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Notes on some Mediterranean *Axinella* with description of two new species

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INTRODUCTION

The problem of giving a satisfactory diagnosis of the genus *Axinella* is unfortunately still unsolved, notwithstanding the attempts made by Ridley & Dendy (1887), Vosmaer (1912, 1933) and the interest devoted to it by many authors as Babic (1922), Topsent (1934), Vacelet (1961, 1969) and others. Especially the distinction between *Axinella* and *Phakellia* is a critical one, as both criteria based on the external form and on the presence of flexuous diactines in the axial skeleton — as observed by Vacelet (1969) — are not reliable. As a radical revision of these genera is still needed, I shall follow, for the moment, the usual criteria which take into account the external form and the characters of the axial skeleton, in the attribution of two species to the genus *Axinella.*

The aim of this article is to describe some specimens that have been collected during recent surveys made for ecological purposes. Most of them come from the Portofino Promontory coast, where our research group has the opportunity to dive all the year round. Other specimens were dredged in the Tyrrhenian Sea among Tuscany Islands and in the Adriatic Sea. Finally a small lot of *Axinella* from the coast of Marseille was kindly made available by Prof. Vacelet.

Some particular attention has been given to a good number of specimens belonging to two very common species, *A. damicornis* and *A. verrucosa*, living in the same environment, in order to add some further discriminatory criteria to Siribelli's (1961) study.

Axinella vaceleti n. sp.

MATERIAL EXAMINED

PTF 63, Portofino, Olivetta, 26 m, rock, 15.9.73, holotype.
PTF 27, Portofino,Aurora, 30 m, rock, 8.1.81, paratype.

PG 2, Golfo Marconi, Paraggi, 15 m, rock, 7.5.81, paratype.
PTF 51, Golfo Marconi, Paraggi, 10 m, rock, 10.2.82, paratype.
MR 1, Marseille, Figuier cave, 5 m, paratype.
MR 2, Marseille, Figuier cave, 5 m, paratype.
MR 3, Marseille, Sugitton Bay, 10 m, paratype.

DESCRIPTION

The examined specimens, all fan-shaped, are 5-6 cm high and 4-5 cm wide (fig. 1). Erect, with a short peduncle, they are formed by a thin undulating lamina showing irregular lobes along its borders. PTF 27 has a fringed contour. The lamina, which has a maximum thickness of 1.5 mm, is irregularly pierced (PG 2 and PTF 51). The bright-orange colour of living specimens fades rapidly after preservation. A superficial net of turgid exhalant canals crosses the surface of the sponge observed in the

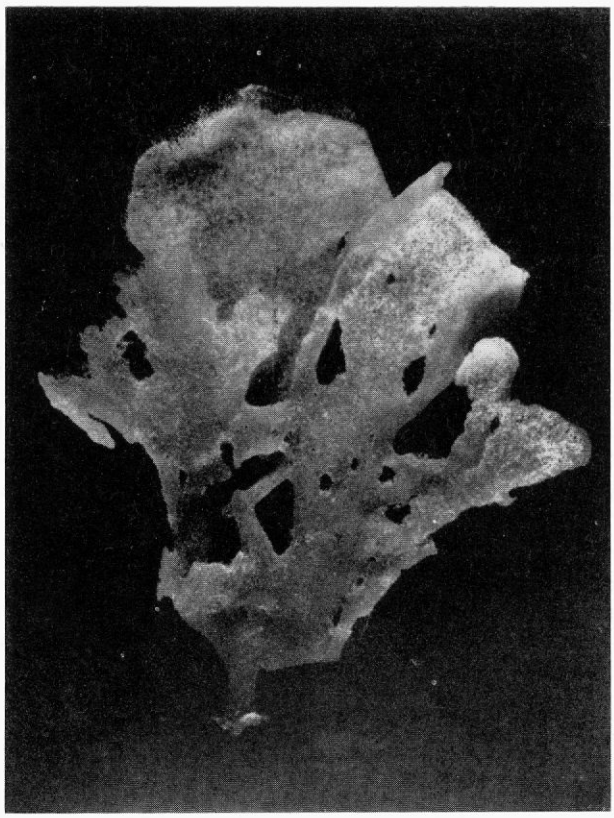


Fig. 1 - *Axinella vaceleti* n. sp., specimen PTF 51 (preserved).

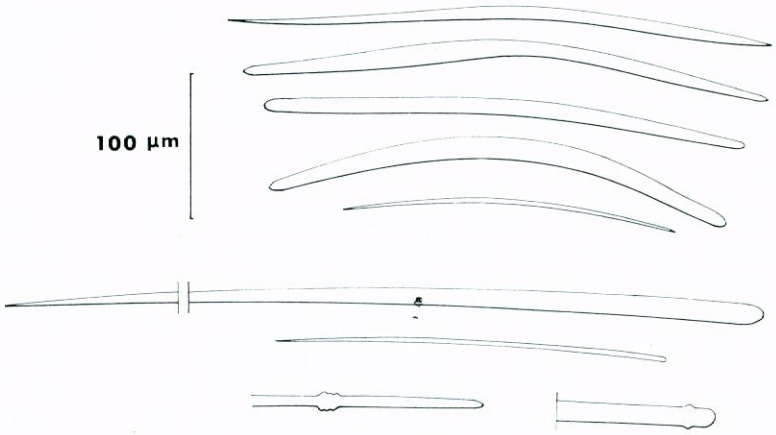


Fig. 2 - Spicules of *Axinella vaceleti* n. sp.

field. Small oscules 2-3 mm wide, surrounded by a thin membrane, seem to be present along the border of the lamina. The last observations have been made on underwater photographs, as these characteristics are not detectable on dead specimens. The consistency of the sponge is soft and elastic, and the surface finely hispid.

SPICULES

Styles to subtylostyles, straight or slightly curved, with well-sharpened points. They measure 270-1450 µm by 2.5-14 µm and are not divisible by classes, as all terms of passage can be found. Shorter styles are generally thicker than the longer ones. Subtylostyles are found in some specimens (especially PTF 51): they show subterminal, irregular swellings or little annular inflations near the heads.

Oxeas: always once or twice bent but rarely flexuous, often anisodiametric. They measure 250-370 µm by 2-12 µm. The small ones have well-sharpened points and are slightly curved, while generally stepped or blunt points are shown by the thicker ones.

Very fine spicules, both oxeas and styles, have been constantly observed.

SKELETON

Ascending bundles of spicules are detectable in the lamina, but they tend to loosen and widen with a plumose effect. This loose frame of spicules can be easily observed in transparency along the upper borders of the lamina. The axial skeleton is composed mostly by oxeas, frequently transformed to strongyles.

ECOLOGY

All the Ligurian specimens were found on rocky slopes covered by muddy sediments, in moderately skiophilous positions. They seem to prefer rather sheltered niches, and in spite of their stipitate form, they often tend to lie down adhering to the bottom contour.

REMARKS

As far as the colour and the external form are concerned, the examined specimens seem to be close to *Axinella guiteli* Topsent (1896). However, notwithstanding the last findings by Topsent (1934) of a few oxeas in its preparations, the skeletal differences are still conspicuous. After Topsent's sole record of *A. guiteli*, only Vacelet (1969) and Boury-Esnault (1971) attributed — with some hesitation — some of their specimens to this species. Vacelet (1969, p. 177), however, refers of numerous findings of a laminar, fan-shaped, orange *Axinella* fairly common on the muddy bottoms of some caves along the littoral of Marseille. Having had the opportunity, thanks to the courtesy of this author, of examining some of these specimens, I found them identical, as far as their morphology is concerned, to the material in my possession. Only negligible differences, due to the presence in Ligurian specimens of irregularly shaped oxeas and of some subtylostyles, were noted in spicule preparations. It seems to me that the studied material represents a homogeneous complex both from the morphological and ecological points of view. I propose to call the new species *Axinella vaceleti*, as it was well known since a long time by this author and by Boury - Esnault (Vacelet, 1969), from cave and rocky coast specimens of North-Western Mediterranean. Since I am not inclined to consider Topsent's *Axinella guiteli* as an anomalous specimen — as supposed by Vacelet (1969) — I suggest to maintain, according to the peculiar external characteristics of the sponge more than to the spicules, for the moment at least, *Axinella guiteli* clearly distinguished from *Axinella vaceleti*.

Axinella centrotylota n. sp.

MATERIAL EXAMINED

AT 1, Pianosa, Tuscan archipelago, unknown depth, trawled, holotype.
AT 2, Pianosa, Tuscan archipelago, unknown depth, trawled, paratype.

DESCRIPTION

Erect, stipitate, the sponge has the shape of a sinuous fan 6 cm high and 8 cm wide, constituted by three lobes with a medium thickness of 3 mm (fig. 3). Two flattened and smaller branches emerge from the main stalk. Well marked grooves on the surface of the lobes probably result from the anastomosis of branches. The upper border of the sponge

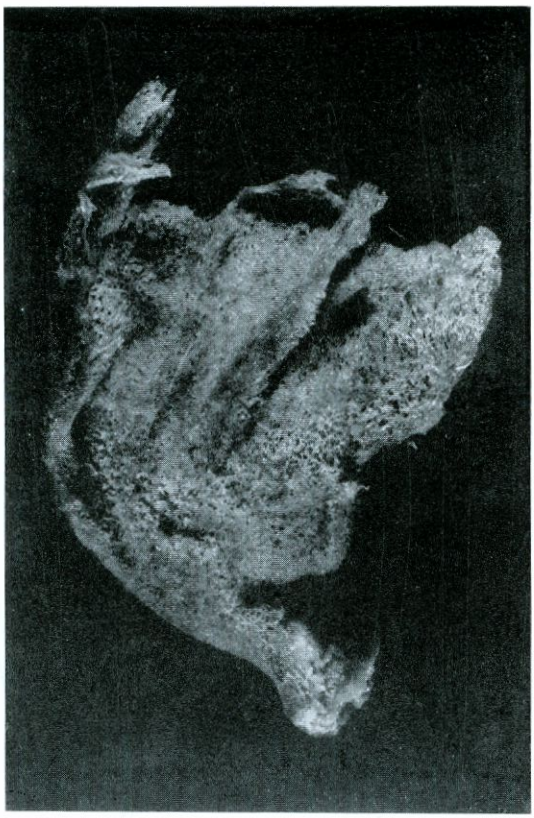


Fig. 3 - *Axinella centrotylota* n. sp., specimen AT 1 (preserved).

appears irregularly fringed. The tough stalk is 13 mm high and 7 mm wide. The colour of the specimens, in formalin, is dark orange; the surface is porous, coarsely hispid. The texture is firm but elastic, owing to the shape of the sponge. No evident vents are detectable in the preserved specimens.

SKELETON

Ascending spicular columns of oxeas embedded in spongin. They anastomose and diverge, forming a net of irregular meshes. The columns are connected by single, smaller bundles of oxeas. Monactinal spicules are far less frequent than oxeas, even in the peduncle, where they are relatively abundant.

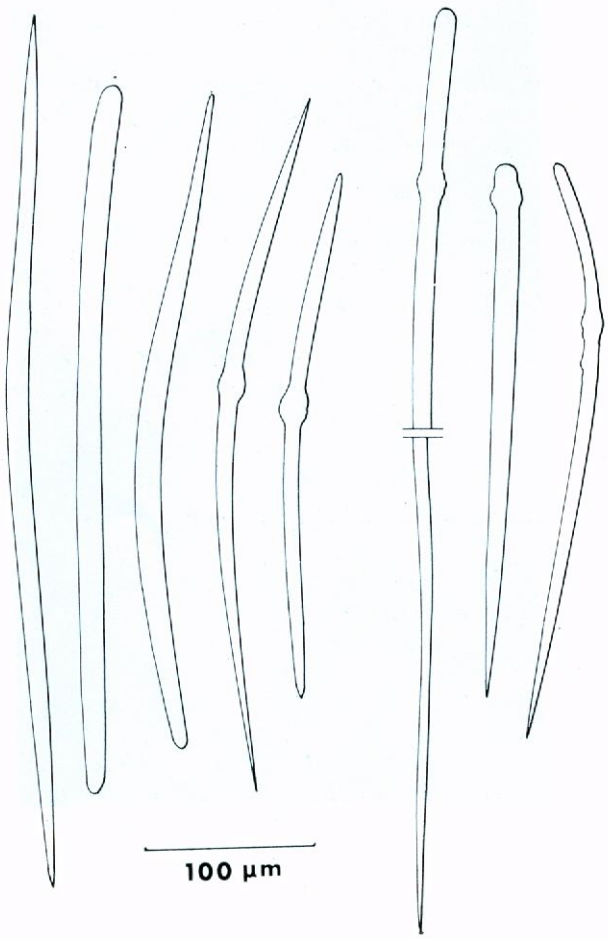


Fig. 4 - Spicules of *Axinella centrotylota* n. sp.

SPICULES

Oxeas measuring 400-490 µm by 10-15 µm. They cannot be divided in categories according to dimensions, but show various forms. Most of them are regularly bent, but also flexuous ones my be observed. Centrotylotism is highly frequent, with generally single, light annular inflations or well-developed central swellings. Oxeas may be regular, but often one or both ends are blunt.

The monactinal spicules, varying from simple styles to subtylostyles to tylostyles, may be divided in two categories according to dimensions:

— Short styles to subtylostyles, mostly straight or less frequently bent at one third of their lenght. They measure 220-360 μm by 10-15 μm. The shortest ones are often the thickest.
— Long styles to subtylostyles to tylostyles, generally straight or lightly curved, measuring 850-1270 μm by 8-10 μm. Both categories of monactines have often blunt points.

REMARKS

These specimens for several characters are much alike to *Axinella damicornis* (Esper) having a similar form and texture, but they strongly differ from the latter in colour, form and dimensions of spicules, for more accentuated centrotylotism and probably habitat. They are separated from *Axinella minuta* (Levi) for the external form and for the presence of larger centrotylote oxeas. To emphasize this last character I propose for this new species the name *Axinella centrotylota*.

? *Axinella macrostyla* Babic

Axinella macrostyla Babic, 1922, p. 242.

MATERIAL EXAMINED

GB 5/13, Adriatic Sea, unknown depth, dredged.

DESCRIPTION

Erect, stipitate, the sponge is formed by two flattened branches slightly diverging (fig. 5). It is 4 cm high, 2 cm wide and not thicker than 2 mm. The short peduncle (3 mm high), which is almost completely occupied by the axis, scantily widens at its base encrusting a Serpulid tube supporting the sponge. The specimen, preserved in alcohol, is greyish-yellow, firm and elastic, extremely hispid.

SKELETON

The strong axis supporting the sponge contains almost only oxeas and small styles embedded in spongin. Stout ascending bundles of oxeas, which anastomose whithout forming a reticulation, may be observed in the fan. The hispidation is mainly due to longer styles, easily visible to the naked eye.

SPICULES

Most oxeas measure 400-500 μm, but smaller (180-200 μm) and larger ones (740-1000 μm) are also present. Their thickness varies between 3 and 18 μm rather independently from length. They are generally bent, often showing a small annular inflation at the middle, but straight ones can also be found, mostly in the stalk. The points are sharp but in some oxeas one end may be blunt.

Fig. 5 - *Axinella macrostyla* Babic, specimen GB 5/13 (preserved).

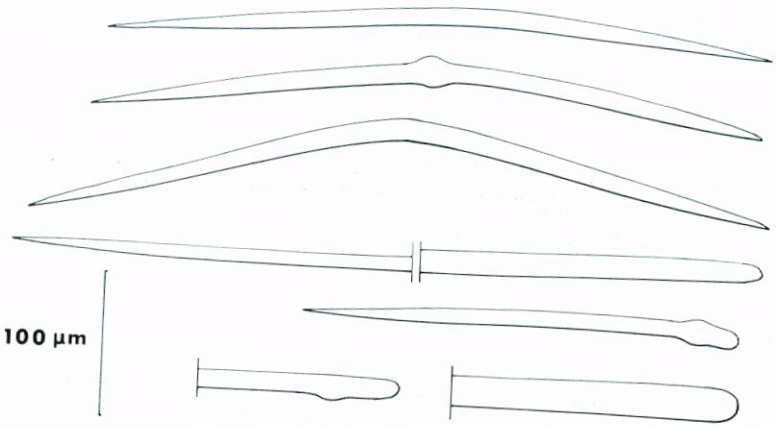


Fig. 6 - Spicules of *Axinella macrostyla* Babic.

Styles may be distinguished as belonging to at least two categories:

— Short, rather straight styles with faint, subterminal swellings, measuring 120-320 μm by 15-20 μm.

— Medium and very long styles, not abundant, straight or flexuous, especially the longest ones. Most of them are smooth, but subtylostyles may be present. They measure from 1600-2500 by 10-15 μm to 4000-4700 by 47 μm.

REMARKS

The closest species, considering the outstanding dimensions of the styles, seems to be *Axinella macrostyla* Babic (1922) which, after having been described from the Adriatic Sea — as far as I know — was no more recorded. The present specimen differs from Babic's *Axinella* in the dimensions of spicules. *A. macrostyla* has only relatively small oxeas (153-225 by 3-5 μm) while the maximum length attained by the styles is 3000 by 37 μm.

Notwithstanding these remarkable differences, I hesitate to establish a new species for this *Axinella* on a single, even if beautiful, specimen, and I prefer temporarily to attribute it to *Axinella macrostyla* Babic.

Axinella damicornis (Esper)

Spongia damicornis Esper, 1974, p. 249.

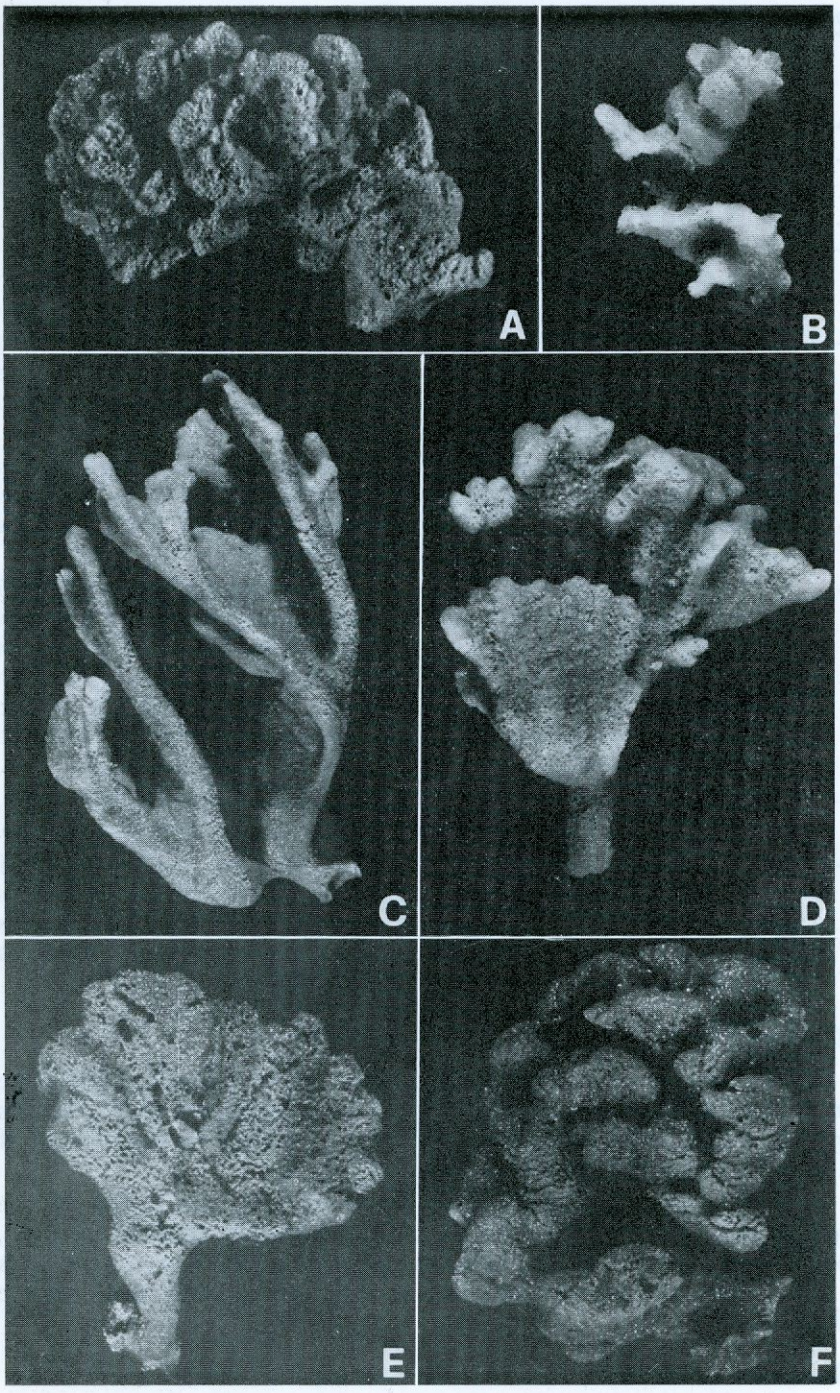
MATERIAL EXAMINED

75/78, Hvarski Canal, 72-83 m, mud and sand, 26.7.57.
1019/110, Dubrovnik, 25 m, rock, 16.9.71.
PTF 26, Portofino, 30 m, rock, 20.2.81.
AX 3, Golfo Marconi, Paraggi, 20 m, rock, 27.11.81.
AX 5, Golfo Marconi, Paraggi, 20 m, rock, 27.11.81.
AX 7, Golfo Marconi, Paraggi, 20 m, rock, 27.11.81.
AX 8, Golfo Marconi, Paraggi, 20 m, rock, 27.11.81.
AX 9, Golfo Marconi, Paraggi, 20 m, rock, 27.11.81.
AX 10, Golfo Marconi, Paraggi, 20 m, rock, 27.11.81.
AX 11, Golfo Marconi, Paraggi, 20 m, rock, 27.11.81.
PTF 95, Portofino, 25 m, rock, 3.11.82.
PTF 96, Portofino, 25 m, rock, 3.11.82.
PTF 97, Portofino, 25 m, rock, 3.11.82.
AX 12, Portofino, 18 m, rock, 24.1.83.
AX 13, Portofino, 18 m, rock, 24.1.83.
AX 14, Portofino, 18 m, rock, 24.1.83.
AX 15, Portofino, 18 m, rock, 24.1.83.
AX 16, Portofino, 18 m, rock, 24.1.83.
AX 17, Portofino, 18 m, rock, 24.1.83.

AX 18, Portofino, 18 m, rock, 24.1.83.
AX 19, Portofino, 18 m, rock, 24.1.83.
AX 20, Portofino, 18 m, rock, 24.1.83.
AX 21, Portofino, 18 m, rock, 24.1.83.

DESCRIPTION

— 75/78 and 1019/110. Small fragments of branched sponges. In 75/78 — the deepest of these specimens — oxeas are stronger than usual, with thickness up to 17 μm.
— PTF 26. Fan-shaped, not branched, 5 cm high and 4.5 cm wide (tab. 1, E).
— AX 3. Fan-shaped, laminar.
— AX 5. Small, atypical specimen, 3.5 cm high, bush-shaped, with irregular, lobate branches (tab. 1, B).
— AX 7. The fan lamina shows complex anastomoses forming a sort of tube.
— AX 8. Branched lamina divided into four lobes.
— AX 9. Big specimen, 7 cm high, with a stout peduncle and many flattened branches anastomosing in their lower part only (tab. 1, C).
— AX 11. Fan-shaped specimen, 6.5 cm high, with flattened, coalescing branches (tab. 1, D).
— PTF 95. The branches are so thickened (3-4 mm) that they assume a fairly lobate form. Styles and tylostyles, most of which about 900 μm long.
— PTF 96. The specimen is calyx-shaped, 3 cm high and 5 cm wide, with branches so thickened and coalescing as to form a mass showing on its upper side a winding pattern (tab. 1, F). Few styles to tylostyles, short and stout (880 by 12 μm).
— PTF 97. Very short specimen, 3 cm high, with a strong peduncle; shape as above.
— AX 10. General form as in PTF 96 and 97, but the interlacing of branches is far looser.
— AX 12. Bush-shaped, with short, spaced, shapeless branches. Uneven, cribrous surface. Oxeas 250-470 by 2.5-12 μm. Styles to subtylostyles to tylostyles 380-1350 by 2-14 μm.
— AX 13. Shape and surface as above, but stouter, rather massive branches. Oxeas, often showing centrotylotism, measure 260-380 by 2-14 μm. Styles to subtylostyles to tylostyles 560-1120 by 7-17 μm.
— AX 14. This bushy specimen has an unusual, horizontal development. Branches, as in previous specimens, are grooved and porous. Oxeas 290-420 by 3-10 μm. Styles to subtylostyles 750-1100 by 6-12 μm.



Tab. 1 - Morphological differences in some specimens of *Axinella damicornis*.

— AX 15. Bush-shaped with a very short peduncle. More or less flattened branches. Surface as above. Presence of many short, straight styles, 220-250 μm long and 12 μm thick, which seem not to be derived from oxeas. Other spicules are as usual.

— AX 16. High, flattened branches coalescing along their total length. Short peduncle and uneven surface as above. Little styles as in AX 15 are abundant and not always straight, but often gently curved.

— AX 17. Bush-shaped specimen with thick, flattened branches partially anastomosing. The surface is far less cribrous than in previous specimens; it looks fairly even in some zones. Abundant styles and subtylostyles reach a lenght of 1350 μm.

— AX 18. Small specimen, 4 cm high, consisting of a folded lamina about 3 mm thick. Surface even. Presence of many slender styles and subtylostyles up to 1520 μm long by 7 μm thick. Shorter tylostyles were also found in small proportion.

— AX 19. As AX 14, this specimen is very elongated (6 cm by 3.5 cm). It shows a flattened peduncle and a complex crown of short coalescing branches (tab. 1, A). Surface cribrous. Short and stout styles and subtylostyles — 180-250 μm by 18 μm — with an annular swelling just under the head are common, especially in the stalk. They often become perfect strongyles, except for the presence of a vestigial swelling. Oxeas are strong, up to 18 μm thick.

— AX 20. This specimen looks like a curved and partially folded fan, with an irregular, seldom pierced, laminar border. Spicules as usual.

— AX 21. Tree-shaped, 4 cm high and 6 cm long, with a mass of thin, flattened anastomosing branches. The very cribrous surface is here and there grooved. A great many oxeas have one or both ends blunted and frequently show central swellings. A few short tylostyles (250-350 μm by 6-8 μm) may be observed.

Spicules

Subtylostyles with subterminal, lengthened or inflated swellings are mostly frequent, but pure styles and in some specimens also tylostyles may be found. Very short styles are always observed in preparations if a portion of the stalk has been included (fig. 7).

Well-formed, bent oxeas with sharpened ends are typical of the species, but blunted or mucronated ends are frequently observed. Spicules, both mono- and diactinal, are never flexuous and rarely show stepped ends (fig. 8). Spicules sizes are not constant, styles being much more variable than oxeas.

Remarks

Despite a high range of variability, it is almost always possible to an experienced observer to recognize this species from its morphology. The

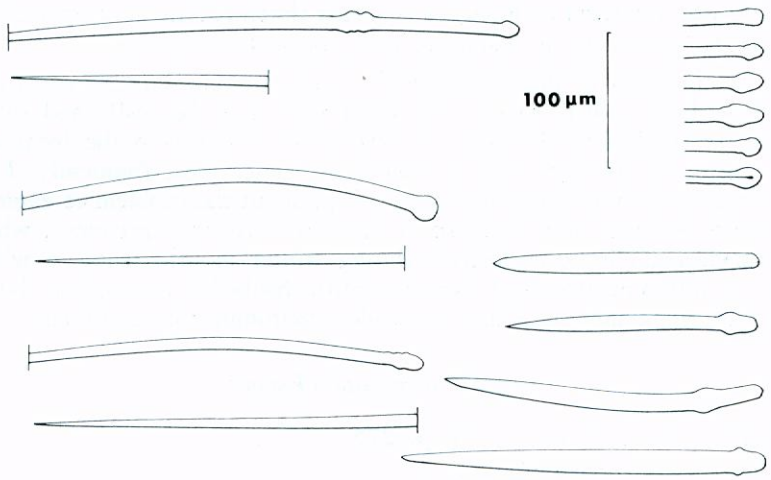


Fig. 7 - *Axinella damicornis* (Esper): monactinal spicules.

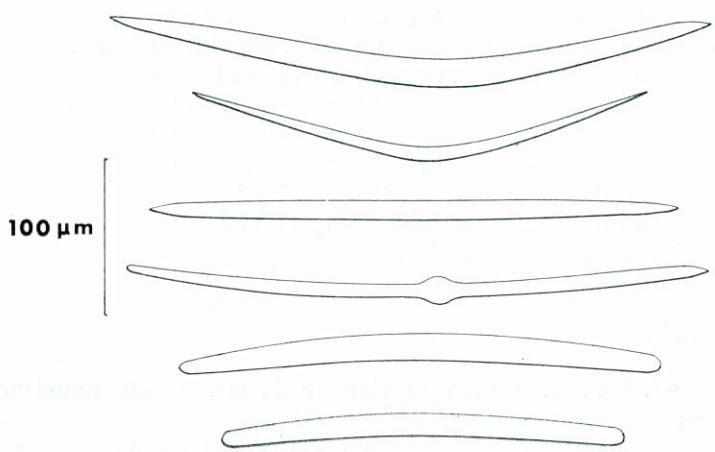


Fig. 8 - *Axinella damicornis* (Esper): oxeas.

ochre-yellow colour of living specimens, the hispidation clearly visible to a naked eye, the form of branches — often flattened but never cylindrical — are the most evident characters to be taken into account.

The problem of distinguishing this species from *Axinella verrucosa*, which Siribelli (1961) so carefully dealt with, may be easily and surely solved, as *A. damicornis* shows a remarkable constancy in the form and composition of spicules, even if their sizes change most frequently. I on the whole agree with Siribelli's views except about the problem of external variability being related to seasonal variations. As my specimens, which were collected almost exclusively during winter months, show a whole range of different aspects, I cannot confirm Siribelli's assumption, but I prefer to relate this variability to single, environmental conditions.

Axinella verrucosa (Esper)

Spongia verrucosa Esper, 1794, p. 275.

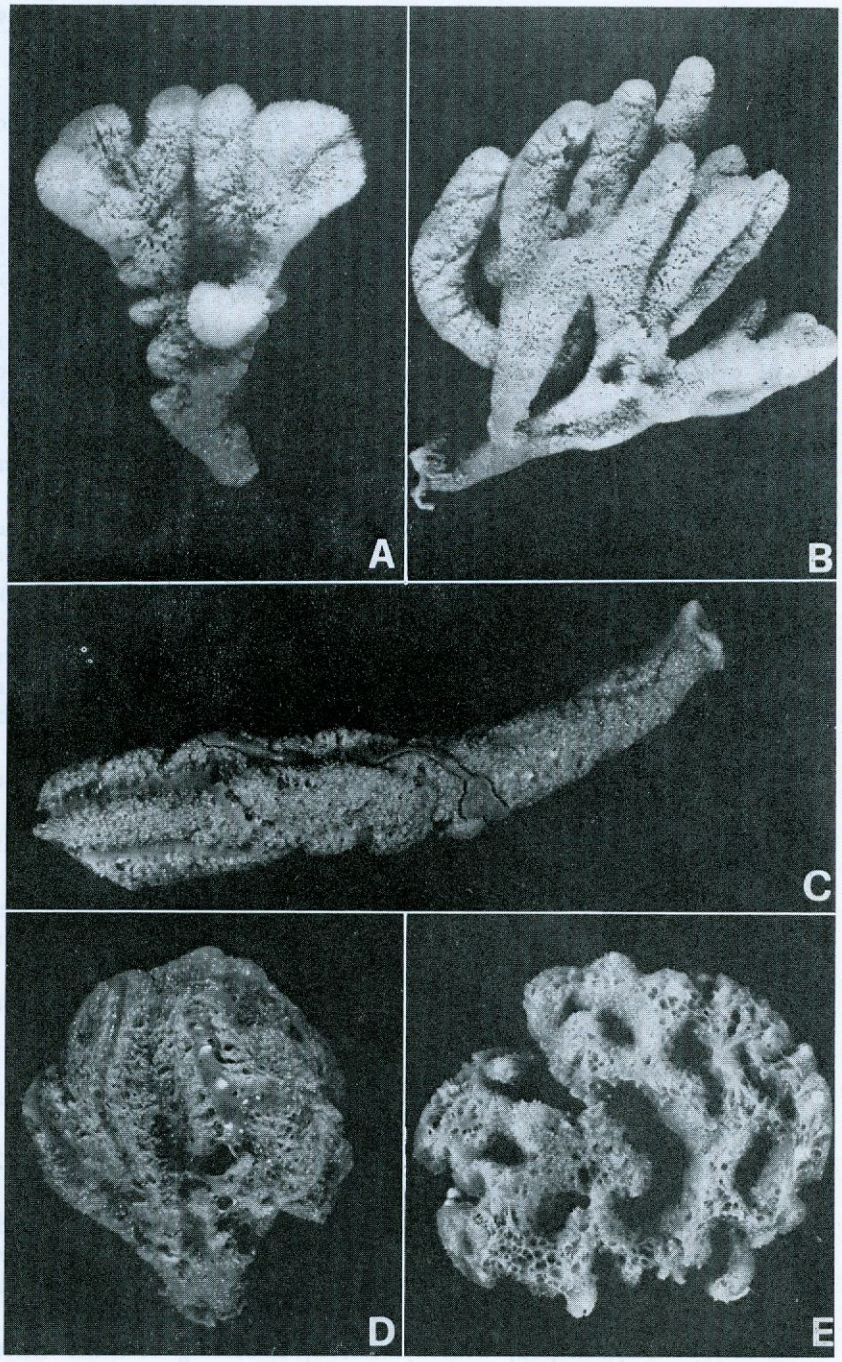
MATERIAL EXAMINED

PTF 67, Golfo Marconi, Paraggi, 20 m, rock, 30.3.73.
PTF 68, Golfo Marconi, Paraggi, 20 m, rock, 30.3.73.
PTF 66, Portofino, 10 m, rocky cliff, 13.2.80.
AX 22, Portofino, 10 m, rocky cliff, 13.2.80.
AX 23, Portofino, 10 m, rocky cliff, 13.2.80.
AX 24, Portofino, 10 m, rocky cliff, 13.2.80.
CN 5, Bergeggi Island, 15 m, rock, 15.4.81.
PG 3, Golfo Marconi, Paraggi, 20 m, rock, 7.5.81.
PG 5, Golfo Marconi, Paraggi, 20 m, rock, 7.5.81.
PTF 42, Golfo Marconi, Paraggi, 15 m, rocky cliff, 4.11.81.
PTF 42 bis, Golfo Marconi, Paraggi, 15 m, rocky cliff, 4.11.81.
AX 2, Golfo Marconi, Paraggi, 20 m, rock, 27.11.81.
AX 4, Golfo Marconi, Paraggi, 20 m, rock, 27.11.81.
AX 6, Golfo Marconi, Paraggi, 20 m, rock, 27.11.81.
PTF 65, S. Fruttuoso, 30 m, cave wall, 17.3.82.
PTF 64, S. Fruttuoso, 30 m, cave wall, 17.3.82.
PTF 98, Portofino, 25 m, rock, 3.11.82.
PTF 103, Portofino, rocky cliff, 18 m, 8.3.83.

DESCRIPTION

— PTF 67. Club shaped, with short peduncle. Great abundance of slender spicules (400-850 μm by 2-5 μm), both oxeas and styles with the same winding aspect and well sharpened pointed ends.
— PTF 68. Club-shaped as above. Slender oxeas reach a length of 980 μm, while stouter ones are little longer (1060 μm by 7 μm). Centrotylote oxeas are frequent.

— PTF 66. Small, cylindrical specimen, 2 cm high. Great abundance of slender, flexuous oxeas and styles as described for PTF 67.
— AX 22. Small, club-shaped specimen 2.5 cm high. Spicules are as usual, except for the presence of a good number of straight or irregularly bent tylostyles (fig. 10, B), with well-formed heads in which is often detectable the terminal vesicle of the axial canal. They measure 280-520 μm by 14-23 μm.
— AX 23. Beautiful specimen 7 cm high with a complex ramification of cylindrical branches anastomosing in their lower parts. Surface fairly smooth with the remnants of the exhalant canals (tab. 2, B). This form agrees with that considered typical for the species.
— AX 24. Coalescing branches form a sort of flattened crown, 5 cm wide and 2 cm high, with a lateral peduncle (tab. 2, E).
— CN 5. A short stalk shoots four massive and tuberculated branches partially anastomosing.
— PG 3. Cylindrical, coalescing branches marked by grooves and tubercles.
— PG 5. Tree-shaped, 6 cm high, with free cylindrical branches. The surface is fairly smooth. In this specimen the percentages of slender and stronger spicules are balanced. The slide has been prepared by cutting a portion of a branch.
— PTF 42. Cylindrical stem which bifurcates at first and then fuses to form a sort of ring.
— PTF 42 bis. Cylindrical stalk with two flattened and lobate branches (tab. 2, A). The specimen is 3.5 cm high and 3 cm wide.
— AX 2. Single, cylindrical branch, 0.5-1 cm thick, dividing into three lobes at its summit. Rather even surface. Most spicules are stout: oxeas about 15 μm thick and styles 19 μm.
— AX 4. Grooved, tuberculated, cylindrical stem with signs of ramification at its upper end.
— AX 6. Massive, sub-globose specimen on a tough peduncle, 4 cm high and 3.5 cm wide (tab. 2, D). Grooved branches, marked by exhalant canals, fuse in a single mass.
— PTF 65. Single cylindrical stem 7 cm high and 1 cm thick (tab. 2, C); surface grooved and tuberculated as usual.
— PTF 64. Thin single stalk 10 cm high and not more than 6 mm thick. Most spicules are rather stout, with a mean thickness of 14 μm. Few thin, slightly bent styles (500-600 μm by 2-5 μm) may also be observed.
— PTF 98. Calyx-shaped, with cylindrical, coalescing branches whose upper ends appear worn-out, corroded.
— PTF 103. Massive specimen with short peduncle and grooved surface. Very few malformed oxeas were observed, measuring about 800 μm



Tab. 2 - Morphological differences in some specimens of *Axinella verrucosa.*

by 7 μm (fig. 10, D). Subtylostyles to tylostyles and malformed strongyles, as shown in fig. 10, C measure 280-870 μm by 3-16 μm. Pure styles (broken) are longer than 1400 μm.

SPICULES

Oxeas are generally curved, but bent and even flexuous ones do occur. Stepped ends are very frequent. Spicules extremities, however, are often blunted or rounded, and all terms of passage between oxeas, styles and strongyles may be observed (fig. 9). Oxeas transformed to strongyles are frequent, while centrotylotism is more rare. Stout oxeas measure 450-730 μm by 7-17 μm, but also longer, winding oxeas (1000 μm or more by 9 μm) with stepped but well-sharpened ends are almost always present (fig. 9).

Most monactines are pure styles, but subtylostyles are common; seldom well-formed tylostyles (see AX 22) have been observed (fig. 10, B); they measure 520-900 μm by 6-15 μm. In some specimens, however (namely CN 5, PTF 66, PTF 67), a great abundance of very thin spicules, both styles and oxeas 1 to 5 μm thick has been noted, while few spicules, even if always present, reach usual dimensions.

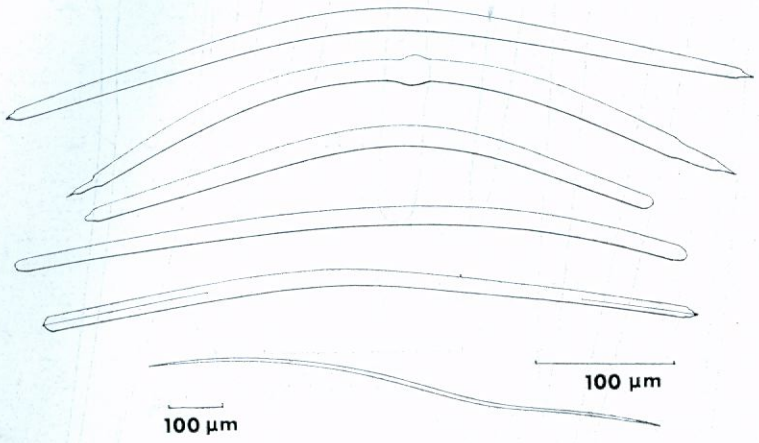


Fig. 9 - *Axinella verrucosa* (Esper): oxeas.

REMARKS

This well known species appear extremely polymorphous both as the external form and the spicules content are concerned.

Siribelli (1961) points out some morphological differences in the thickness and roughness of branches attributing them to seasonal variations.

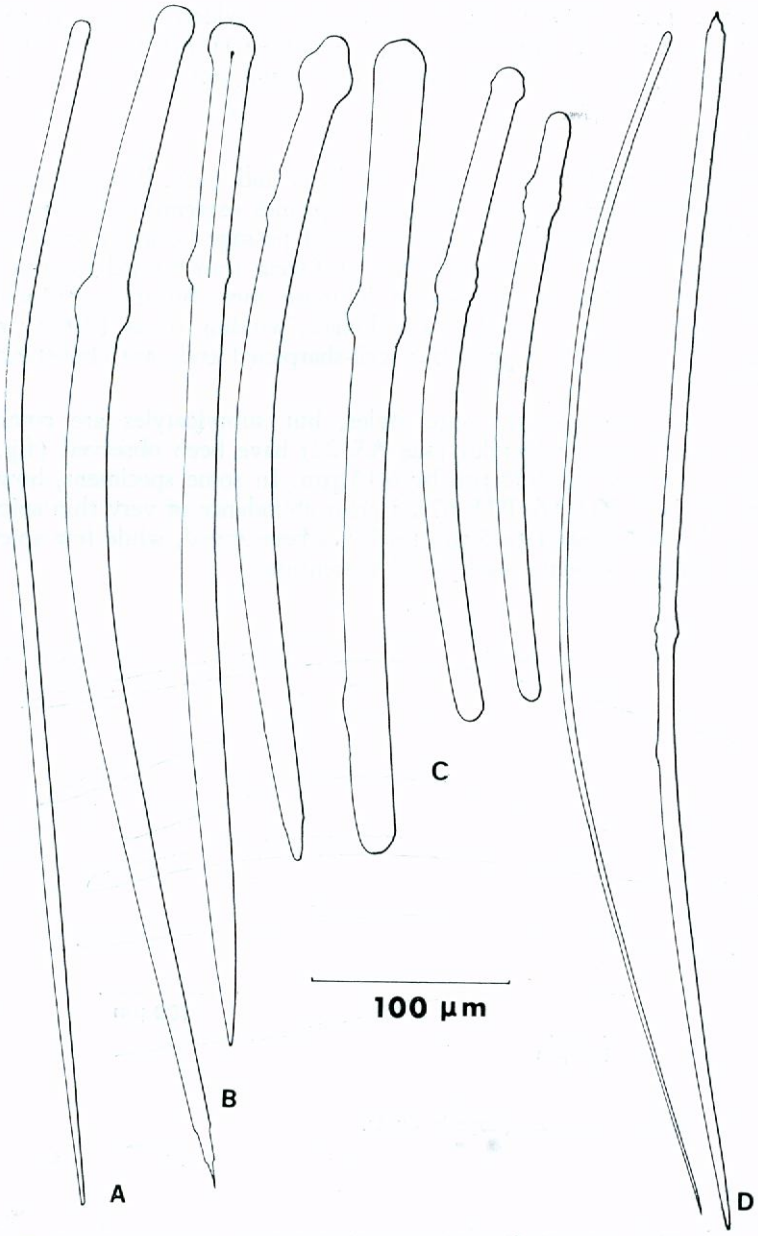


Fig. 10 - *Axinella verrucosa* (Esper): A) normal style; B) subtylostyles and tylostyles; C) malformed strongyles; D) long styles and malformed oxeas from specimen PTF 103.

I cannot confirm these observations as I find the same kind of variability in my specimens, all collected during winter or spring.

As far as the skeleton is concerned, the content of diactinal spicules (fig. 9) is fairly constant while that of monactines shows a high range of variability. Such variability affects the overall spicular pattern causing often serious problems of identification, but with a careful study of a good number of specimens some terms of passage between the extreme situations (see description of specimens) may be found. Furthermore I have observed in some specimens (often globular or club-shaped) such an abundance of very slender spicules as to lend me to think I was dealing with a different, new, species. Only for the presence of a few spicules of the usual kind I am unwilling to separate specimens which show so peculiar skeleton contents.

As far as the shape and external characteristics are concerned, the examined specimens could be divided into groups, having as common and steady characters only colour (ochre-yellow in life and orange-yellow in formalin) and faint hispidation. Spicular differences moreover cannot be surely related with the morphological ones.

RIASSUNTO

Sono state studiate alcune spugne raccolte nel corso di indagini ecologiche condotte in Mar Ligure, Mar Tirreno e Mar Adriatico. Vengono descritte due nuove specie appartenenti al genere *Axinella*.

SUMMARY

Some sponge specimens collected during surveys made in Ligurian, Tyrrhenian and Adriatic Seas for ecological purposes have been studied. Two new species belonging to the genus *Axinella* are described.

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REFERENCES

BABIC K., 1922 - Monactinellida und Tetractinellida des Adriatischen Meeres. *Zool. Jahrb., Abt. System.*, 46, 217-302.

BOURY-ESNAULT N., 1971 - Spongiaires de la zone rocheuse de Banyuls-sur-mer. II. Systématique. *Vie Milieu*, 22, 2, B, 287-350.

ESPER *E.J.C.*, 1794 - Die Pflanzenthiere in Abbildungen nach der Natur mit Farben erleuchtet nebst Beschreibungen. 2, 1-303.

LEVI C., 1957 - Spongiaires des côtes d'Israël. *Bull. Research. Council Israël*, 6 B, 3-4, 201-212.

RIDLEY S.O. & A. DENDY, 1887 - Report on the Monaxonida collected by H.M.S. Challenger during the years 1873-1876. *Rep. Scient. Results Challenger. Zoology*, 20, 59, 1-275.

SIRIBELLI L., 1961 - Differenze nell'aspetto esterno e nello scheletro fra *Axinella verrucosa* O.S. e *Axinella damicornis* (Esper) O.S. (*Demospongiae*). *Annuario Ist. Museo Zool. Napoli*, 13, 5, 1-24.

TOPSENT E., 1896 - Matériaux pour servir à l'étude de la faune des Spongiaires de France. *Mem. Soc. Zool. de Fr.*, 9, 113-133.

——, 1934 - Eponges observées dans les parages de Monaco. I. *Bull. Inst. océanogr. Monaco*, 650, 1-42.

VACELET J., 1961 - Spongiaires (Démosponges) de la région de Bonifacio (Corse). *Recl. Trav. Stn. mar. Endoume*, 22, 21-45.

——, 1969 - Eponges de la Roche du large et de l'étage bathyal de Méditérranée. *Mém. Mus. natn. Hist. nat., Paris*, 59, 145-219.

VOSMAER G.C.J., 1933-35 - The Sponges of the Bay of Naples (Porifera, Incalcaria). La Haye, 1-875.

——, 1912 - On the distinction between the genera *Axinella, Phakellia, Acanthella*. *Zool. Jahrb. Suppl.*, 12, 307-322.