II.—Notes on some Microzoa and Mollusca from East Crete.

By Rev. R. Ashington Bullen, B.A., F.G.S.

(PLATES XVIII and XIX.)

THE fossil or sub-fossil remains to which I propose to devote this short paper were procured from a cave-deposit in East Crete by Miss Dorothea M. A. Bate, whose valuable work among the Pleistocene Mammalia in Crete is so well known.

Early in 1905 she kindly sent me some helicoid shells from a cave-deposit in East Crete, together with an interesting collection of land and fresh-water mollusca from various parts of the island, all which I have recorded elsewhere.[1] There were also some marine mollusca found at Kutri, West Crete, in a cave about 25 feet O.D. Mr. E. A. Smith, F.Z.S., identified one as *Calliostoma Laugieri* (Payraudeau), and there were others in the same cave-deposit, which, recognizing as marine, Miss Bate did not collect. These occurred in the same cave, in a crevice of which was also a quantity of sea-sand.

The new material, very small in amount but very great in interest, Miss Bate procured from a large mammalian bone of Pleistocene date, found by her in a cave at Kharoumes, East Crete, 12 to 15 feet O.D.; and, as the minute organisms found therein are all of a marine facies, their evidence, added to the other facts from Kutri, points to oscillations of the land-surfaces, leading to the submergence and re-emergence of those land-surfaces, other evidences of which were commented on by Raulin and Spratt more than 40 years ago, in 1861 and 1865 respectively. The late eminent geologist, Professor Prestwich, carefully summed up their evidence as follows[2]:—"From M. Victor Raulin's work on Crete I gather that there is evidence of the elevation of the island within the historical period to the extent of 15 to 25 feet, and, further, that at a height of about 65 feet a raised beach of Quaternary age is met with at many points of the coast. Admiral Spratt has shown that within recent times there has been a subsidence of the east coast of Crete, whilst the west side has been elevated to the extent of 26 feet.[3] Anchor blocks have been found 11 feet above the sea-level, and the port of Kissamo has been raised 18 feet out of the sea within Christian times. The two piers of the port of Phalasarna,[4] a city of late Hellenic date, and described by Strabo, are now 22 feet above their original level.[5] Spratt also found *Pectunculi* of recent species 40 feet above the shore, and indications of another raised beach, or old sea-level, at 100 feet."

[1] Proceedings of the Malacological Society, vol. vi, p. 307.

[2] Prestwich, "Evidences of the Submergence of Western Europe and the Mediterranean Coasts": Phil. Trans., vol. 184 (1893), p. 969.

[3] Spratt: "Travels and Researches in Crete," vol. ii, p. 241 (the district between Selino and Lissos).

[4] Now Kutri.

[5] Bate: Geol. Mag., Dec. V, Vol. II (1905), p. 199 sqq.

The evidence brought home by Miss Bate tends, in my opinion, to reinforce and corroborate the observations summed up by Prestwich in the above passage.

In a recent volume of the GEOLOGICAL MAGAZINE Miss Bate has described this district in her account of her "Search for Pleistocene Mammalia in Crete."[1] The only cave-deposits found in this part of the island were situated in the rugged limestone cliffs bordering the southern end of the Bay of Kharoumes, not many miles south of Palaikastro. At the foot of these cliffs, and only a few feet to a few yards above the sea, were discovered one small bone-cave, and, on either side, portions of the stalagmitic flooring of two others; all being situated closely together and extending for a distance of a hundred and fifty yards.

In Spratt's map of Eastern Crete[2] the Bay of Kharoumes appears as Caruba, and in the French military map[3] as Carouba for both village and bay, which latter spelling Spratt also uses for the name of the village. As Miss Bate invariably calls the place and bay by the name Kharoumes, this is undoubtedly the later current Cretan form. But to the south of Carouba is a village marked in the French map Asokiramo, which is unnoticed in Spratt's map, and is evidently nearer the original of the name Kharoumes. So acute an observer as Spratt would not be likely to make a mistake in the spelling of a name, especially as he says the karouba[4] is the chief produce, and a village to the north of Zakro Bay is named from it. So here in the text we get yet another spelling of the name! Probably Spratt was not responsible for the spelling of the map, as other persons' names are appended to it, but it is all very puzzling and does not make for clearness or exactitude. And may one venture to say that even in England nothing is more common than the variation in a place-name, and that many of the names differ now from their pronunciation and spelling at the time of the engraving of the Survey maps, though there is sufficient similarity in the variants for purposes of identification.

The Kharoumes Bay district, according to Spratt's Geological map, presents a somewhat central mass of slates and schists, surrounded by a limestone district, flanked on the north, west, and south-east by marine Tertiary deposits. It was in the limestone part of this district only that terrestrial mollusca so far have been found in the stalagmitic breccia.

With regard to the marine microzoa from the same place, critically examined for me by Mr. R. Holland, his report is as follows:—"This material, although very small in amount, has proved extremely interesting on account of the very striking series of varieties of

[1] Spratt: op. cit., vol. ii, pp. 230–2. See also ibid., vol. ii, pp. 135–6. (Evidence of successive uplifts indicated by wave-abrasion and the occurrence of boring molluscs in the cliffs; many shells still *in sitû*.)

[2] Op. cit., vol. i, *ad fin.*

[3] Ile de Crête: dessiné et heliogravé au Service Géographique de l'Armée.

[4] The carob-tree, or St. John (the Baptist's) Bread, is found wild in all countries skirting the Mediterranean. At Malta it is almost the only tree. In Spain we get its Moorish name, algarroba.

Peneroplis pertusus (Förskal). This foraminifer is remarkable for its great morphological range, and, although most authors have given specific names to many of the varying forms, it is now generally held that all these are simply varieties of one protean species (see vol. ix of the 'Challenger' Reports). The occurrence in this small amount of material of so wide a range of forms strongly supports this view. With the exception of *Peneroplis pertusus*, *Planorbulina mediterranensis*, and *Miliolina reticulata*, the specimens are generally poorly developed." The reason of this we shall see immediately.

The total number of specimens is 148. Some of these are obscured in places by the reddish cement by which they were kept in adhesion to each other and to the bone on which they were found. The worn appearance of a large proportion of them testifies to their great age. On examination with a $\frac{1}{10}$ objective the foraminiferal tests, where broken, are seen generally to be filled with a shining crystalline calcitic material stained red, a colour evidently derived from the cave-earth; some of them, especially *Orbitolites complanata*, are covered with a calcitic crust, which hides the foramina, and there is in the hollows between the striæ of others a chalky-looking paste, white in colour, seemingly derived from the attrition or solution of other foraminiferal tests. The polyzoa also have become crystalline in substance from the infiltration of a calcitic solution. All these characters explain why Mr. Holland, from the microscopist's point of view, reports the specimens as poorly developed, for these characters differentiate them from recent specimens of the same species and betoken their fossil or sub-fossil character.

LIST OF SPECIES FOUND.

Mollusca.

Terrestrial.

Helix pellita,[1] [2] Fér. Cave-breccia, Kharoumes.

Marine.

Calliostoma Laugieri[2] (Payraudeau). Pleistocene mammalian bone, cave, Kutri.

Cardium sp.

Rissoa crenulata, Montagu. Pleistocene mammalian bone, cave, Kharoumes.

Crustacea.

Valves of *Entomostraca*. Ditto.

Polyzoa.

Crisia eburnea (Linné). Ditto.

Bugulopsis sp.

[1] Recorded by Pilsbry as a recent shell at Morca, Syra, and Rhodes. Its occurrence at Kharoumes is believed to be its first record from a Pleistocene deposit. From available evidence it appears not now extant in Crete.

[2] Specimens now in Geological Department, British Museum.

1 ×2½

2 ×3

3 ×25

4 ×25

5 ×25

6 ×35

7 ×25

8 ×35

9 ×25

10 ×35

11 ×45

12 ×35

13 ×25

14 ×25

16 ×30

15 ×25

G.M. Woodward del. et lith. West, Newman imp.

Mollusca, Bryozoa & Foraminifera from Crete.

FORAMINIFERA.

Biloculina elongata (D'Orb.). Pleistocene mammalian bone, cave, Kharoumes.
Dentalina sp.
Discorbina globularis (D'Orb.). Ditto.
D. opercularis (D'Orb.). Ditto.
D. orbicularis (Terquem). Ditto.
D. turbo (D'Orb.). Ditto.
Globigerina bulloides [1] (D'Orb.). Ditto.
Miliolina seminulum (Linn.). Ditto.
M. oblonga (Montagu). Ditto.
M. bicornis (Walker & Jacob). Ditto.
M. subrotundata (Montagu). Ditto.
M. valvulata [2] (Reuss). Ditto.
M. tricarinata (D'Orb.). Ditto.
M. reticulata (D'Orb.). Ditto.
M. circularis (Bornemann). Ditto.
Orbitolites complanata (Lamk.). Ditto.
Peneroplis pertusus (Förskal). Ditto.
Planorbulina mediterranensis, D'Orb. Ditto.
Polymorphina lactea [2] (Walker & Jacob). Ditto.
Polystomella macella (Fichtel & Moll.). Ditto.
Rotalia becarii (Linn.). Ditto.
Rotaline form undetermined. Ditto.
Spiroloculina grata, Terquem. Ditto.
S. limbata, D'Orb. Ditto.
Truncatulina lobatula (Walker & Jacob). Ditto.
T. ungeriana (D'Orb.). Ditto.
Vertebralina striata (D'Orb.). Ditto.
V. sp.[3] Ditto.

I have the pleasure of thanking the friends mentioned in the paper for help, also Mr. R. Bullen Newton, F.G.S., for submitting the material from Kharoumes to Mr. R. Holland, and Professor T. Rupert Jones, F.R.S., for critically reading my MS.

EXPLANATION OF PLATES.

PLATE XVIII: MOLLUSCA, BRYOZOA, FORAMINIFERA, ETC., FROM CRETE.

FIG.
1. Mollusca: *Helix pellita*. × 2½.
2. ,, *Calliostoma Laugieri*. × 3.
3. Crustacea: Valve of Entomostracan, *Loxoconcha* sp.
4. Bryozoa: *Bugulopsis* sp. × 25.
5. ,, *Crisia eburnea*. × 25.
6. Foraminifera: *Biloculina elongata*. × 35.
7. ,, *Miliolina seminulum*. × 25.
8. ,, *M. oblonga*. × 35.
9. ,, *M. bicornis*. × 25.
10. ,, *M. subrotunda*. × 35.

[1] With abnormal aperture (Holland).
[2] Striate variety (Holland).
[3] With spiroloculine early chambers (Holland).

FIG.
11. Foraminifera: *M. valvulata.* × 45.
12. ,, *M. tricarinata.* × 35.
13. ,, *M. reticulata.* × 25.
14. ,, *Spiroloculina grata.* × 25.
15. ,, *S. limbata.* × 25.
16. ,, *Vertebralina* sp. × 30.

PLATE XIX: FORAMINIFERA FROM CRETE.

1. Foraminifera: *Peneroplis pertusus.* × 25.
2. ,, ,, × 35.
3. ,, ,, × 25.
4. ,, ,, × 35.
5. ,, *Dentalina* sp. × 25.
6. ,, *Orbitolites complanata.* × 25.
7. ,, ,, × 50.
8. ,, *Polymorphina lactea.* × 25.
9. ,, *Globigerina bulloides.* × 30.
10. ,, *Planorbulina mediterranensis.* × 30.
11. ,, *Discorbina globularis.* × 45.
12. ,, *D. opercularis.* × 45.
13. ,, *D. orbicularis.* × 45.
14. ,, *D. turbo.* × 45.
15. ,, *Truncatulina lobatula.* × 45.
16. ,, *T. ungeriana.* × 45.
17. ,, *Rotalia becarii.* × 45.
18. ,, *Polystomella macella.* × 45.

III.—SEDGWICK MUSEUM NOTES.

NEW FOSSILS FROM THE HAVERFORDWEST DISTRICT.

By F. R. COWPER REED, M.A., F.G.S.

(PLATE XX.)

GASTEROPODA.

A FEW Gasteropoda were recorded by Messrs. Marr and Roberts [1] from the *Trinucleus seticornis* Beds, principally from the Redhill stage, but Mr. Turnbull has been fortunate in obtaining a comparatively large number of species. The specimens are not usually well preserved, and the specific or even generic determination of all is not possible with the present material. Some interesting new forms, however, can be detected, and the following list can now be given:—

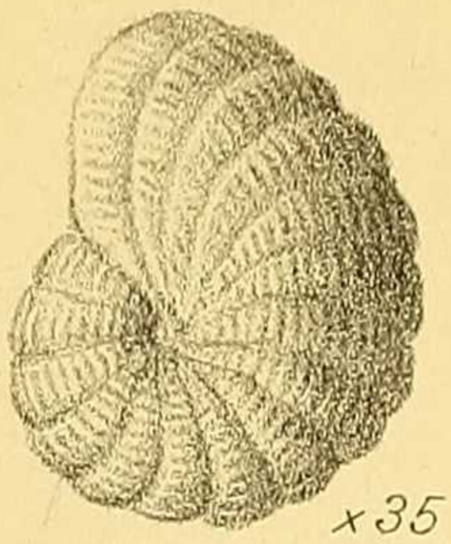
R. *Eotomaria Robertsi*, sp. nov.
R. *E.* cf. *elliptica*, His.
R. *E.* sp.
R, S. *Liospira* sp.
S. *Lophospira* cf. *turrita*, Portl.
R. *L.* sp.
R. *Hormotoma* (?) sp.
S. *Clathrospira* (?) sp.
S. *Trochonema* sp.

[1] Marr & Roberts, Quart. Journ. Geol. Soc., vol. xli (1885), pp. 476–490.

1

×25

2



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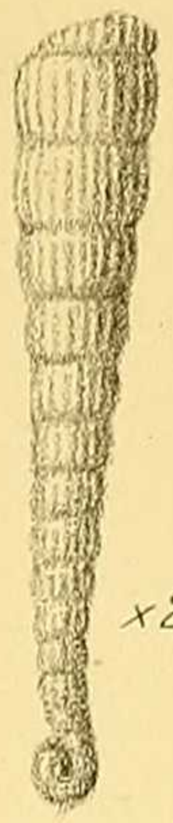

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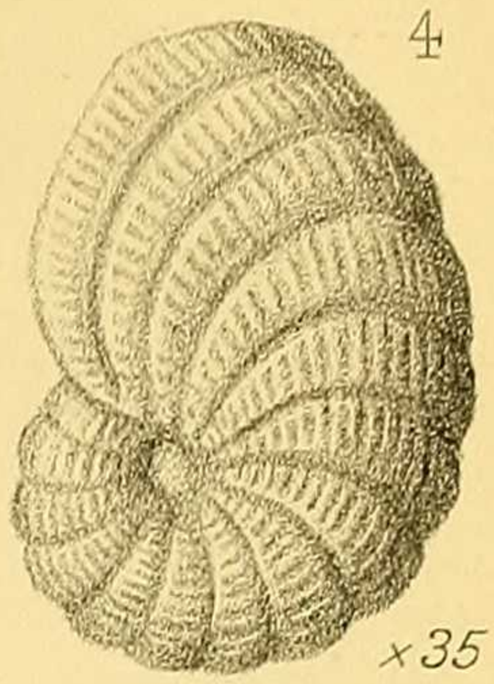

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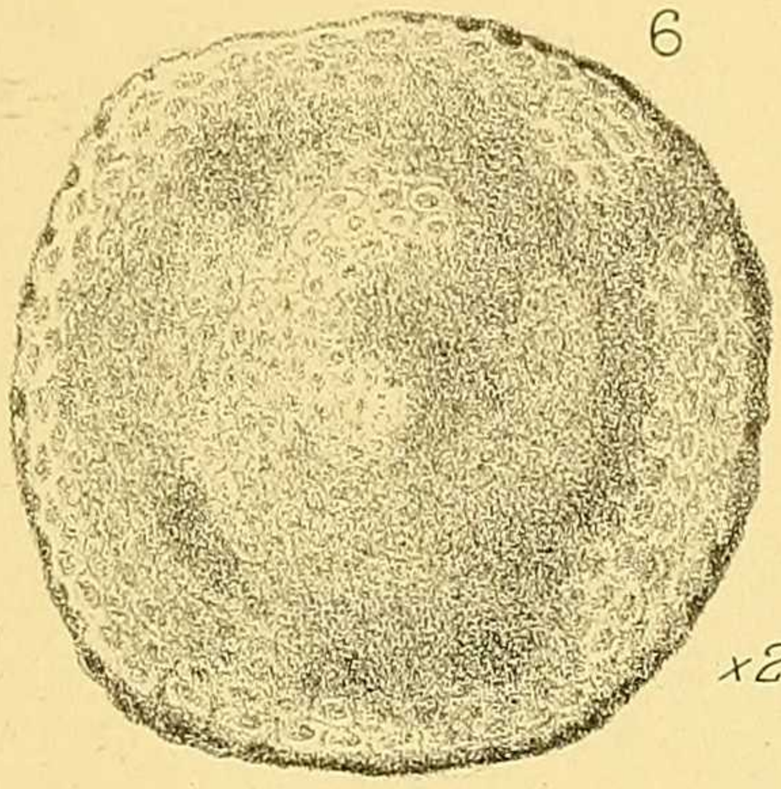

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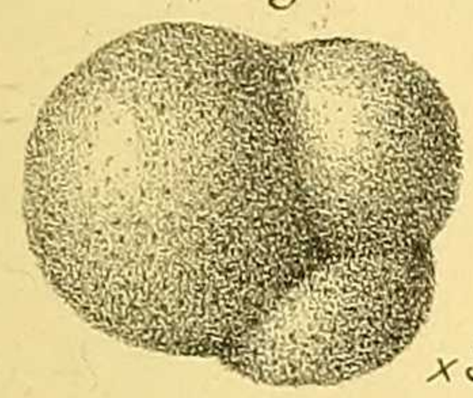

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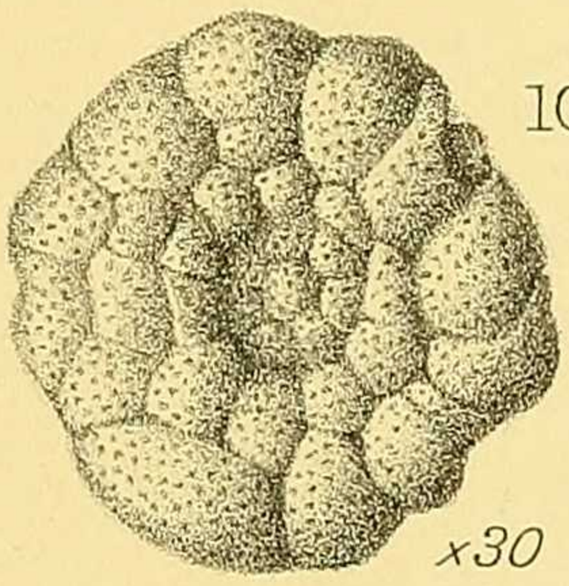

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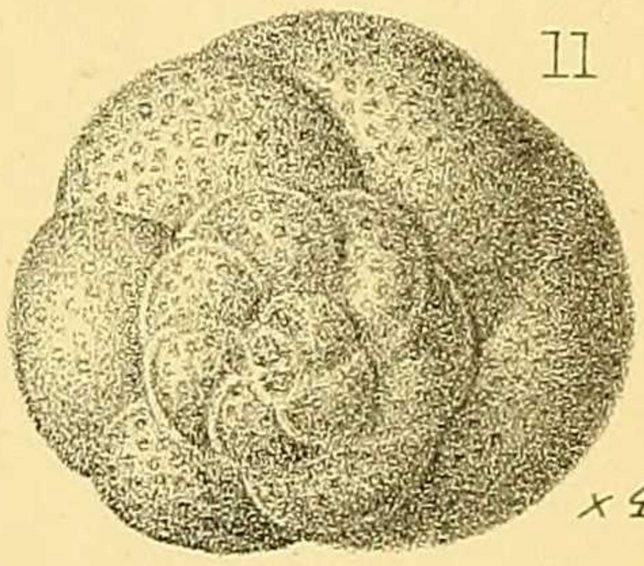

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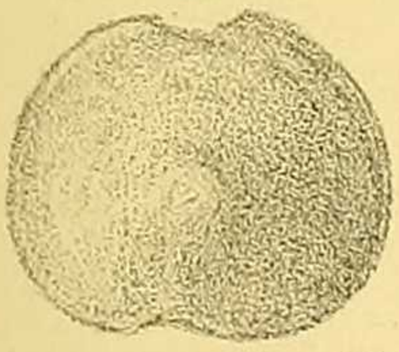

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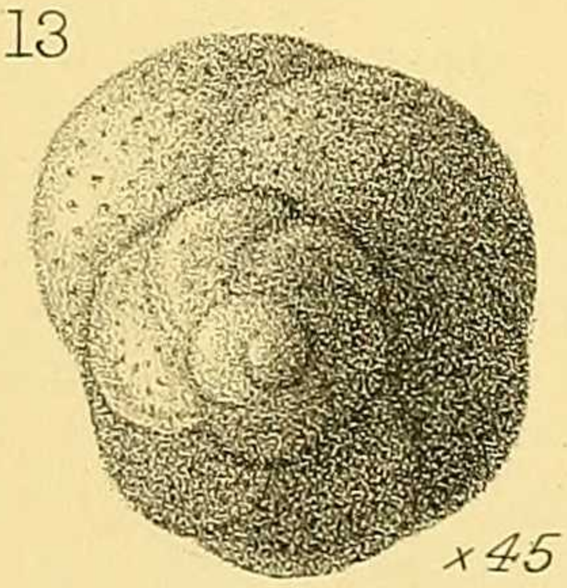

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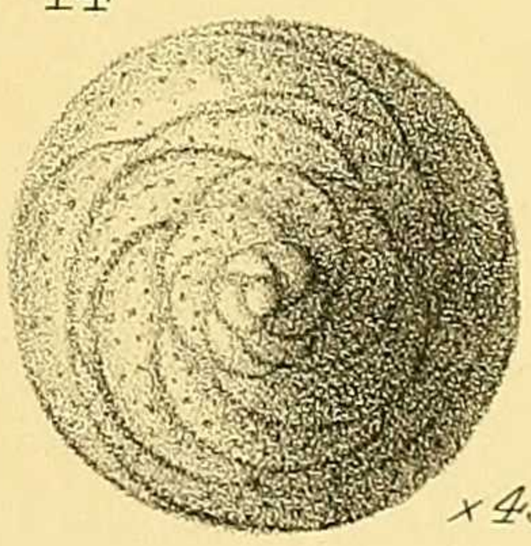

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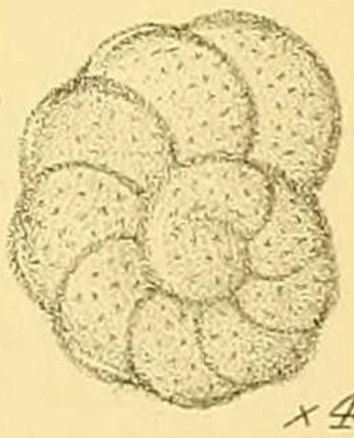

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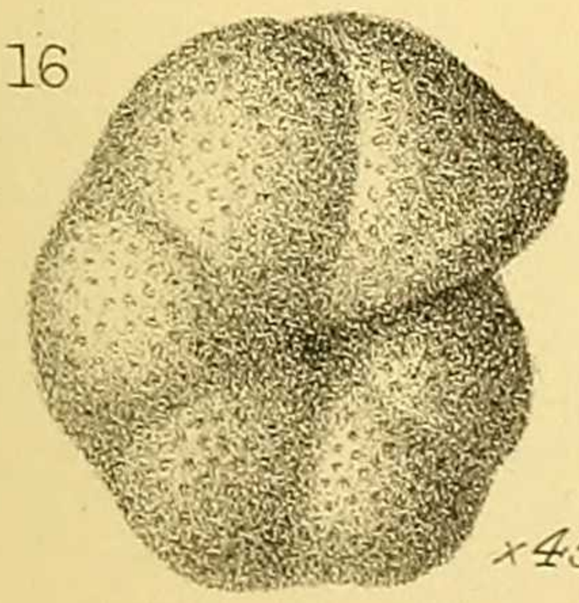

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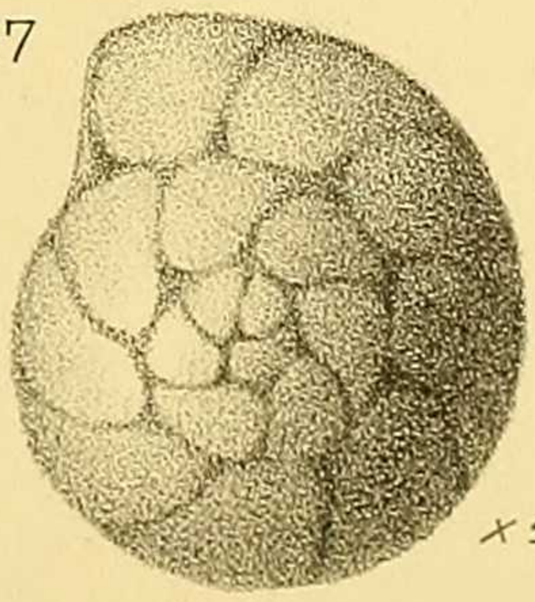

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