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Note on Syringammina, a New Type of Arenaceous Rhizopoda

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of dark lines in the coronal spectrum, that doubt is now completely removed.

The results have amply proved the value of the photographic method employed, and it has been shown how an eclipse of only seventy seconds' duration can be made to yield important information.

IV. Note on *Syringammina*, a New Type of Arenaceous Rhizopoda." By Henry B. Brady, F.R.S. Received April 10, 1883.

[Plates 2, 3.]

The specimens to which the following note refers were dredged in the Faroë Channel in the autumn of last year, during the cruise of H.M.S. "Triton," and were sent to me for examination by Mr. John Murray, F.R.S.E., under whose direction the scientific observations of the expedition were carried out.

It is now a well-known fact that the region lying between the north coast of Scotland and the Faroë Islands possesses certain features of unusual interest owing to the existence, side by side, of two sharply defined areas, of which the bottom temperature differs to the extent of 16° or 17° Fahr. The depth of the two areas is very similar, ranging from 450 to 640 fathoms, and they are separated by a narrow ridge having an average depth of about 250 fathoms. The physical aspects of this phenomenon have been the subject of much discussion, and the biological conditions attendant thereupon are of almost equal importance; indeed, so far as the Rhizopoda are concerned, there are few areas of the same extent that have so well repaid the labour of investigation. On the "Lightning" Expedition of 1868, superintended by Dr. Carpenter and Sir Wyville Thomson, the cold area furnished amongst other interesting organisms, the large Lituoline Foraminifer *Reophax sabulosa*, a form which has since been obtained near the same point on the cruise of the "Knight Errant," but has never been met with elsewhere. The warm area yielded at the same time *Astrorhiza arenaria*, a large sandy species previously unknown to British naturalists. On the "Porcupine" Expedition of 1869, another modification of the latter genus, *Astrorhiza crassatina*, was obtained in the cold area; and near the boundary line an entirely new arenaceous type was dredged, to which the generic named *Botellina* has been assigned by Dr. Carpenter. From the fact that all the specimens of the form appeared more or less broken, it has been inferred that the tests were adherent when living; but the fragments were abundant, and consisted of stout tubes, many of them upwards of an inch in length, the interior being subdivided by a labyrinth of irregular

sandy partitions. More recently, in 1880, on the cruise of the "Knight Errant,"* the rare genus *Storthosphæra* was found in the warm region, and in the cold area specimens of *Cornuspira* which measured more than an inch in diameter, rivalling in size the finest of the tropical Orbitolites, and therefore amongst the largest known Porcellanous Foraminifera.

The bottom-dredgings obtained on the cruise of the "Triton" in August and September, 1882, have not been fully examined, but the surface-gatherings made by means of the tow-net are remarkable for the abundance of the curious pelagic type *Hastigerina*. This genus had not previously been found living in the British seas, and the specimens procured were equal in size and beauty to any of those collected in southern latitudes during the "Challenger" voyage.

Of the Rhizopoda contained in the dredgings, by far the most noteworthy is the arenaceous form which I propose to describe in the present paper. It may be stated at the outset that two specimens were secured, but owing to the excessively fragile nature of the organism, both were in a more or less fragmentary condition, though sufficient remains to indicate their principal structural features.

The general appearance of one of the specimens, drawn to the natural size, is shown in Pl. 2, figs. 1, 2, 3; the second was too much broken to be of service except for purposes of dissection. The figured specimen is about an inch and a half (38 millims.) in diameter, and about eight-tenths of an inch (20 millims.) in thickness, but it is probable that the latter dimension may not be much more than half that of the entire organism; indeed, it is evident that the test when complete was a rounded mass, which if developed with any degree of symmetry, must have been a sphere of about an inch and a half diameter. The structure revealed by the fractured surfaces is that of a congeries of branching and inosculating tubes radiating from a common centre.

The fragile nature of the investment is due to the fact that the walls are composed of fine sand with scarcely a trace of inorganic cement. In this respect the organism bears a close resemblance to several well-known arenaceous Rhizopods, notably to *Astrorhiza arenaria*, but the difference in size renders the absence of incorporating cement a much more noticeable feature; for whilst the test of the latter species, though loosely arenaceous, has sufficient strength and substance to bear handling without injury, that of the present form will scarcely support its own weight when taken out of water, and crumbles into a mass of sand on the gentlest attempts at manipulation. It is hardly possible to lift even small fragments by means of forceps, and the specimen would have been in less satisfactory

* "Proc. Roy. Soc. Edinb.," 1882, vol. xi, pp. 708–717.

condition than they are, were it not that the disintegrated portions formed a layer of sand in the bottom of the bottle, partially embedding the larger pieces. Owing to this want of cohesion it has been found impossible to prepare thin sections of any part of the test.

The inferior aspect of the specimen, represented in Pl. 2, fig. 1, is entirely a fractured surface, and is probably something approaching a median section; but it is much too uneven to show any regularity of structure, except at some points near the periphery. The only portion remaining of what was originally the exterior of the test is shown in the side view, fig. 3, at the point marked *a*. The convex or "superior" aspect of the specimen, as it stands on the plate, exhibits chiefly the open ends of the transversly-broken tubes.

The different portions of the structure examined in detail reveal little beyond what may be realised at the first glance.

The "inferior" surface of the specimen displays somewhat more regularity in the radial arrangement of the tubes than could be made apparent in the drawing, owing to the unevenness of the fracture. The organic centre appears to have been broken away, and it is impossible to say whether there has been originally any true nucleus, in the shape of a well-defined primordial chamber. The central portions, so far as they are left, consist of a network of branching and often contorted tubes, of somewhat smaller diameter than those of the exterior, and less regularly disposed (Pl. 3, fig. 8).

Nearer the periphery the system of tubes takes a distinctly radial character, and in a favourable section appears divided into concentric layers or tiers of gradually increasing depth (fig. 6). The concentric "partitions" exhibited in the radial section of the test, fig. 6, *d.d.*, are not, like the "labyrinthic layers" of *Parkeria*, continuous septa of cancellated structure, but are formed by lateral branches, given off at intervals, which unite so as to produce a more or less regular network (fig. 7). As nearly as can be made out, there may have been ten or eleven such reticulated "partitions," at intervals varying from $\frac{1}{20}$ inch (1·26 millims.) near the centre, to $\frac{1}{10}$ inch (2·5 millims.) near the periphery.

As already stated the tubes are not of uniform diameter, those near the centre measuring sometimes no more than $\frac{1}{50}$ inch (0·5 millim.), whilst near the exterior they often exceed $\frac{1}{25}$ inch (1 millim.), the average diameter being about $\frac{1}{35}$ inch (0·735 millim.). The external surface is granular, but in the dry condition it is tolerably smooth; the interior is smooth and well finished. The internal cavity whether of the radial tubes or the branches is continuous, exhibiting neither constrictions, septa, nor labyrinthic subdivision. The thickness of the walls is about $\frac{1}{200}$ inch (0·125 millim.).

The peripheral ends of the tubes are rounded, and closed by an

aggregation of sand-grains of somewhat lighter colour than the rest of the test, in precisely the same way as in *Astrorhiza arenaria* and its immediate allies. The rounded terminations are shown in the side view, fig. 3, at the point marked *a*; and on a larger scale in fig. 5.

With regard to the animal inhabiting the test, there is not much to be said. When examined by Mr. Murray, fresh from the dredge, the tubes were partially filled with dark-coloured sarcode; and in the preserved specimens, the peripheral portions of the fragments that have been dissected were in this condition. Owing to the intermixture of sand-grains it has been found impossible to examine the tube-contents under high magnifying powers, but they appear in all respects similar to the sarcode found in the tests of many of the larger arenaceous Foraminifera which have been preserved in the same way, namely, a dark, somewhat firm, granular, gelatinous mass, which on drying forms nearly black branching threads.

There can be no doubt that the organism described in the foregoing paragraphs is the representative of a new type of arenaceous Rhizopoda, and the generic term *Syringammina* (σῦριγξ, ιγγος, a pipe, ἄμμος, sand) with the trivial name, *fragilissima*, appears appropriate for its designation. In the absence of complete specimens its zoological characters cannot be fully stated, but the following will serve for its identification.

Syringammina fragilissima, nov. gen. et sp.

Test free; consisting of a rounded mass of branching, inosculating tubes radiating from a common centre, and arranged in more or less distinct concentric tiers or layers, which are marked by the formation at intervals of a network of lateral branches. Walls arenaceous, composed of nearly uniform fine sand, with little or no inorganic cement. Apertures terminal, situated at the peripheral ends of the tubes, closed in with loosely aggregated sand-grains. Colour dark grey when wet, drying to a much lighter tint. Diameter about $1\frac{1}{2}$ inch.

The precise habitat of the specimens is given in the following note from the log of the "Triton:"

"Station 11. August 28th, 1882,—lat. 59° 39′ 20″ N., long. 7° 13′ W.; depth 555 fathoms; ooze. Surface temperature, 57°·2; bottom temperature 45°·5 Fahr."

The position is to the west of the Wyville Thomson Ridge, and close to the "Holtenia Ground" of the "Porcupine" Expedition. Mr. Murray informs me by letter that "the dredge employed on this occasion was of very much lighter description than those generally used in deep-sea dredging. It came up with a large quantity of ooze in the bag, the top layers of which were of pale brown colour, soft and watery, the deeper layers somewhat compact and of slaty hue.

One of the specimens rolled out of the oozy layer of the deposit when the dredge was emptied on the deck and broke, unfortunately, in the hands of the sailor who lifted it; the other was found on passing the mud through the sieves, and when first observed appeared quite spherical."

I learn that a somewhat similar specimen was dredged at a depth of 1000 fathoms off the Azores, during the "Challenger" cruise, but that it went to pieces in the sieve.*

A few words must be added respecting the zoological position and affinities of the new genus. On the whole, *Syringammina* finds its nearest allies, so far as living Foraminifera are concerned, in the deep-sea varieties of *Astrorhiza*. Comparing it with *Astrorhiza arenaria*,† its investing walls are found to be constructed in precisely the same way of loosely aggregated sand, and even in the size of the grains there is great similarity, though this may be in a measure accidental. But whereas the test of *Astrorhiza* consists (typically) of a few tubes, generally unbranched, radiating on one plane from a central cavity or chamber, that of *Syringammina* is formed of a multitude of tubes which radiate nearly equally in all directions, and have numerous branches which inosculate freely. In *Astrorhiza*, as in *Syringammina*, the peripheral ends of the tubes serve as the general aperture; and in both the orifices are masked by aggregations of loose sand, forming rounded and apparently closed terminations.

The genus *Parkeria* has already been referred to in describing the mode of increase by concentric layers, and both in size and general contour there is considerable resemblance between *Syringammina* and the fossil type. But the similarity of internal structure, apparent on a comparison of some of the drawings now furnished, with the illustrations accompanying the original memoir on *Parkeria* and *Loftusia*,‡ is much more remarkable and cannot be passed over without notice. Owing to the difference in the magnifying powers employed, the resemblance in the drawings is more striking than in

* It may be of service to those who have the opportunity of dredging, to note that the sandy skeletons of organisms of this sort may be sufficiently strengthened to bear handling by placing the specimens for a time in strong alcohol, and then drying; afterwards, when thoroughly dry, saturating with a very dilute solution of dammar in benzole, and draining on blotting-paper. The dammar solution should be so weak that it does not leave a gloss on the surface of the specimen when finished.

† M. Sars, Carpenter, and Norman assign these deep-sea sandy forms to the same genus as the shallow-water organism, *Astrorhiza limicola*, which has a chitinous investment, coated with soft mud. I have not disturbed the arrangement, but my impression is that they represent two distinct genera.

‡ "Phil. Trans.," 1869. Compare for example the structure of *Syringammina* as shown in figs. 6, 7 of the present paper with that of *Parkeria* and *Loftusia* as represented in some of the figures in Plates 73 and 79 of the memoir referred to.

the specimens; nevertheless the radiate tubular structure and the concentric arrangement of the parts are features common to both forms. On the other hand, the cancellated layers of *Parkeria*, which form continuous septa of greater or less thickness, are only represented in *Syringammina* by an open network of anastomosing tubes. Mr. Murray has called my attention to the close similarity that exists between the texture of the natural surface of the recent form, and that presented by some infiltrated specimens of *Parkeria*, after being etched by means of acid.

Morphologically, however, *Syringammina* appears to find a closer parallel in the group of fossil Rhizopods described by Professor Duncan under the term *Syringosphæridæ*.* Of these the test in its typical condition is a spheroidal body from 1 to 3 inches in diameter, composed of radiating tubes open at their peripheral ends. The tubes, which are branched and inosculating, are arranged in conical bundles radiating from the centre of the test, and the intervening spaces are filled with an accessory network of branching tubes which present a variety of characters. The walls are formed of granular carbonate of lime. The tubes of this fossil type are of much smaller diameter than those of *Syringammina*, and their association in conical bundles is a very distinctive feature; besides which, the test presents no evidence of concentric structure.

The material at present available for investigation is insufficient for any detailed comparison of the structure of these organisms, but it is amply sufficient to show that there exist analogies of great interest between the groups they respectively typify; and it encourages the hope that living specimens may yet be found that shall satisfactorily elucidate the still doubtful points in the organization of the fossil types.

EXPLANATION OF THE PLATES.

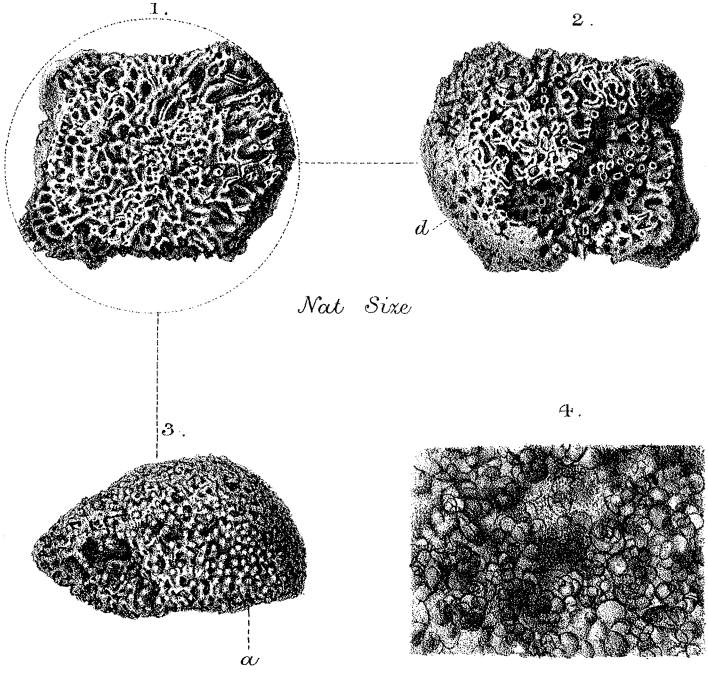
Plate 2.

Figs. 1, 2, 3. *Syringammina fragilissima*, natural size.

1. Inferior aspect, representing an uneven fractured surface near the middle of the specimen. The dotted line indicates approximately the original outline.
2. Superior aspect of the specimen, representing chiefly an uneven fractured surface near the periphery. At *b* the exterior is coated with a film of dried sarcode.
3. Lateral aspect. The portion marked *a* represents the uninjured natural surface.

* "Karakoram Stones or Syringosphæridæ," by Professor P. Martin Duncan, M.B., F.R.S., &c., in the "Report on the Scientific Results of the Second Yarkand Mission," 4to, 3 plates. Calcutta, 1879.

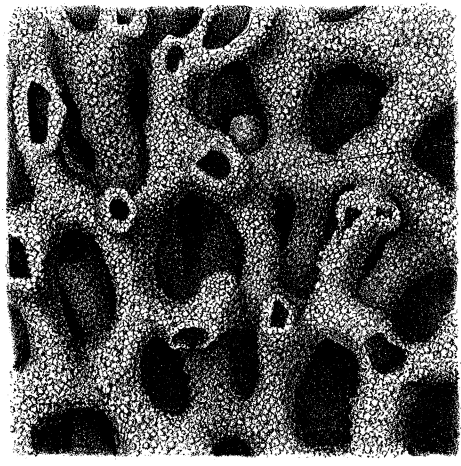
Also "On the Genus *Stoliczkaria*, Duncan, and its Distinctness from *Parkeria*, Carpenter," "Quart. Journ. Geol. Soc.," 1882, vol. xxxviii, p. 69, Pl. 2.



A. T. Hollick, ad. nat. del. et lith. Mintern Bros. imp

SYRINGAMMINA FRAGILISSIMA.

6.



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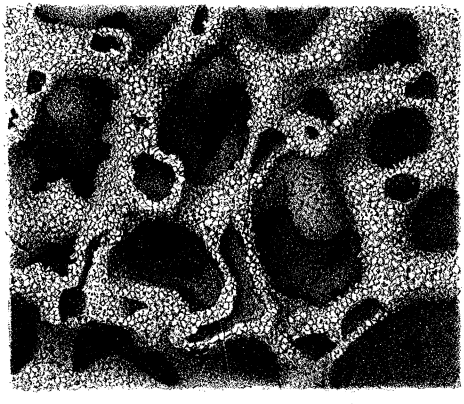

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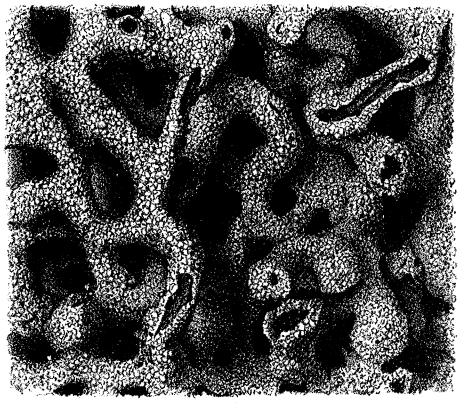

A. T. Hollick, ad nat. del. et lith. Mintern Bros. imp

SYRINGAMMINA FRAGILISSIMA.

Fig. 4. Section of the test, magnified 50 diameters.
The section is of very unequal thickness, but serves to show the arenaceous structure of the test, and the character of the constituent grains, many of which are minute Foraminifera.

Fig. 5. A portion of the surface at *a* (fig. 3) magnified 8 diameters; showing the closed terminations of the tubes; and, at *c*, a portion of one of the concentric reticulated "partitions."

PLATE 3.

Fig. 6. Radial section (fractured surface) magnified 8 diameters; *d.d.* reticulated "partitions."

Fig. 7. Tangential section (fractured surface) on the plane of one of the reticulated "partitions" (*d.d.*), magnified 8 diameters.

Fig. 8. Inferior aspect; a portion magnified 8 diameters, showing the smaller size and contorted form of the tubes near the centre of the test.

April 26, 1883.

THE TREASURER, V.P., in the Chair.

The Presents received were laid on the table and thanks ordered for them.

The following Papers were read:—

I. "Contributions to the Chemistry of Food." By JAMES BELL, Ph.D., F.C.S. Communicated by Professor FRANKLAND, F.R.S. Received April 4, 1883.

(Abstract.)

This paper contains the results of researches on butter, cheese, milk, the cereal foods, bread and lentil flour.

The author some time ago, as the result of a series of experiments, indicated that it was probable the soluble and insoluble fatty acids in butter fat did not exist as simple glycerides, but in the complex form of compound ethers—palmitic and oleic acids being combined in the same molecule with butyric acid. The results of a further investigation into the character of butter fat are given, which tend to confirm this theory of its constitution. Butter fat is proved to vary in composition far beyond the limits previously supposed, and a table of representative samples is given, showing the ordinary variations which occur. Ordinary fats are contrasted with butter fat, and it is sug-

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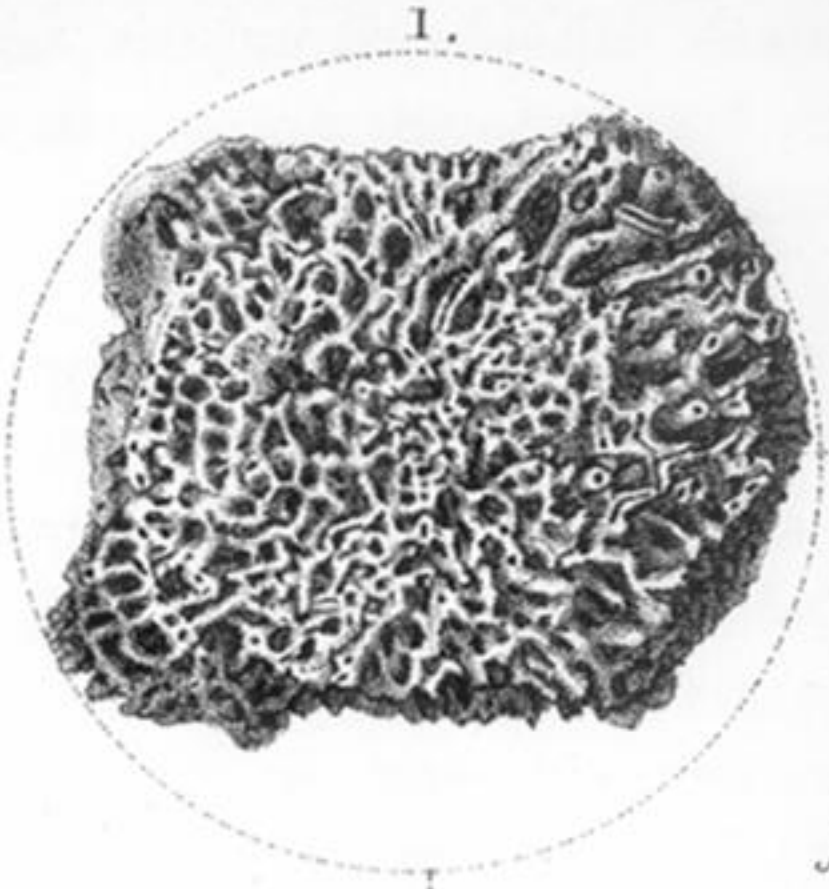

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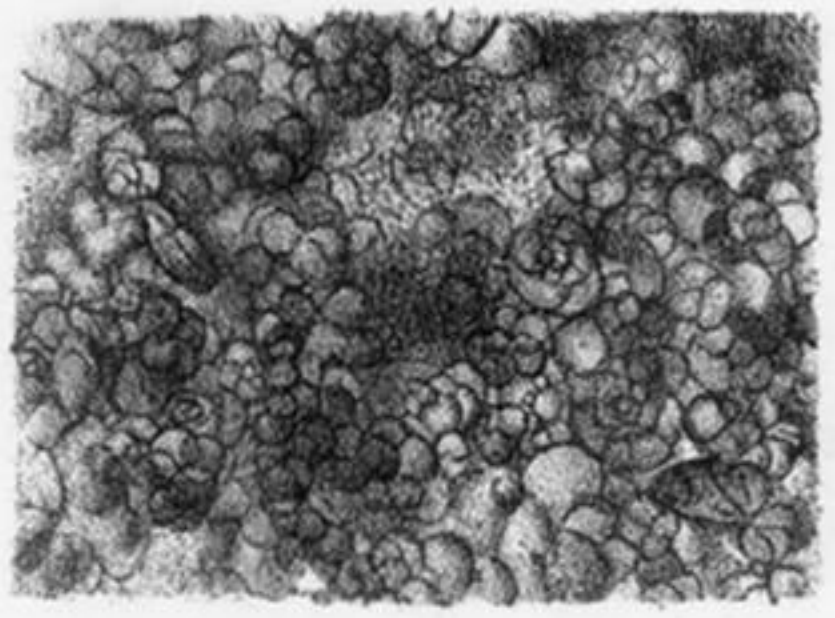

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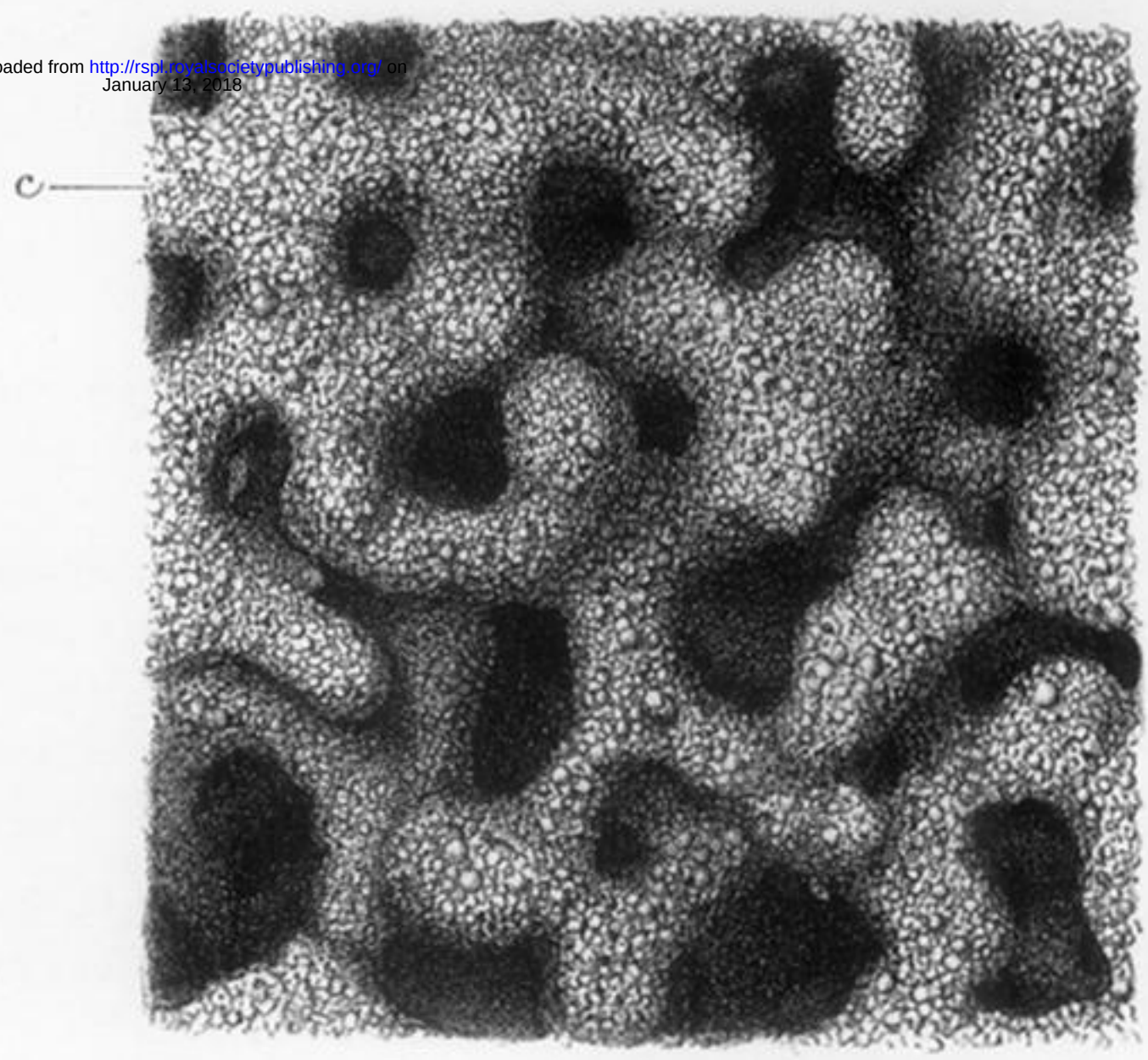

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SYRINGAMMINA FRAGILISSIMA.

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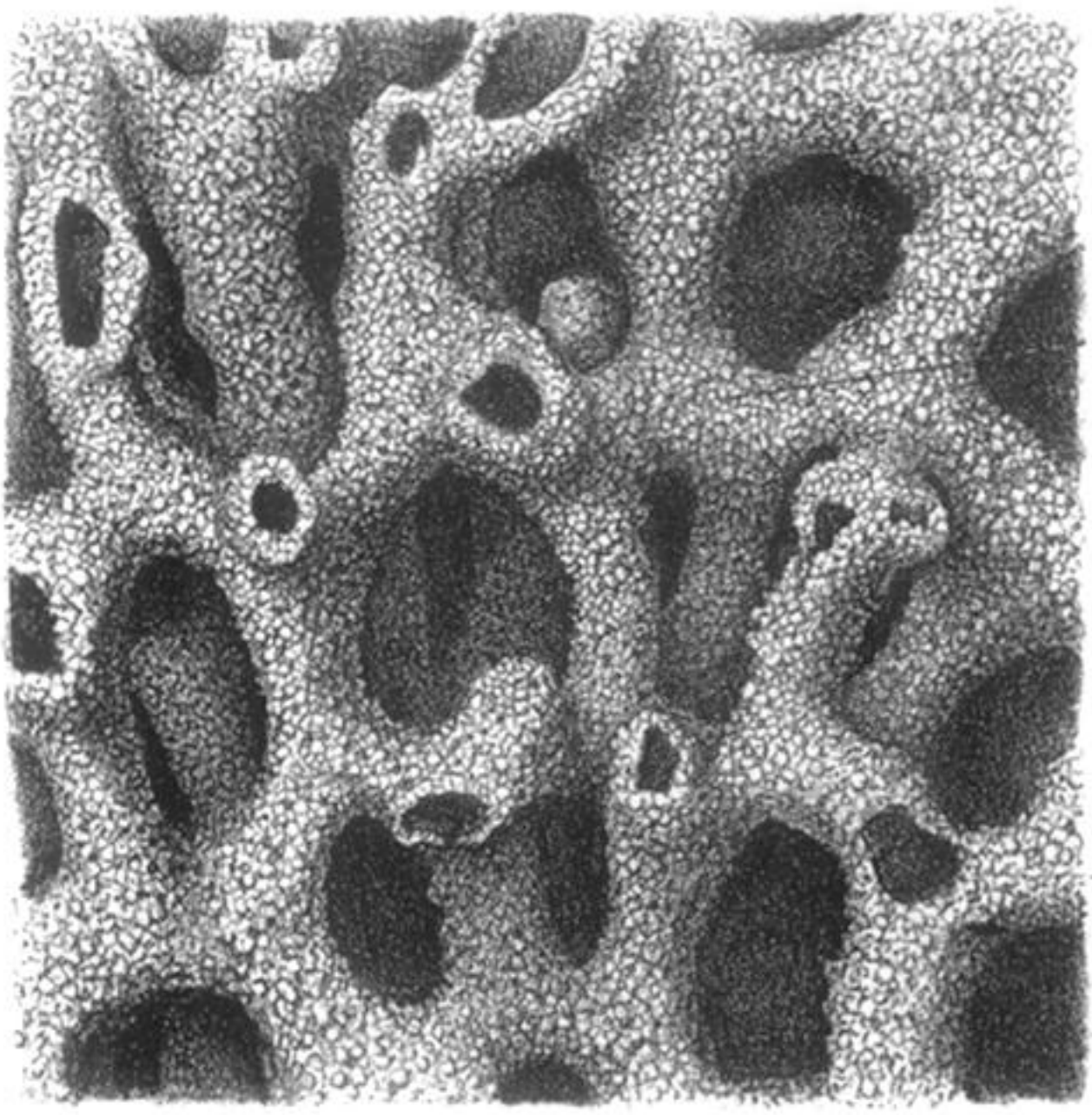

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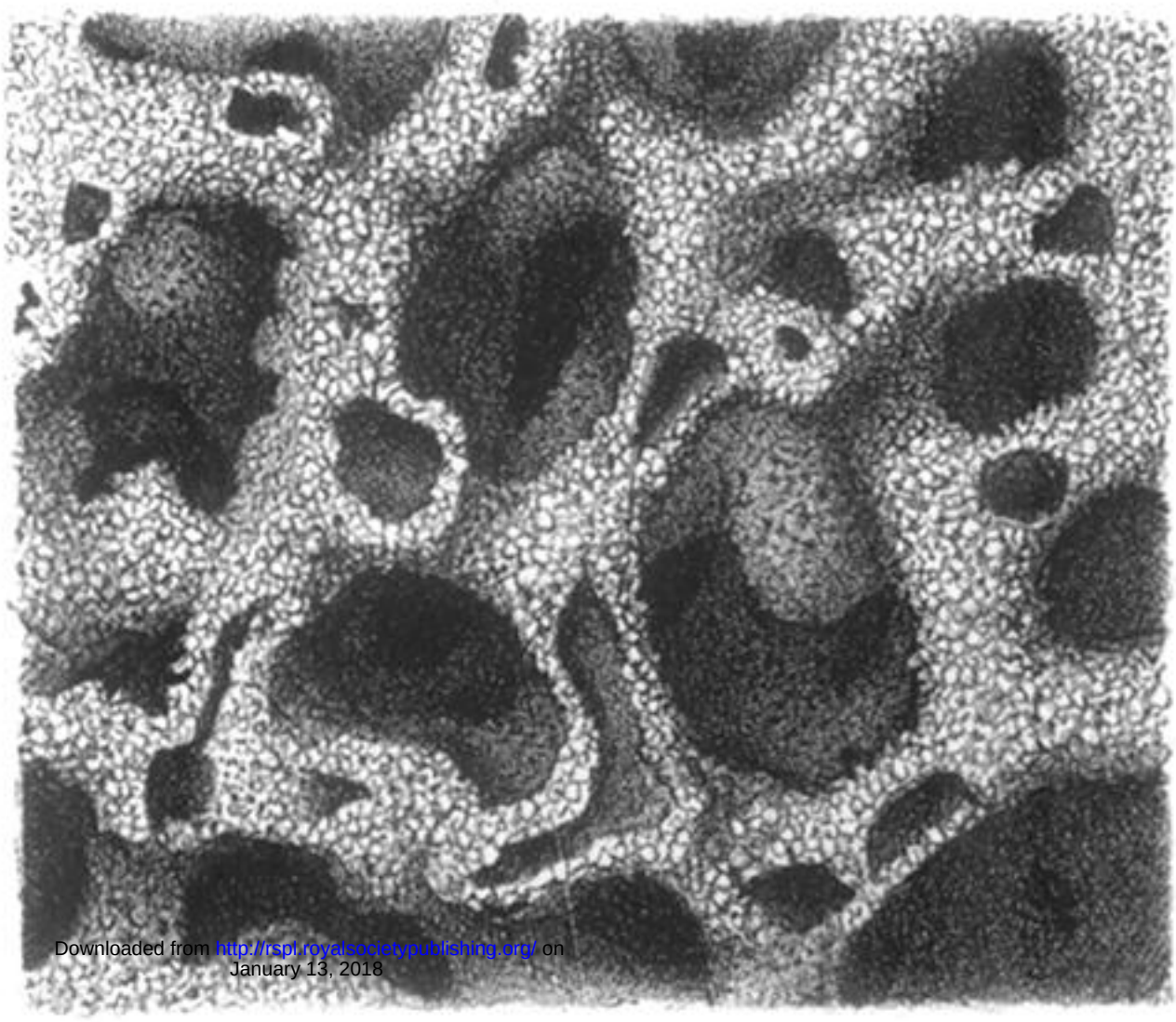

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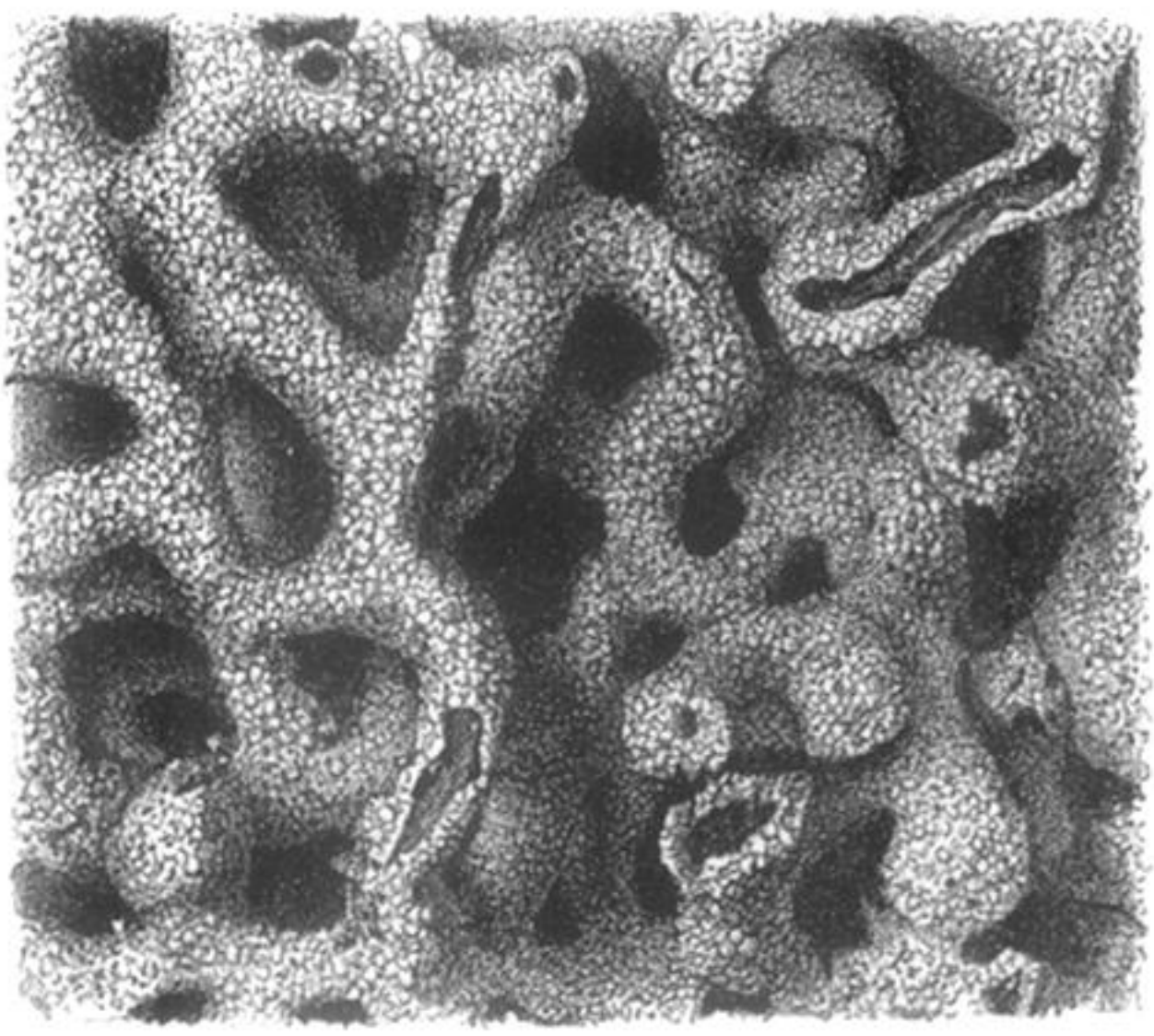

SYRINGAMMINA FRAGILISSIMA