Parafavreina, n. gen., a new thalassinid anomuran (Crustacea, Decapoda) coprolite form-genus from the Triassic and Liassic of Europa and North Africa.

by

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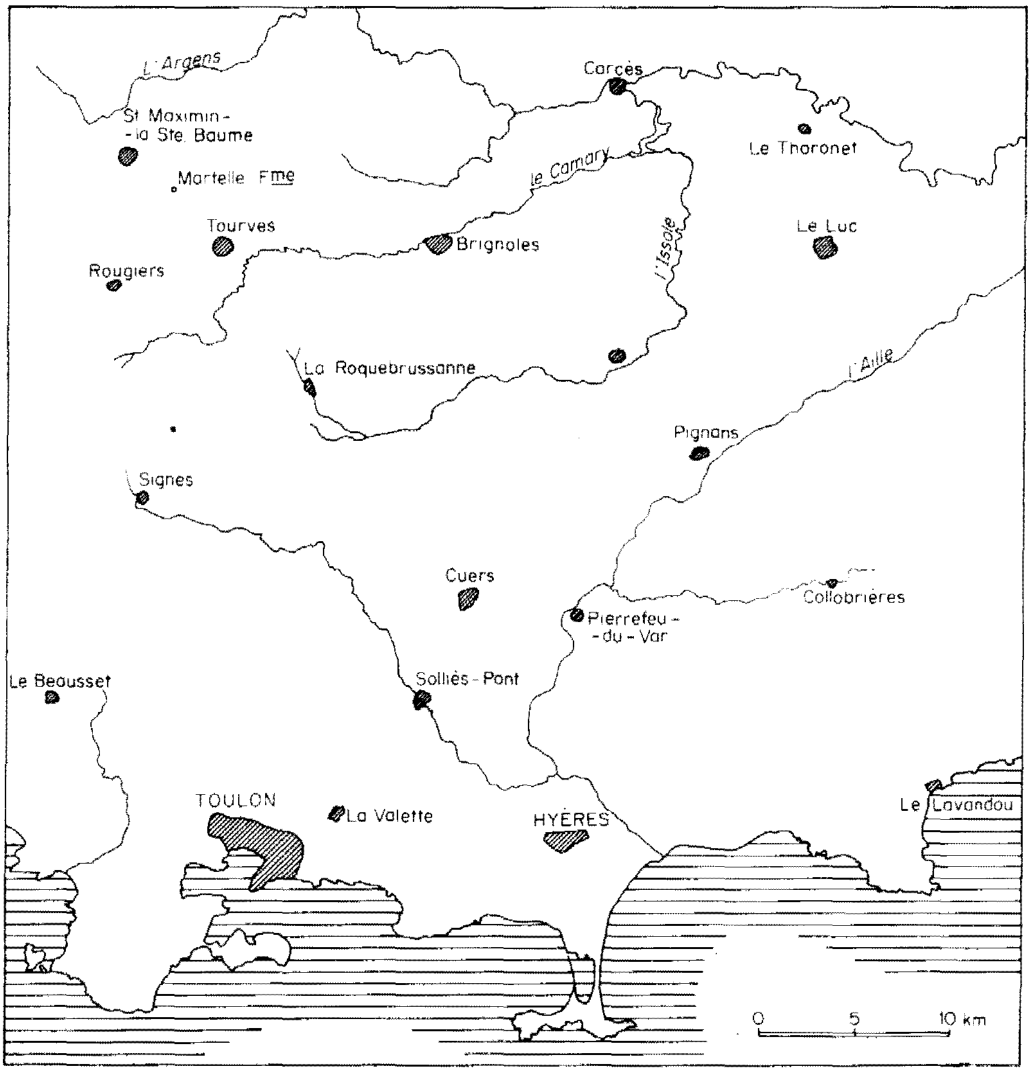

text-fig. 1 Map showing the geographic location of Le Thoronet.

Summary

Parafavreina thoronetensis, n. gen., n. sp., is a thalassinid anomuran coprolite characterized by numerous longitudinal canals of isosceles triangular cross sections. The canals are arranged in 2 bilaterally symmetric groups and those of each group form in the adult a loop-like pattern. *Parafavreina thoronetensis* is common in Rhetian beds. Its total range extends from the Norian to the Middle Lias and geographically it occurs in Austria, France, Italy, Spain and Algeria.

Rhetian limestones outcropping in the quarry near Thoronet, about 45 km NNE of Toulon, Provence, southern France (text-fig. 1), contain thin beds composed almost exclusively of coprolites of anomuran crustaceans (Pl. 1, fig. 2). These coprolite beds were discovered by CARON and the fecal pellets subsequently examined by BRÖNNIMANN and ZANINETTI who recognized among a number of morphologically different forms a new thalassinid anomuran form-genus here named *Parafavreina*, n. gen. The present note contains the description of this taxon.

The accompanying coprolites referable to the new galatheid anomuran form-genus *Thoronetia* Brönnimann, Caron and Zaninetti, 1972 will be described in a separate paper.

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Class Crustacea
Order Decapoda (Anomura)
Tribe Thalassinidea
Genus *Parafavreina* BRÖNNIMANN, CARON and ZANINETTI, n. gen.

Type species: *Parafavreina thoronetensis* BRÖNNIMANN, CARON and ZANINETTI, n. sp.

Definition:

The rod-shaped coprolites of *Parafavreina*, n. gen., are subcircular to „dorso-ventrally" slightly compressed in transverse sections. The „ventral" side is usually flattened and the „dorsal" side convex. The coprolites are perforated by 2 bilaterally symmetric groups of longitudinal canals with transverse sections in the form of isosceles triangles.

Remarks:

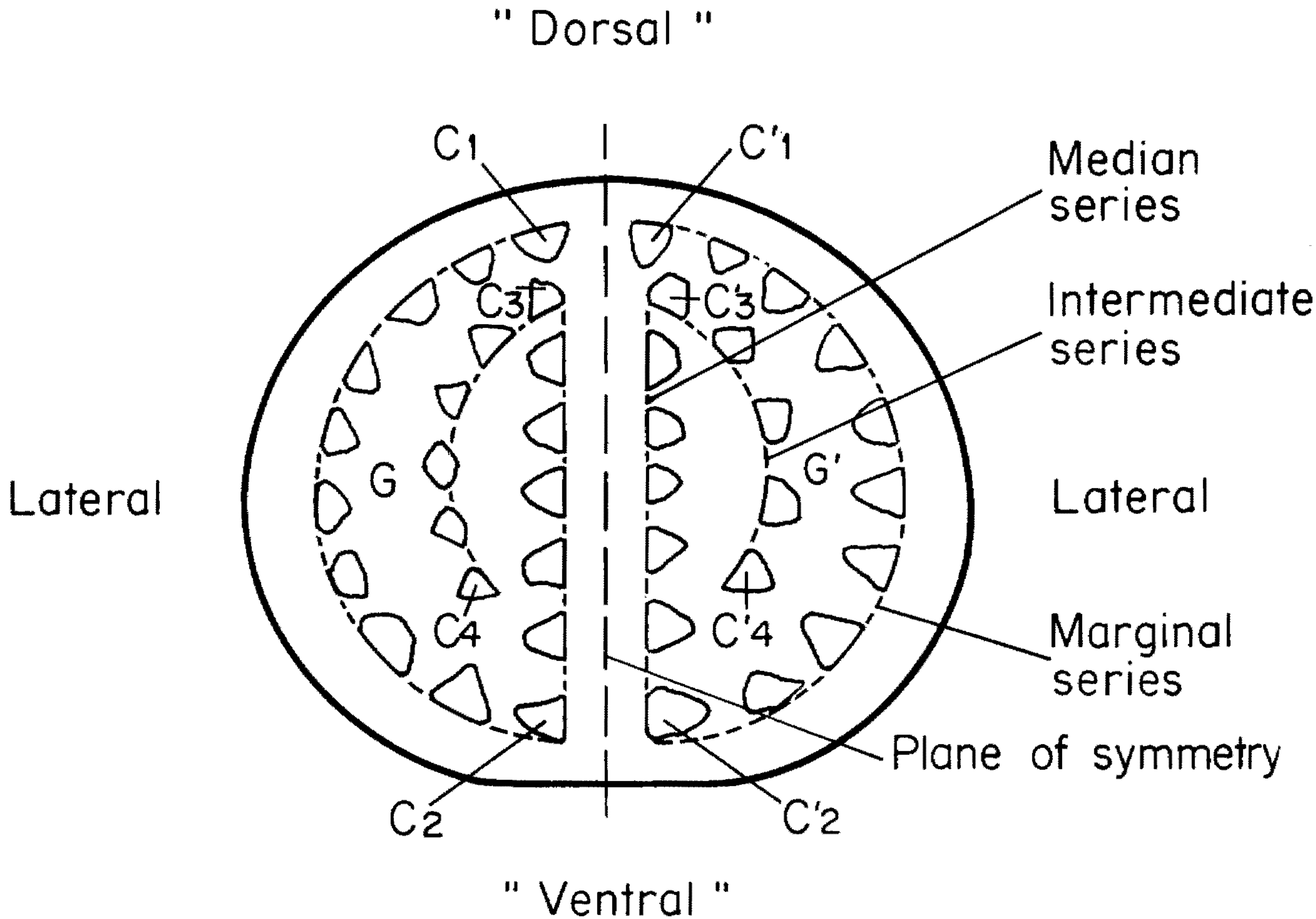
Parafavreina, n. gen., differs from the other form-genera of thalassinid anomuran coprolites by the isosceles triangular cross sections of the longitudinal canals.

Occurrence:

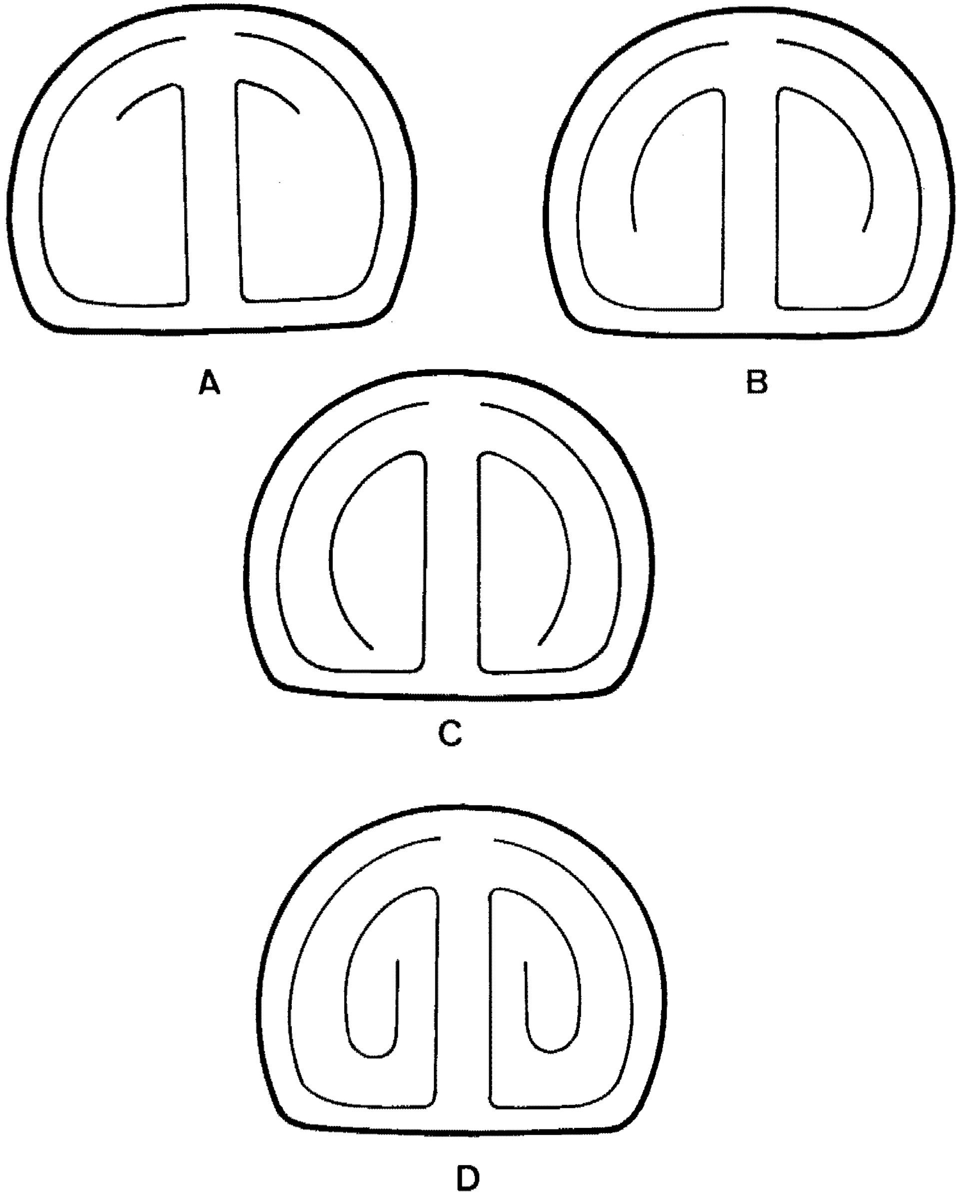
Parafavreina, n. gen., is here described from the Rhetian of Provence, southern France. It has also been recorded by CUVILLIER, BASSOULET and FOURCADE (1969, p. 184, pl. 1, fig. 1, 2,) as Favrelna type 1 from the Middle Lias of the Sierra de Tomillo, Hellin, Province of Albacete, Spain, and from the Toarcian of the Djebel Arar, Saharian Atlas, Algeria. The specimen from the Sinemurian of the Lot Valley, France, illustrated by DUFAURE (1958, pl. 6, fig. 8) as *Coprolithus* cf. *salevensis* PAREJAS may also be representative of *Parafavreina.* It is compared by CUVILLIER, BASSOULET and FOURCADE (1969, p. 184) with their Favreina type 1 which is undoubtedly a *Parafavreina.* FARINACCI (1967, p. 460, pl. II, fig. 2) illustrated as *Coprolithus* oblique transverse cuts of coprolites from the Lower Lias, Massiccio limestone of the Monte Lacerone, Sabina, Italy. They may be referable to *Parafavreina*. Whether some of the coprolites illustrated by CUVILLIER and SACAL (1957, pl. IV, fig. 2 (Characées primitifs?)) from the Infralias of the Saint-Médard (Gers) well I may belong to *Parafavreina* could not be ascertained as we were unable to obtain the thin section for examination. CUVILLIER, BASSOULET and FOURCADE (1969, p. 184) compare them with their Favreina type 1. The transverse cut of a coprolite illustrated by BASSOULET and GUERNET (1970, pl. 2, fig. 3) from the Middle Lias of the region of Thebes, Greece, and named Favreina type 2 is a *Parafavreina.* Favreina type 2 of BASSOULET and GUERNET (1970) is different from Favreina type 2 of CUVILLIER, BASSOULET and FOURCADE (1969) on the basis of the rounded to tear-shaped cross sections, the different arrangements and the more numerous and smaller longitudinal canals of Favreina type 2 of BASSOULET and GUERNET. GAETANI (1970, p. 428, pl. 27, fig. 3(?), fig. 4) illustrated typical representatives of *Parafavreina* under the name of *Favreina salevensis* (PAREJAS) from the Hettangian Sedrina limestone, Bergamo, Italy. Also the oblique transverse cuts of coprolites illustrated by VILLA and POZZI (1962, p. 474, pl. XXXII, fig. 1) from the Rhetian of the Valtellina, Northern Italy, seem to belong, in part at least, to *Parafavreina.* The single, strongly oblique transverse cut of a coprolite from the Lower Lias, possibly Hettangian, Corna formation, Val Gobbia, SSE of the Dosso Valley, province Brescia, Italy, shows parafavreine features (CITA, 1965, pl. II, fig. 1), and the centered transverse section of a coprolite illustrated by CZURDA and NICKLAS (1970, pl. V, fig. 10) from the Norian „Hauptdolomit“ (beds with Megalodon) and named „Pellet (fecal) vom Typus ‚*Favreina*‘ “ is to judge from the canal pattern also referable to *Parafavreina.* This latter reference indicates the stratigraphically oldest and geographically northernmost occurrence of *Parafavreina.*

Stratigraphic range:

The total range of *Parafavreina* is Norian to Middle Lias.



text-fig. 2 Diagrammatic cross section of *Parafavreina thoronetensis*, n. sp., with explanation of terminology.



text-fig. 3 A-C Diagrammatic cross sections of different ontogenetic stages of *Parafavreina thoronetensis*, s. sp.
D Diagramm of *Parafavreina*, n. sp., as illustrated by Bassoulet and Guernet (1970, pl. 2, fig. 3) erroneously under the name of Favreina type 2 Cuvillier, Bassoulet and Fourcade (1969).

Parafavreina thoronetensis BRÖNNIMANN, CARON and ZANINETTI, n. sp.

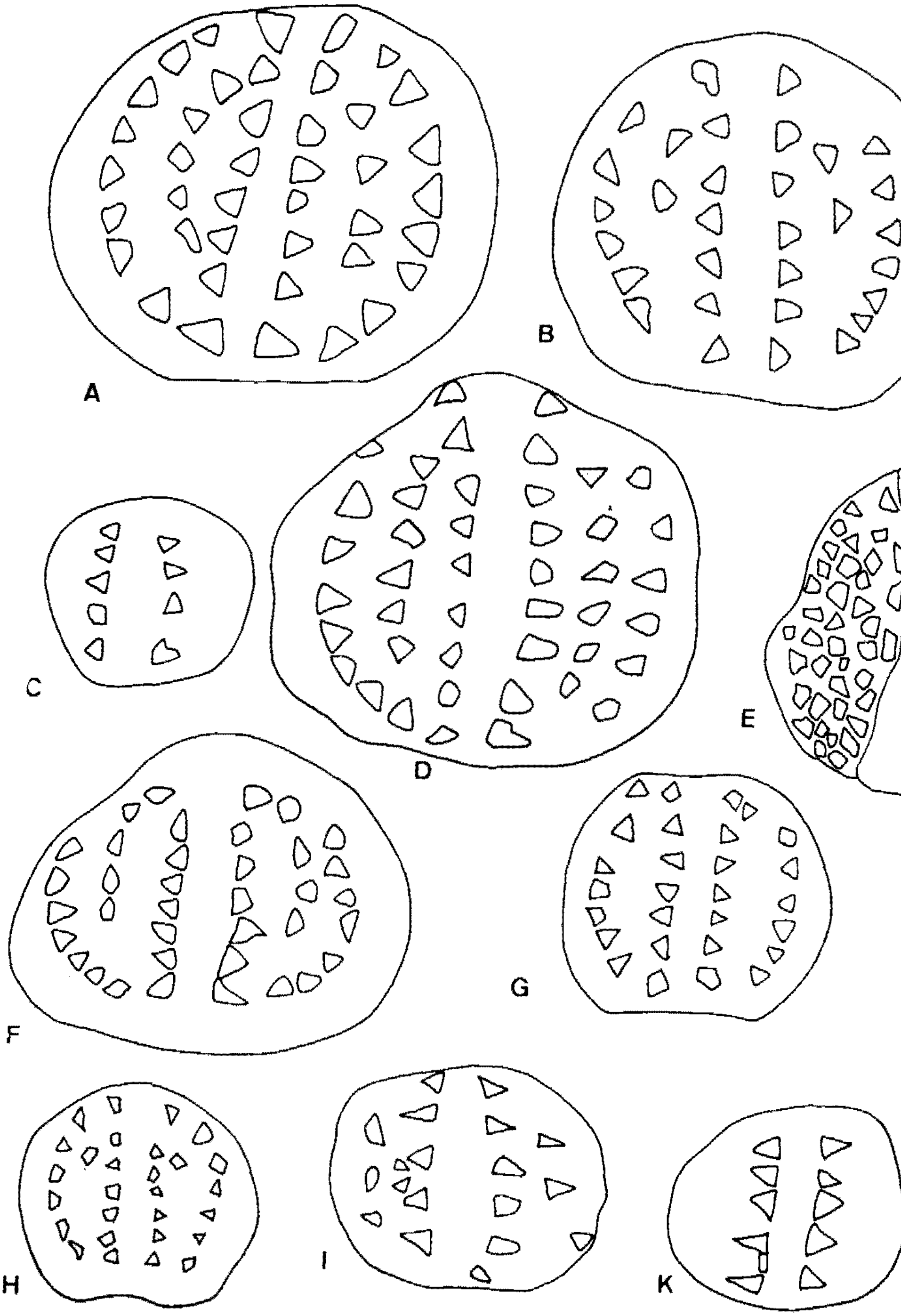
Pl. 1, Fig. 1–16, Pl. 2, Fig. 1–10.
Text-fig. 2–4.

Synonymy:

? 1958. *Coprolithus* cf. *salevensis* Paréjas. Dufaure, pl. 6, Fig. 8.
1962. Coproliti. Villa and Pozzi, pl. 32, fig. 1.
1964. Unnamed coprolite. Pirini and Mosna, pl. X, fig. 29.
1965. Foecal (sic) pellets. Cita, pl. II, fig. 2.
? 1967. *Coprolithus.* Farinacci, pl. II, fig. 2.
1969. Favreina type 1. Cuvillier, Bassoulet and Fourcade, p. 184, pl. 1, fig. 1, 2.
1970. *Favreina salevensis* (Paréjas). Gaetani, pl. 27, fig. 3, 4.
1970. „*Favreina*". Czurda and Nicklas, pl. V, fig. 10.

Description of holotype:

As holotype of *Parafavreina thoronetensis*, n. sp., is designated the transverse section illustrated by pl. 1, fig. 12 and by fig. A of text-fig. 4. It is from thin section CARON R9H-12.30 which has been cut from Middle Rhetian limestones outcropping in the quarry at Thoronet about 45 km NNE of Toulon, Provence, southern France, (text-fig. 1). The maximum width of the transverse section of the holotype, perpendicular to the plane of bilateral symmetry, is about 272μ, its maximum height in the plane of bilateral symmetry about 240μ. The rod-like coprolite is „dorsally" convex and „ventrally" flattened not grooved. It is perforated by 2 bilaterally symmetric groups G and G' of longitudinal canals. As illustrated diagrammatically in text-fig. 2 each group consists of 3 series of canals: a marginal series C_1 to C_2 (C_1' to C_2') of 8 to 9 canals which lie on a curve parallel to the lateral outline of the coprolite, a straight median series C_2 to C_3 (C_2' to C_3') of 6 to 7 canals aligned parallel to the plane of bilateral symmetry and a shorter intermediate series C_3 to C_4 (C_3' to C_4') of 4 to 5 canals, again arranged in a curve parallel to the marginal series. In each group the 3 series are interpreted to form a loop-like pattern: $C_1 \rightarrow C_2$ ($C_1' \rightarrow C_2'$), then $C_2 \rightarrow C_3$ ($C_2' \rightarrow C_3'$), and then $C_3 \rightarrow C_4$ ($C_3' \rightarrow C_4'$). Canals C_1 (C_1') and C_2 (C_2') are occasionally slightly larger than other canals. The „dorsal" canal C_1 (C_1') is in this interpretation defined as the beginning of the curved marginal series of canals. This interpretation is the result of the examination of numerous cross sections of well-preserved coprolites of different dimensions showing different developments of the canals and occuring in one and the same thin section. Most probably they represent coprolites from different growth stages of the crustaceans which produced them (pl. 1, text-fig. 3). A characteristic feature of the loop-like pattern is its angularity at the points C_2 (C_2') and C_3 (C_3'). Three different stages in the development of the loop-like pattern are diagrammatically illustrated in text-fig. 3 A–C. The cross sections of the longitudinal canals are isosceles triangles. The marginal series shows the apices of the triangles directed toward the center and those of the median and the intermediate series toward the periphery of the coprolite. The base of the isosceles



text-fig. 4 *Parafavreina thoronetensis*, n. sp.
Fig. A: Holotype
Fig. A, C, D, E, F, H, I, K, from Caron sample R9H-12.30 Rhetian, Thoronet.
Fig. B, G from Caron sample R9H-12.34. All about 120 x.

triangles ranges from about 1 to 3μ, and the height from about 2 to 4μ. The luminae of some of the canals are recrystallized by dolomite rhombohedrons and the true outlines of the isosceles triangles are in such cases only preserved as phantoms and frequently difficult to ascertain. Neighboring canals appear quite often to be interconnected by thin lines which run from base to base of the triangles. This is illustrated by pl. 1, fig. 13 (left marginal series).

Remarks:

As holotype of *Parafavreina thoronetensis*, n. sp., has been chosen a transverse section of a coprolite in which the loop-like pattern formed by the longitudinal canals is well developed. It is probably from an adult crustacean. Apart from cross sections of large coprolites which measure up to 400μ in lenght and up to 300μ in width with marginal, median and intermediate series similar in the number of canals to those encountered in the holotype, we found also numerous smaller coprolites with a smaller number of longitudinal canals. As a result of recrystallization (dolomitization) the canals may show rhomboid cross sections. The type with the fewest longitudinal canals is represented by the smallest coprolites. It is illustrated by pl. 1, fig. 11, 14 (specimen middle right), and by fig. C and K of text-fig. 4. It exhibits only 2 straight series of 4 to 5 canals parallel to the axis of bilateral symmetry. In these series the apices of the isosceles triangles are pointed toward the margin. These 2 series of canals correspond with the median series of the holotype. The canals of the specimen pl. 1, fig. 11, are large in relation to the size of the coprolite probably because the cut runs somewhat obliquely to the longitudinal axis of the pellet. Another more complicated type is illustrated by pl. 1, fig. 6 (upper specimen), fig. 9 (specimen at left), pl. 2, fig. 10 and by fig. I of text-fig. 4. Here 2 to 3 canals are added peripherally to the straight median series. In text-fig. 4 I, the 2 small triangles in the left group between the median and the peripheral series are probably nuclei of recrystallization independent of the canals. The peripheral series of canals seems to correspond with the beginning of the marginal series of canals of the holotype. We then encountered cross sections of intermediate-size coprolites with canal patterns which could be better compared than the 2 above mentioned types with that of the holotype. They show a curved marginal and a straight median series of triangular canals with apices directed inward respectively outward. They are illustrated by pl. I, fig. 3, 4, 5, 6 (upper specimen), 8, 9 (specimen at right), 10; pl. 2, fig. 10, and by fig. G of text-fig. 4. In the same thin section occur also somewhat larger-sized coprolites than those with a simple marginal and median series of canals in which a short intermediate series consisting of one or more triangular canal(s) occur(s). They are illustrated by pl. 1, fig. 6 (lower specimen), 7 and by fig. B, H of text-fig. 4. The apices of the triangles of these intermediate canals are directed, as in the holotype, toward the periphery of the coprolite. All of these simpler canal systems are interpreted as having been produced by the less complex stomach appendices of younger animals than that which produced the holotype. The dimension of the coprolites can be arranged according to the canal pattern. Those with the simpler patterns are smaller than the holotype with the complete loop-like pattern.

In the same thin sections occur associated with typical *P. thoronetensis* coprolites with longitudinal canals of isosceles triangular cross sections in which the median series is well developed, the marginal and intermediate series however are short, consisting of about 1 to 2 canals in the intermediate and of about 2 to 3 canals in the marginal series. It is illustrated by pl. 1, fig. 14 (upper left), and fig. 16 (upper right). The „dorsal" sides of these coprolites have irregularly shaped erosional features. Effects of the partial erosion of the dorsal side of a coprolite is also detectable on the specimens illustrated by pl. 1, fig. 15 (upper part) and by fig. D and F of text-fig. 4. A similar pattern although consisting of more numerous canals of rounded cross sections has also been illustrated in *Favreina murciensis* CUVILLIER, BASSOULET and FOURCADE (1969, pl. 1, fig. 7) from the lower Senonian, Sierra del Cuchillo, Yeda, Murcia, Spain. Also this canal pattern seems to be the result of partial erosion of the „dorsal" portion of the coprolite, which apparently consists of softer material than the „ventral" side.

Coprolithus cf. *salevensis* PAREJAS illustrated by DUFAURE from the Sinemurien of the Lot Valley, central France (1958, pl. 6, fig. 8) has been assigned with reservation to *P. thoronetensis*. The cross sections of the longitudinal canals might be triangular but it is impossible to definitely establish their shape in DUFAURE's illustration. The canals are arranged as in *P. thoronetensis* in a curved marginal series, an also curved intermediate series and a straight median series.

Favreina type 1 of CUVILLIER, BASSOULET and FOURCADE (1969 pl. 1, fig. 1, 2) exhibits longitudinal canals with isosceles triangular cross sections arranged in the same pattern as described in *P. thoronetensis*. The specimen illustrated by these authors in pl. 1, fig. 2, corresponds well with the holotype of *P. thoronetensis*, that of pl. 1, fig. 1, is possibly on the „dorsal" side (lower part of the specimen) slightly eroded because the marginal series do not extend completely over the „dorsal" side. Also this coprolite possesses isosceles triangular canals which however seem to be strongly recrystallized. The „ventral" side (upper part of the specimen in the cited illustrations) is in both cross sections flattened as in *P. thoronetensis*.

Evolution:

It has been noticed that the maximum number of longitudinal canals is about 20 to 25 in Rhetian coprolites from Thoronet. In those from the Sinemurian of the eastern border of the Massif Central, France, encountered in a thin section donated by Dr. L. COUREL, Dijon, occur about 32 longitudinal canals. They are arranged as in the holotype of *P. thoronetensis* and the specimen is here referred to *P. thoronetensis* BASSOULET and GUERNET (1970, pl. 2, fig. 3) illustrated and named erroneously as Favreina type 2 of CUVILLIER, BASSOULET and FOURCADE (1969, pl. 1, fig. 3, 4) the cross section of a coprolite from the Middle Lias of Greece showing isosceles triangular cross sections of the longitudinal canals. This form has to be referred to *Parafavreina*, n. gen. Its loop-like pattern however exhibits a final innermost turn which does not exist in the holotype of *P. thoronetensis* and it should probably be referred to a new species of *Parafavreina* characterized by a more complicated pattern of longitudinal canals (text-fig. 3 D). Although it is premature to make evolutionary deductions on the basis of these data it seems to be justified to draw other workers attention to the possibility that the number of stomach appendices of anomuran crustaceans may increase and the loop-like pattern of the longitudinal canals become more complicated in the course of time.

Occurrence:

Parafavreina thoronetensis, n. sp., occurs abundantly in the Rhetian dolomitic limestones and dolomites outcropping in an quarry at Thoronet, Provence, France. It is accompanied by other anomuran coprolites which however are not as common as *P. thoronetensis*. In one of the thin sections from CARON sample R9H-12.34 we encountered a specimen of *Glomospirella friedli* KRISTAN-TOLLMANN which clearly exhibits the early „sigmoidal" enrollment of the deuteroloculus. *Glomospirella friedli* has been recorded in beds of Norian to Rhetian age (BRÖNNIMANN, POISSON and ZANINETTI, 1970).

P. thoronetensis has also been encountered in thin section GAETANI T 18, from the Hettangian Sedrina limestone, Val Adra Section, province Bergamo, Italy, where it is associated with *Palaxius* sp. It occurs also in thin section GAETANI G 384 from the Hettangian Corna limestone, Pozzo Glaciale section, province Bergamo, Italy. Specimens of *P. thoronetensis* from both localities have been illustrated under the name of *Favreina salevensis* (PAREJAS) by GAETANI (1970, pl. 27, fig. 3, 4). In thin sections CROS R. 17 and R. 18 from the infraliasic limestones outcropping in the Val Salata about 14 km N of Cortina d'Ampezzo, Dolomites, Italy, occurs *P. thoronetensis* together with *Palaxius salataensis* BRÖNNIMANN, CROS and ZANINETTI. VILLA and POZZI (1962, pl. 32, fig. 1) illustrated typical *P. thoronetensis* form the Rhetian coprolite bed of Baita della Gera, Valtellina, northern Italy. CUVILLIER, BASSOULET and FOURCADE (1969, pl. 1, fig. 1, 2) illustrated 2 transverse cuts of *P. thoronetensis* as *Favreina* type 1 from the Middle Lias of the Sierra de Tomillo, province Albacete, Spain, and from the Toarcian of Djebel Arar, Saharian Atlas, Algeria. The transverse sections of a coprolite illustrated by CITA (1965, Pl. II, fig. 2) from the Lower Lias, possibly Hettangian Corna formation, Val Gobbio, SSE of the Dosso Valley, province Brescia, Italy, and by CZURDA and NICKLAS (1970, pl. V, fig. 2) from the Norian „Hauptdolomit" of the Northern Calcalps, Vorarlberg, Austria, represent also *P. thoronetensis*. *Coprolithus* cf. *salevensis* PAREJAS (DUFAURE, 1958, pl. 6, fig. 8) from the Sinemurian of the Lot Valley, France, and *Coprolithus* (FARINACCI, 1967, pl. 2, fig. 2) from the Lower Lias Massiccio limestone, Monte Lacerone area, Sabinia, Italy, are possibly also referable to *P. thoronetensis*. We also found *P. thoronetensis* characterized by more numerous canals than in the holotype in a thin section donated by Dr. L. COUREL, Dijon, from the Lower Lias of the northeastern border of the Massif Central, France.

In summary, *P. thoronetensis* occurs from Norian to Middle Liasic beds of Austria, France, Italy, Spain and Algeria.

Remarks on deformed coprolites:

We have already mentioned that many specimes of *P. thoronetensis* have been „dorsally" eroded suggesting that the „dorsal" portion of the coprolite consisted of softer material and thus was less resistant to friction than its flattened „ventral" portion. The irregular „dorsal" outlines as seen in transverse cuts and the reduced number of longitudinal canals of the „dorsal" marginal series clearly indicate that the softer portions of the rods were worn away through abrasion. Apart from this another probably mechanical process may have considerably affected the originally rod-shaped coprolites.

This process for which we employ the term „micro-boudinage" is well known in oolitic and pseudoolitic textures.

It resultated in secondary deformation of many of the fecal pellets in the Rhetian limestones from Thoronet. The deformed coprolites are usually linearly arranged suggesting that the deformation occured along planes of stress either diagenetically or post-diagenetically. Deformed specimes of *P. thoronetensis* are illustrated by pl. 2, fig. 1-5, 7, and by fig. E of text-fig. 4. The extremities of the rod-shaped bodies are usually drawn out into fine interconnecting threads. The transverse sections of the longitudinal canals retain also under extreme deformation their triangular outlines. In some cases even their original loop-like pattern is preserved.

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Explanations to the plates

Plate 1

Fig. 1-16 *Parafavreina thoronetensis* Brönnimann, Caron and Zaninetti, n. sp.
Fig. 12: Holotype of *P. thoronetensis*, n. sp.
Fig. 1, 3–16: 85 x.
Fig. 2: 25 x.

Plate 2

Fig. 1-10 *Parafavreina thoronetensis* Brönnimann, Caron and Zaninetti, n. sp.
Fig. 1–5, 7–10: 85 x.
Fig. 6: 170 x. (same specimen as pl. 1, fig. 1, left).

Fig. 11 *Thoronetia quinaria* Brönnimann, Caron and Zaninetti, 1972.
Deformed specimen 85 x.

Plate 1

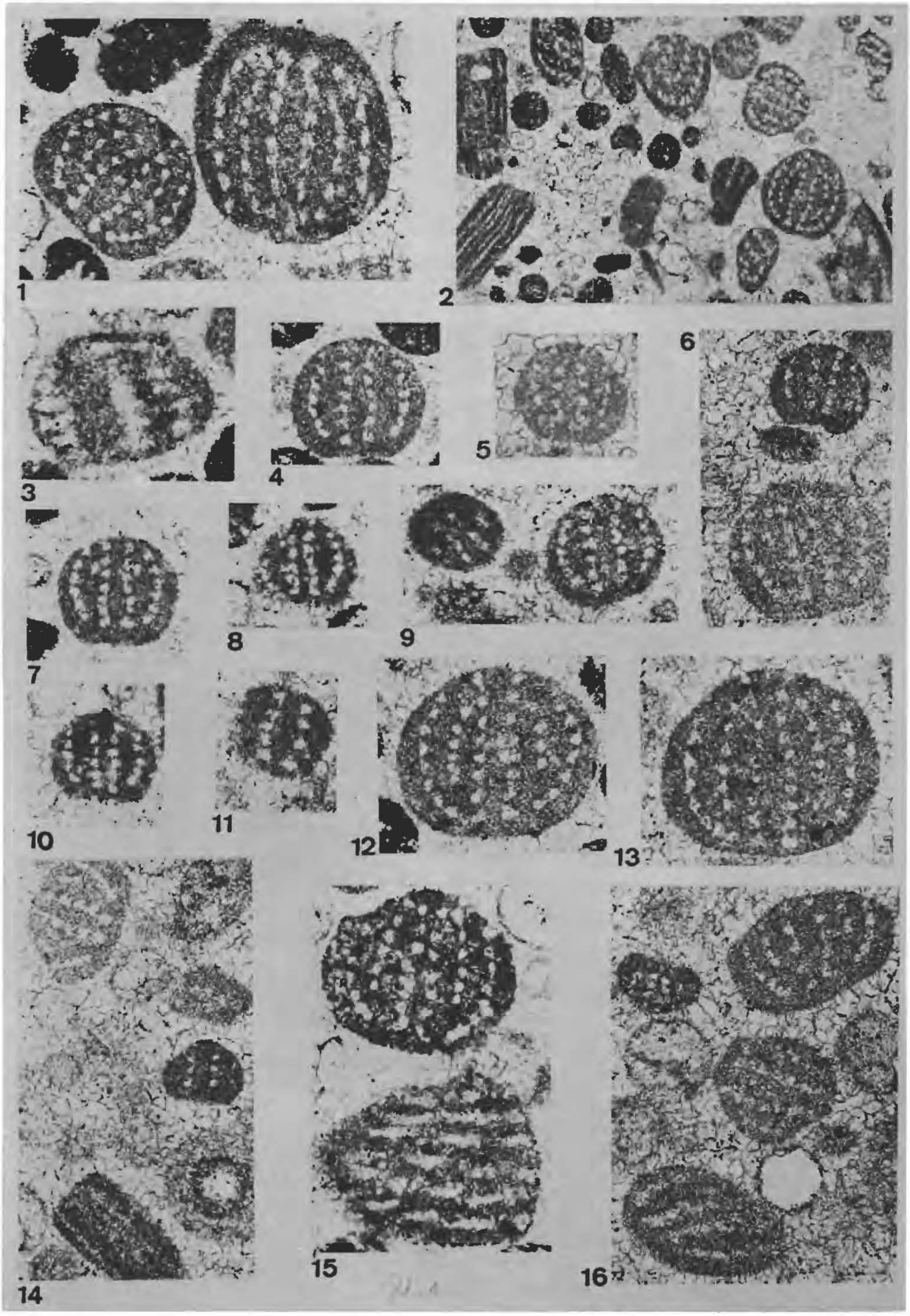

Plate 2