The upper Bedoulian and lower Gargasian Ostracoda of the Aptian stratotype: Taxonomy and biostratigraphic correlation

Jean-François BABINOT 1

Michel MOULLADE 1,2

Guy TRONCHETTI 1

Abstract: In the vicinity of Saint-Saturnin-lès-Apt (Vaucluse, SE France), which is included in the area of the historic Aptian stratotype of Apt-Gargas, are four sections in a succession that permits the study in a very detailed and continuous way of the last beds of the upper Bedoulian and those of the lower Gargasian. The Ostracod content of the microfauna is relatively important and in a satisfactory state of preservation. 46 species have been indexed of which three are new: Cytherella circumrugosa nov. sp., Cytherelloidea bedouliana nov. sp. and Parexophthalmocythere (Parexophthalmocythere) sp. Until the present day, our comprehension of this group of microfossils in this stratigraphic interval was very fragmentary, not just in the Apt region but also in the Bedoulian historic stratotype area (Cassis-la Bédoule). This new study made it possible to determine a good number of species not previously reported in the stratotypes, to refine the generic status of many forms and to place some of them in open nomenclature.

The completion of a chronologic distribution chart collated with a recently published foraminiferal zonation (Cabri, Luterbacheri and Ferreolensis zones) shows very clearly the bipartite distribution of a good part of the Ostracod fauna. Accordingly, two ensembles are recognized, one at the end of the upper Bedoulian (index species Protocythere bedoulensis), the other characterizing the lower Gargasian, identified by the appearance and development of Parataxodonta inornata. The two groups are sharply separated by an episode of impoverished microfaunas at the base of the Gargasian.

Key Words: Aptian; historical stratotype; Ostracoda; taxonomy; biostratigraphy

Citation: BABINOT J.-F., MOULLADE M. & TRONCHETTI G. (2007).- The upper Bedoulian and lower Gargasian Ostracoda of the Aptian stratotype: Taxonomy and biostratigraphic correlation.- Carnets de Géologie / Notebooks on Geology, Brest, Article 2007/05 (CG2007_A05)


Jusqu’à présent nos connaissances sur ce groupe de microfossiles restaient très fragmentaires dans cet intervalle stratigraphique, aussi bien dans le secteur d’Apt que dans le stratotype historique du Bédoulien (Cassis - La Bédoule). Par cette nouvelle étude il a été possible de déterminer bon nombre d’espèces non encore signalées dans les stratotypes, d’affiner le statut générique de nombreuses formes et de placer quelques-unes d’entre elles en nomenclature ouverte.

La réalisation d’un tableau de répartition chronologiquement calibré sur une échelle zonale de Foraminifères récemment publiée (zones à Cabri, Luterbacheri et Ferreolensis) montre de façon nette la bipartition d’une bonne partie de l’ostracofaune. On distingue ainsi un premier ensemble daté de la fin du Bédoulien supérieur (espèce-index : Protocythere bedoulensis) et un deuxième ensemble caractérisant le Gargasien inférieur, marqué par l’apparition et le développement de Parataxodonta inornata. Ces deux ensembles sont nettement séparés par un épisode d’appauvrissement des microfaunes, situé à la base du Gargasien.

Mots-Clefs : Aptien ; stratotype historique ; Ostracodes ; systématique ; biostratigraphie

Introduction

For some ten years now, new research in the field and pluridisciplinary studies in the laboratory have been in progress in the Aptian historic stratotypes of southeastern France. Old sections have been reinterpreted, and others, new ones, have been...
studied in detail. These sections are distributed between a first group attributed to the lower and middle Gargasian in the Cassis-Roquefort La Bédoule (Bouches-du-Rhône) area (MOULLADE et alii, 2004, 2005) and a second group, outcrops of upper Bedoulian-lower Gargasian age, that up to now have been studied only a little or not at all, northwest of Apt near the hamlet of La Tuilière, in the parish of Saint-Saturnin-lès-Apt (Vaucluse) (Figs. 1-2). The general aspect and supplementary information on these sections is detailed in MOULLADE & TRONCHETTI, 2004 and MOULLADE et alii, 2006.

![Figure 1: General map of the studied area (from MOULLADE et alii, 2006).](image)

A zonal biostratigraphic framework made at Cassis using the distribution of planktonic and benthic Foraminifera (MOULLADE et alii, 2005) was applied in the La Tuilière sector (MOULLADE et alii, in preparation) and will be used as the basis for the establishment of the stratigraphic distribution of each species of Ostracod.

Information about the Ostracoda of the Aptian stratotypes is still fragmentary. The principal monographic publication about the Aptian-Albian of Apt is already old (OERTLI, 1958); the microfaunas were collected along a section northwest of Apt ending at the Gargas hill top. The author identified 20 species (among which 8 were new) that he attributed to the Gargasian-Lower Albian. Some have been figured in more general works (OERTLI, 1963), and later on with supplementary descriptions and precise details of nomenclature (BABINOT et alii, 1985). Components of these associations have been reported in many areas of Western Europe.

In the framework of the pluridisciplinary activities mentioned above a first approach to the census and revision of the Ostracoda was completed for the Bedoulian (Lower Aptian) of the Cassis-La Bédoule stratotype (BABINOT, 1998). The number of species (in general very poorly preserved) counted in the type-Bedoulian is very small. Of the dozen forms present, only five could be determined.

**Main results and biostratigraphic correlation**

One of the major interests of this analysis is its contribution of new micropaleontologic data concerning a stratigraphic interval in the stratotype of the Aptian of Apt that was little or poorly known, namely the uppermost Bedoulian.
and the lower Gargasian. This consequent improvement of our knowledge is gained from a composite section reconstituted in the stratotype area from a succession of several partial sections (which overlap to some extent), namely Pichouraz, La Tuilière W, Les Gays 1 and 2 (MOULLADE et alii, 2006).

Figure 2: Detailed map of the studied area.

The material for study consists of 88 samples taken systematically at two or sometimes even one-meter intervals throughout the series. The forms identified were arranged in the chronological order of their appearance (Figs. 3, 4, 5, 6 & 7). Taxonomic uncertainties remain for some of them, often because of their poor preservation and/or their rarity. Although their internal morphologic and anatomic characteristics are difficult to interpret, these data are described and discussed in the systematics section because they may eventually be of use later on. Two species are described as being new: Cytherella circumrugosa, Cytherelloidea bedouliana, a third (Parexophthalmocythere (Parexophthalmocythere) sp.) was not named formally because of a lack of adequate material.

The biostratigraphic scale of Foraminifera mentioned above made possible a precise correlation of the assemblages of Ostracoda with the three biozones recognized on the basis of planktonic foraminifera: The Cabri Zone of the uppermost upper Bedoulian, the Luterbacheri and Ferreolensis zones of the lower Gargasian. The continuity of the outcrops, apparently gapless, strengthens the local value of the range of each species and the descriptions of changes in the qualitative and quantitative composition of the associations.

46 species of Ostracoda were identified, among which 12 had already been listed and/or described in the Gargas Hill area (OERTLI, 1958; MOULLADE, 1965). The other species constitute two assemblages; one includes named species already reported in other regions (mainly Western Europe); the other is made up of specimens left in open nomenclature, with remarks concerning their generic status.

As the sections studied are globally under levels that previously cropped out extensively in the Gargas Hill area, it was logical and foreseeable that at La Tuilière there would be remains of strata older than the "Gargasien" (OERTLI's terminology, 1958). The presence of Bedoulian strata as shown by their Ammonites (DUTOIR, 2005) and Foraminifera (MOULLADE et alii, 2006), is consolidated by a relatively rich association of Ostracoda, with Protocythere bedoulensis as the marker. This species was described by MOULLADE (1963) at the extreme base of the "Gargasien" (sensu FABRE-TAXY et alii, 1965). CONTE (1994), on the basis of new collections of ammonites, placed this level in the terminal beds of the Bedoulian. A sporadic presence of P. bedoulensis has also been recognized in the Barremo-Aptian of the Vocontian Basin (MOULLADE, 1963), but this species had never been mentioned in the Apt stratotype sector. It is present quasi-permanently in the Pichouraz section (samples 2270 to 2293) in upper Bedoulian beds (top of the Cabri Zone). The uppermost beds of this substage are also marked by the sporadic presence of a new species of Cytherelloidea (described here as C. bedouliana nov. sp.) cited from and located in concomitant levels of the Cassis-La Bédoule stratotype (MOULLADE in FABRE-TAXY et alii, 1965) but without having been described formally. The upper Bedoulian is also marked by a special abundance of a dozen species (Figs. 3 & 7) of which half are confined to this interval: Neocythere (C.) gottisi, Schuleridea cf. derooi, S. aff. harrisiana, Cornicythereis gatyensis,
Figure 3: Distribution of Ostracoda in the Pichouraz section.

*Bythoceratina* (*C.*) *marginata*, *Patellacythere*? sp., *Cytherelloidea bedouliana* nov. sp. Thus, the Ostracod fauna of the upper Bedoulian at La Tuilière appears richer and more diversified than those in levels of the same age at Cassis-La Bédoule.

The transition from the upper Bedoulian to the lower Gargasian is marked by a very sharp decrease in the number of specimens collected. The impoverishment lasts from the base of the Gargasian (top of the Pichouraz section) up to the halfway point of the Les Gays 1 section, that is the first half of the *Luterbacheri* Zone. The assemblages are limited to two or three species represented by one or two individuals, often poorly preserved. Only *Cytherella* gr. *ovata* subsists, its abundance remaining essentially stable. In conclusion, it must be noted that there is a new species present in these oligospecific levels (*Parexophthalmocythere* (*P.*) sp.) but it is represented only by juvenile stages; this form is rare, but interesting from a stratigraphic viewpoint because of its location at the passage from Bedoulian to Gargasian.

The last ten meters of the *Luterbacheri* Zone are characterized by an important faunal renewal; the increase in diversity occurs quite brusquely, then the assemblage becomes richer progressively and remains so without much change to the top of the Les Gays 1 and 2 sections. In addition to several forms already represented in the upper Bedoulian (for example *Hechticythere derooi*) numerous species comprise an association that
permits the characterization of this portion of the lower Gargasian (upper levels of the Luterbacheri Zone and all of the Ferreolensis Zone). *Parataxodonta inornata* is its index fossil; it is interesting to note that the type of this form was described, "at the base of the Upper Aptian of the Isle of Wight" (Kaye, 1965b). The appearance of *Saxocythere tenuissima* at this level supports this dating. A total of 18 species demarcate this interval, of which a good number were described or mentioned by OERTLI (1958), and from which he reported the existence of the Gargasian.

**Paleobiogeographic remarks**

The composition of the microfaunas of Ostracoda from the type Aptian have strong affinities with those of the Lower Aptian of the Jura and the Paris Basin, the south and east of England, the Isle of Wight, the offshore of southern Ireland, and to a lesser extent with those of northern Germany and Portugal (Algarve). Another lot of specimens is also encountered in the Albian and Cenomanian of the same regions, with the addition of Netherlands. For the Aptian of the Jura (together with that of the Paris Basin) SAUVAGNAT (1999) calculated (p. 183) that the JACCARD similarity index for sites in southeastern France was 13 to 31%. On the basis of the precisions provided by our study these index data may be revised upward.

**Systematics (J.-F.B.)**

To lighten the text, the following abbreviations are used: RV = right valve; LV = left valve; DM = dorsal margin; VM = ventral margin; AM = anterior margin; PM = posterior margin, C = carapace (complete shell, *i.e.* both valves) (plate legends).


In an additional effort toward brevity, with the exception of special cases, we refer the reader to the list of synonyms established by J. SAUVAGNAT (1999) with regard to the Aptian-Albian of the Jura.

All of the material and the types figured are deposited in the collections of the Sedimentology and Paleontology Center of the University of Provence, Saint-Charles Campus, Marseilles.

**Subclass OSTRACODA LATREILLE, 1802**
**Order PLATYCOPIDA SARS, 1866**
**Suborder PLATYCOPINA SARS, 1866**
**Family CYTHERELLIDAE SARS, 1866**
**Genus Cytherella JONES, 1849**

Cytherella ex gr. ovata (ROEMER, 1841)
(Pl. 1, figs. 1-3)

1841 - Cytherina ovata, ROEMER: Norddeutsches Kreidegebirge, p. 104, pl. 16, fig. 21.

**Remarks.** In his 1966 work, HERRIG presents an important synonymic list for this species, a list that was completed later on (DAMOTTE, 1971; BABINOT, 1980; SAUVAGNAT, 1999). If the paleoecologic interest of this form is far from being negligible, it is not the same for any kind of biostratigraphic application. It is reported in the whole of the Cretaceous of Europe (except perhaps in the Berriasian) from the Boreal domain to the Mesogean area. In the sector studied it is present in almost every sample, always in an important and constant number of individuals.
Figure 5: Distribution of Ostracoda in the Les Gays 1 section.

**Cytherella cf. parallela** (Reuss, 1846)
(Pl. 1, fig. 4)


**Synonymy list:** See the compilations listed in the preceding.

**Remarks.** If the bibliographies of the last few decennia are consulted it seems that if construed strictly the species would exist only in the northern domains of Europe. OERTLI (1958) reported some slight morphologic variations between individuals of the Aptian-Albian of Apt and Bohemian topotypes, notably in the PM of the valves. Also without real stratigraphic interest, *C. cf. parallela* is much rarer than *C. ex gr. ovata* and is encountered only sporadically in all the sections.

**Cytherella circumrugosa** nov. sp.
(Pl. 1, figs. 5-7)

**Origin of the name:** Presence of ridges on the periphery of the valves.

**Holotype:** A LV, n° HAP 1, deposited in the Centre de Sédimentologie et Paléontologie, University of Provence, Saint-Charles Campus, Marseilles.

**Paratypes:** 2 valves, n° PAP 1/1 and PAP 1/2

**Stratum typicum:** Les Gays section 1 (sample 2342)

**Diagnosis:** Relatively large in size, DM and VM subparallel, a set of peripheral concentric ridges that weaken progressively toward the inner portion of the surface of the valves.
**Description:**

a) Left valve (holotype): Regularly inflated; AM and VM generally parallel, but each with a weak concavity, clearly defined on the anterior third of the DM (well-developed frontal lobe), on the VM less well-marked and in a median position. AM and PM regularly rounded, the AM broader. System of wavy ridges on the outer edge, well defined at the front end (5-6 ridges clearly visible) that attenuate progressively in the ventral and posterior areas. These ridges may anastomose by means of small bridges that connect them in an orderly way; they are less well-defined but visible under high magnification toward the valve surface.

b) Right valve (paratypes): It differs from the LV in that the DM is divided into two parts (forming an angle in the posterior quarter). The PM is narrower than the AM with a maximum convexity in the ventral half. The ridge system is similar.

**Affinities:** Very similar in shape to *Cytherella aff. contracta* contracta VEEN, 1932 (*in* WEAVER, 1982) of the Cenomanian of England, but in that species the front part of the carapaces are more flattened and apparently smooth.

**Dimensions** (type series and topotypes grouped):
Length: 0.72-0.85 mm
Height: 0.34-0.41 mm

**Distribution:** Lower Gargasian of *Les Gays* 1 and 2.

**Cytherella sp. aff. speetonensis KAYE, 1963** *(Pl. 1, figs. 8-10)*

**1963a - Cytherella speetonensis,** KAYE: Cytherellidae Brit. Lower Cret., p. 112, pl. 18, figs. 7-8:

**Remarks.** The small number of specimens in our material does not permit a reliable determination of this species. It differs from *C. circumrugosa* nov. sp. in that the DM and VM are more convergent toward the posterior end, the dorsal concavity is more attenuated and there is no ornamentation.

**Distribution:** Upper Bedoulian of *Pichouraz*, lower Gargasian of *La Tuilière* W and *Les Gays* 1. Lower Aptian of the *Jura.*
**Figure 7:** Composite distribution of Ostracoda in the upper Bedoulian-Lower Gargasian of the area of La Tuilière.
Diagnosis: AM widely spread out, bounded by a narrow ridge, dorsal ridge in two segments, rear overhung by a rectilinear ridge ornamented with spiny nodes at the ends, surface of valves coarsely reticulate.

Description: AM very widely spread out, regularly curved, projecting far over the VM for a third of its length; DM straight, VM short, slightly sinuous in outline; PM rounded, with a stronger mid-dorsal convexity. The lateral surface has a system of ridges with a) a very thin, salient anterior ridge of which the trace joins the basis of the antero-dorsal angle to the forward end of the VM, b) a dorsal ridge in two segments that are more or less well-connected, c) a thicker and convex ridge parallel to the ventral margin, d) a posterior ridge-like relief, rectilinear or slightly arched, overhanging the PM, with spiny nodes at the two extremities, of which the importance varies from one individual to another. Fine spines fringe the PM and there is a mid-dorsal circular depression (a trait common to many species of this genus). The valve surfaces are ornamented by a rather coarse, embossed reticulation.

Affinities: Cytherelloidea bedouliana nov. sp. has morphologic features that are the same as those of Cytherelloidea sp. 1 DAMOTTE & GROSODIÈR of the Lower Aptian of Louvement (Haute-Marne), so this form is placed in synonymy. Our species is also very close in ornamentation to Cytherelloidea sp. 2 from the Barremian of the Vocontian domain (SCARENZI-CARBONI, 1984, unpublished), but in that form the DM and VM are much closer to being parallel (front part not inflated). C. kayei WEAVER, 1982 from the Cenomanian of England has a posterior zone with a different configuration. Cytherelloidea sp. 1 CABRAL, 1995 from the Lower Aptian of the Algarve (Portugal) is narrower, with the front less spread out and the posterior reliefs simpler.

It is very interesting to report that this form had already been considered as new under the name Cytherelloidea n. sp. MOULLADE (in FABRE-TAXY et alii, 1965, p. 196 and tabl. fig. 10), but it was neither described nor figured because of a paucity of material. The authors mentioned its presence at the Bedoulian-Gargasian (sensu ante) boundary of the stratotype at Cassis-La Bédoule. In the same sector it was found at the top of the "Comte Quarry" (basal Gargasian) (Coll. MOULLADE). So C. bedouliana may be considered as a marker of the Bedoulian-Gargasian transition.

Dimensions: Length: 0.40-0.83 mm Width: 0.27-0.38 mm

Distribution: Upper Bedoulian-basal Gargasian at Pichouraz and Cassis-La Bédoule (Aptian stratotypes); Lower Aptian of the Haute-Marne (Champagne).

Order CLADOCOPIDA SARS, 1866 Suborder CLADOCOPINA SARS, 1866 Family POLYCOPIDAE SARS, 1866 Genus Polycope SARS, 1866

Polycope oweni KAYE, 1965 (Pl. 1, fig. 16)

Remarks. Only one specimen is available, but it is typical of the genus. Ornamentation is in the form of aligned microtubercles which constitute a network in the form of a polygonal mesh. This arrangement appears slightly less dense than on the specimens figured in previous publications.


Order PODOCOPIDA MÜLLER, 1894 Suborder PODOCOPINA SARS, 1866 Superfamily AMIRDIACEA SARS, 1888 Family AMIRDIIDAE SARS, 1888 Genus Cardobairdia BOLD, 1960 Cardobairdia minuta (VEEN, 1936) (Pl. 2, figs. 15-17)

1940 - Krausella minuta TRIEBEL - BONNEMA: Untergr. nord. Niederlande, p. 115, pl. 3, figs. 32-34.
1960 - "Krausella" minuta TRIEBEL - BOLD: Eocene Oligoc. Trinidad, p. 155, pl. 6, fig. 3.
Remarks. Although this species is relatively rare it is known throughout the Middle-Upper Cretaceous of Europe. It was reported originally by TRIEBEL in 1936, but the work was never published. So VEE is the author of this form (WEAVER, 1982).

The La Tuilière material is externally identical to that described and figured by OERTLI (1958) under the name Krausella sp. 301 and also very close to specimens from England, with the two valves smooth and dissymmetric, the LV overlapping the RV, except posteriorly. KAYE & BARKER (1965) indicate that the hinge appears to be reduced to "a simple overlap". A cardinal structure has been studied by electron microscope (RV, Pl. 2, fig. 16a): It is of an antimerodont type with a long, low anterior tooth divided into 10 to 12 denticles and a more prominent posterior tooth also crenellate, rising up posteriorly. This layout is analogous to that figured by HERRIG (1966, text-fig. 47) on the basis of specimens from the Maastrichtian of the island of Rügen, that he placed in the genus Cardobairdia that was defined in the Eocene-Oligocene of Trinidad (BOLD, 1960). Note, however, that the specimens from Rügen are slightly larger. The long time-span of this apparently static form is thus confirmed.

The genus Krausella (? Krausellidae BERDAN, in MOORE, 1961) has a hinge without teeth and is known only in the Ordovician-lower Silurian and hence cannot be considered for the generic assignment of this species.

Distribution: A unique individual in the upper Bedoulian at Pichouraz. It appears to be more widely distributed in the lower Gargasian of Les Gays 1 and 2, in the "Albian inférieur" (fide OERTLI, 1958) of Apt. Upper Aptian (Lincolnshire) and Cenomanian of England. Maastrichtian of Germany and the Netherlands.

Family BYTHOCYPRIDIDAE MADDocks, 1969
Genus Bythocypris Brady, 1880
Bythocypris ? sp.
(Pl. 1, fig. 15)

Remarks. Very rare, poorly preserved specimens with a closed carapace. Even the generic attribution is a little uncertain. Bythocypris ? sp. SAUVAGNAT, 1999 from the Lower Aptian of the Jura has a more elongate carapace.

Distribution: Upper Bedoulian of Pichouraz.

Superfamily CYPRIDACEA BAIRD, 1845
Family MACROCYPRIDIDAE MÜLLER, 1912
Genus Macrocypris Brady, 1867
Macrocypris sp. 1
(Pl. 1, fig. 20)

Remarks. Morphologic criteria and size conform with those of the genus. Very rare, this form is close to Macrocypris sp. 302 OERTLI 1958 from the "Lower Albian" of Apt, but the valves of this form are larger.

Distribution: Uppermost Bedoulian and lower Gargasian of Pichouraz.

Macrocypris ? sp. 2
(Pl. 1, figs. 18-19)

Remarks. Large valves, rare, often deformed as flattened closed carapaces. The PM is very elongated along the median longitudinal axis. Its assignment to the genus Macrocypris remains hypothetical because of its odd shape

Distribution: Lower Gargasian of Pichouraz and Les Gays 2.

Family PARACYPRIDIDAE SARS, 1923
Genus Paracypris Sars, 1866
Paracypris acuta (CORNUEL, 1848)
(Pl. 1, fig. 17)


Remarks. A "classic" form of the European Lower Cretaceous, of moderate size, with a very acuminate PM and a strong ventral concavity. Of little stratigraphic value, for it is reported from the upper Wealden to the Aptian by many authors (see synonymic list and commentary in SAUVAGNAT, 1999).

Distribution: Occurs in all of the sections studied at La Tuilière. Hauterivian-Aptian of France (Paris Basin, Jura, Ardèche, Vercors), England and Ireland (off the south coast). Wealden-Barremian of Germany.

Paracypris wrothamensis KAYE, 1965
(Pl. 2, figs. 1-3)


Remarks. This large species is differentiated because of the rather
unusual trace of the dorsal margin, particularly of the RV (the anterior cardinal angle juts out behind a concave portion that connects with the AM). Its comparison with other forms is given in the original description (Kaye, 1965a, p. 227). On the other hand, *P. cf. jonesi* Bonnema, 1940 is reported in the "Aptian - Albian" of Apt (Oertli, 1958): This species probably comes from higher levels on the Gargas Hill. It is less elongated and has no prominent dorsal angulosities.

**Distribution:** Sparse, but always present in the lower Gargasian of Les Gays 1 and 2. Albian of the Paris Basin and Jura; Albian-Cenomanian of England.

**Family PONTOCYPRIDIDAE Müller, 1894**

**Genus Pontocyprella Ljubimova, 1955**

*Pontocyprella harrisianna* (Jones, 1849) (Pl. 3, figs. 11-12)

1849 - Cythere (Bairdia) harrisianna, Jones: Entomostr. Cret. England, p. 25, pl. 6, fig. 17.

**Remarks.** The outline of the valves of the specimens seen conforms exactly with those figured by many authors. *P. rara* Kaye, 1963, from the Lower Aptian of Lincolnshire, identical in all points with *P. harrisianna*, was made synonymous legitimately by Weaver (1982). The forms figured by Sauvagnat (1999) in the Upper Albian of the Jura have more ventral and more pointed PM.

**Distribution:** Upper Bedoulian of Pichouraz, extremely rare in the lower Gargasian. Albian of the Jura, Albian-Cenomanian of England, Germany, Netherlands, Poland, Bulgaria

*Pontocyprella sp. aff. harrisianna* (Jones, 1849) (Pl. 3, figs. 9-10)

**Remarks.** Form close to the preceding, but smaller in size and with a slightly more ventral PM. These few specimens may be juvenile forms of *P. harrisianna*, but the paucity of our material does not permit certainty in this regard.

**Distribution:** Upper Bedoulian of Pichouraz.

*Pontocyprella maynci* Oertli, 1958 (Pl. 3, figs. 13-17)


**Remarks.** Species characterized by the fact that "la hauteur maximale mesure très régulièrement presque 60% de la longueur" ("the maximum height measures very regularly almost 60% of the length" (in original diagnosis, OERTLI, 1958, loc. cit.)). The information concerning the characteristics of the hinge is perfectly confirmed.

**Distribution:** Lower Gargasian of La Tuilière W and of Les Gays 1 and 2. "Aptian - Albian" of Apt.

**Genus Liasina Gramann, 1963**

*Liasina rectimarginata* (Nuyts, 1990) (Pl. 6, figs. 20-21)

1990 - Cardobairdia rectimarginata, Nuyts: Krausella minuta nomen nudum and three new sp. Cenomanian S. England, p. 67, pl. 1, figs. 5-8.


1993 - Iliffeoecia rectimarginata (Nuyts) - Wouters: Cret. Interst. genus Iliffeoecia, p. 57, pl. 1, fig. 12; pl. 2, figs. 5-8.


**Remarks.** *Cardobairdia rectimarginata* Nuyts from the Lower Cenomanian of England was classed in the genus *Iliffeoecia* (Wouters, 1993); this genus was later considered as a more recent synonym of *Liasina* Gramann (Wouters, 1998).The same species was collected in the Lower Cenomanian of the Netherlands (WITTE et alii, 1992). Specimens almost identical to the illustrations of Witte et alii are present, but very rare in our material. Internal structures are not visible.

Small, quadrangular in outline, without ornamentation, *Liasina* is considered to be an old taxon (first representatives in the Sinemurian) and is still present in the Recent. The line of descent includes in particular *L. vestibulifera* (Gramann, 1963) and *L. lanceolata* (Apostolescu, 1959), respectively from the Lias of Germany and the Bathonian of the Paris Basin, and *L. rectimarginata* (Nuyts, 1990) of the Cenomanian of England and the Netherlands. Now living in the Pacific, Indian and Atlantic oceans is *L. iliffei* (Maddock,
Wooters (1998) insists on the very small amount of diversification in this lineage, with this species that has lasted at least 25 to 30 MA (from Cenomanian to Maastrichtian). The assimilation of our specimens with this last-named form would increase even more the stability of the adaptation (morphologic stasis) which thus increases to more than 50 MA. This longevity might be due to an unchanged marine interstitial habitat, considered, in particular in Ostracoda, as one of the oldest adaptive habitats (Wooters, 1993, 1998).


Superfamily CYTHERACEA Baird, 1850
Family BYTHOCERATIDAE Sars, 1926
Subfamily BYTHOCERATINAE Sars, 1926
Genus Bythoceratina Hornibrook, 1952

Specimens attributable to the subfamily Bythoceratinae are disseminated (in small numbers) in all of the sections. Their preservation is defective, they are often encrusted and/or broken; the reliability of their determination as to species (even to genus) is therefore subject to caution. Four different forms have been recognized, but only one is worthy of discussion.

Sugenus Bythoceratina (Cuneoceratina) Gründel & Kozur, 1971
Bythoceratina (Cuneoceratina) marginata Weaver 1982
(Pl. 2, figs. 6-8)


Remarks. In our material this form is the most abundant representative of the species of the genus Bythoceratina.

Description: DM slightly arched, AM regularly rounded, bounding a crescentic flattened area; PM raised upward and linked to the VM by a slightly concave trace. Central area with an antero-median node linked by an arc to a massive dorsal coast that is attenuated posteriorly. A second massive medio-ventral tubercle overhangs the medio-dorsal area thus forming a depression that varies with the individuals. It was not possible to see internal characteristics.

Affinities: Bythoceratina umbonata glabra Weaver, 1982 of the Lower Cenomanian has a similar outline, but the antero-dorsal and ventral bulges are much less prominent (see also Witte et alii, 1992, pl. 3, fig. 12).

Distribution: Relatively constant, but with a few individuals in the upper Bedoulian of Pichouraz. Lower Cenomanian of England.

Sugenus Bythoceratina (Bythoceratina) Hornibrook, 1952
Bythoceratina ? sp. 1 (Pl. 2, fig. 5)

Description: Rare, small in size. Ornamentation in the form of a regularly spaced punctuation, absent posteriorly. Short medio-ventral, sinuous ridge and slight mid-dorsal depression.

Distribution: In two samples from the uppermost Bedoulian of Pichouraz.

Bythoceratina sp. 2 (Pl. 2, figs. 9-10)

Remarks. Also rare, this form resembles Bythoceratina (C.) marginata, but the lay-out of the details of ornamentation is different. Almost all the available specimens are broken.

Distribution: Lower Gargasian of Les Gays 1 and 2.

Genus Patellacythere Gründel & Kozur, 1971
Patellacythere ? sp. (Pl. 2, fig. 4)

Remarks. In this form certain characters of Bythoceratina (C.) marginata are found, but the valve is shorter, the PM less acuminate, the medio-ventral tubercle very blunt. There are some analogies with Patellacythere parva Weaver, 1982 from the Cenomanian of England. It is also possible that this form is the larval stage of B. (C.) marginata. There is not enough material available to forge a reliable opinion regarding the precise taxonomic position of this form.
Family CYTHERIDEIDAE Sars, 1925
Subfamily CUNEOCYTHERINAE MANDELSTAM, 1960
Genus Dicrorygma Poag, 1962

Dicrorygma minuta (Kaye, 1963) (Pl. 2, figs. 11-14)

1963b - Dolocythereida minuta, Kaye: Mesoz. Ostr. Cytherideidae, p. 34, pl. 1, figs. 4-5.
1966 - Dicrorygma (Dicrorygma) minuta KAYE - GRÜNDEL, Ostr. Unterkreide Deutschland, p. 19, pl. 2, figs. 26-27; pl. 10, fig. 3.

Remarks. This species was described originally from the Hauterivian-Barremian of England (Speeton Clay) and attributed to the genus Dolocythereida. GRÜNDEL (1966) restudied the species and from its characteristics (hinge, marginal zones and pore canals) placed it in the genus Dicrorygma. This opinion was accepted by several authors on material from the Lower Cretaceous (COLIN et alii, 1981; CABRAL, 1995; SAUVAGNAT, 1999). The specimens studied here are slightly more elongate, but the differences are small: The shape, valve volume and mode of overlapping justify a very probable identification with this species.


Subfamily SCHULERIDEINAE MANDELSTAM, 1950
Genus Schuleridea Swartz & Swain, 1946

Schuleridea jonesiana (Bosquet, 1852) (Pl. 2, fig. 18)

1956 - Schuleridea jonesiana (Bosquet) - Mer tens: Alb./Gen. NW Deutschland Ostr., p. 193, pl. 10, figs. 38-40.

Remarks. This species is very widespread in Europe. Shape, ornamentation and hinge confirm that our material conforms to that of the original diagnosis.


Schuleridea cf. derooi DAMOTTE & GROSDIDIER, 1963

(Pl. 2, figs. 19-20)

1963b - Schuleridea derooi, DAMOTTE & GROSDIDIER: Ostr. Crét. inf. Champagne. II. Aptien, p. 154, pl. 1, fig. 4a-i.

Remarks. The material studied consists of relatively well-preserved carapaces and valves, on which some basic diagnostic features are visible: Compression of the front of the valves and of the ocular area in dorsal view, marked convexity of the ventral region on the LV. The original figures show no spines. Other specimens with antero- and postero-ventral spines have been figured (DAMOTTE & MAGNIEZ-JANNIN, 1973), which is also the case in the Aptian of the Jura (SAUVAGNAT, 1999) and in our material (see Pl. 2, figs. 18 & 20). These spine-bearing forms resemble S. jonesiana. Because of valve volume and shorter outline we propose to refer these specimens to Schuleridea derooi. Finally, it is probable that the illustrations of S. derooi (in KAYE & BARKER, 1965) are those of a different species.


Subfamily CYTHERIDEINAE Sars, 1925
Genus Dolocythereida TRIEBEL, 1938
Subgenus Parasternbergella GRÜNDEL, 1971

Dolocythereida (Parasternbergella) intermedia OERTLI, 1958 (Pl. 3, figs. 1-5)

1971 - Dolocythereida (Parasternbergella) intermedia OERTLI - GRÜNDEL: Taxon. V. Entwicklung Cytheridea, p. 29.
1981 - Dolocythereida (Parasternbergella) intermedia OERTLI - COLIN et alii: Jur. Cret. Ostr. Southern Ireland, pl. 11.1, fig. 3.
Remarks. Thanks to the excellent preservation of the material, we can attribute the numerous specimens available to the subgenus *Parasternbergella*, which is characterized by a merodont hinge with no subdivisions of its elements. Their assignment to the species *intermedia* (originally described from Gargas, near La Tuilière) is also confirmed.

**Distribution:** Lower Gargasian of Les Gays 1 and 2 Gargasian of Gargas (Vaucluse). Aptian of England and Ireland.

**Subgenus Puracytheridea** GRÜNDEL, 1971

*Dolocytheridea (Puracytheridea) aff. bosquetiana* (JONES & HINDE, 1890) (Pl. 3, fig. 6)


1890 - *Pontocypris bosquetiana*, JONES & HINDE: Suppl. Cret. Entom., p. 4, pl. 2, fig. 65; pl. 4, fig. 3.

1956 - *Dolocytheridea bosquetiana* (JONES & HINDE) - MERTENS: Alb/Cen. NW Deutschland, p. 196, pl. 10, figs. 45-47.

**Remarks.** We cannot confirm that our specimens belong to the subgenus *Puracytheridea*. The material is too rare, but nevertheless has the same specific features. The figured specimen (Pl. 3, fig. 6) is presumably that of a female.

**Distribution:** Lower Gargasian of Les Gays 1. Middle Albian-Lower Cenomanian of France, England, Ireland Germany, the Netherlands, Poland, northern Spain.

*Dolocytheridea ? sp.* (Pl. 3, fig. 7)

**Remarks.** The one valve resembles in outline the genus *Pontocypris*, but the "bairdioid" aspect typical of this genus is not displayed. The elements of the hinge are more like those of *Dolocytheridea*.

**Distribution:** Lower Gargasian of Les Gays 1.

**Family CYTHERURIDAE** MÜLLER, 1894

**Subfamily PARACYTHERIDEINAE** PURI, 1957 *(sensu GRÜNDEL, 1975)*

**Genus Parataxodonta** MANDELSTAM, 1956

*Parataxodonta inornata* (KAYE, 1965) *(Pl. 3, figs. 18-25)*


1965b - *Orthonotacythere inornata*, KAYE: Ostr. Apt. Isle of Wight, p. 41, pl. 6, fig. 11.


**Remarks.** The genus *Parataxodonta* was described in the Aptian-Albian of Kazakhstan with the generotype being *P. uralensis* MANDELSTAM, 1956. The author classed this genus in the Protocytherinae. This classification is also that of the Treatise on Invertebrate Paleontology (MOORE, 1961), but with reservations. The new material at our disposition permits us to assign without question this form (originally described and illustrated in open nomenclature by OERTLI, 1958) to the Upper Aptian species of the Isle of Wight, described under the name *Orthonotacythere inornata* (KAYE, 1965b). Detailed examination of the hinge (see Pl. 3, figs. 19, 20, 20a) shows that it is intermediate between adont / prionodont (a single cardinal element in relief along the DM, entirely crenulated) and holomerodont (in the RV the arrangement is the same, but the teeth hardly project). Such a pattern is that of the genus *Parataxodonta* (see original figures in MANDELSTAM, 1956). In the genus *Orthonotacythere* the dental reliefs are much more clearly differentiated. Classifying this species in the genus *Parataxodonta* had already been proposed under the name "*P. mandelstami* n. sp." (MOULLADE, 1965), but with no figures (consequently a nomen nudum).

A specific attribution for this taxon is much easier now, thanks to the abundance and excellent preservation of our material. The DM is rectilinear to slightly concave, the PM is very pointed and ends at the level of the DM and is connected to the VM by a regularly convex curve; two vertical excrescences occupy the forward half of the sides, bounding a flattened sulcus. All these features are smooth. KEMPER'S (1995) illustrations are exactly like ours. And lastly, there is a strong sexual dimorphism, the supposed males being longer and narrower than the females.

**Distribution:** Exclusively in the lower Gargasian of Les Gays (top of the Luterbacheri Zone and the entire Ferreolensis Zone). "Aptian - Lower Albian" of the Gargas Hill (OERTLI, 1958 and material from the GIROUD-D'ARGOUD and MASSE collection, Marseilles). Gargasian of Gargas (MOULLADE, 1965), of the Pas d'Ouillier (W. La Bédoule) and from...

**Genus Paranotacythere Bassioumi, 1974**

*Paranotacythere catalaunica* (DAMOTTE & GROSIDIER, 1963)

(Pl. 4, figs. 1-5)


**Remarks.** Although they are not discussed in the text of the original description, the relationships of this species with the other members of the genus have been analyzed, thanks to the excellent plates of photographs (NEALE, in BATE & ROBINSON, 1978) for England as well as in the voluminous work of revision by BASSIOUNI (1974) on the genus *Paranotacythere*. This author puts the species *catalaunica* in synonymy with *P. inversa* tuberculata (KAYE, 1963), a disputable opinion because the general form and certain details of the ornamentation are different.

*Orthonotacythere inversa* (CORNUEL), inserted in the list of synonyms of *P. catalaunica*, has been revised under the name *Paranotacythere (P.) inversa* inversa (CORNUEL) (BASSIOUNI, 1974). *P. choyensis* SAUVAGNAT, 1999 of the Middle Albian of the Jura has a slightly different ornamentation, is narrower, with the postero-ventral margin flattened and smooth.

**Distribution:** Lower Gargasian of Les Gays 1 and 2. Lower Cenomanian of England.

**Subfamily CYTHEROPTERINAE Hanai, 1957**

**Genus Cytheropteron Sars, 1866**

*Cytheropteron* sp. aff. *nanissimum* DAMOTTE & GROSIDIER, 1963

(Pl. 4, fig. 6)


**Remarks.** Very rare (two specimens in our material); this small species has the characteristics of the genus. The specific determination is still provisional.

**Distribution:** Lower Gargasian of Les Gays 1 and 2.

**Genus Eocytheropteron Alexander, 1933**

*Eocytheropteron stchepinskyi* DAMOTTE & GROSIDIER, 1963

(Pl. 4, fig. 7)


**Remarks.** We have only one valve, figured here, that presents the morphologic traits and ornamentation of this species described from the Lower Aptian of Champagne. *E. nova reticulata* KAYE & BARKER, 1965 is larger, with a broader ventral overlapping, a similar but more vigorous system of reticulation and costulae, particularly on the level of the series of meshes bordering the VM.

**Distribution:** Lower Gargasian of Les Gays 1 and 2 (sample 2345). Lower Aptian of the Paris Basin, the Jura and the Isle of Wight (England).
Subfamily EUCYTHERURINAE PURI, 1974, emend. Maddocks & Steineck, 1987

Genus Phodeucythere GRÜNDEL, 1978

Phodeucythere cf. trigonalis (Jones & Hinde, 1890) (Pl. 3, fig. 8)


Remarks. Triangular shape conforming with that of the genus; small and smooth. Material, only one specimen (a carapace) similar to P. trigonalis but with the PM more rounded

Distribution: Lower Gargasian of Les Gays 1 (sample 2326). Aptian-Albian of England, Germany, the Netherlands, Poland, Albian of the Jura.

Genus Microceratina SWANSON, 1980

Microceratina ? sp. (Pl. 6, fig. 19)

Remarks. Described originally from New Zealand, this genus is reduced to around ten species, of which nine are distributed from Miocene to Recent, and one older one in the Maastrichtian of the island of Rugen (Herrig, 1966; Mazzini & Gliozzi, 2000). Knowledge has improved thanks to the discovery of forms of Tethyan origin in the Upper Jurassic of Libya and the Cenomanian of Morocco (Colin et allii, 2005). These authors made a detailed analysis of the bibliography of species morphologically referable to this genus; the major criterion for their recognition is the existence of groups of pores ("en meurtrière" = loophole-like, "en fente" = split-like) in the meshes of the reticulum.

We have only one carapace with the characteristics of this genus, but could not observe the details of the microstructure of the reticulum.


Genus Chapmanicytherura WEAVER, 1982

Chapmanicytherura cf. kayei WEAVER, 1982 (Pl. 6, fig. 18)


Remarks. Our material is comprised of only one carapace that can be referred to this species. It is ornamented with the characteristic, bulb-shaped nodes. The genus Chapmanicytherura may be a synonym of Microceratina, but C. kayei should not be attached to this genus according to Colin et allii (2005, p. 19). Other forms are very close, like Eucytherura aff. nuda Kaye, 1965 of the Albian of England and the Cenomanian of the Dordogne, France (Colin, 1973). Taking these remarks into account, we leave this form provisionally in the genus Chapmanicytherura.

Distribution: Lower Gargasian of La Tuilière W.

Family NEOCYTHERIDAE Wilkinson, 1988

Genus Neocythere MERTENS, 1956

The genera Neocythere and Centrocythere, created by Mertens in 1956, as well as the genus Physocythere Gründel, 1966, are very close morphologically. In an analysis, already old (Kaye, 1963c), the same phrase is used to begin the emended description of these three entities: "... carapace rounded, inflated, ventrally tumid"; in fact, their forms are quite identical. Kaye (1963c) considered these three forms to be subgenera: N. (Neocythere) with an amphidont hinge N. (Physocythere) with a merodont hinge, N. (Centrocythere) being distinguished by the structure of the anterior tooth of the RV. Added to these bases of discrimination are variations in the detail of the several elements along with the presence or absence of a dorsal "accommodation groove".

Subgenus Neocythere (Centrocythere) MERTENS, 1956

Neocythere (Centrocythere) gottisi DAMOTTE & GROSIDIER, 1963 (Pl. 4, figs. 8-12)

1963b - Centrocythere gottisi, Damotte & Grosdidier: Ostr. Crét. inf. Champagne, II. Aptien, p. 157, pl. 2, fig. 9a-i.

Remarks. A species whose constant presence in the upper Bedoulian of Pichouraz has a local value as an index fossil. The hinge (see Pl. 4, figs. 10, 12, 12a) corresponds well with the diagnosis of the subgenus Centrocythere sensu Kaye.
The valves have a straight or slightly convex DM and a PM a little below the mid point of the height; the ornamentation consists of concentric costulae, well defined and well separated on the periphery and in short segments in the central area of the valves where their disposition is anarchic. Almost identical configurations are shown (AINSWORTH, 1986) in a publication concerning the Aptian of the Fastnet basin, SW Ireland.

**Distribution:** Upper Bedoulian of Pichouraz. Lower Aptian of the Paris Basin, Jura, Southern England, Isle of Wight, off shore southern Ireland, Portugal.

**Subgenus Neocythere (Neocythere) MERTENS, 1956**

**Neocythere (Neocythere) mertensi OERTLI, 1958**  
(Pl. 4, figs. 13-17)


**Description:** Valves ornamented with 3-4 large peripheral crests and a very dense reticulation in the center, with an elongate eye tubercle. The hinge (see Pl. 4, figs. 14, 16, 16a) is consistent with that of the subgenus with an anterior crenulated tooth (5 denticles) and a dorsal articulation groove for the LV. The type material (OERTLI, 1958) comes from the Gargas Hill, so a little higher stratigraphically than that of our material.

**Distribution:** Last beds of the lower Gargasian of Les Gays 2. Gargasian of the Gargas Hill. Lower-Middle Aptian of northern Germany.

**Family PROTOCYTHERIDAE LJUBIMOVA, 1955**

**Subfamily PROTOCYTHERINAE LJUBIMOVA, 1955**

**Genus Protocythere TRIEBEL, 1938**

**Protocythere bedouensis MOULLADE, 1963**  
(Pl. 4, figs. 18-23)

1984 - *Protocythere bedouensis* MOULLADE - SCARENZI-CARBONI: Ostr. Bassin vocontien, pl. 6, fig. 3.

**Remarks.** This large, easily recognizable species is present in abundance in all of the upper Bedoulian samples from Pichouraz. It disappears abruptly at the limit with the lower Gargasian. There is no additional information to bring to the original description, except the presence on many individuals of some short spines on the ventral slope of the PM which in any case were drawn in the original illustrations by the author of the species (MOULLADE, 1963).

**Distribution:** Upper Bedoulian of Pichouraz and of the La Tuilière W sections. Bedoulian of Cassis-La Bédoule (stratotype) and of the Vocontian Basin (Drôme, Ardêche). This species may be present as of the Hauterivian-Barremian in Bulgaria (com. P. DONZE). It has also been found in the Upper Hauterivian and Lower Barremian of Morocco (ROSSI & MALZ, 2005; ROSSI, 2006), in the Gargasian-Clansayesian of Morocco (ANDREU-BOUSSUT, 1991) and also in the Aptian of Ecuador (com. J.-P. COLIN).

**Genus Hechticythere GRÜNDEL, 1974**

**Hechticythere derooi (OERTLI, 1958)**  
(Pl. 5, figs. 1-5)


**Remarks.** The genus *Hechticythere* is characterized by the trace of three longitudinal ridges, together forming a kind of Z. On the LV of *H. derooi* there is a subvertical swelling that unites the dorsal and median ridges a little back of the middle, a detail not reported in the original description (see Pl. 5, figs. 1-2). This species is close to *H. alexanderi* HOWE & LAURENCICH, 1958 from the Grayson Marls (Albian) of Texas (direct comparison made with the help of topotypes [MOULLADE collection] authenticated by HOWE). But as OERTLI (1958) had already reported *H. alexanderi* is more elongate, the PM is more pointed, the ridges are less inflated. Very rare and poorly preserved individuals from the Bedoulian of La Bédoule were referred to *H. alexanderi* (BABINOT, 1998) but this determination is questionable.

**Distribution:** Upper Bedoulian of

**Hechtycycythere cf. derooi** (OERTLI, 1958)  
(Pl. 5, figs. 6-11)

**Remarks.** This form, relatively abundant in our material, has been collected only from the upper Bedoulian. In many ways it is closely analogous to *H. derooi*, notably in the trace and volume of the lateral ridges, but it is smaller, the PM more acuminate, the hinge less well developed, and the marginal zones are very narrow. *H. croutesensis* (DAMOTTE & GROSIDIÉR, 1963) from the Lower Aptian of Champagne is close, but differs in a more elongate and narrower silhouette, an AM that is more curved at the ventral level, the absence of a frontal lobe in the RV, a very long dorsal ridge that continues past the eye tubercle. The examination of individuals collected from the Lower Aptian of Jura (gift of SAUVAGNAT in the BABINOT collection) confirms these differences.

Consequently, a hypothesis can be formulated that this material may represent juvenile specimens of *H. derooi*.

**Distribution:** Upper Bedoulian of Pichouraz.

**Genus Saxocythere** KEMPER, 1971

*Saxocythere tenuissima* KEMPER, 1971  
(Pl. 5, figs. 12-15)


**Remarks.** The criteria for the generic attribution of this form are based on hinge elements, and at the species level on the characteristics of the lateral ridges. The hinge of the RV (Pl. 4, fig. 14a) shows a modification toward the extremities of an antimerodont hinge (see the original diagnosis in KEMPER, 1971). The ridges are very narrow, pointed (in particular the middle ridge is a little constricted in the middle), the eye tubercle is weakly conspicuous, the PM stretched out and pointed; there is always a swelling below the frontal lobe. A direct comparison with KEMPER’s type material (kindly provided by F.W. LUPPOLD, Hannover) shows without ambiguity that our material is identical to that from Germany.

**Distribution:** Lower Gargasian of Les Gays 1 and 2. Lower part of the Upper Aptian of Germany (East of Rheine, Lower Saxony).

**Family TRACHYLEBERIDIDAE** SYLVESTER-BRADLEY, 1948

**Subfamily TRACHYLEBERIDINAE** SYLVESTER-BRADLEY, 1948

**Genus Parexophthalmocythere** OERTLI, 1959

**Subgenus Parexophthalmocythere** OERTLI, 1959

*Parexophthalmocythere* (Parexophthalmocythere) sp.  
(Pl. 6, figs. 2-9)

**Description:** Small species (maximum length 0.45 mm). DM and VM strongly convergent toward the posterior end. AM marked by a line-up of 15 spines of variable shapes, bounding an anterior area that is smooth and flat. The PM has a convex spiny ventral slope, the concave dorsal portion passing with a sharp bend to the DM. The side is divided into two irregularly swollen areas separated by a vertical depression. The entire surface is very finely reticulate and is ornamented by tubercles of variable size and by spines (apparently hollow, or pore conuli). A very prominent eye tubercle is a characteristic of this genus. The side broadens ventrally and extends past the VM in a sort of wing like a keel. The hinge is of a merodont type, so conforms to the revised diagnosis of the subgenus (GRÜNDEL, 1975b), with a widely open ocular sinus.

Our material is sparse and the measurements obtained are probably those of juvenile stages. Undoubtedly this is a new form, but without adults it would be unwise to create a new species.

The species attributed to the genus *Parexophthalmocythere* are few in number (see the KEMPf index, 1986) and all have been listed from the Lower Cretaceous. On the other hand, the subgenus *Amphiexophthalmocythere* GRÜNDEL, 1975 ranges up to the Cenomanian.

The species nearest to ours is *P. rodewaldensis* BARTENSTEIN & BRAND, 1959 from the Hauterivian of Germany, but it is more elongated, the distal spines are stronger and there is no ventral keel. *P. spinosa* BARTENSTEIN & BRAND, 1959 from the Valanginian has simpler ornamen-
Finally, *P. berriasensis* DONZE, 1965 from the Lower Valanginian of the Ardèche is very narrow and differs in the details of ornamentation.

**Distribution:** Uppermost beds of the upper Bedoulian and the first levels of the Lower Gargasian of Pichouraz and La Tuilière W. Consequently, it is a species to be considered as a possible local marker of the transition between the two substages.

**Genus Cornicythereis GRÜNDEL, 1973**

*Cornicythereis gatyensis* (DAMOTTE & GROSDIDIER, 1963) (Pl. 5, fig. 16)


**Remarks.** According to the very complete list of synonyms established by SAUVAGNAT (1999) it appears that this species has often been confused with *C. cornueli* (DEROO, 1957) and *C. lamplughi* (KAYE, 1963). *C. gatyensis* has an irregular dorsal excrescence, but it is uninterrupted and the median ridge is "clearly separated from the central muscle tubercle". We see this feature on the only specimen available in our material.

**Distribution:** Base of the Pichouraz section (upper Bedoulian). Lower Aptian-Middle Albian of the Paris Basin, the Jura, England, Ireland, Germany.

**Genus Platycythereis TRIEBEL, 1940**

*Platycythereis rectangularis* OERTLI, 1958 (Pl. 5, figs. 21-23)

1985 - *Platycythereis rectangularis* OERTLI - BABINOT et alii: pl. 49, fig. 10.

**Remarks.** Our specimens are very like those of the original figures. At the genus level we reject its attribution to *Chapmanicythereis*, as proposed by GRÜNDEL (1973). Indeed, that genus is characterized by a peripheral ridge in marked relief, but this structure does not exist on the specimens in our material. So we confirm and retain the original generic attribution.

**Distribution:** A form rare and scattered throughout all of the sections of La Tuilière sector. Found recently in the "Aptian" of the Gard (G. CONTE's material in the BABINOT collection).

**Platycythereis sp.** (Pl. 5, fig. 24; Pl. 6, fig. 1)

**Remarks.** Specimens smaller than those of the preceding species, with no peripheral ridge or an oblique median rib, and with no spines on the antero-ventral edge. These sparse, poorly preserved forms are perhaps juvenile stages of *P. rectangularis*. We leave them in open nomenclature.

**Distribution:** All the sections in La Tuilière sector.

**Genus Rehacythereis GRÜNDEL, 1973**

*Rehacythereis buchlerae* (OERTLI, 1958) (Pl. 6, figs. 10-14)

1985 - *Rehacythereis buchlerae* (OERTLI) - BABINOT et alii: pl. 49, fig. 6.

**Remarks.** An easily recognized species, abundant in many Aptian beds of southeastern France. In the material studied here, its first occurrence is in the Ferreolensis Zone of the Lower Gargasian. There is nothing to add to the original diagnosis-description, if it is only the placement of this form in the genus *Rehacythereis* (see the discussion in GRÜNDEL, 1973).

**Distribution:** Lower Gargasian of Les Gays 1 and 2. Gargasian of the Gargas Hill, Cassis-La Bédoule, Uzès (Gard). upper Gargasian of the Camp du Castellet (Var) and of the Mède (Bouches-du-Rhône).

**Rehacythereis cf. bartensteini** (OERTLI, 1958) (Pl. 6, fig. 15)

1985 - *Rehacythereis bartensteini* (OERTLI) - BABINOT et alii: pl. 49, fig. 5.

**Remarks.** Our material is limited to a single juvenile RV from the top of the Les Gays 2 section (upper part of the
Ferreolensis Zone), but the determination is uncertain. Adult specimens from the Gargas Hill that may be considered topotypes have been figured here as supplementary information (see Pl. 6, figs. 16-17) (J.-P. Massé's and G. Giroud-d'Argoud's material in the Babinot collection).

**Conclusions**

The detailed analysis of the microfaunas of Ostracoda in the Saturnin-lès-Apt (La Tuilière) sector has improved significantly our knowledge of the micropaleontologic content of a geologic reference area, the stratotype of the Aptian stage in the Apt region. More precisely, this new contribution pertains to a poorly known part of the stage, that is the top of the upper Bedoulian (Lower Aptian) and the lower Gargasian. It made possible the correlation of an important number of species with the foraminiferal zonal scale. In addition to the forms already reported in the stratotype, a good number of species described in diverse regions of Western Europe have been identified and their stratigraphic range precised. The examination of the distributions makes it possible to characterize with precision the two substages by bringing to light that there are two groups with different compositions which succeed each other in time. However, the evolution of the Ostracod populations is perturbed by an episode of severe impoverishment dated at the base of the lower Gargasian. Numerous elements of the Ostracod fauna coexisted in a number of regions, thus indicating a relative homogeneity of Aptian microfaunas on the North Tethyan margins.

**Acknowledgments**

Here we thank two reviewers whose remarks have improved this article: One of them is J.-P. Colin (Cestas, France) who also aided us in a friendly and efficient way by participating in the examination of some problems of systematics and by furnishing supplemental information; the other is J. Sauvagnat (Geneva) who, in addition, loaned us and in certain cases even gave us material for comparison. We have also taken into account the comments of a third (anonymous) reviewer. We are also grateful to H. Malz (Bramsche, Germany) for his bibliographic aid, and for the same to F. W. Luppold (Hannover, Germany). Finally, we are greatly indebted to Nestor Sander for having translated in English the French version of our manuscript.

The photographic plates were made by R. Notonier and A. Tonetto using a PHILIPS S XL 30 ESEM provided by the Service commun de Microscopie Électro- nique of the University of Provence, Marseilles.

**Bibliographic references**


Bassionui M.A. (1974).- Pararotacythere n.g. (Ostracoda), aus der Zeitraum Oberjura bis Unterkreide (Kimmeridgian bis Albian) von Westeuropa.- Geologisches Jahrbuch, Hannover, vol. 17, p. 3-111.

Bold W.A. van den (1960).- Eocene and Oligocene Ostracods of Trinidad.- Micropaleontology, Lawrence, vol. 6, n° 2, p. 145-196.


MOULLADE M., TRONCHETTI G., BELLIER J.-P. (2005).- The Gargasian (Middle Aptian) strata from Cassis-La Bédoule (Lower Aptian historical stratotype, SE France): Planktonic and benthic foraminiferal assemblages and biostratigraphy.- Carnets de Géologie / Notebooks on Geology, Brest, Article 2005/02 (CG2005_A02), 20 p.


WITTE L., LISSENBERG T. & SCHUURMAN H. (1992).- Ostracods from the Albian/Cenomanian boundary in the Achterhoek area (eastern part of the Netherlands).- Scripta Geologica, Leiden, vol. 102, p. 33-84.


**Plate 1:**

1-3 - *Cytherella* ex gr. *ovata* (ROEMER, 1841)
   1. C, left lateral view, Sample 2276
   2. RV, lateral view, Sample 2305
   3. C, dorsal view, Sample 2340

4 - *Cytherella cf. parallela* (REUSS, 1846)
   RV, lateral view, Sample 2342, paratype n° PAP 1/1

5-7 - *Cytherella circumrugosa* nov. sp.
   5. RV, lateral view, Sample 2342, paratype n° PAP 1/1
   6. LV, lateral view, Sample 2342, paratype n° PAP 1/2
   7. LV lateral view, Sample 2342, Holotype n° HAP 1

   7a. *idem*, detail of the anterior part

8-10 - *Cytherella aff. speetonensis* KAYE, 1963
   8. RV, lateral view, Sample 2338
   9. LV, lateral view, Sample 2284
   10. RV, lateral view, Sample 2290

11-14 - *Cytherelloidea bedouliana* nov. sp.
   11. RV, lateral view, Sample 2292, paratype n° PAP 2/1
   12. LV, lateral view, Sample 2300, paratype n° PAP 2/2
   13. RV, lateral view, Sample 2300, Holotype n° HAP 2
   14. RV, dorsal view, Sample 2300, paratype PAP 2/3

15 - *Bythocypris* ? sp.
   C, left lateral view, Sample 2280

16 - *Polycopse oweni* KAYE, 1965
   C, right lateral view, Sample 2303

17 - *Paracypris acuta* (CORNUEL, 1848)
   LV, left lateral view, Sample 2339

18-19 - *Macropyris* ? sp. 2
   18. C, right lateral view, Sample 2346
   19. C, left lateral view, Sample 2359

20 - *Macropyris* sp. 1
   C, right lateral view, Sample 2291

**Plate caption**

C = Complete shell, *i.e.* both valves
RV = Right valve
LV = Left valve
AM = Anterior margin
PM = Posterior margin
DM = Dorsal margin
VM = Ventral margin
Plate 2:

1-3 - *Paracypris wrothamensis* **KAYE, 1965**
1. LV, lateral view, Sample 2345
2. RV, lateral view, Sample 2345
3. C, right lateral view, Sample 2363

4 - *Patellacythere* sp.
C, right lateral view, Sample 2292

5 - *Bythoceratina* ? sp. 1
C, left lateral view, Sample 2366

6-8 - *Bythoceratina* (*Cuneoceratina*) *marginata* **WEAVER, 1982**
6. LV, lateral view, Sample 2280
7. C, left lateral view, Sample 2275
8. RV, lateral view, Sample 2298

9-10 - *Bythoceratina* sp. 2
9. RV, lateral view, Sample 2339
10. LV, lateral view, Sample 2336

11-14 - *Dicrorygma minuta* **(KAYE, 1963)**
11. RV, lateral view, Sample 2352
12. LV, lateral view, Sample 2283
13. RV, lateral view, Sample 2301
14. RV, internal view, Sample 2301

15-17 - *Cardobaedia minuta* **(VEEN, 1936)**
15. C, right lateral view, Sample 2344
16. RV, internal view, Sample 2339
16a. *idem*, detail of the hinge
17. C, lateral view left, Sample 2344

18 - *Schuleridea jonesiana* **(BOSQUET, 1852)**
RV, lateral view, Sample 2284

19. LV, lateral view, Sample 2270
20. C, right lateral view, Sample 2279

Plate caption
C = Complete shell, *i.e.* both valves
RV = Right valve
LV = Left valve
AM = Anterior margin
PM = Posterior margin
DM = Dorsal margin
VM = Ventral margin
Plate 3:

1-5 - *Dolocytheridea (Parasternbergella) intermedia* OERTLI, 1958
   1. LV, lateral view, Sample 2342
   2. C, lateral view, Sample 2338
   3. LV, internal view, Sample 2364
   4. LV, internal view, Sample 2364
   5. RV, internal view, Sample 2342

6 - *Dolocytheridea (Puracytheridea) aff. bosquetiana* (JONES & HINDE, 1890)
   RV, lateral view, Sample 2327

7 - *Dolocytheridea ? sp.*
   LV, lateral view Sample 2327

8 - *Phodeucythere cf. trigonalis* (JONES & HINDE, 1890)
   RV, lateral view Sample 2326

9-10 - *Pontocyarella sp. aff. harrisiana* (JONES, 1849)
   9. C, left lateral view, Sample 2285
   10. C, right lateral view, Sample 2285

11-12 - *Pontocyarella harrisiana* (JONES, 1849)
   11. LV, lateral view, Sample 2284
   12. RV, lateral view, Sample 2275

13-17 - *Pontocyarella maynci* OERTLI, 1958
   13. LV, lateral view, Sample 2333
   14. RV, lateral view, Sample 1303
   15. RV, internal view, Sample 2332
   16. C, right lateral view, Sample 2332
   17. LV, internal view, Sample 2305

18-25 - *Parataxodontina inornata* (KAYE, 1965)
   18. RV, lateral view, Sample 2337
   19. LV, internal view, Sample 2341
   20. RV, internal view, Sample 2328
   20a. *idem*, detail of the hinge
   21. LV, internal view, Sample 2341
   22. RV female, lateral view, Sample 2337
   23. RV male, lateral view, Sample 2337
   24. C, dorsal view, Sample 2339
   25. LV juvenile specimen, lateral view, Sample 2329

Plate caption

C = Complete shell, *i.e.* both valves
LV = Left valve
RV = Right valve
AM = Anterior margin
PM = Posterior margin
DM = Dorsal margin
VM = Ventral margin
Plate 4:

1-5. *Paranotacythere catalaunica* (DAMOTTE & GROSDIDIER, 1963)
   1. LV, lateral view, Sample 2338
   2. LV, lateral view, Sample 2338
   3. RV, lateral view, Sample 2344
   4. RV, internal view, Sample 2344
   5. LV, dorsal view, Sample 2338

   LV, lateral view, Sample 2345

7. *Eocytheropteron stchepinskyi* DAMOTTE & GROSDIDIER, 1963
   LV, lateral view, Sample 2345

8-12. *Neocythere* (Centrocythere) *gottisi* DAMOTTE & GROSDIDIER, 1963
   8. LV, lateral view, Sample 2275
   9. C, right lateral view, Sample 2275
   10. RV, internal view, Sample 2275
   10a. *idem*, detail of the hinge
   11. C, dorsal view, Sample 2276
   12. LV, internal view, Sample 2285

13-17. *Neocythere* (Neocythere) *mertensi* OERTLI, 1958
   13. LV, lateral view, Sample 2301
   14. LV, internal view, Sample 2302
   15. C, dorsal view (juvenile specimen), Sample 2301
   16. RV, internal view, Sample 2302
   16a. *idem*, detail of the hinge
   17. LV, lateral view (juvenile specimen), Sample 2302

18-23. *Protocythere bedoulensis* MOULLADE, 1963
   18. C, right lateral view, Sample 2292
   19. RV, internal view, Sample 2292
   20. LV, lateral view, Sample 2275
   21. RV, lateral view, Sample 2279
   22. LV, internal view, Sample 2293
   23. C, dorsal view, Sample 2279

Plate caption
C = Complete shell, *i.e.* both valves
RV = Right valve
LV = Left valve
AM = Anterior margin
PM = Posterior margin
DM = Dorsal margin
VM = Ventral margin
Plate 5:

1-5 - *Hechticythere derooi* (OERTLI, 1958)
   1. C, lateral view left, Sample 2271
   2. LV, lateral view, Sample 2298
   3. C, right lateral view, Sample 2298
   4. RV, lateral view, Sample 2298
   5. RV, internal view, Sample 2334

6-11 - *Hechticythere* sp. aff. *derooi* (OERTLI, 1958)
   6. LV, lateral view, Sample 2293
   7. LV, lateral view, Sample 2288
   8. RV, internal view, Sample 2327
   8a. *idem*, detail of the hinge
   9. LV, internal view, Sample 2288
   10. RV, lateral view, Sample 2300
   11. RV, dorsal view, Sample 2293

12-15 - *Saxoxythere tenuissima* KEMPER, 1971
   12. RV, lateral view, Sample 2345
   13. LV, lateral view, Sample 2334
   14. RV, internal view, Sample 2334
   14a. *idem*, detail of the hinge
   15. RV, lateral view, Sample 2334

16 - *Cornicythereis gatyensis* DAMOTTE & GROSDIDIER, 1963
   C, left lateral view, Sample 2270

17-20. - *Pedellacythere aff. pitstonensis* (WEAVER, 1982)
   17. LV, lateral view, Sample 2346
   18. RV, lateral view, Sample 2302
   19. LV, dorsal view, Sample 2336
   20. LV, lateral view, Sample 2335

21-23 - *Platycythereis rectangularis* OERTLI, 1958
   21. RV, lateral view, Sample 2283
   22. RV, lateral view, Sample 2328
   23. LV, lateral view, Sample 2298

24 - *Platycythereis* sp.
   RV, lateral view, Sample 2292

Plate caption
C = Complete shell, *i.e.* both valves
RV = Right valve
LV = Left valve
AM = Anterior margin
PM = Posterior margin
DM = Dorsal margin
VM = Ventral margin
Plate 6:

1 - *Platycythereis* sp.
   LV, lateral view, Sample 2292

2-9 - *Parexophthalmocythere (Parexophthalmocythere)* sp.
   2. RV, lateral view Sample 2362
   3. RV, lateral view, Sample 2368
   4. RV, internal view, Sample 2368
   5. LV, lateral view, Sample 2355
   6. LV, internal view (fragment), Sample 2368
   7. LV, internal view, Sample 2368
   8. RV, lateral view, Sample 2351
   9. LV, lateral view, Sample 2368

10-14 - *Rehacythereis buechlerae* (OERTLI, 1958)
   10. LV, lateral view, Sample 2336
   11. LV, lateral view, Sample 2336
   12. RV, lateral view, Sample 2345
   13. RV, lateral view (juvenile specimen), Sample 2336
   14. C, dorsal view, Sample 2336

15 - *Rehacythereis aff. bartensteini* (OERTLI)
   RV, juvenile specimen, lateral view, Sample 2301

16-17 - *Rehacythereis bartensteini* (OERTLI)
   16. LV, lateral view, topotype, Gargas Hill
   17. RV, lateral view, topotype, Gargas Hill

18 - *Champanicytherura cf. kayei* WEAVER, 1982
   RV, lateral view, Sample 2353

19 - *Microceratina ? sp.*
   RV, lateral view, Sample 2337

20-21 - *Liasina rectimarginata* (NUYS, 1990)
   20. C, right lateral view, Sample 2343
   21. C, left lateral view, Sample 2346

Plate caption
C = Complete shell, i.e. both valves
RV = Right valve
LV = Left valve
AM = Anterior margin
PM = Posterior margin
DM = Dorsal margin
VM = Ventral margin