Charbonnier (2009)
Pseudastacus Oppel, 1861					
Pseudastacus pustulosus (Münster, 1839)	Solnhofen	Germany	Tithonian	Late Jurassic	Münster (1839); Oppel (1861b, 1862); Garassino & Schweigert (2006)
?*Pseudastacus pusillus* Van Straelen, 1925	May-sur-Orne	France	Bajocian	Middle Jurassic	Van Straelen (1925)
Pseudastacus lemovices n. sp.	Chauffour-sur-Vell	France	Sinemurian	Early Jurassic	this work
Palaeophoberus Glaessner, 1932					
Palaeophoberus portlandicus Roger & Lapparent, 1944	Hannaches	France	Tithonian	Late Jurassic	Roger & Lapparent (1944)
Palaeophoberus suevicus (Quenstedt, 1867)	Reutlingen	Germany	Aalenian	Middle Jurassic	Quenstedt (1867); Glaessner (1932)
Chilenophoberus Chong & Förster, 1976					
Chilenophoberus atacamensis Chong & Förster, 1976	Cordillera de Domeyko	Chile	Oxfordian	Late Jurassic	Chong & Förster (1976)
Tillocheles Woods, 1957					
Tillocheles kaoriae Yokoi & Karasawa, 2000	Hokkaido	Japan	Cenomanian, Turonian	Late Cretaceous	Yokoi & Karasawa (2000)
Tillocheles shannonae Woods, 1957	Queensland	Australia	Albian	Early Cretaceous	Woods (1957)

is important to understand the history of this group. After a review of the species included in *Pseudastacus*, we describe a new species from the Early Jurassic of France and discuss the systematics and age of stenochirid lobsters.

MATERIAL AND METHODS

The studied material consists of a single slab with five specimens of lobsters (Fig. 1). All are compressed and laterally and/or dorsoventrally flattened on the surface of the slab. The slab was collected during the digging of a pit in the garden of Mrs Boutang and Mr Gomme, at Chauffour-sur-Vell, Corrèze department, France (Fig. 1A). The sediment corresponds to a marine sublithographic limestone of Sinemurian age, possibly early Sinemurian (see Lefavrais-Raymond *et al.* 1976). After these authors, the limit between the early and late Sinemurian is only cartographic, and the late Sinemurian of the area is well dated by the occurrence of a regional bed yielding the dasycladalean green alga *Palaeodasycladus mediterraneus* (Pia, 1920).

The sample is exposed at the "L'Espace de découverte de la Faille de Meyssac et de la Pierre" (acronym: CN-NMP), the local museum of Noailhac (Corrèze department) located 10 km away from the type locality.

The five specimens were studied using a binocular microscope and a camera lucida. The line drawings were made by the first author. Specimens displaying low contrast were imaged by the second author under cross-polarized light (i.e. light source equipped with a linear polarizing filter and camera lens also equipped with a polarizing filter whose optical axis is perpendicular to that of light source polarizer) to reduce reflexion and glare. The same specimens were also imaged: 1) under UV-light for those presenting a UV-yellow fluorescence; and 2) covered in 95% ethanol to see cuticular remains with a low angle light to reveal relief. The palaeontological arrangement of this study follows the systematics proposed by Karasawa *et al.* (2013).

SYSTEMATIC PALAEONTOLOGY

Class MALACOSTRACA Latreille, 1802
Order DECAPODA Latreille, 1802
Suborder PLEOCYEMATA Burkenroad, 1963
Infraorder ASTACIDEA Latreille, 1802
Superfamily STENOCHIROIDEA Beurlen, 1928
Family STENOCHIRIDAE Beurlen, 1928

Genus *Pseudastacus* Oppel, 1861

Pseudastacus Oppel, 1861b: 360.

TYPE SPECIES. — *Bolina pustulosa* Münster, 1839, by subsequent designation of Glaessner (1929: 350).

INCLUDED SPECIES. — Schweitzer *et al.* (2010) listed five species included in *Pseudastacus*: *P. hakelensis* Fraas, 1878 (Cenomanian, Lebanon), *P. minor* Fraas, 1878 (Cenomanian, Lebanon), *P. mucronatus* (Phillips, 1835) (Hauterivian, United Kingdom), *P. pusillus* Van Straelen, 1925 (Bajocian, France), and *P. pustulosus* (Münster, 1839) (Tithonian, Germany).

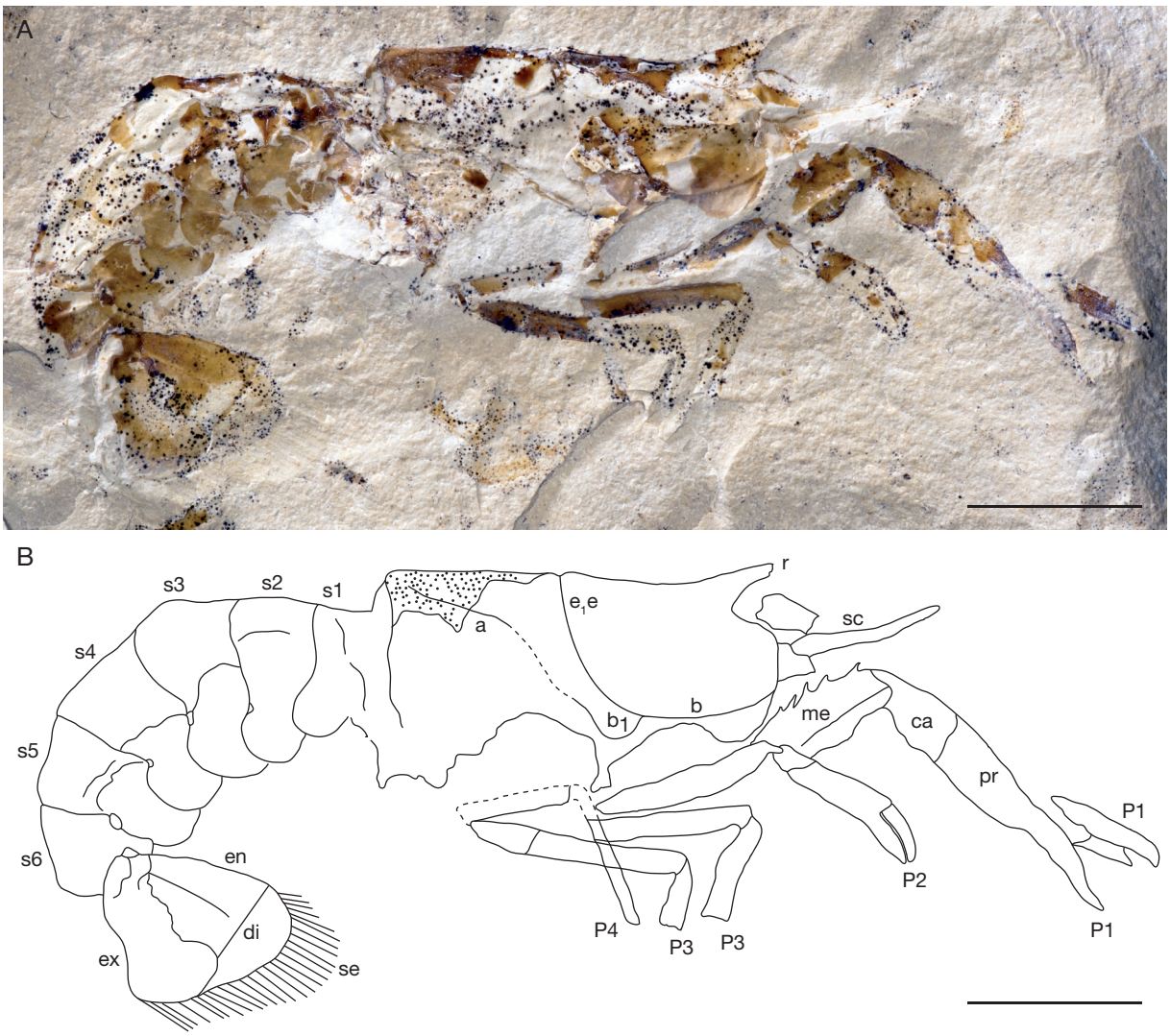

Fig. 2. — Holotype CN-NMP-130-1 of *Pseudastacus lemovices* n. sp. from the Sinemurian of Chauffour-sur-Vell, France: **A**, specimen in right lateral view, cross-polarized light; **B**, interpretative line drawing. Abbreviations: **a**, branchiocardiac groove; **b**, antennal groove; **b$_1$**, hepatic groove; **ca**, carpus; **di**, diaeresis; **en**, uropodal endopod; **ex**, uropodal exopod; **e$_1$e**, cervical groove; **pr**, propodus; **P1**-**P4**, pereiopods 1 to 4; **me**, merus; **r**, rostrum; **sc**, scaphocerite; **se**, setae; **s1**-**s6**, pleonal somites 1 to 6. Photograph: D. Audo. Scale bars: 5 mm.

Taxonomic comments

Pseudastacus hakelensis was moved to *Notahomarus* by Charbonnier *et al.* (2017). The type material of *Pseudastacus minor* is lost (G. Schweigert pers. comm. 2019) and the illustration proposed by Fraas (1878: pl. 4, fig. 2) is not conclusive concerning the taxonomic determination. Indeed, his illustration is relatively strange for the following reasons: 1) either there is a wrong number of pleonal somites (7 instead of 6 excluding the telson), or the first somite is rather large; 2) the rostrum is exceedingly long in comparison with the rest of the carapace; and 3) as the carapace and pleon seem to be in connection suggesting that the specimen was a corpse, the first chelipeds appear strangely placed and should be positioned more anteriorly; in addition, the general morphology of the chelae does not fit with that observed in *Pseudascatus*.

The type material of *Pseudastacus pusillus* was destroyed during World War II (see Bigot 1945) and the figure proposed by Van Straelen (1925: pl. 9, fig. 7) is not conclusive. Even if the line drawing provided by Van Straelen (1925: fig. 134) shows the carapace groove pattern, it is difficult to confirm the assignation to *Pseudastacus*, which was already proposed with a question mark in the original publication.

The type material of *Pseudastacus mucronatus* corresponds to a fragment of P1 chela figured by Phillips (1829: pl.3, fig. 3) and Phillips (1835: pl. 3, fig. 3), and refigured by Bell (1863: pl. 9, fig. 6). This isolated chela is very massive and the occlusal margins of index and dactylus show very strong tubercles alternating with smallest ones. This general morphology is not consistent with the more elongate and thinner P1 chelae observed in *Pseudascatus*. Following Woods (1931: 89), this P1 chela might be referred to *Hoploparia dentata* (Roemer, 1841).

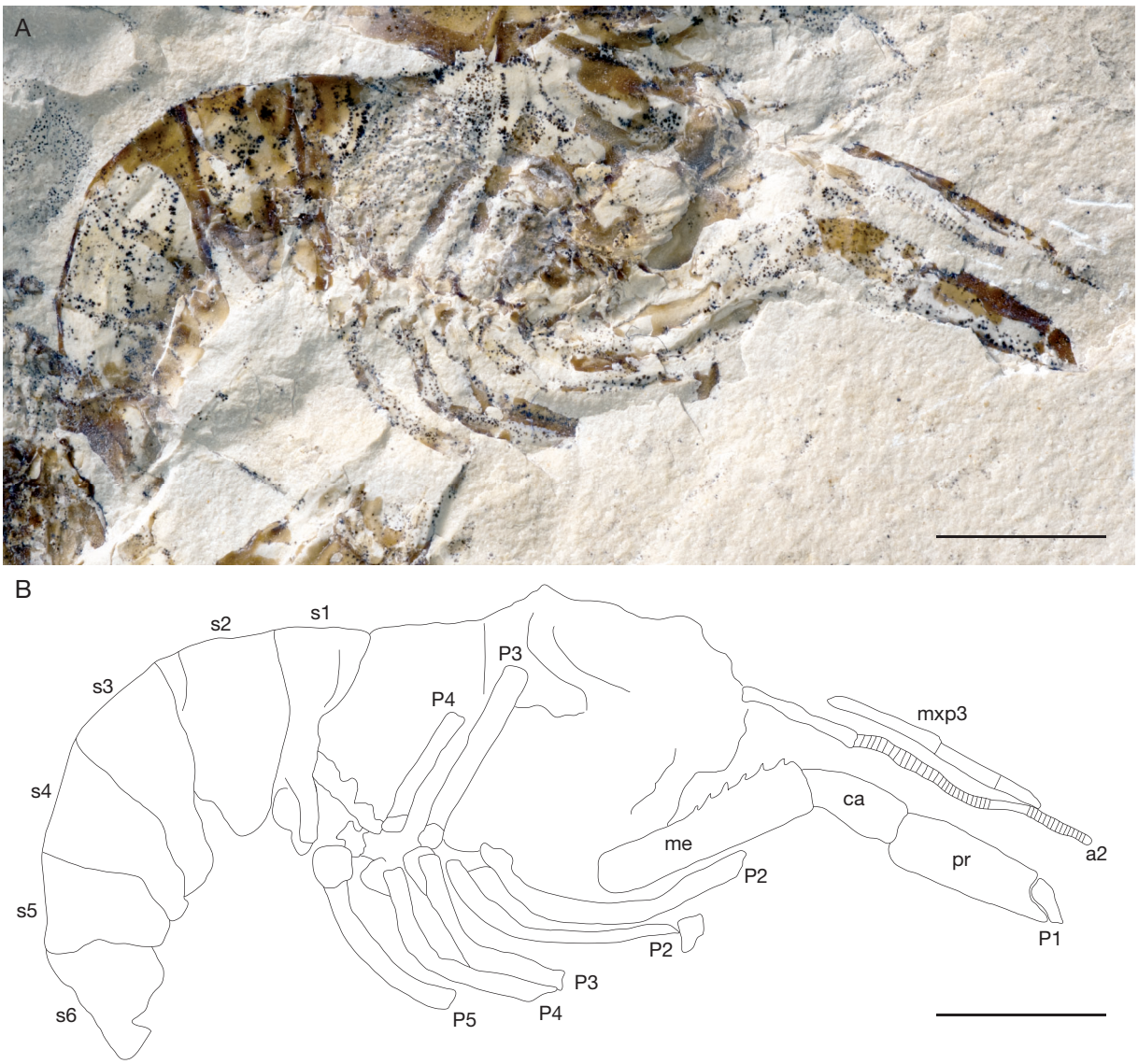

Fig. 3. — Paratype CN-NMP-130-2 of *Pseudastacus lemovices* n. sp. from the Sinemurian of Chauffour-sur-Vell, France: **A**, specimen in right lateral/ventral view, cross-polarized light; **B**, interpretative line drawing. Abbreviations: **a2**, antenna; **ca**, carpus; **pr**, propodus; **P1**-**P5**, pereiopods 1 to 5; **me**, merus; **mxp3**, third maxilliped; **s1**-**s6**, pleonal somites 1 to 6. Photograph: D. Audo. Scale bars: 5 mm.

Pseudastacus lemovices n. sp.
(Figs 2-6)

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Etymology. — The specific epithet refers to the "Lemovices" (used as a noun in apposition), a Gaulish tribe of Central Europe who established themselves in Limousin and Poitou regions between 700 and 400 BC. The type locality Chauffour-sur-Vell is located in Limousin.

Type material. — **Holotype**: CN-NMP-130-1.
Paratypes: 4, CN-NMP-130-2 to CN-NMP-130-5. All are preserved in compression at the surface of a single slab of limestone.

Type locality. — Chauffour-sur-Vell, Corrèze department, Limousin, Nouvelle-Aquitaine region, France.

Type age. — Early Jurassic, Sinemurian (after Lefavrais-Raymond *et al.* 1976).

Description

Carapace

Subcylindrical carapace (length, excluding rostrum: *c.* 11 mm; height: *c.* 6.5 mm); straight dorsal margin; ventral margin poorly preserved; triangular rostrum, elongate, relatively large, with pointed distal extremity, bearing three lateral spines; deep cervical groove, subvertical at level of dorsal margin and ventrally curved before joining concave antennal groove; sinuous branchiocardiac groove joined ventrally to rounded hepatic groove; large and deep orbital incision, ventrally limited by antennal spine.

Pleon

Somite 1, smallest than the others; somites 1 to 5 (s1-s5) with rounded pleura, almost straight anteriorly and concave posteriorly; s2-s5 with longitudinal carina separating tergopleuron from the rest of the tergum; s6 shorter than s5; telson poorly preserved.

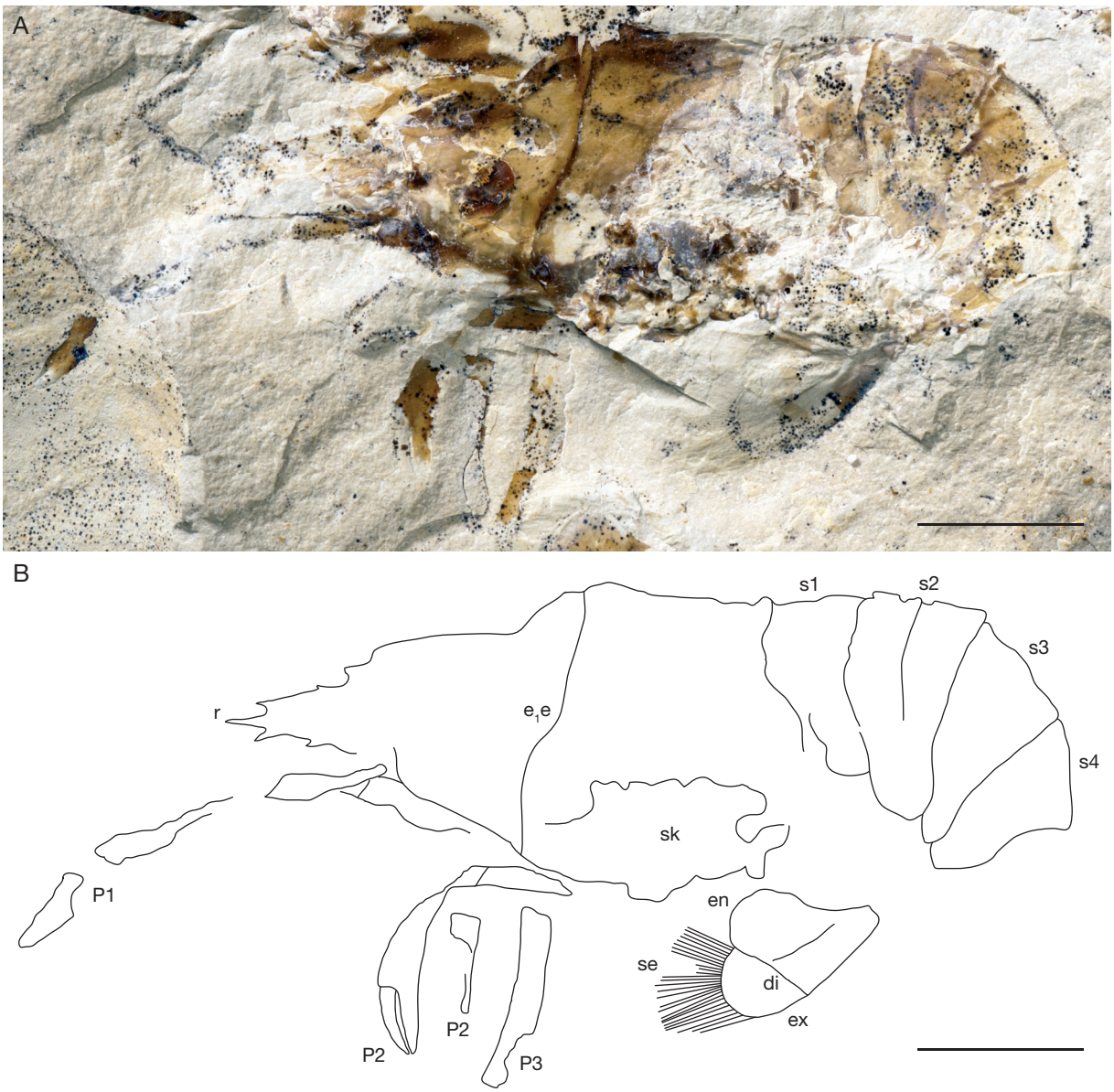

Fig. 4. — Paratype CN-NMP-130-3 of *Pseudastacus lemovices* n. sp. from the Sinemurian of Chauffour-sur-Vell, France: **A**, specimen in left lateral/dorsal view, cross-polarized light; **B**, interpretative line drawing. Abbreviations: **di**, diaeresis; **en**, uropodal endopod; **ex**, uropodal exopod; **e_1e**, cervical groove; **P1**-**P3**, pereiopods 1 to 3; **r**, rostrum; **se**, setae; **sk**, endophragmal skeleton; **s1**-**s4**, pleonal somites 1 to 4. Photograph: D. Audo. Scale bars: 5 mm.

Cephalic appendages
Rounded eye (preserved only on paratype CN-NMP-130-4); antennulae (a1) poorly preserved, short, with multi-articulated flagella; antennae (a2) composed of elongate antennal peduncle bearing large, elongate, and pointed scaphocerite, and strong multi-articulated flagella; third maxilliped, elongate and smooth;

Thoracic appendages
Pereiopods 1 to 5 (P1-P5) decreasing in size posteriorly; chelate pereiopods 1 to 3 (P1-P3); P1 larger and longer than P2 and P3; short and stout P1 chela with index and dactylus of equal length, with slightly curved distal extremity and finely serrated occlusal margins; dorsal margin of P1 merus with one longitudinal median row of strong tubercles; P1 carpus and propodus with smooth dorsal margin; small P2 and P3 chelae with index and dactylus of equal length, slightly curved distal extremity; P4 and P5, smallest and smooth, poorly preserved.

Pleonal appendages
Pleopods not preserved; uropods of equal length, with distal margins fringed by elongate setae; uropodal exopod with longitudinal median carina and straight diaeresis.

Ornamentation
Carapace uniformly covered by small pits; pereiopods smooth; pleonal somites smooth. Some specimens show a relatively smooth carapace. Thus, the carapace ornamentation is variable in aspect, according to which of the cuticle layers are

FIG. 5. — Paratype CN-NMP-130-4 of *Pseudastacus lemovices* n. sp. from the Sinemurian of Chauffour-sur-Vell, France: **A**, specimen in left lateral view, cross-polarized light; **B**, interpretative line drawing. Abbreviations: **a**, branchiocardiac groove; **as**, antennal spine; **a1**, antennula; **a2**, antenna; **b**, antennal groove; **b_1**, hepatic groove; **e_1e**, cervical groove; **o**, eye; **r**, rostrum; **sc**, scaphocerite; **s1**-**s6**, pleonal somites 1 to 6; **t**, telson. Photograph: D. Audo. Scale bars: 5 mm.

preserved: smooth or finely pitted; both aspects may in fact correspond to diverse degrees of abrasion and/or decortication of carapace (similar cases were observed in erymid lobsters: see Charbonnier *et al.* 2014; Hyžný *et al.* 2015).

DISCUSSION

The new species possesses anatomical characters typical of Astacidea: the first three pereiopods are chelate, the first pereiopods are stronger than the others, there are no mid-lateral hinges between the pleonal somites, the cervical groove is deep and the branchiocardiac groove is oblique. Moreover, following the key proposed by Wahle *et al.* (2012), the new species is assigned to the family Stenochiridae based upon the following characters: rostrum bearing lateral spines; cervical groove extends transversely from dorsomedian; branchiocardiac groove extends obliquely across lateral portion of carapace; uropodal exopod with diaeresis; pereiopods 2 and 3 bearing very small chelae. More precisely, the new species is assigned to *Pseudastacus* Oppel, 1861b based on the typical groove pattern of the carapace (deep cervical groove crossing dorsal midline; well-developed branchiocardiac groove, joined ventrally to hepatic groove), the elongate triangular rostrum with three lateral spines; the short and stout P1 chela. *Pseudastacus lemovices* n. sp. differs from *P. pustulosus* by the ornamentation of the carapace (uniformly covered by tubercles in *P. pustulosus*; uniformly covered by pits in *P. lemovices* n. sp.) and of the first pereiopod (uniformly covered by tubercles in *P. pustulosus*; smooth in *P. lemovices* n. sp.).

In addition, this association of five specimens may suggest a mass mortality event linked to an environmental stress (e.g., anoxia, temperature). It may also point to a gregarious behaviour as observed in different extant and fossil lobsters (see Klompmaker & Fraaije 2012 and references therein).

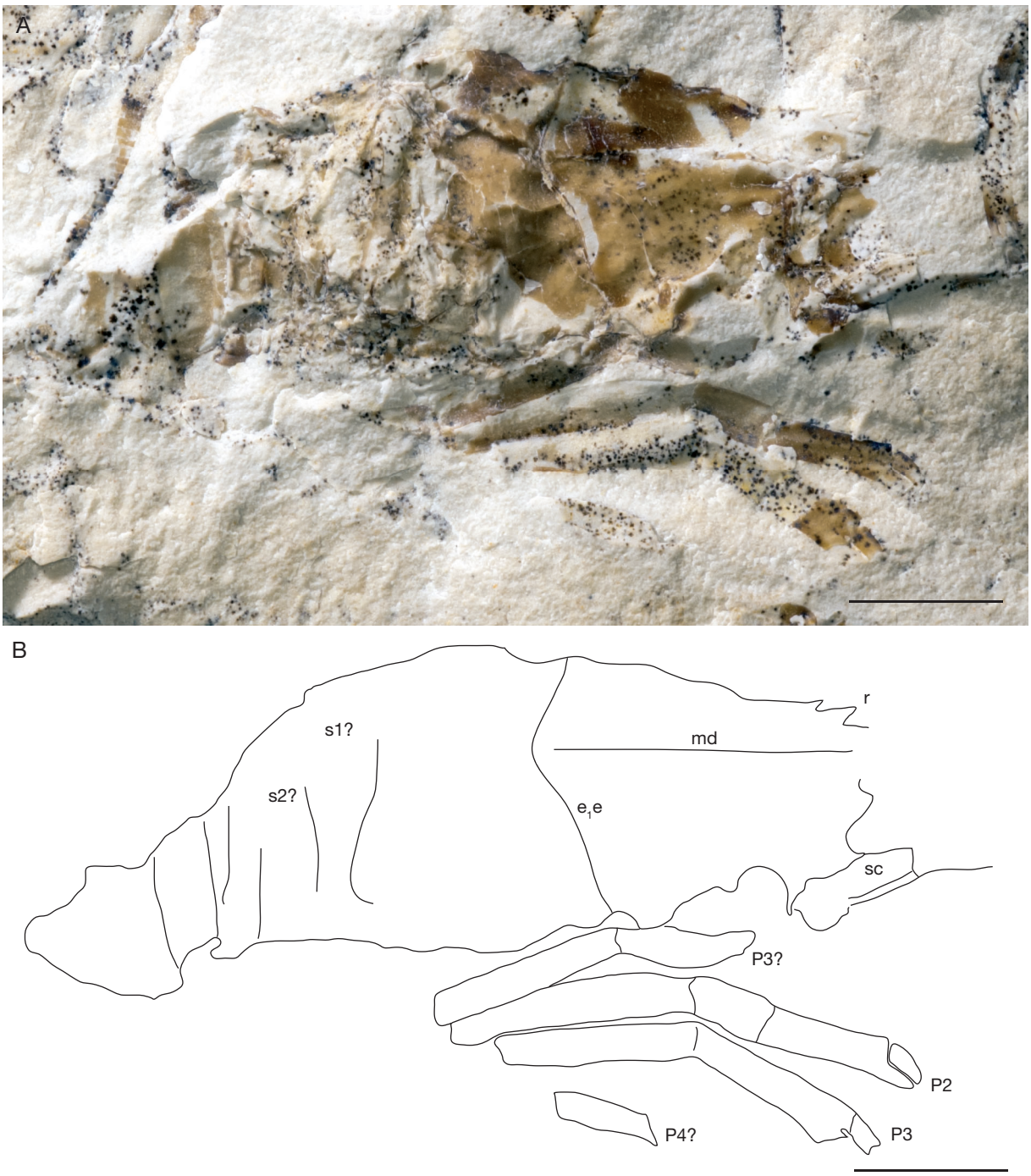

FIG. 6. — Paratype CN-NMP-130-5 of *Pseudastacus lemovices* n. sp. from the Sinemurian of Chauffour-sur-Vell, France: **A**, specimen in ventral view, cross-polarized light; **B**, interpretative line drawing. Abbreviations: **e_1e**, cervical groove; **md**, dorsal midline; **P2**-**P4**, pereiopods 2 to 4; **r**, rostrum; **sc**, scaphocerite; **s1**-**s2**, pleonal somites 1 to 2. Photograph: D. Audo. Scale bars: 5 mm.

CONCLUSIONS

Pseudastacus Oppel, 1861b, was placed for long time in the family Nephropidae Dana, 1852 as reported by Van Straelen (1925), Beurlen (1928), Glaessner (1929, 1969), and Chong & Förster (1976). Albrecht (1983) included *Pseudastacus* in his new family Proastacidae, whereas Tshudy & Babcock (1997) included it in their new family Chilenophoberidae. Garassino & Schweigert (2006) preferred to follow Albrecht (1983) considering the analysis of Tshudy & Babcock (1997) was not founded by a morphological review of the type material, but only on line drawings in literature. Later, De Grave *et al.* (2009) and Schweitzer *et al.* (2010) maintained *Pseudastacus* in the Chilenophoberidae. Finally, Karasawa *et al.* (2013) proposed to synonymize the Chilenophoberidae with the Stenochiridae Beurlen, 1928, and to place *Pseudastacus* in this latter family. Here we follow this placement.

Until now, stenochirid lobsters had only representatives in the Middle Jurassic of France and Germany, in the Late Jurassic of France, Germany and Chile, in the Early Cretaceous of Australia, and in the Late Cretaceous of Japan (for details see Table 1). In conclusion, the Early Jurassic *Pseudastacus lemovices* n. sp. is the oldest representative of the genus and of the family.

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