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Bioerosion on a *Terebratula scillae* population from the Lower Pleistocene of Lecce area (Southern Italy)

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ABSTRACT

This paper deals with shell bioerosion in a population of *Terebratula scillae* SEGUENZA from the Lower Pleistocene in Lecce area, Southern Italy. The most important traces belong to shell breakage attributed to predatory activity; borings (*Entobia* isp., *Maeandropolydora* isp.); drill holes (*Oichnus simplex* BROMLEY; *Oichnus* isp.); and etching scars (*Centrichnus eccentricus* BROMLEY and MARTINELL; *Podichnus centrifugalis* BROMLEY and SURLYK).

The distribution analysis of the traces of epibiosis on the shells of *T. scillae* induces us to think that we are dealing with a pedicle-anchored form, living with completely raised valves. Besides, both percentage and nature of predation marks (probably due to gastropods or decapod crustaceans) do not depose for a very intense predation pressure.

Keywords: Bioerosion. Palaeoecology. *Podichnus*. *Centrichnus*. *Oichnus*. *Terebratula*. Pleistocene. Southern Italy.

RESUMEN

El presente artículo trata sobre la bioerosión en las conchas de una población de *Terebratula scillae* SEGUENZA del Pleistoceno inferior del área de Lecce, Sur de Italia. Las principales trazas pertenecen a roturas de la concha atribuidas a la actividad de depredadores; perforaciones (*Entobia* isp., *Maeandropolydora* isp.); agujeros (*Oichnus simplex* BROMLEY; *Oichnus* isp.); e impresiones (*Centrichnus eccentricus* BROMLEY and MARTINELL; *Podichnus centrifugalis* BROMLEY and SURLYK).

El análisis de la distribución de las trazas de epibiosis sobre las conchas de *T. scillae* induce a pensar que se trata de una forma anclada mediante el pedículo, que vivía con las valvas completamente levantadas. Por otra parte, ni los porcentajes ni la naturaleza de las señales de depredación (probablemente debidas a gasterópodos o a crustáceos decápodos) indican una presión de depredación demasiado intensa.

Palabras clave: Bioerosión. Paleoecología. *Podichnus*. *Centrichnus*. *Oichnus*. *Terebratula*. Pleistoceno. Sur de Italia.

INTRODUCTION

This is an analysis of bioerosion found on shells of a *Terebratula scillae* SEGUENZA population from the surroundings of Lecce (Apulia, Southern Italy), Lower Pleistocene in age (Fig. 1). Three hundred and fifty seven individuals have been studied, 80 of which exhibit bioerosion.

Figure 1. Location of the studied outcrop near Lecce, Apulia, Southern Italy.

The Albanese Quarry succession (Figs. 2 and 3) outcrops for about 8.5 m. Its lower part consists of calcarenites, overlaid by 3.5 m of sands. In the highly fossiliferous calcarenites, *Arctica islandica*, *Mya truncata* and *Pecten jacobaeus* have been found. Most of the fossils are internal moulds and they are randomly distributed in the rock. The sands contain pelecypods (among which *Chlamys varia* and *C. multistriata* are dominant), bryozoans, gastropods, and echinoderms. In the middle part of the sandy unit, a layer up to 30 cm thick, particularly rich in *Terebratula scillae*, has been recorded.

In a preceding paper on the Cava Albanese *T. scillae* population, Taddei Ruggiero (1994) suggested that *T. scillae* presumably lived in a circa-littoral environment, with a muddy detritic sea bottom.

TRACE FOSSIL DESCRIPTION

The 80 specimens show up to 89 traces. Some individuals have more than one trace, including some of different types. Since these specimens belongs to a collection of the Palaeontological Museum of the University of Naples, it was impossible to destroy the shells to make some endocasts.

The most important traces belong to durophagous structures, borings (*Entobia* isp.; *Maeandropolydora* isp.), drill holes (*Oichnus simplex* BROMLEY; *Oichnus* isp.) and etching scars (*Centrichnus eccentricus* BROMLEY & MARTINELL; *Podichnus centrifugalis* BROMLEY AND SURLYK), following Ekdale et al. (1984) classification for bioerosion structures.

Figure 2. Albanese quarry. The *Terebratula scillae* level is indicated by the arrow.

Durophagous structures (Plate I, fig. 1)

We have found the two valves clearly showing corresponding breakages. They are from very tiny to 1 cm in length, laying along the growth lines. The breakages have been produced on what was, prior to the trauma, the edge of the shell. All the breakages have been mended by the brachiopods. The growth of the individuals continued, sometimes apparently undisturbed, sometimes with modifications of the shape of the individuals, according to the intensity of the damage. These traces are numerous, but not very intrusive. Similar traces have been described by several authors (Carriker, 1951; Landers, 1954; Martinell et al., 1982) and have been attributed to predatory activities either by decapod crustaceans or carnivorous gastropods.

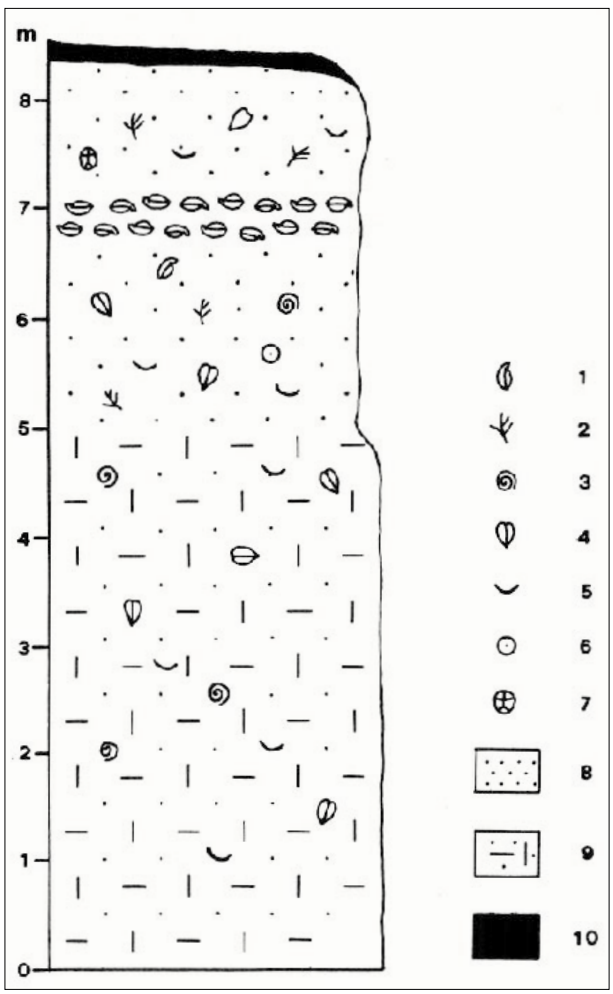

Figure 3. Albanese quarry, stratigraphical succession of lower Pleistocene calcarenites and sands; (1) *Terebratula scillae*; (2) Briozoa; (3) Gastropods; (4) Pelecypods; (5) Pectinids; (6) Regular echinoids; (7) Irregular echinoids; (8) Sands; (9) Calcarenites; (10) Soil.

Borings

Entobia isp. (Plate I, fig. 2)

Small openings (0.3-0.6 mm) nearly circular in shape. They are distributed irregularly on the umbo surface. This type of traces are commonly attributed to the sponge genus *Cliona*, but, in our sample, it is not possible to come to a specific attribution for the scarcity of material. Only two trace fossils of this ichnogenus have been found.

Maeandropolydora isp. (Plate I, fig. 5-6)

They are tubular cavities (found in 5 specimens), isolated, irregularly bending and constant in diameter (1-1.5 mm), with two lengthened openings. Such traces have been attributed to *Maeandropolydora* relying upon comparison with the material described by Bromley and D'Alessandro (1983), which also comes from the Pleistocene of Apulia. Only one sample (Plate I, fig. 6) shows different features: tubular, isolated cavities, in U or hook shapes. The diameter is about 0.5 mm, openings were not noticed.

Drill holes

Oichnus simplex BROMLEY (Plate I, fig. 3)

They consist of subcircular boreholes, (only one specimen, 3.2 mm in diameter), not piercing throughout the shell. The hemispherical shape allows us to interpret it as the result of a carnivorous gastropod activity (Bromley, 1981).

Oichnus isp. (Plate I, fig. 4)

They are subcircular holes (2 specimens, 3-5 mm in diameter) located on the cardinal commissure. A slightly abraded area is noticeable around the hole and tangentially to it; it is subcircular in shape and measures c. 11-14 mm in diameter.

Similar traces have been previously found in two *Terebratula* populations from Southern Italy. The first was a *T. scillae* population from the lower Pleistocene of Calabria (Taddei Ruggiero, 1989, 1991); the second, a *T. terebratula* (= *T. calabra*) population from the upper Pliocene

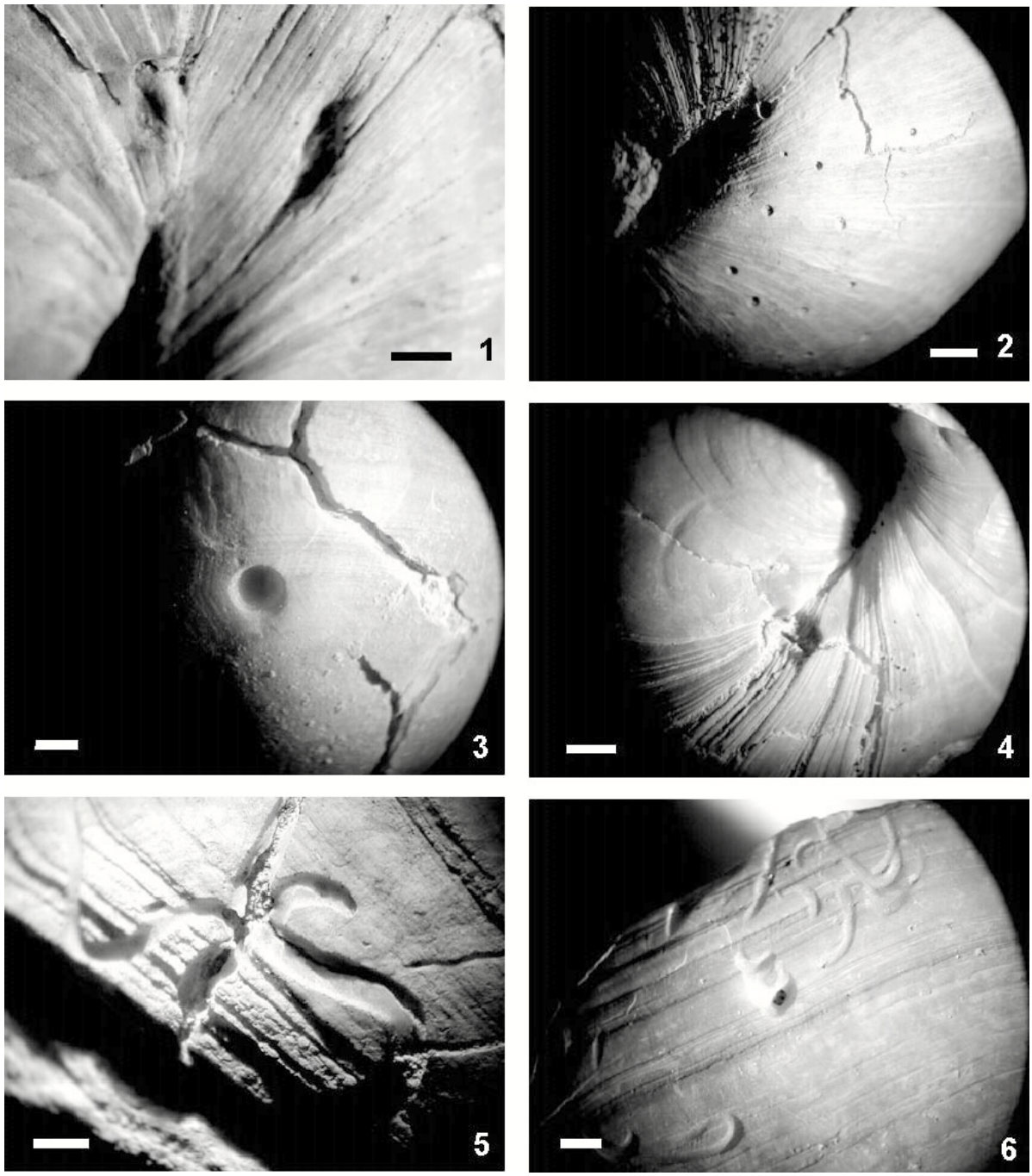

Plate I
Bioerosion on *Terebratula scillae* shells:
1. Breackage, spec. nº 3142.
2. *Entobia* isp., spec. nº 3050.
3. *Oichnus simplex*, spec. nº 3121.
4. *Oichnus* isp., spec. nº 3115.
5. *Maeandropolydora* isp. spec. nº 3052.
6. *Maeandropolydora* isp. spec. nº 3128.

Scale bar = 2 mm

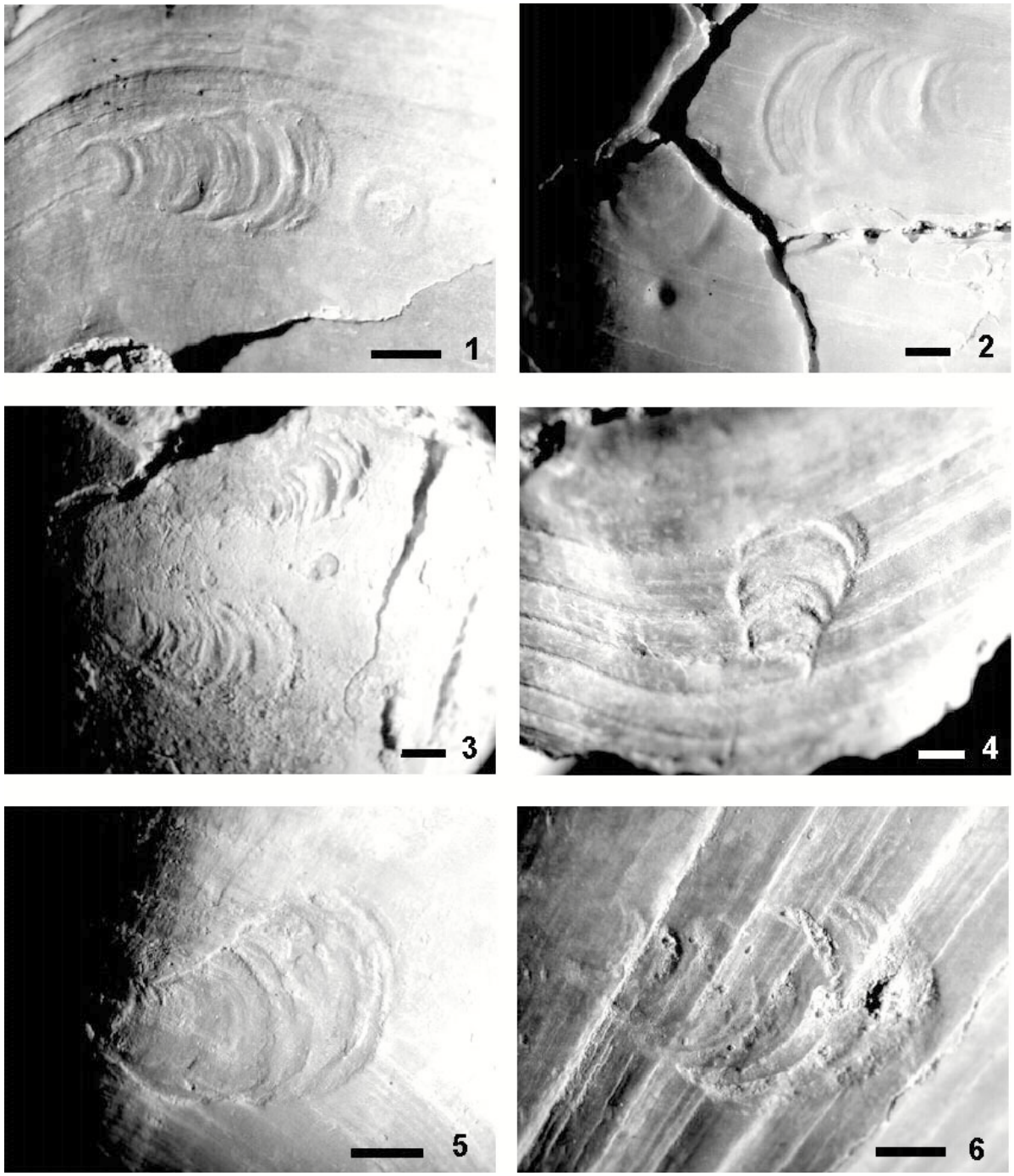

Plate II
Centrichnus eccentricus on Terebratula scillae shells:
1. Spec. nº 3147.
2. Spec. nº 3129.
3. Spec. nº 3070.
4. Spec. nº 3001.
5. Spec. nº 3040.
6. Spec. nº 3465.

Scale bar = 2 mm

of Apulia (Taddei Ruggiero, 1999). Traces have been attributed to bioerosive activity of parasite capulid gastropods. The capulid inserts its proboscis through the hole to take food from the food-gathering tract of the brachiopod. Since the prey does not die, we suggest that its predator-lowered feeding rate caused a shrinkage in its growth rate; indeed, the dimensions of the two specimens (sp. n° 3504: length (le) = 6.7 cm, width (wh) = 4.5 cm, thickness (th) = 3.4 cm; and sp. n° 3115 le = 5.4 cm, wh 0= 4.3 cm, th = 3.0 cm) are lower than those for samples showing a strictly comparable number of growth lines, thus recognized to be of the same age (sp. n° 3404: le = 8.0 cm, wh = 5.8 cm, th = 4.8 cm; sp. n° 3050: le = 8.5 cm, wh = 5.7 cm, th = 4.8 cm). Our hypothesis is so far unprecedented in the literature and it would be interesting to test it on a wider sample.

Etching scars

Centrichnus eccentricus BROMLEY and MARTINELL (Plate II , figs. 1-6)

Etching traces, on smooth substrate consisting of brachiopod carbonate shells. They are regular, and more or less marked. They are constituted by several bow-shaped furrows. The initial, subcircular part of the trace is 2-3 mm in width, then its furrows become bow-shaped, concave toward the initial part, increasing in width up to 7 mm.

This is the most frequent trace (30 specimens). It is presumed to have been produced by the cemented attachment of Anomiidae bivalves (Bromley and Martinell, 1991).

Podichnus centrifugalis BROMLEY and SURLYK (Plate III, figures 1-6)

They are clustered perforations on a subcircular area. Those closer to the centre are smaller in diametre and orthogonal to the shell surface. Peripheral perforations are larger, obliquely oriented and penetrate more deeply into the shell.

Nineteen *Podichnus* have been found on 16 individuals of *T. scillae*. The dimensions of the area affected by the pits vary from 4 to 10 mm.

Both the amount and the distribution of the pits are greatly variable, and often more than one trace has been noticed on one individual. *Podichnus* may be rather regular and symmetrical to very asymmetrical.

- Asymmetrical traces: the pits are widely scattered, perpendicular pits are displaced to one side of the trace. These pits are small, while the peripheral ones increase in size and depth; moreover they are oblique to the shell surface (Plate III, figs. 1-3, 6 left).

- Symmetrical traces: the trace is etched into the substrate with a small number of pits, those pits are regularly outdistanced and perpendicular to the surface. Peripheral pits are symmetrical to the centre (Plate III, figs. 4-6 right).

Bromley and Surlyk (1973) associated these traces with those caused by the fixing of the pedicle of some brachiopods belonging to the rhynchonellids and terebratulids. The difference among traces of the brachiopods on a smooth surface is related to the different pedicle morphology. The traces found in this population can be correlated to those produced by a short and massive pedicle, provided with papillae.

Inside the valve, in correspondence to the bioerosion, a shell thickening was observed, due to the reconstruction of new layers. This indicates that the organism mended the damage.

As to the cause of the damage, we recognize these traces as due to specimens belonging to the *T. scillae* species itself, because the trace size corresponds to that of the foramen (4 to 7 mm in diameter) and due to the fact that this species is the only brachiopod occurring in the assemblage.

We can compare these traces with those found in another population of *T. scillae* from the lower Pleistocene of Calabria (Taddei Ruggiero, 1991). They are similar in having the bioeroded-area of similar size (5-9 mm). Pier-

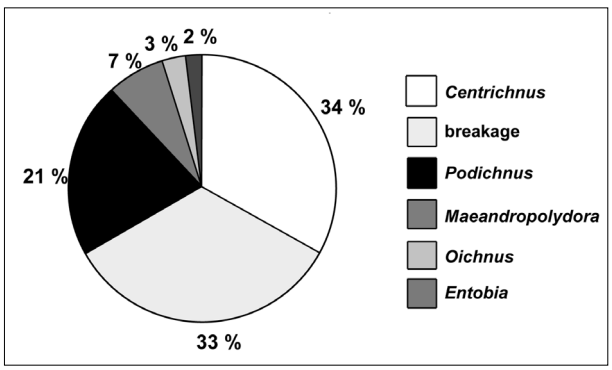

Figure 4. Bioerosion percentages.

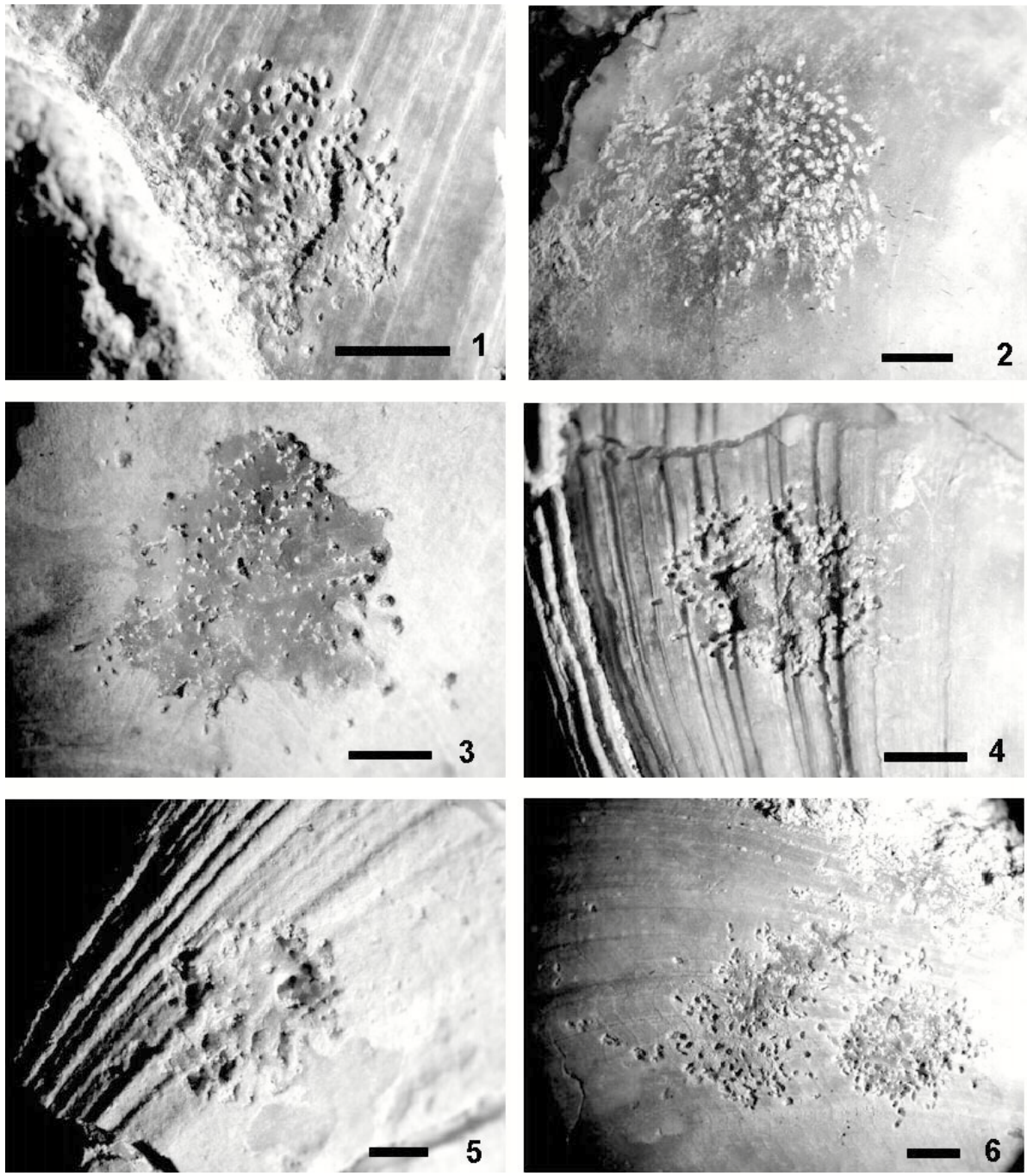

Plate III
Podichnus centrifugalis on Terebratula scillae shells:
1. Spec. nº 3050.
2. Spec. nº 3145.
3. Spec. nº 3146
4. Spec. nº 3000.
5. Spec. nº 3477.
6. Spec. nº 3147.

Scale bar = 2 mm

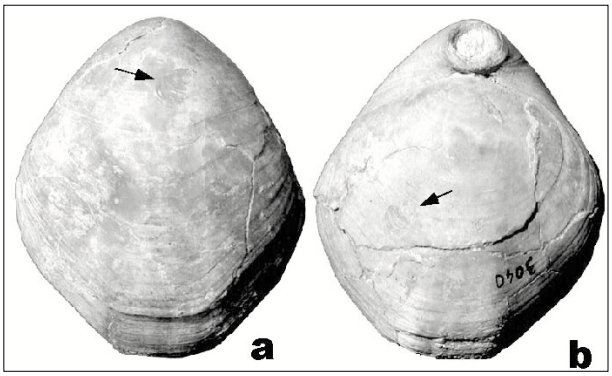

Figure 5. *Terebratula scillae*, specimen nº 3040, 7.5 cm in length; pedicle (a) and brachial (b) valve, both exhibiting *Centrichnus eccentricus.*

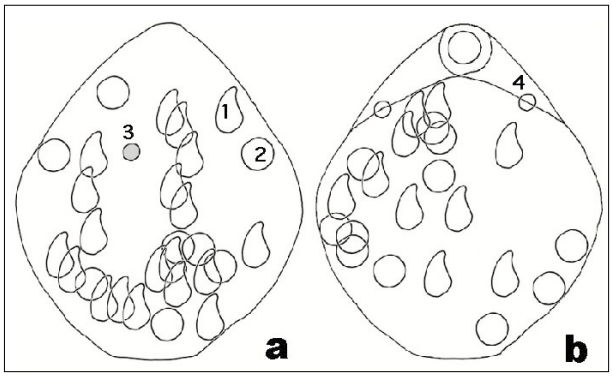

Figure 6. Trace position on the pedicle (a) and brachial (b) valves of *Terebratula scillae*. (1) *Centrichnus eccentricus*; (2) *Podichnus centrifugalis*; (3) *Oichnus simplex*; (4) *Oichnus* isp.

cings are not deep, but they appear different in having more gathered pits. These traces have been also compared with those of *T. terebratula* (= *T. calabra*) from the upper Pliocene of Apulia (Taddei Ruggiero, 1999); the differences are fairly evident in dimensions (1.5-3.3 mm), compactness and regularity of shape in the last species.

In all the cited cases, the thickening of the shell in correspondence with the injuries, has been observed.

OBSERVATIONS

We have calculated the percentages for the different kinds of traces based on the total number of recovered traces (89). The three most abundant traces are *Centrichnus* (34%), breakages (33%) and *Podichnus* (21%). *Maeandropolydora* (7%), *Oichnus* (3%) and *Entobia* (2%) are far less common (Fig. 4).

The studied bioerosion is prevailingly (55% of the total number of traces) due to epibionthic organisms such as Anomiidae and *T. scillae* itself.

The position of the different traces on the shell surface shows that the pedicle valve is more affected by the traces, but their distribution on the valves appears almost uniform, while only on the umbo of the pedicle valve is completely free of bioerosion (Figs. 5 and 6).

Podichnus centrifugalis is produced by short and massive pedicles, provided with papillae, by individuals belonging to *Terebratula scillae* itself. Variability in the form of *Podichnus* suggests that the hold-fast papillae could be much longer in some individuals. On the other hand, the pedicles of brachiopods can be morphologically fairly variable even within the same species, e.g. *Terebratulina retusa* (Bromley and Surlyk, 1973).

CONCLUSIONS

The most interesting traces on the shell of *Terebratula scillae* are etching scars:

- *Centrichnus eccentricus*, trace produced by the attachment of Anomiidae, is very frequent and it usually appears well evident on the almost smooth surface of the brachiopods.

- *Podichnus centrifugalis*, trace produced by the attachment of the pedicle of other individuals of *Terebratula scillae* itself, shows a remarkable variability. This variability allows to hypothesize that the pedicle of *Terebratula scillae*, nowadays an extinct genus, was short and thick with hold-fast papillae of varying length.

The trace distribution on the shell surface leads us to think that *T. scillae* did use to live attached by its pedicle to the substrate (which allegedly consists of other individuals of *T. scillae*) with its valves completely raised.

The durophagous structures are numerous and produced in the edge of the shell, at the moment of the breakup. Borings are very limited in abundance. Predators on *Terebratula* were likely to have been gastropods and decapod crustaceans. The percentage of pierced shells in *Terebratula* population, and the little breackage traces, indicate that the predatory activities was not very intense.

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