

Specific distinctive criteria in *Neomeris* (Dasycladales)

Spezifische Unterscheidungskriterien innerhalb *Neomeris* (Dasycladales)

by

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Abstract

A comparative study of the morphological features mentioned by Botanists and Palaeontologists in the description of recent and fossil *Neomeris* species is proposed.

Features of the reproductive organs appear to be one of the most useful criteria to separate species or groups of species, so as the aspect of the calcified envelopes surrounding the fertile ampullae on fossil specimens.

Zusammenfassung

Eine Studie der Gattung *Neomeris* anhand morphologischer Merkmale, die von Botanikern und Paläontologen für die Beschreibung von rezenten und fossilen Vertretern dieser Gattung verwendet werden, wird vorgestellt.

Merkmale der Reproduktionsorgane scheinen am geeignetsten für die Trennung von Arten oder Artengruppen zu sein. Bei fossilen Vertretern sind es dementsprechend die kalkifizierten Hüllen, die die fertilen Ampullae umgeben.

1. Introduction

Genus *Neomeris* is known from the Lower Cretaceous but most species have been discovered in Palaeogene sediments. More than forty fossil species have been described whereas only seven species live in modern seas, mainly in the Atlantic, Indian and Pacific oceans.

Living representatives of *Neomeris* have a cylindrical or clavate thallus, 1 to 5 centimeters high, tapered towards the tip. In the axial area, the siphonous stalk bears whorls of primary branches. At the upper part of the Alga, each primary branch develops a fertile ampulla located terminally at the top of the branch and surrounded by two, rarely three, secondary branches. The ampulla only contains one cyst. The whole thallus is anchored to a substratum by means of rhizoidal branches.

The purpose of this paper is to examine the morphological

features used by Botanists and Palaeontologists in the description of recent and fossil *Neomeris*, so as to point out the best criteria which may efficaciously lead to the distinction of fossil species.

2. Materials and methods

The informations concerning recent *Neomeris* species have been collected in the Botanical literature. We have mainly consulted studies of CRAMER (1887, 1890), SOLMS-LAUBACH (1893), HOWE (1909), EGEROD (1952), DAWSON (1956), TAYLOR (1960), VALET (1969), BERGER and KAEVER (1992). Data on fossil species included in hard rocks and only known in thin sections have been taken in synthesis publications (BASSOULLET et al., 1978; DELOFFRE & GÉNOT, 1982) and in some more specialized papers.

At last, we have studied numerous species whose specimens have been extracted from sandy sediments of the Paris Basin, the Mons Basin (Belgium), Cotentin and Brittany (north-west and west of France).

Specimens have been observed with a scanning electron microscope.

3. Results and discussion

Distinctive criteria of recent *Neomeris* species

According to the descriptions of recent *Neomeris* species proposed by Botanists, it appears that some morphological features are more particularly used to distinguish species or groups of species:

– the shape of the distal ends of the secondary branches: spindle-shaped, not enlarged to form a continuous cortex in *Neomeris cokeri* HOWE; flattened, forming a faceted cortex in the other species,

– the shape of the fertile ampulla: sphaerical or almost sphaerical in *Neomeris dumetosa* LAMOUROUX, *N. mucosa* HOWE, *N. stipitata* HOWE and *N. van bosseae* HOWE; long – obovoid or pyriform in *N. annulata* DICKIE and *N. cokeri* HOWE; ellipsoidal in *N. bilimbata* KOSTER,

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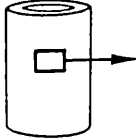
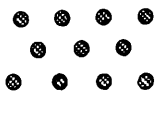
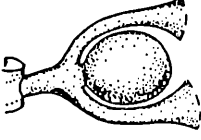
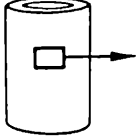
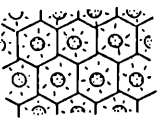
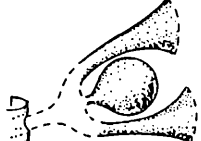
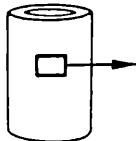
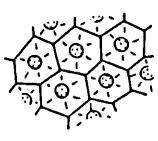
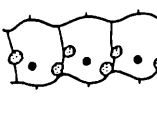
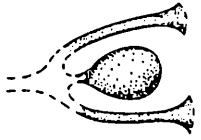
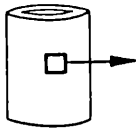
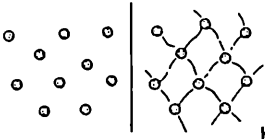
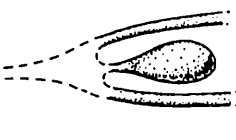
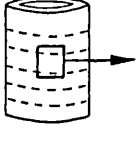
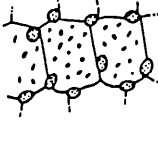
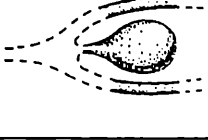
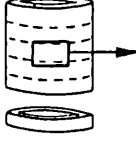
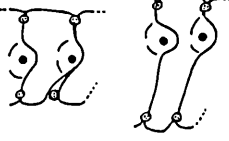
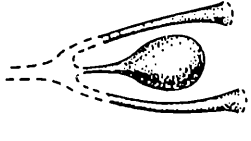
	Shape of the skeleton	External surface (detail)	Internal surface (detail)	Branches and fertile organs
1 <i>Neomeris larvarioides</i> (MORELLET, 1913)	 a	 b	 c	 d
2 <i>Neomeris fragilis</i> (DEFRANCE, 1825)	 a	 b	 c	 d
3 <i>Neomeris courtzi</i> MORELLET, 1913	 a	 b	 c	 d
4 <i>Neomeris herouvalensis</i> STEINMANN, 1899	 a	 b	 c	 d
5 <i>Neomeris radiata</i> MORELLET, 1922	 a	 b	 c	 d
6 <i>Neomeris fercourtsensis</i> GÉNOT, 1980	 a	 b	 c	 d
 location of the secondary branches  location of the peduncle bearing the fertile ampulla				 non - calcified organs  calcified organs (even exceptionally)

Table 1: Morphological features of *Neomeris* (*Neomeris*) species observed on free specimens (part 1).

– the shape of the cyst: ovoid or obovoid in *N. annulata*, *N. cokeri*, *N. mucosa* and *N. van bosseae*; almost sphaerical in *N. dumetosa* and *N. stipitata*; ellipsoidal in *N. bilimbata*,
– the shape of the distal ends of primary branches: almost rounded in *N. mucosa*, rounded or flattened on both sides in *N. bilimbata*, with three expansions in *N. van bosseae*,
– the shape of the stopper closing the mature fertile ampulla: flattened, thin in *N. van bosseae*, conical in *N. mucosa*, discoidal and thick in *N. bilimbata*,
– the location and the degree of calcification:
– Primary branches strongly calcified but remaining distinct or very slightly coherent in *N. annulata* and *N.*

van bosseae; weakly calcified and not coherent in *N. bilimbata*, *N. cokeri* and *N. stipitata*; more or less calcified, coherent or not in *N. mucosa*; presence of typical calcified lamellae between branches in *N. dumetosa*,
– Secondary branches strongly calcified except the cortical surface in *N. annulata*, *N. bilimbata*, *N. van bosseae* and *N. stipitata*; slightly calcified except the upper ends, strongly calcified, in *N. dumetosa*; external upper face of secondary branches calcified in *N. mucosa*, more or less calcified in *N. cokeri*.
Size of the thallus and of the organs are also mentioned in specific definitions but these data may be variable according to the environmental conditions.

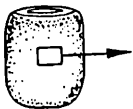
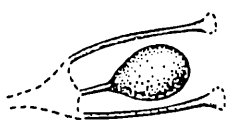
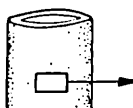
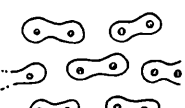
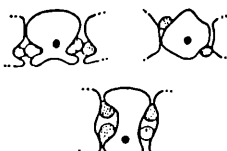
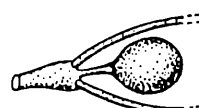
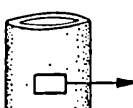
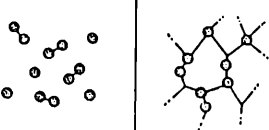
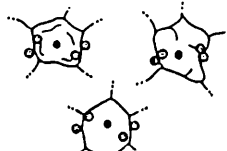
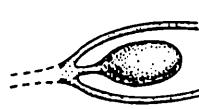
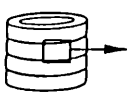
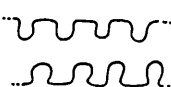
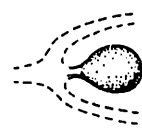
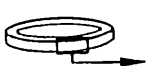
	Shape of the skeleton	External surface (detail)	Internal surface (detail)	Branches and fertile organs
1 <i>Neomeris pustulosa</i> MORELLET, 1917				
2 <i>Neomeris scrobiculata</i> (GUMBEL, 1872)				
3 <i>Neomeris arenularia</i> MORELLET, 1913				
4 <i>Neomeris alternans</i> MORELLET, 1939				
5 <i>Neomeris bipartita</i> GÉNOT, 1987				
6 <i>Neomeris pseudo-eruca</i> MORELLET, 1922				
 location of the secondary branches  location of the peduncle bearing the fertile ampulla				 non - calcified organs  calcified organs (even exceptionally)

Table 2: Morphological features of *Neomeris* (*Neomeris*) species observed on free specimens (part 2).

Distinctive criteria of fossil *Neomeris* species

Some of the morphological features known in recent *Neomeris* may not be observed in fossil species because of the partial initial calcification of the Alga: the top of the thallus, the external upper face of the secondary branches, the cyst inside each fertile ampulla, the rhizoids and the deciduous hairs are never present in fossils. Most fossil *Neomeris* are described thanks to the preservation of their reproductive organs and secondary branches. Primary branches are exceptionally present in fossils. Therefore, if we consider species only known from sections (specimens included in hard rocks), the features

of the reproductive organs will be the most frequently mentioned data in the description of species, especially the shape of the ampullae:

- ovoid in *N. aciculata* MASLOV & JARCEVA (Palaeocene, Ukrainia), *N. budaense* JOHNSON (Cenomanian, Texas, Portugal), *N. drimi* RADOIČIĆ (Turonian, Serbia), *N. grandis* DIENI et al., *N. oroseiana* DIENI et al. (Palaeocene, Sardinia), *N. jerinae* RADOIČIĆ (Santonian, Serbia) and *N. plagnensis* DELOFFRE (Thanetian–Sparnacian, Pyrenees),
- ovoid, elongated in *N. tyrrhenica* DIENI et al. (Palaeocene, Sardinia),
- ovoid to ellipsoidal in *N. cretacea* STEINMANN (Albian, Mexico),

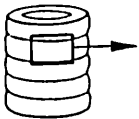
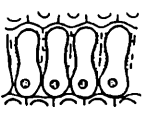
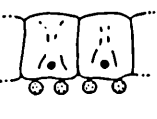
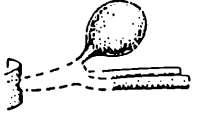
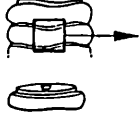
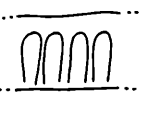
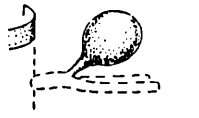
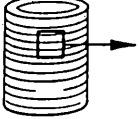
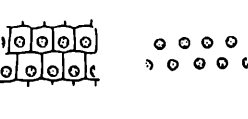
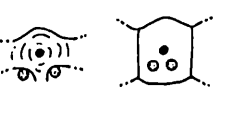
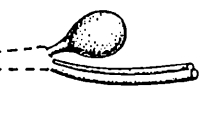
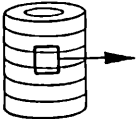
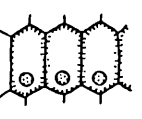
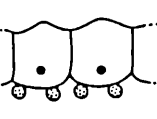
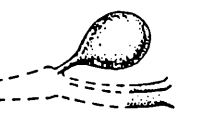
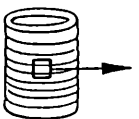
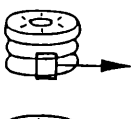
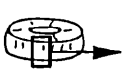
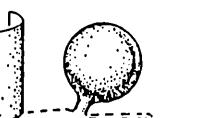
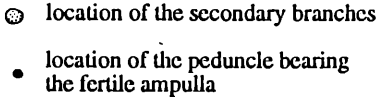
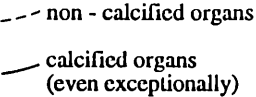
	Shape of the skeleton	External surface (detail)	Internal surface (detail)	Branches and fertile organs
1 <i>Neomeris auversiensis</i> (MORELLET, 1913)	 a	 b	 c	 d
2 <i>Neomeris encrinula</i> (DEFrance, 1822)	 a	 b	 c	 d
3 <i>Neomeris craniphora</i> (MORELLET, 1908)	 a	 b	 c	 d
4 <i>Neomeris filiformis</i> (MORELLET, 1913)	 a	 b	 c	 d
5 <i>Neomeris reticulata</i> (DEFrance, 1822)	 a	 b	 c	 d
6 <i>Neomeris limbata</i> (DEFrance, 1822)	 a	 b	 c	 d
7 <i>Neomeris montensis</i> (MORELLET, 1922)	 a	 b	 c	 d
				

Table 3: Morphological features of *Neomeris* (*Larvaria*) species observed on free specimens.

– ovoid to almost sphaerical in *N. dalpiazii* DIENI et al. (Palaeocene, Sardinia),
– pyriform to ellipsoidal in *N. pfenderae* KONISHI & EPIS (Hauterivian–Danian, Arizona),
– sphaerical in *N. koradae* DIENI & al. (Palaeocene, Slovenia, Sardinia).
Most of these species have secondary branches represented by cylindrical canals with, in some of them,

a more or less widened upper extremity often difficult to interpret. Only three species show primary branches: *N. drimi*, *N. jerinae* and *N. koradae*.
When specimens can be extracted from the sediment, more features are available to define and separate species:
– the aspect of the external surface of the skeleton with the ornamentation of the wall and the presence, in some

species, of alveols corresponding to the enlarged distal extremities of the secondary branches: well preserved specimens of *N. larvarioides* (MORELLET), *N. fragilis* (DEFrance), *N. courtyi* MORELLET and *N. filiformis* (MORELLET), palaeogene species of the Paris Basin, show this feature (Tabl. 1, Fig. 1b, 2b, 3b; Tabl. 3, Fig. 4b),

– the aspect of the internal surface of the skeleton (when the calcification of primary branches is absent) with the particular outline of the calcified envelopes surrounding the ampullae: hexagonal in *N. courtyi* MORELLET and *N. herouvalensis* STEINMANN (Tabl. 1, Fig. 3c–4c; pl. 1, Fig. 3–4); very irregular in *N. fragilis* (DEFrance) and *N. pseudo-eruca* MORELLET (Tabl. 1, Fig. 2c; Tabl. 2, Fig. 6c; pl. 1, Fig. 2, 14); square with concave sides in *N. radiata* MORELLET (Tabl. 1, Fig. 5c; pl. 1, Fig. 5); oblique parallelogram in *N. fercourtsensis* GÉNOT and *N. bipartita* GÉNOT (Tabl. 1, Fig. 6c; Tabl. 2, Fig. 5c; pl. 1, Fig. 6, 7, 13); multilobate in *N. scrobiculata* (GÜMBEL), *N. arenularia* MORELLET and *N. alternans* MORELLET (Tabl. 2, Fig. 2c, 3c, 4c; pl. 1, Fig. 9–12); more or less rectangular in *N. auversiensis* (MORELLET) and *N. filiformis* (MORELLET) (Tabl. 3, Fig. 1c, 4c; pl. 2, Fig. 1, 6); rounded to more or less rectangular or slightly hexagonal, according to individuals, in *N. craniphora* (MORELLET) and *N. reticulata* (DEFrance) (Tabl. 3, Fig. 3c, 5c; pl. 2, Fig. 4, 5, 7, 8); trapezoidal in *N. limbata* (Tabl. 3, Fig. 6c; pl. 2, Fig. 10–13). All these species are originating in the palaeogene sediments of the Paris Basin.

The aspect of the fertile ampulla is also mentioned in the descriptions: sphaerical or almost sphaerical without peduncle in *N. larvarioides* (Tabl. 1, Fig. 1d), with a short peduncle in *N. fragilis* (Tabl. 1, Fig. 2d); sphaerical to slightly ovoid in *N. limbata* and *N. montensis* (Tabl. 3, Fig. 1d, 6d, 7d); ovoid to almost sphaerical in *N. auversiensis*, *N. filiformis* and *N. reticulata* (Tabl. 3, Fig. 1d, 4d, 5d); ovoid in *N. courtyi*, *N. radiata* (Tabl. 1, Fig. 3d, 5d), *N. bipartita*, *N. pseudo-eruca* (Tabl. 2, Fig. 5d, 6d), *N. encrinura* and *N. craniphora* (Tabl. 3, Fig. 2d, 3d); ovoid elongated in *N. herouvalensis* (Tabl. 1, Fig. 4d) and *N. alternans* (Tabl. 2, Fig. 4d); ovoid with a long peduncle in *N. pustulosa*, *N. scrobiculata* (Tabl. 2, Fig. 1d, 2d); ovoid to ellipsoidal in *N. arenularia* (Tabl. 2, Fig. 3d).

Concerning the branches, the calcification is very variable between species (GÉNOT, 1980, 1985, 1987). Very few species show complete primary branches: *N. larvarioides* and exceptionally *N. scrobiculata* (Tabl. 1, Fig. 1d; Tabl. 2, Fig. 2d). Calcification is frequently preserved but very irregular along secondary branches according to species (Tabl. 1–3, Figures d). Nevertheless, the degree of variability of the calcification seems relatively constant within each species.

4. Conclusion

If we examine and compare the different morphological features mentioned by Botanists and Palaeontologists to describe *Neomeris* species, some of them are more particularly useful to characterize and separate species. It appears that morphological data concerning the reproductive organs, mainly the shape of the organs, may be considered as a good criteria to separate species or groups of species. The shape of the calcareous envelopes around the fertile ampullae may also be a specific distinctive criteria; unfortunately, this feature is only observed on specimens that can be isolated from the sediment. At last, calcification is too variable and incomplete in most species to define efficacious distinctive criteria based on the morphological features of the branches.

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PLATE 1

Internal surface of the calcified skeleton in *Neomeris* (*Neomeris*) species.

Scale: the white line represents 100 µm on each figure.

- Fig. 1. *Neomeris larvarioides* (MORELLET), Lutetian, Le Bois-Gouët, Brittany.
- Fig. 2. *Neomeris fragilis* (DEFRANCE), Lutetian, Grignon, Paris Basin.
- Fig. 3. *Neomeris courtyi* MORELLET, Stampian, Etampes, Paris Basin.
- Fig. 4. *Neomeris herouvalensis* STEINMANN, Cuisian, Hérouval, Paris Basin.
- Fig. 5. *Neomeris radiata* MORELLET, Lutetian, Liancourt-Saint-Pierre, Paris Basin.
- Fig. 6. *Neomeris fercourtensis* GÉNOT, Lutetian, Liancourt-Saint-Pierre, Paris Basin.
- Fig. 7. *Neomeris fercourtensis* GÉNOT, Lutetian, Fercourt, Paris Basin.
- Fig. 8. *Neomeris pustulosa* MORELLET, Lutetian, Le Bois-Gouët, Brittany.
- Fig. 9. *Neomeris scrobiculata* (GÜMBEL), Cuisian, Pierrefonds, Paris Basin.
- Figs. 10–11. *Neomeris arenularia* MORELLET, Auversian, Le Fayel, Paris Basin.
- Fig. 12. *Neomeris alternans* MORELLET, Stampian, Rauville, Cotentin.
- Fig. 13. *Neomeris bipartita* GÉNOT, Lutetian, Mont-de-Magny, Paris Basin.
- Fig. 14. *Neomeris pseudo-eruca* MORELLET, Lutetian, Chaussy, Paris Basin.

PLATE 1

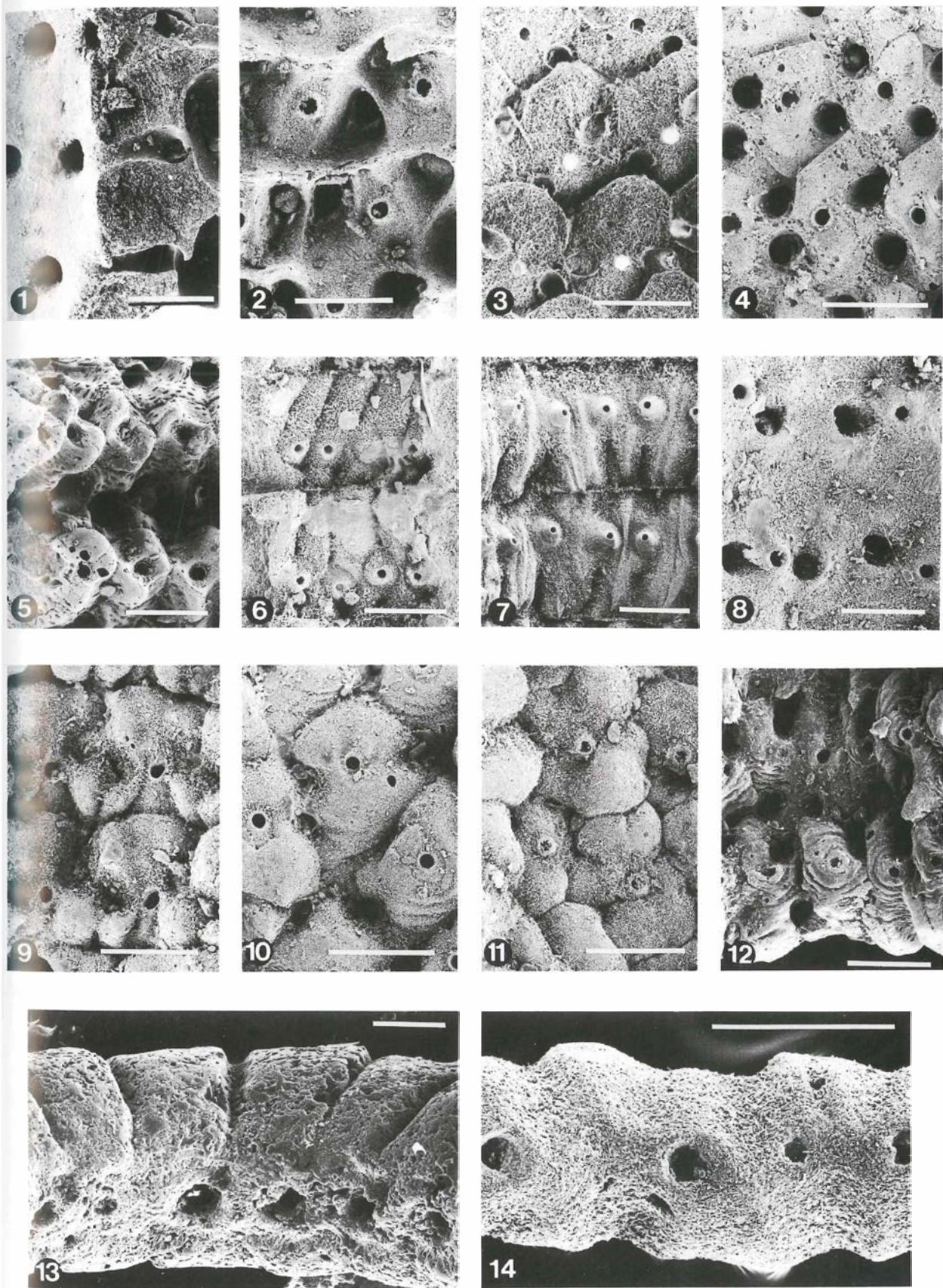


PLATE 2

Internal surface of the calcified skeleton in *Neomeris* (*Larvaria*) species.

Scale: the white line represents 100 µm on each figure.

- Fig. 1. *Neomeris auversiensis* (MORELLET), Auversian, Auvers-sur-Oise, Paris Basin.
Fig. 2. *Neomeris encrinula* (DEFRANCE), Lutetian, Le Bois-Gouët, Brittany.
Fig. 3. *Neomeris encrinula* (DEFRANCE), Marinesian, Le Ruel, Paris Basin.
Figs. 4–5. *Neomeris craniphora* (MORELLET), Thanetian, Boncourt, Paris Basin.
Fig. 6. *Neomeris filiformis* (MORELLET), Lutetian, Chaussy, Paris Basin.
Figs. 7–8. *Neomeris reticulata* (DEFRANCE), Lutetian, Grignon, Paris Basin.
Fig. 9. *Neomeris montensis* (MORELLET), Montian, Mons Basin.
Fig. 10. *Neomeris limbata* (DEFRANCE), Lutetian, Le Bois-Gouët, Brittany.
Figs. 11, 12, 13. *Neomeris limbata* (DEFRANCE), Lutetian, Grignon, Paris Basin.

PLATE 2

