

### III.—TERTIARY FORAMINIFERAL LIMESTONES FROM SINAI.

By FREDERICK CHAPMAN, A.L.S., F.R.M.S.

(PLATES XIII AND XIV.)

(Concluded from the July Number, p. 316.)

#### NUMMULITES, Lamarck [1801].

*Preliminary remarks on the genus.*—The interesting observations on the dimorphism of the genus *Nummulites*, which have been made from time to time by special investigators, such as Von Hantken, Munier-Chalmas & Schlumberger, De la Harpe, Rupert Jones, and Van den Broeck, have resulted in the establishment of couples of so-called species, constituting a species in the zoological sense, in which the smaller form, with a large central chamber, is referred to as form A, whilst form B usually has a larger test and invariably possesses a diminutive central chamber. The two forms are otherwise spoken of as the megalospheric and microspheric forms. In some cases there may be little doubt as to the accuracy of the assignment of the two forms to one species, especially since they may be the only examples present in the rock. In the case of a stratum containing more than two species, however, there may be no small difficulty in coupling the actual forms which constitute the species, for there is often little in either the internal or external characters to guide one in linking the forms. In our present state of knowledge, therefore, it appears to be most convenient to describe the forms under their specific denominations as already known, at the same time pointing out their relationship to one another. Some good suggestions as to the naming of *Nummulites* and other Foraminifera which exhibit the two modes of growth and shell form have lately been made by Dr. A. Silvestri.<sup>1</sup>

With regard to the older method of grouping the *Nummulites* according to their superficial appearance and texture, this can be at the best only an artificial method of arrangement, for it sometimes happens that two different forms constituting a zoological species may be found to belong to two of the separated so-called groups; as, for instance, *N. curvispira*, which has been placed in the granulate group, and *N. complanata* or *N. complanata*, var. *Pachoi*, in the group of smooth forms. Moreover, it will be seen by referring to Rupert Jones' Catalogue of Fossil Foraminifera in the British Museum,<sup>2</sup> that *N. curvispira* is an example of the granulate group which does not invariably exhibit the characters ascribed to it.

*Nummulites planulata* (Lamarck). (Pl. XIII, Fig. 2a.)

*Lenticulites planulata*, Lamarck, 1804: *Annales du Muséum*, vol. v, p. 187.

*Nummulites planulata* (d'Orb.), d'Archiac & Haime, 1853: *Deser. Anim. groupe nummulitique Inde*, vol. i, p. 142, pl. ix, figs. 5a, 6a-c, 7a-h, 8a-d, 9a, b, 10a-c.

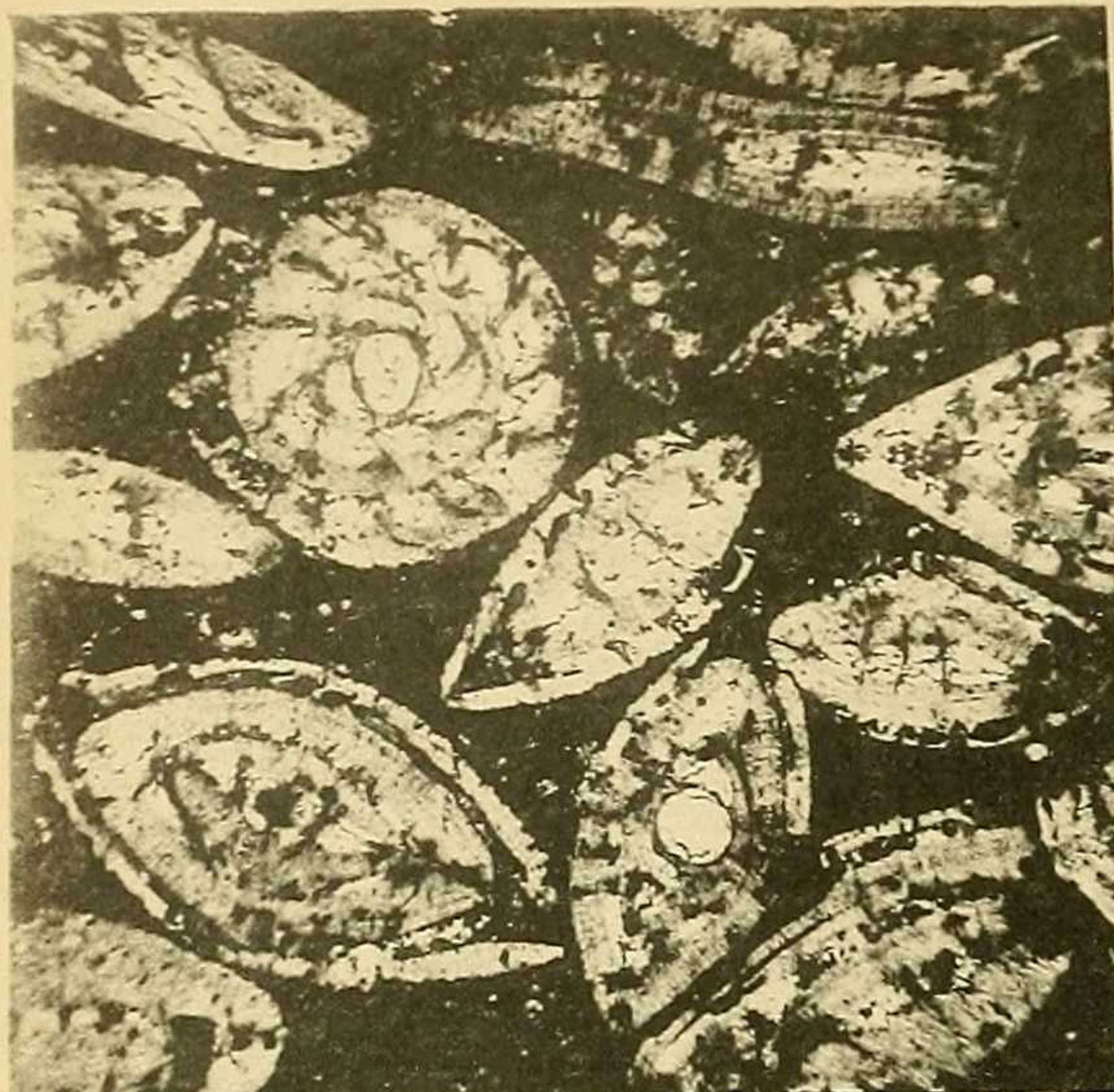
One recognizes this form by the minute or almost invisible central chamber, and the flatness of the test. In section it exhibits from

<sup>1</sup> Atti dell' Accad. Pont. Nuovi Lincei, Anno lili (1900), pp. 1-10. See also Van den Broeck: *Bull. Soc. Belge Géol. Pal. Hydr.*, vol. x (1896), 1899.

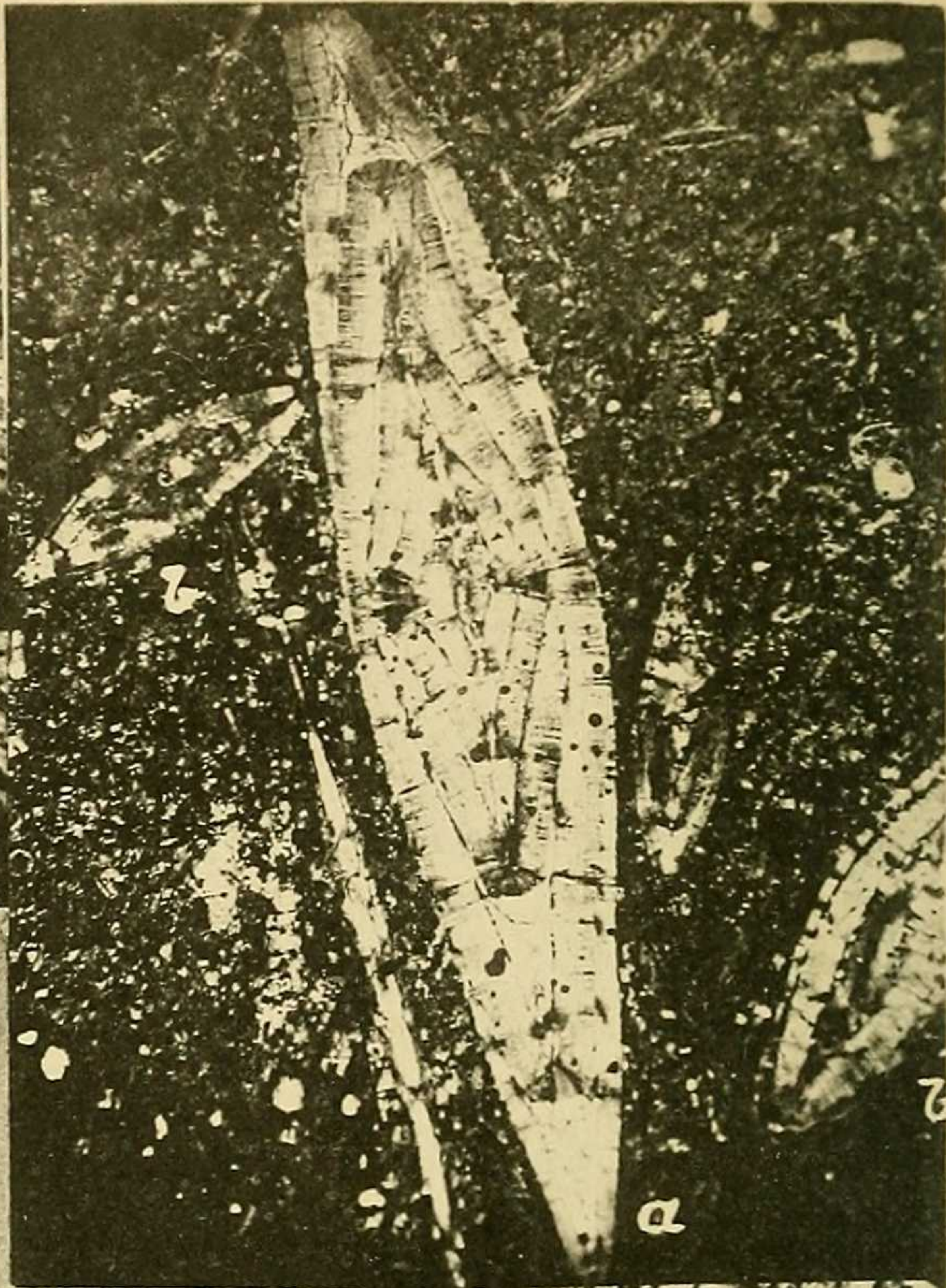
<sup>2</sup> Op. cit., pp. 46, 47, specimens P 1014 and P 890.



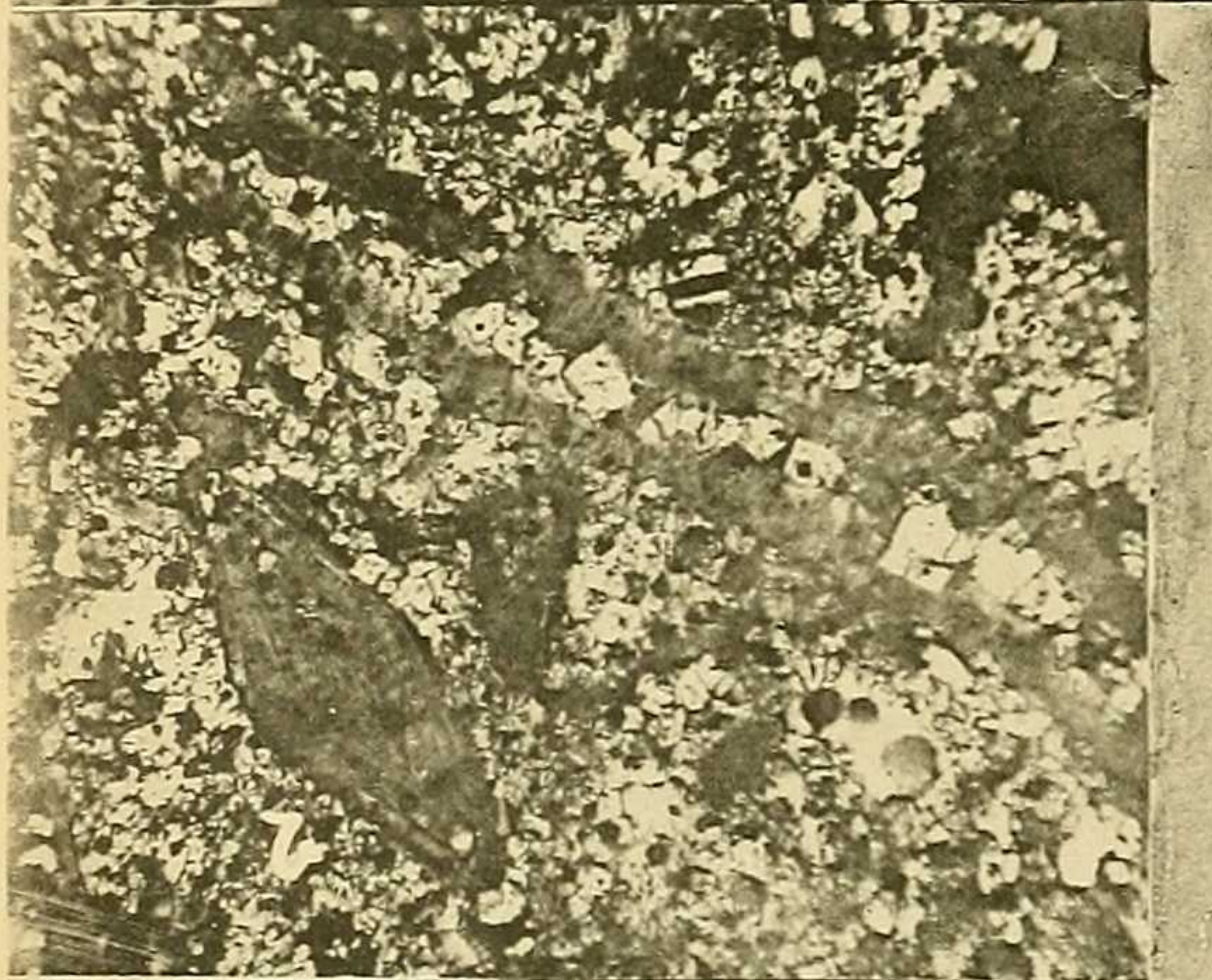
1  
× 16



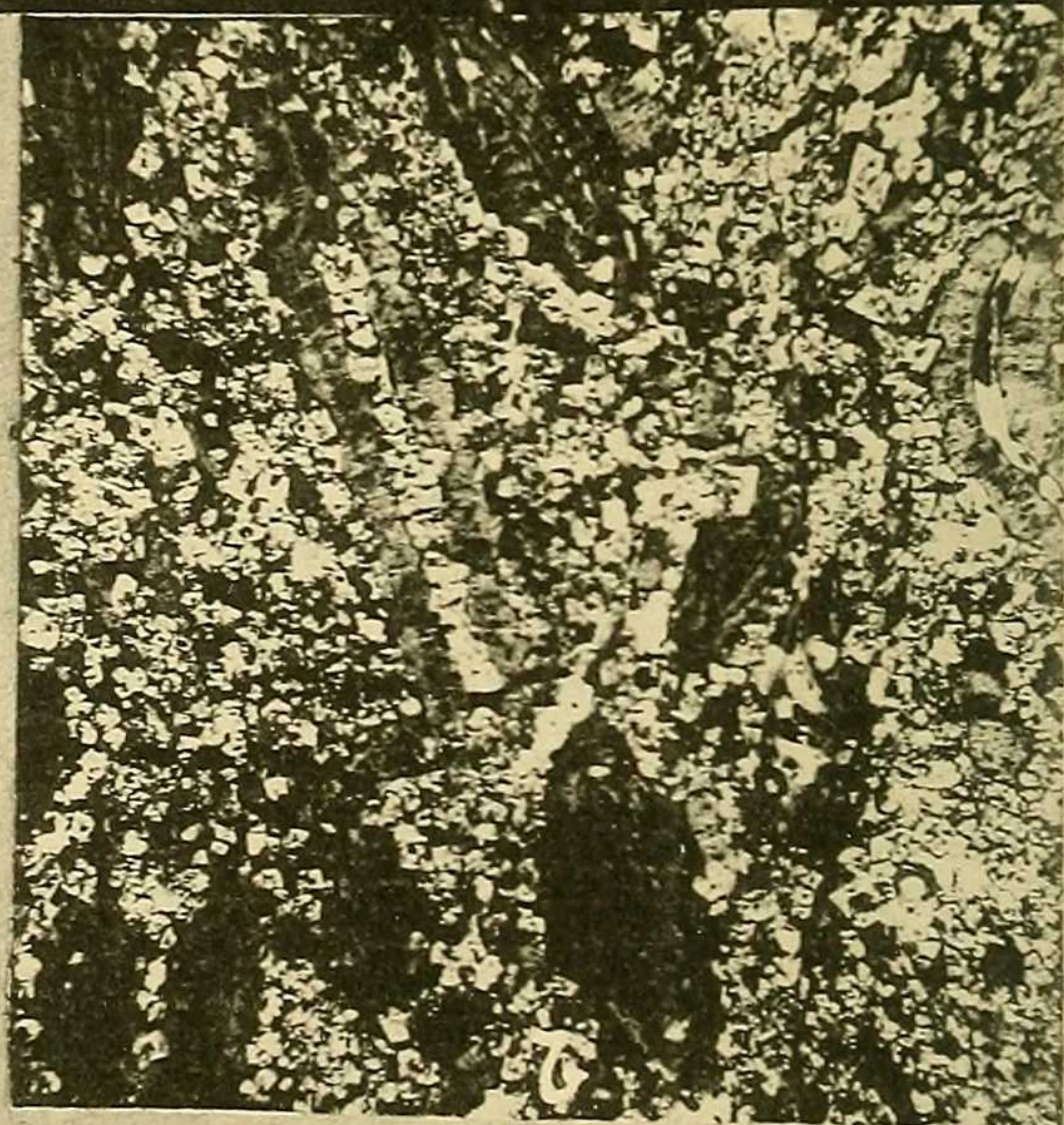
2  
× 12



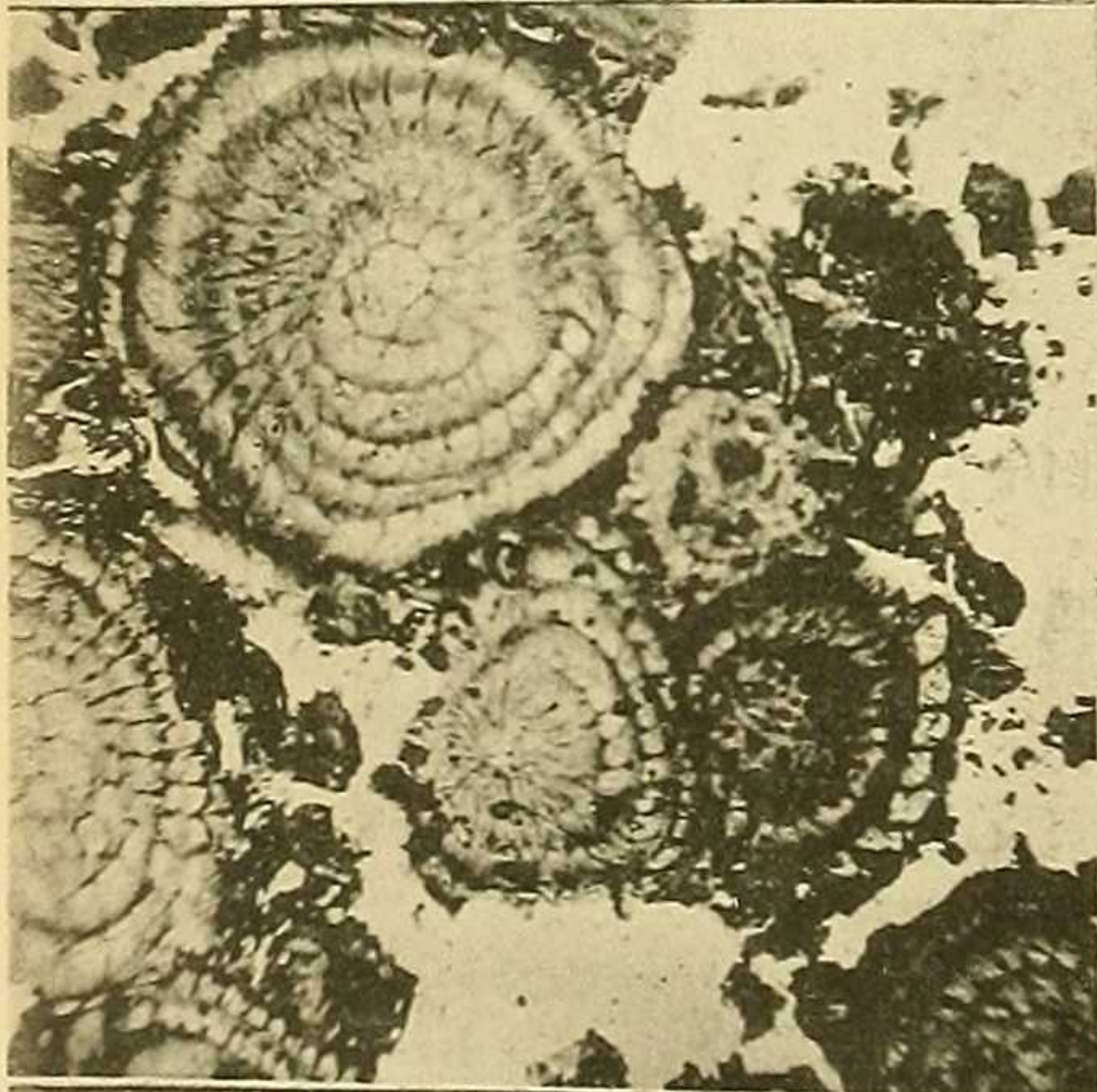
3  
× 16



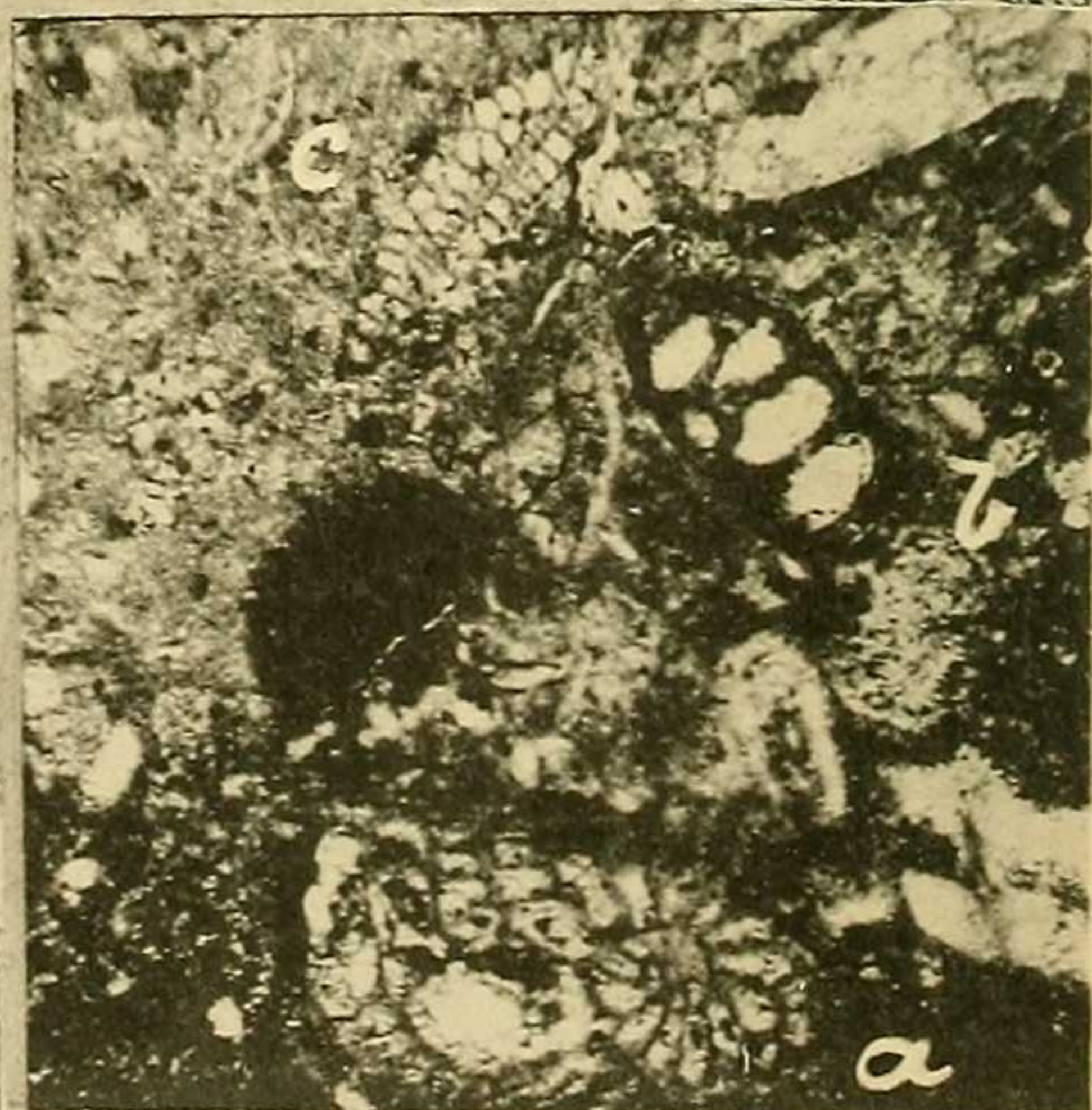
4  
× 16



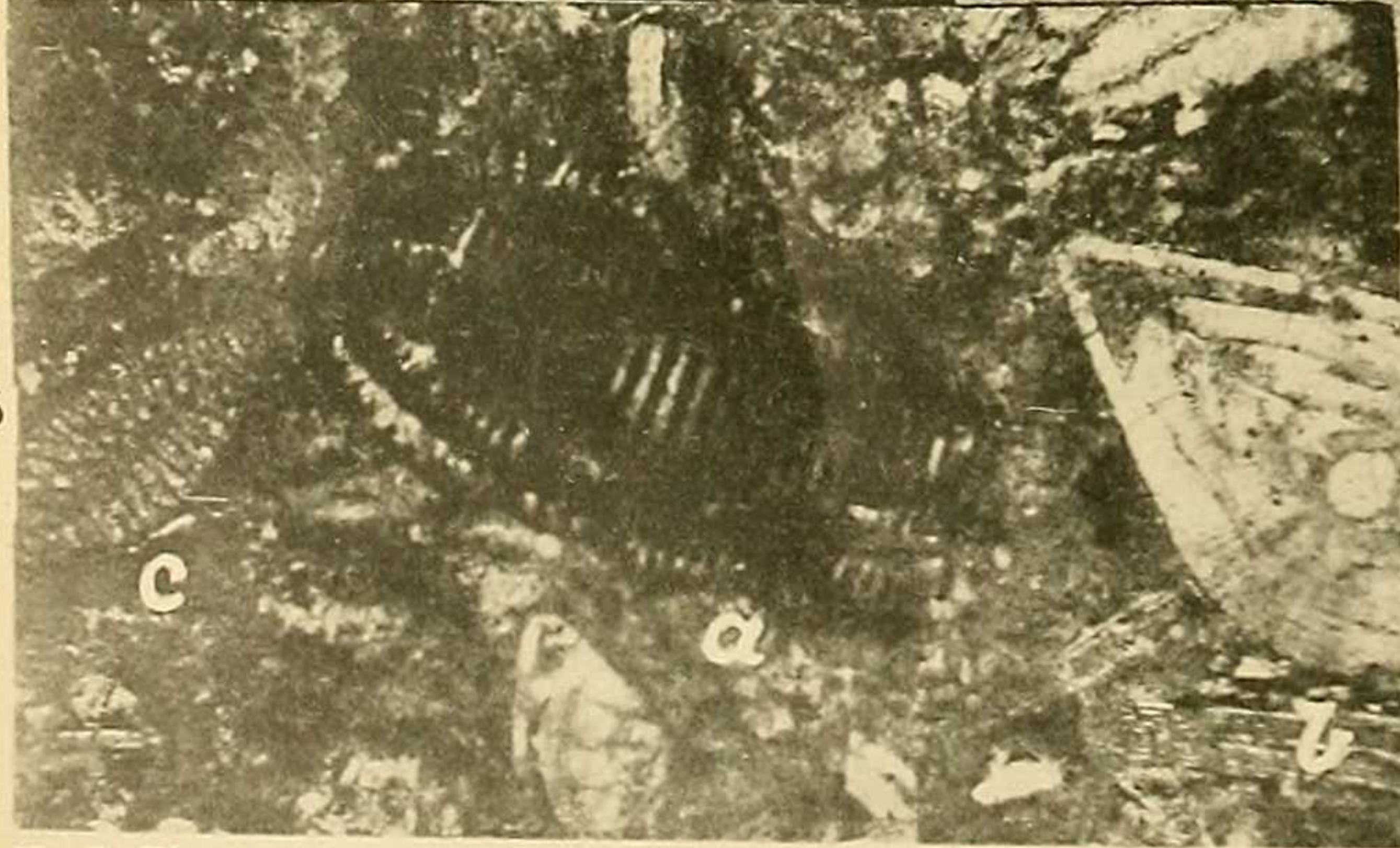
5  
× 4½



7  
× 16



6  
× 16



F. C. Photo.



four to six whorls, which increase rapidly in breadth (in median section), especially towards the last.

The specimens here dealt with are very typical when compared with d'Archiac's figures. Those forms of the same group or type recorded by De la Harpe from Egypt<sup>1</sup> differ chiefly in their umbonate centre and comparatively sharp peripheral edge.

*N. planulata* appears to be distributed chiefly through the Lower and Middle Eocene beds of Europe, but it is occasionally found with a higher range. This species has been recorded by Dr. Fraas from Egypt.

Coll. Geol. Surv. Egypt, No. 4,112, Box No. 2l. ? Bartonian (Upper Eocene) or ? top of Mokattam Series (Middle Eocene) : Jebel Abyad, beach deposit (later). Common.

*Nummulites Guettardi*, d'Archiac & Haime, var. *antiqua*, De la Harpe. (Pl. XIII, Fig. 6b.)

*Nummulites Guettardi*, d'Archiac, var. *antiqua*, De la Harpe, 1883: Palæontographica, vol. xxx, Pal. Theil, p. 172, pl. xxx (i), figs. 37-42.

The central chamber in our specimens from Sinai is fairly large, agreeing in this particular with the typical examples of the species figured by d'Archiac.<sup>2</sup> De la Harpe, however, states that his specimens have a small central chamber, so that it is possible that we have here the two forms A and B confused by the above-named authors.

The variety *antiqua* differs from the typical *N. Guettardi* in having a lenticular and more compressed shell. The type form was found by De la Harpe only in the Upper Eocene beds of Egypt.

The above variety was found by De la Harpe in rocks of the Libyan Series (Lower Eocene) of Nekeb, east of Farâfrah, and of El-Guss-Abu-Said.

Coll. Geol. Surv. Egypt, No. 3,902, Box No. 15l. Libyan Series (Lower Eocene) : Jebel Krer, Sinai (same range as Jebel Abyad). Common.

*Nummulites Ramondi*, Defrance. (Pl. XIII, Figs. 3b, 4b.)

*N. Ramondi*, Defrance, 1825: Dict. Sci. Nat., vol. xxxv, p. 224. D'Archiac & Haime, 1853: Descr. Anim. groupe nummulitique Inde, vol. i, p. 128, pl. vii, figs. 13a-d, 14a, 15a, 16a, 17a, b.

This is a small species, but has no large central chamber. The peripheral edge is sharper than that of *N. Guettardi*, and the test is much thinner.

*N. Ramondi* is one of the most widely distributed of the nummulites; amongst many localities it has been found in France, the Alps, the Pyrenees, Egypt, the Crimea, and India. From Egypt De la Harpe obtained it in the Lower Libyan Series of Jebel Têr.

Coll. Geol. Surv. Egypt, Nos. 4,113 and 4,135, Box Nos. 4l and 3l respectively. Libyan Series (Lower Eocene) : junction of Wadi

<sup>1</sup> Palæontographica, vol. xxx (1883), Pal. Theil, pp. 161-4, pl. xxx, figs. 1-18: *N. Fraasi*, *N. Rüttimeyeri*, and *N. Chavannesi*.

<sup>2</sup> Descr. Anim. groupe nummulitique Inde, vol. i (1853), p. 130, pl. vii, figs. 18a-c, 19a, b.



Baba and Wadi Shellál, Sinai. Common. ? No. 3,598, Box No. 13l. Mokattam Series (Middle Eocene) : Wadi Khadáhid. Rare.

*Nummulites Heberti*, d'Archiac & Haime.

*Nummulites Heberti*, d'Archiac & Haime, 1853 : Descr. groupe nummulitique Inde, vol. i, p. 147, pl. ix, figs. 14a-g, 15a. De la Harpe, 1883 : Palæontographica, vol. xxx, Pal. Theil, p. 178, pl. xxxi (ii), figs. 26, 27.

This is a very minute nummulite, having an umbonate centre and a sharp peripheral edge. The central chamber is almost invisible. The specimens from Sinai measure about 2 mm. in diameter and .85 mm. in thickness. *N. Heberti* was found by Schwager in both the Libyan and Bartonian Series of Egypt.

Coll. Geol. Surv. Egypt, No. 4,112, Box No. 2l. ? Bartonian (Upper Eocene) or ? top of Mokattam Series (Middle Eocene) : Jebel Abyad, Sinai, beach deposit (later). Frequent. Also No. 3,902, Box No. 15l. Libyan Series (Lower Eocene) : Jebel Krer (same range as Jebel Abyad), Sinai. Rare.

*Nummulites variolaria* (Lamarck). (Pl. XIII, Fig. 2b.)

*Lenticulites variolaria*, Lamarck, 1804 : Ann. du Muséum, vol. v, p. 187, No. 2.

*Nummularia variolaria* (Lam.), Sowerby, 1829 : Mineral Conchology, vol. vi, p. 76, pl. dxxxviii, fig. 3.

*Nummulites variolaria* (Sow.), d'Archiac & Haime, 1853 : Descr. Anim. groupe nummulitique Inde, vol. i, p. 146, pl. ix, figs. 13a-g.

*N. variolaria* (Lam.), De la Harpe, 1883 : Palæontographica, vol. xxx, Pal. Theil, p. 179, pl. xxxi (ii), figs. 28-36.

This is one of the most widely distributed nummulites. It occurs in Hampshire, near Brussels, Biarritz, in Hungary, Asia Minor, Kurdistan, etc. It is usually characteristic of the Middle and Upper Eocene. In Egypt it has been found in the Lower and Upper Eocene (De la Harpe).

It is fairly common in the specimen from Sinai, No. 4,112, and is associated with *N. planulata*. The characters by which one recognizes it in section are the lenticular outline and sharp peripheral edges. In the tangential aspect the sections exhibit the regularly striated shell surface. The central chamber is moderately large.

Coll. Geol. Surv. Egypt, No. 4,112, Box No. 2l. ? Bartonian Series (Upper Eocene) or ? top of Mokattam Series (Middle Eocene) : beach deposit, Jebel Abyad, Sinai. Frequent.

*Nummulites subdiscorbina*, De la Harpe. (Pl. XIII, Fig. 1.)

*Nummulites subdiscorbina*, De la Harpe, 1883 : Palæontographica, vol. xxx, Pal. Theil, p. 185, pl. xxxii (iii), figs. 8-15.

This species is not unlike *N. Guettardi*, var. *antiqua*, but differs in the greater proportionate breadth of the test; it also exhibits strongly developed double cones of tubuli at the umbilical axis. This species is relatively larger than *N. Guettardi*, var. *antiqua*.

De la Harpe states that *N. subdiscorbina* usually accompanies the larger species *N. discorbina*, but this is not the case with those of the Sinaitic limestones. The Egyptian specimens were found near Cairo, at Beni Hassan and Minieh.

Coll. Geol. Surv. Egypt, No. 4,111, Box No. 1l. Mokattam Series (Middle Eocene) : top of Jebel Abyad, south of Wadi Gharandel, Sinai. Abundant.



The group of *Nummulites Gizehensis* (Forskål), Ehrenberg.

From a zoological standpoint the various forms of nummulites so closely associated in certain beds of the Mokattam Series in Egypt and neighbouring areas, referred to under the name of *N. Gizehensis* and its varieties, are clearly local modifications of the more widely distributed *Nummulites complanata*, Lamarck. In consideration of the practical use of distinctive terms for local varieties in relation to their stratigraphical distribution, it is here proposed to retain the grouping of this series so minutely and carefully worked out by Dr. De la Harpe.

*Nummulites Gizehensis* (Forskål), Ehrenberg, var. *Ehrenbergi*,  
De la Harpe. (Pl. XIV, Fig. 15.)

*Nautilus Gyzeheensis*, Forskål, 1775: *Descriptiones Animalium*, p. 140. 1776: *Icones rerum naturalium*, etc.

*Nummulites Gyzeheensis*, Ehrenberg, 1838: *Abhandl. Akad. Wiss. Berlin*, p. 93.

*N. Gyzeheensis*, Ehr., d'Archiac & Haime, 1853: *Descr. Anim. groupe nummulitique* *Inde*, vol. i, p. 94, pl. ii, figs. 6a-f, 7a, 8.

*N. Gizehensis Ehrenbergi*, De la Harpe, 1883: *Palæontographica*, vol. xxx, Pal. Theil, p. 190, pl. xxxii, figs. 16-25; pl. xxxiii, figs. 1, 2.

This is the well-known form with the thick disc and rounded edge. The septa between each chamber are unusually thick and inclined.

This variety has been chiefly obtained from Egypt, but it has also been recorded from Sinai, Syria, Anatolia, and Vicentin. In Sinai it occurred at Wady Gharandel (Rupert Jones and Bauerman). It has also been doubtfully recorded from Biarritz.

Coll. Geol. Surv. Egypt, No. 4,163, Box No. 5l. Mokattam Series (Middle Eocene): near top of Jebel Safariat, Sinai. Several specimens.

*Nummulites Gizehensis* (Forskål), Ehrenberg, var. *Lyelli*, d'Archiac & Haime. (Pl. XIV, Fig. 14.)

*Nummulites Lyelli* (pars), d'Archiac & Haime, 1853: *Descr. Anim. groupe nummulitique* *Inde*, vol. i, p. 95, pl. iii, figs. 1a, b, 2. Fraas, 1867: *Aus dem Orient*, p. 129.

*N. Gizehensis Lyelli*, d'Archiac, De la Harpe, 1883: *Palæontographica*, vol. xxx, Pal. Theil, p. 192, pl. xxxiii (iv), figs. 3-10.

This is a large variety, and perhaps approaches the type *N. complanata* most closely. It is rather regular in outward form, and has the peripheral edge fairly sharp and thin. The septa, seen in section, run nearly straight across from whorl to whorl, especially in the later turns of the shell, instead of being arcuate and inclined, as in the variety previously mentioned. The chambers are irregularly spaced. The specimens from Sinai measure as much as 38 mm. in diameter and about 6 mm. in thickness.

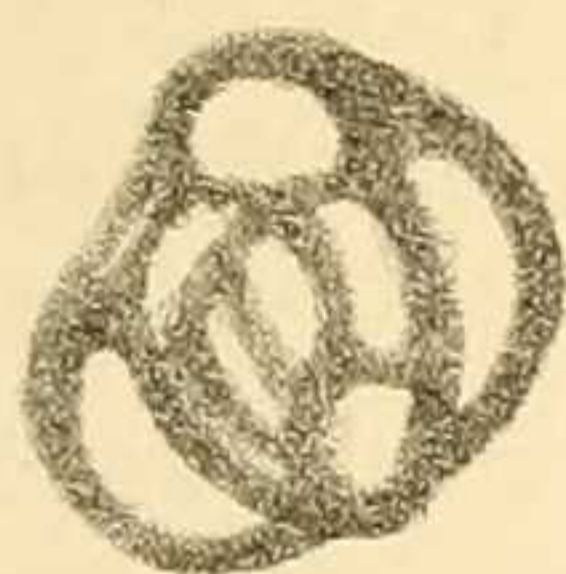
*N. Gizehensis*, var. *Lyelli*, has been recorded from Egypt, near Cairo; and from Syria, in the white limestone of Gerizhem.

Coll. Geol. Surv. Egypt, No. 4,163, Box No. 5l. Mokattam Series (Middle Eocene): near top of Jebel Safariat, Sinai. Very common.

*Nummulites Gizehensis* (Forskål), Ehrenberg, var. *Pachoi*, De la Harpe.

*Nummulites Gizehensis Pachoi*, De la Harpe, 1883: *Palæontographica*, vol. xxx, Pal. Theil, p. 193, pl. xxxiii (iv), figs. 14-18; pl. xxxiv (v), figs. 1-5.





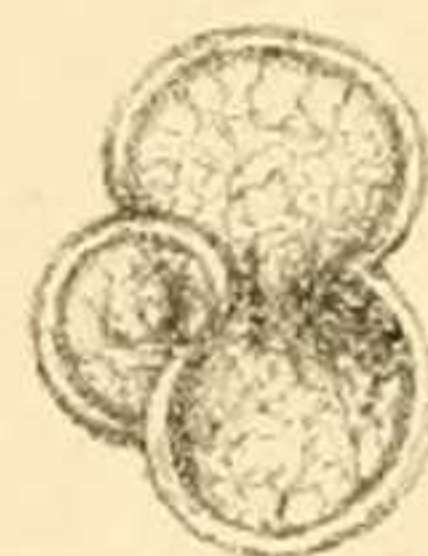
1 x 30



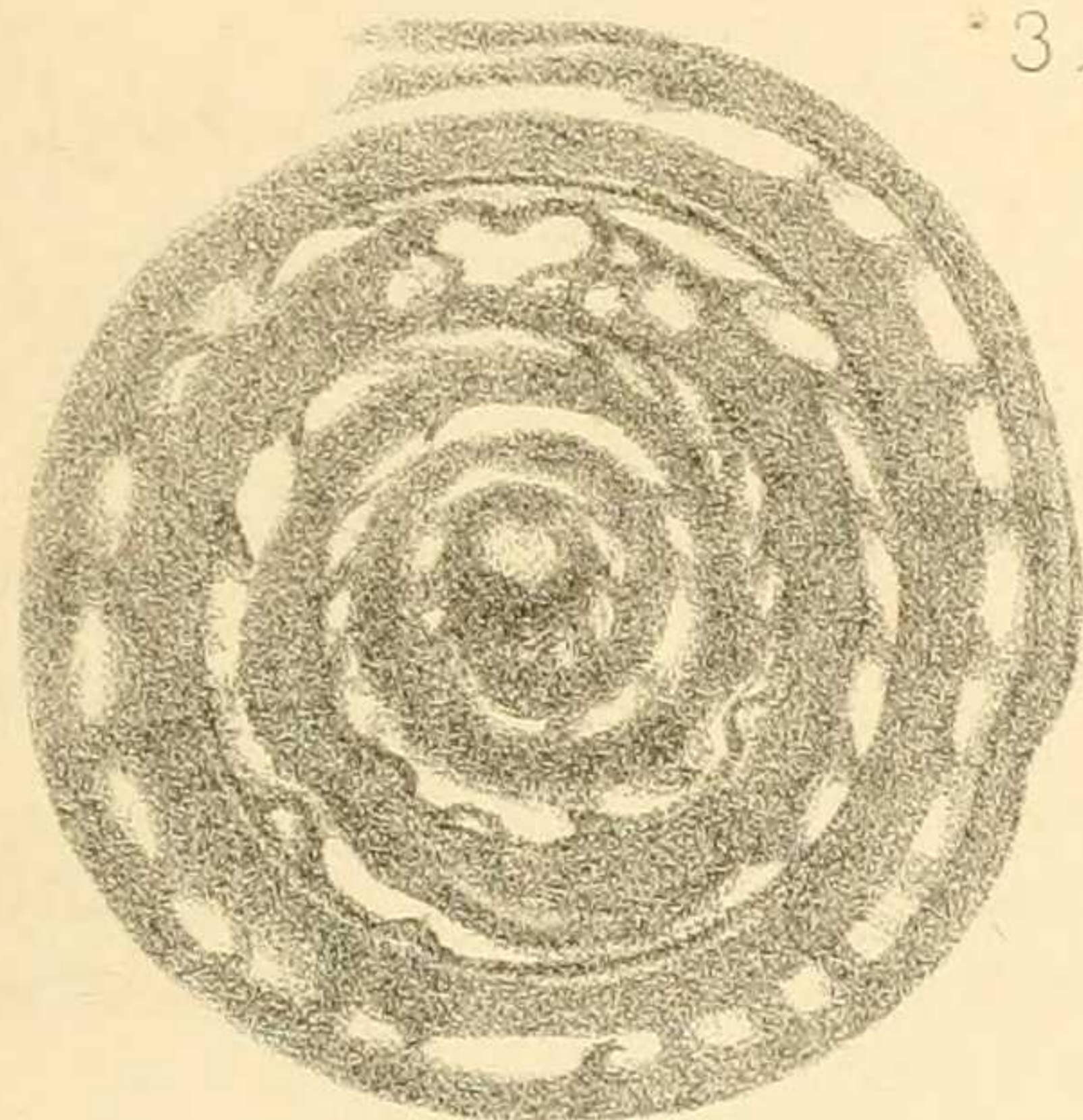
3 x 15



4 x 30



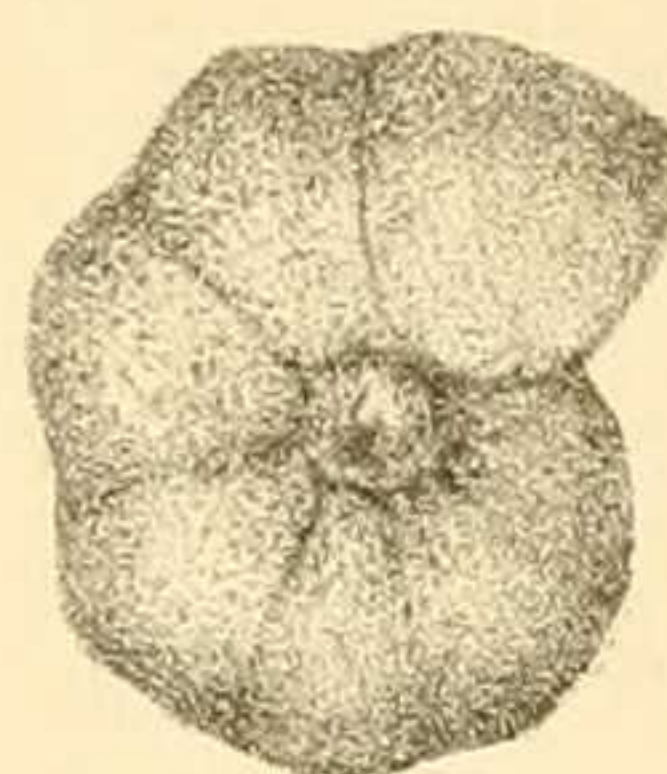
5 x 30



2 x 15



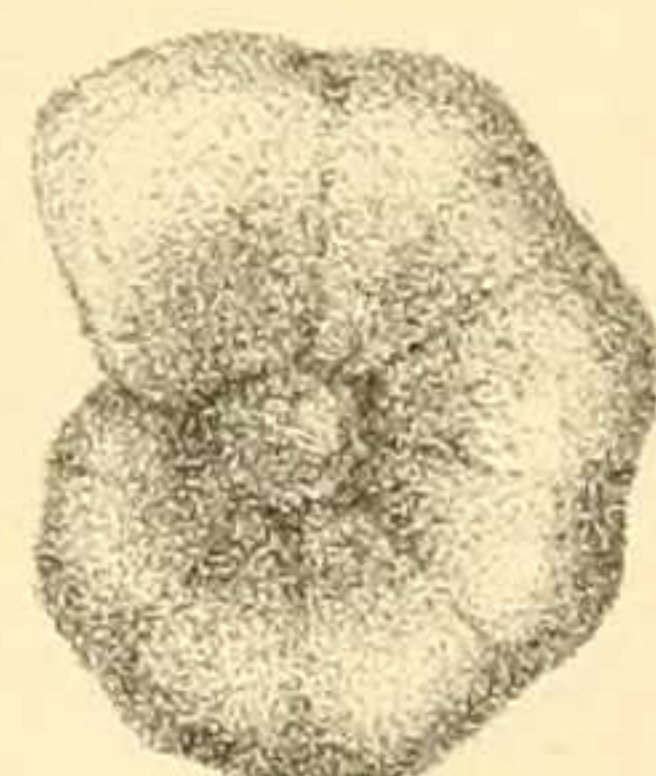
6 x 30



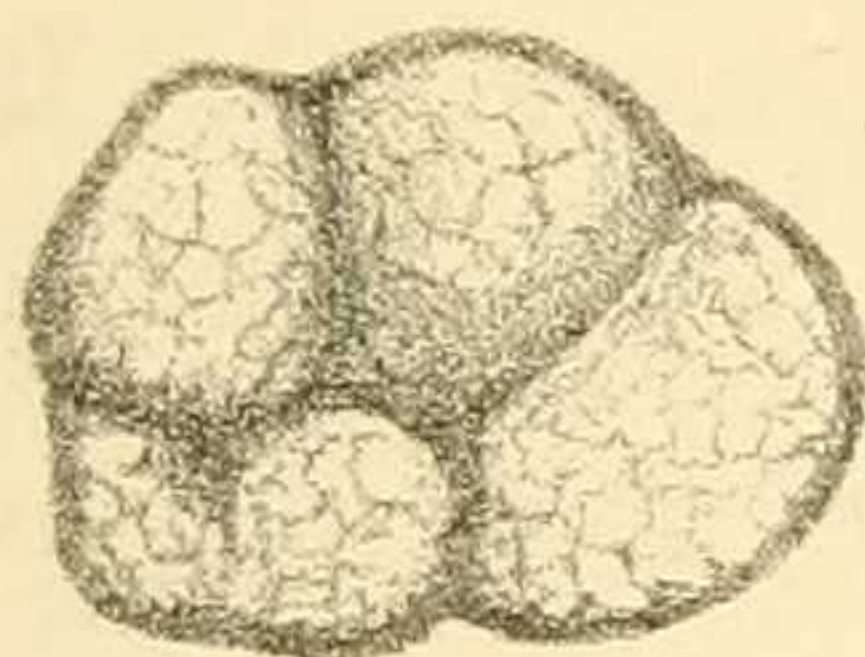
10 a x 30



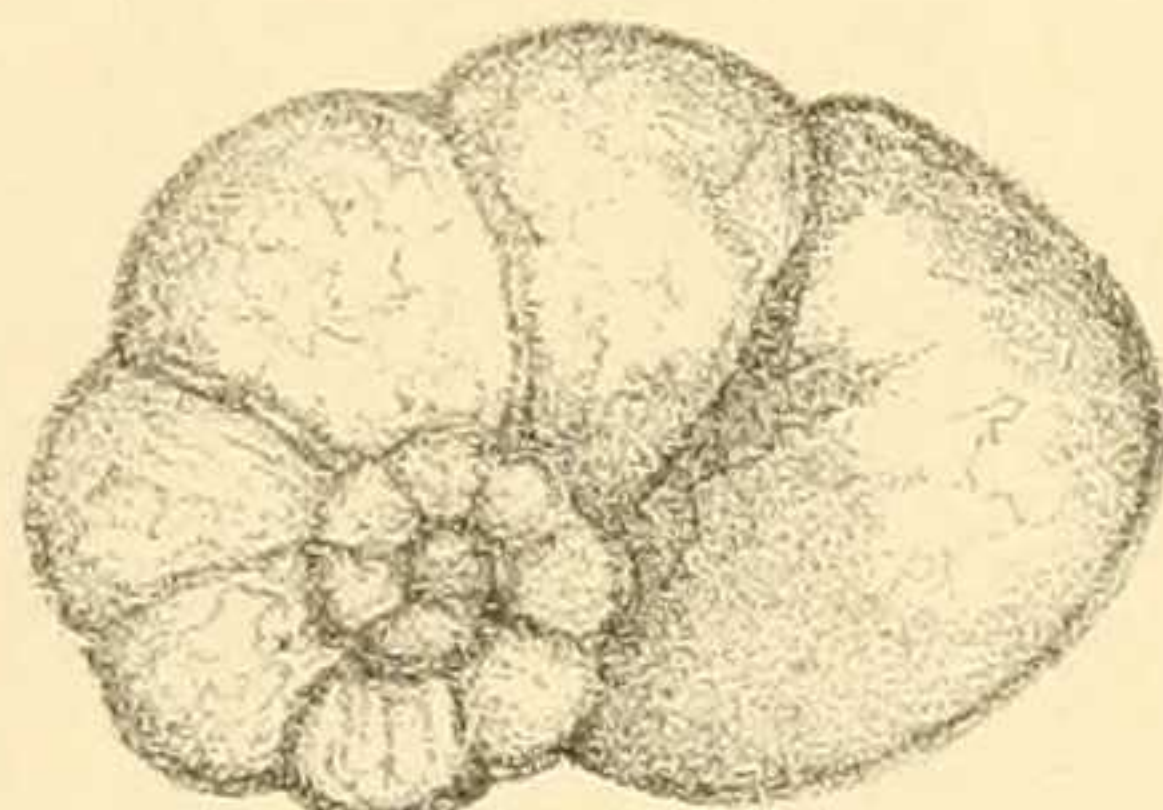
7 x 30



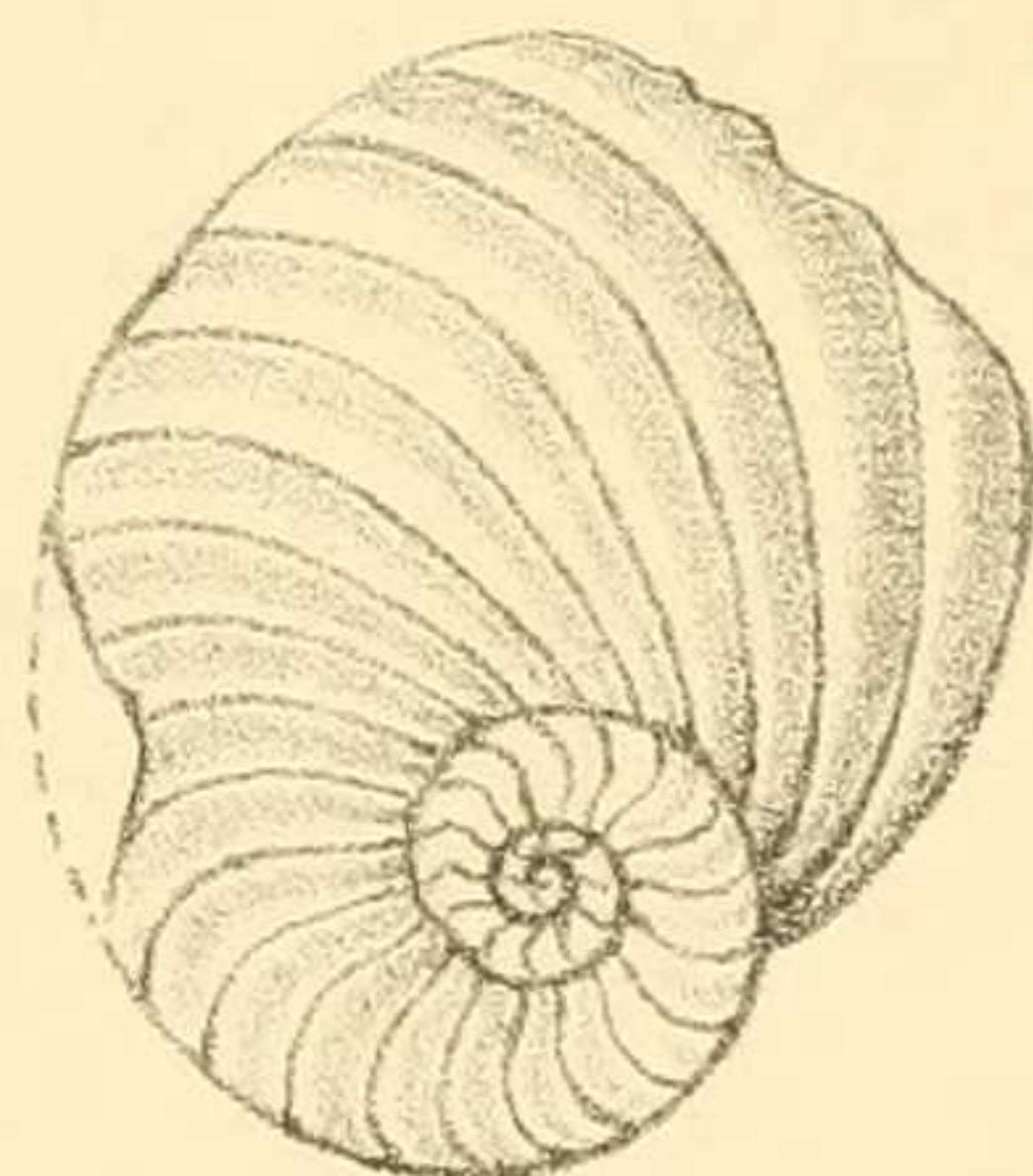
10 b x 30



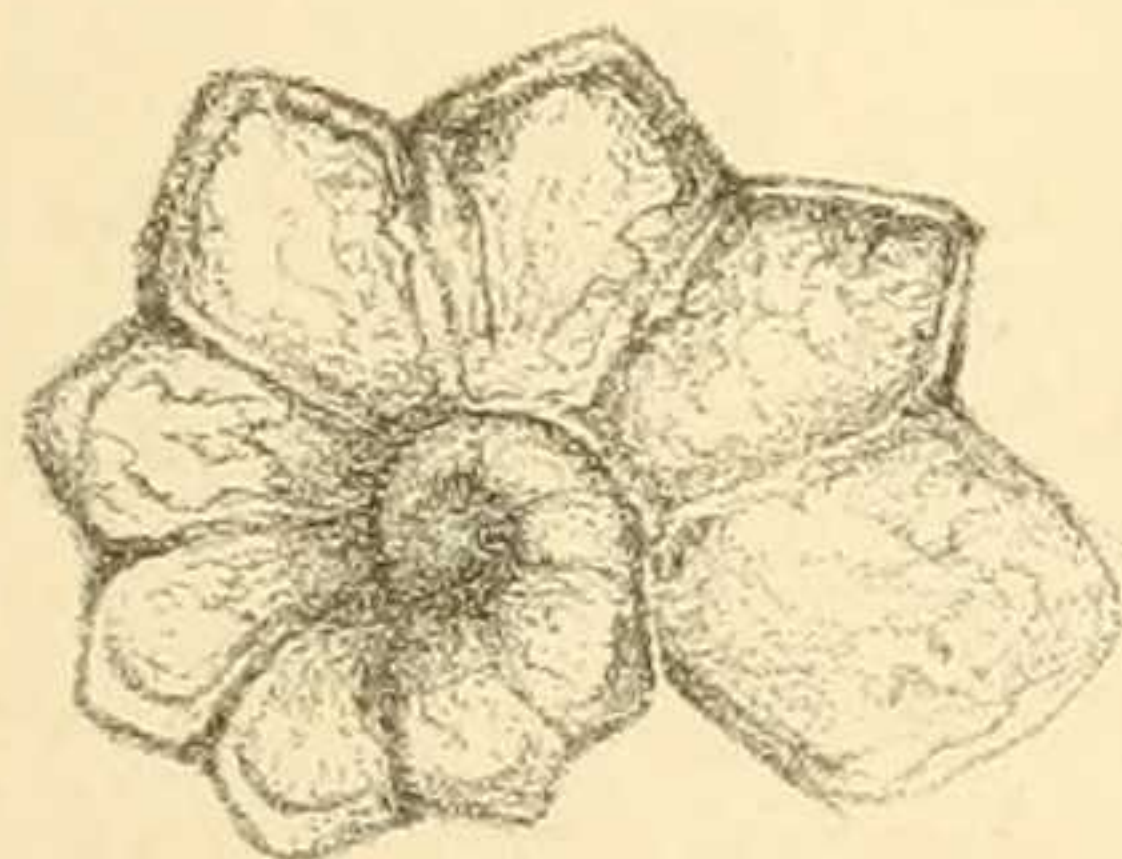
8 x 30



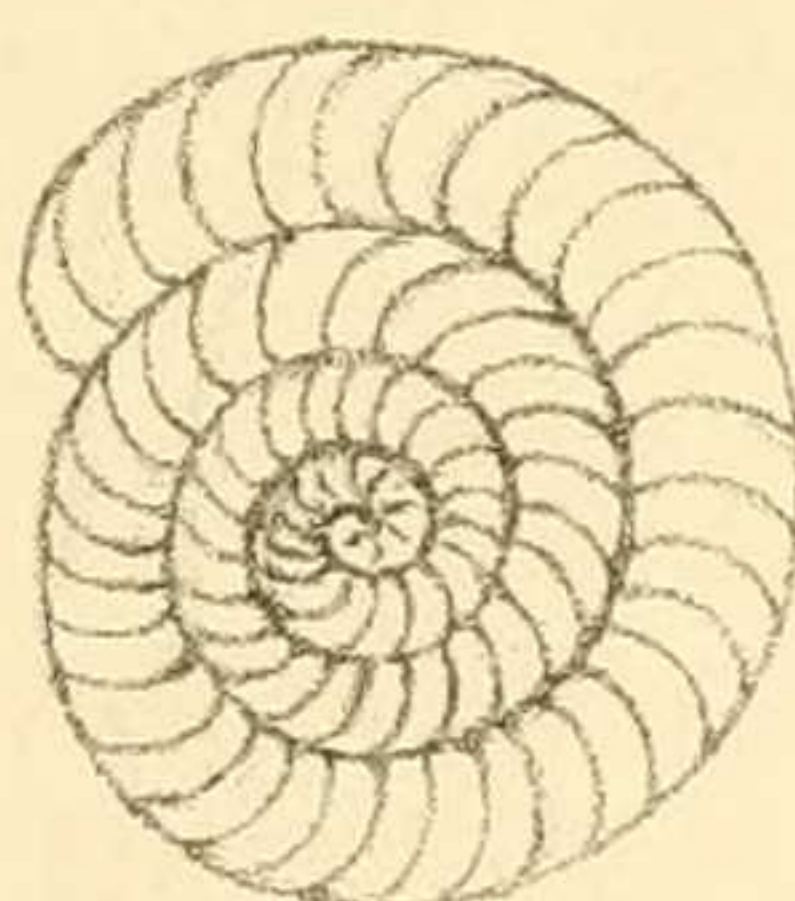
9 x 30



12 x 3



11 x 15



13 x 3



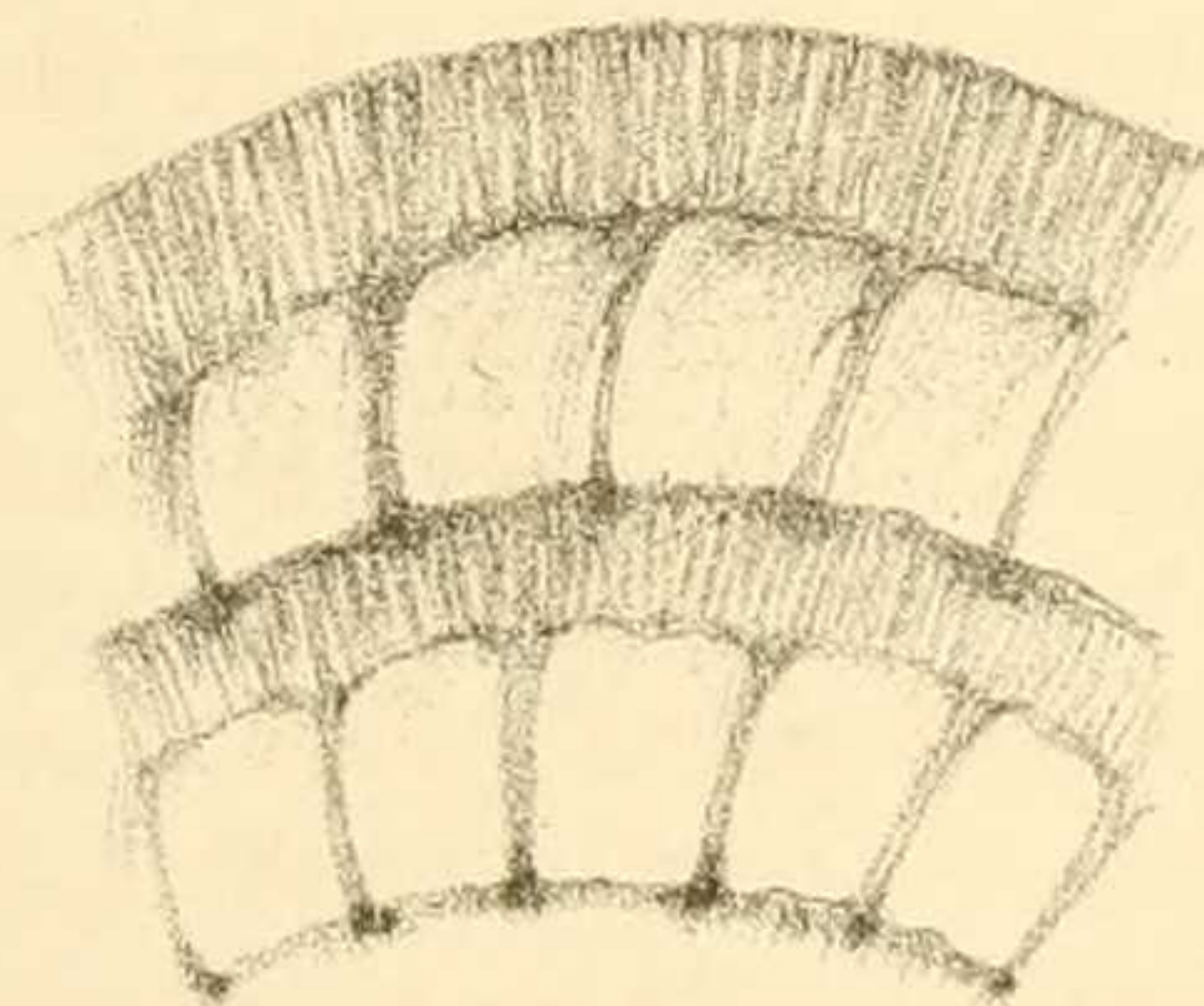
16 a x 2



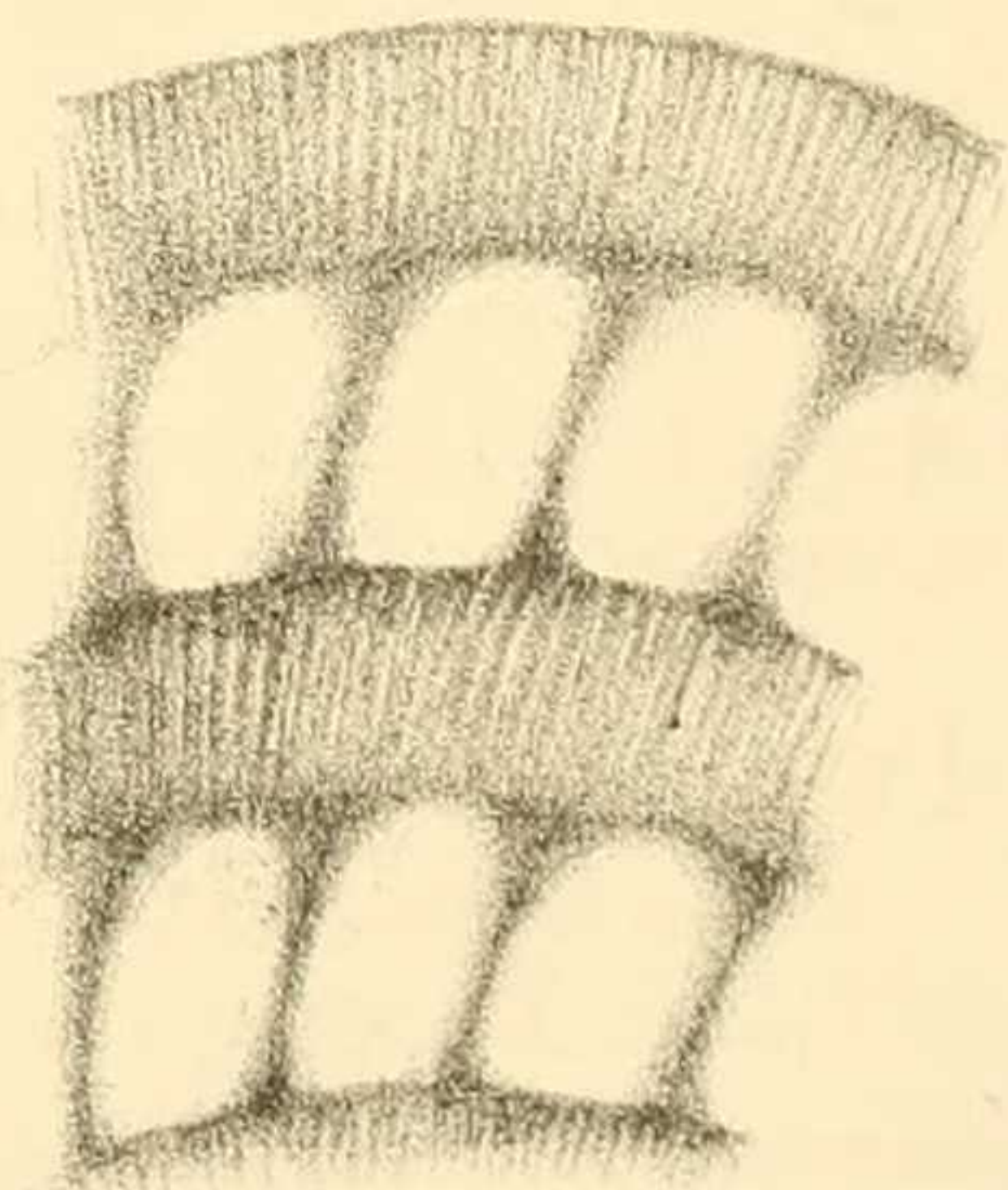
16 b x 2



16 c x 2



14 x 15



15 x 15



This variety is large, or moderately large compared with others of the same type; discoid, compressed, and with rounded, blunt, or sharp edges. The cross section shows the sides to be parallel.

De la Harpe has recorded this variety from the Pyramids of Gizeh, in the Wadi Emsid-el-Flûs, between Mêr and Farâfrah, on the Gâret-el-Dalleh, and near Rajân, between the Fajûm and Beharieh.

Coll. Geol. Surv. Egypt, No. 4,111, Box No. 11. Mokattam Series (Middle Eocene): top of Jebel Abyad, south of Wadi Gharandel, Sinai. Frequent. No. 4,163, Box No. 51. Mokattam Series (Middle Eocene): near top of Jebel Safariat, Sinai. Frequent. Also No. 3,598, Box No. 131. Mokattam Series (Middle Eocene): Wadi Khadâhid, Sinai. Frequent.

*Nummulites curvispira*, Savi & Meneghini. (Pl. XIII, Fig. 5.)

*Nummulina curvispira*, Savi & Meneghini, 1851: Consid. Geol. Toscana, p. 137.

*Nummulites curvispira* (Menegh.), d'Archiac & Haime, 1853: Deser. Anim. groupe nummulitique Ind. p. 127, pl. vi, figs. 15a-d. Fraas, 1867: Aus dem Orient, p. 130. De la Harpe, 1883: Palæontographica, vol. xxx, Pl. Theil, p. 200, pl. xxxiv (v), figs. 42-67.

This nummulite, although very variable, is generally of a flattened lenticular shape, with rounded peripheral edge, sometimes more or less sharp. In the latter feature it approaches *N. Rouaulti*, d'Arch. and Haime. Clean fresh specimens often show the flexuose striation which is characteristic of *N. Gizehensis*. The surface of specimens slightly weathered is radially or sinuously striate, with granulations sparsely scattered between them. The central chamber is usually very large, and is followed by a semilunar segment. The whorls are somewhat irregular, and there are usually six turns on a radius of 3 mm. The chambers are elongate and greatly curved.

*N. curvispira* has already been recorded from Sinai (Wadi Gharandel) by Rupert Jones. It is commonly found at most of the localities in Egypt in the Mokattam Series, at Mokattam, Gizeh, Minieh, Beni Hassan, and the Libyan Desert.

Coll. Geol. Surv. Egypt, No. 4,111, Box No. 11. Mokattam Series (Middle Eocene): top of Jebel Abyad, south of Wadi Gharandel, Sinai. Frequent. No. 3,598, Box No. 131. Mokattam Series (Middle Eocene): Wadi Khadâhid, Sinai. Very common.

*Nummulites Barroni*, sp. nov. (Pl. XIV, Figs. 16a, b, c.)

Test lenticular, swollen in the centre, hollowed near the periphery, edge quite sharp. Surface striate and sometimes feebly granulate. Average diameter, 5 mm.; thickness at the centre, 2 mm.; shell with from 4 to 5 whorls; 4 turns in a radius of 2 mm. Septa strongly arched. Central chamber subspherical and very large, one measuring .75 mm.

This species recalls *N. Rouaulti* by its general shape, but the edge is much sharper, and the thickness at the centre is greater in relative proportion to size.

The three species *N. curvispira*, *N. Rouaulti*, and *N. Barroni* are probably related, and represent a group of the megalospheric type which has a dimorphic relationship with *N. Gizehensis* and its varieties.



This species is named after Mr. T. Barron, F.G.S., who collected the specimens during his work in Sinai, January to June, 1899.

Coll. Geol. Surv. Egypt, No. 3,598, Box No. 13l. Mokattam Series (Middle Eocene): Wadi Khadáhí, Sinai. Common.

ORBITOIDES, d'Orbigny [1847].

*Orbitoides (Discocyclina) dispansa* (Sowerby). (Pl. XIII, Figs. 6c, 7c.)

*Lycophris dispansus*, Sowerby, 1837 [1840]: Trans. Geol. Soc. Lond., ser. II, vol. V, pp. 327, 718, pl. xxiv, figs. 16, 16a, b.

*Orbitoides dilabida*, Schwager, 1883: Palæontographica, vol. xxx, Pal. Theil, p. 140, pl. xxix, figs. 7a-e.

Schwager records this species under the name of *O. dilabida* from both the Libyan and the Mokattam Series of Egypt; Dr. Carter found it in Scinde, Kutch, and Arabia.

Nearly all our Sinaitic examples are slightly abraded, as if rolled by current agency, and in one of the specimens, No. 4,112, of later age, they are quite fragmentary.

Coll. Geol. Surv. Egypt, No. 4,111, Box No. 1l. Mokattam Series (Middle Eocene): top of Jebel Abyad, south of Wadi Gharandel, Sinai. Frequent. No. 4,112, Box No. 2l. (Derived)? Bartonian Series (Upper Eocene) or? top of Mokattam Series (Middle Eocene): beach deposit, Jebel Abyad, Sinai. Rare, broken. No. 3,902, Box No. 15l. Libyan Series (Lower Eocene): Jebel Krer, Sinai. Common.

*Orbitoides (Discocyclina) papyracea* (Boubée).

*Nummulites papyracea*, Boubée, 1832: Bull. Soc. géol. France, ser. II, p. 445.

*Orbitoides (Discocyclina) papyracea* (Boubée), Gümbel, 1868 [1870]: Abhandl. M. ph. Cl. k. bayer. Ak. Wiss., vol. x, p. 690, pl. iii, figs. 3-12, 19-29.

*O. papyracea* (Boubée), Schwager, 1883: Palæontographica, vol. xxx, Pal. Theil, p. 139.

*O. nudimargo*, Schwager, 1883: op. cit., p. 139, pl. xxix, figs. 8a-e.

The specimens in the Sinaitic limestones show every deviation between the forms figured by Schwager as *O. nudimargo* and ordinary specimens of *O. papyracea*, which sometimes have a slightly thicker test. Our examples are seen in section and are generally more or less fragmentary.

*O. papyracea* has been found in both the Libyan and Mokattam Series in Egypt.

Coll. Geol. Surv. Egypt, No. 4,111, Box No. 1l. Mokattam Series (Middle Eocene): top of Jebel Abyad, south of Wadi Gharandel, Sinai. Frequent. No. 3,902, Box No. 15l. Libyan Series (Lower Eocene): Jebel Krer, Sinai. Rare.

*Orbitoides (Discocyclina) ephippium* (Schlotheim).

*Lenticulites ephippium*, Schlotheim, 1820: Die Petrefactenkunde, p. 89.

*Orbitoides (Discocyclina) ephippium* (Schlotheim), Gümbel, 1868 [1870]: Abhandl. m. ph. Cl. k. bayer. Ak. Wiss., vol. x, p. 696, pl. iii, figs. 15, 16, 38, 39.

*Orbitoides ephippium* (Schlotheim), Schwager, 1883: Palæontographica, vol. xxx, Pal. Theil, p. 139.

A few characteristic examples of the above species occur in our sections. It was recorded by Schwager from the Mokattam Series of Egypt.



Coll. Geol. Surv. Egypt, No. 4,111, Box No. 11. Mokattam Series (Middle Eocene): top of Jebel Abyad, south of Wadi Gharandel, Sinai. Rare, somewhat fragmentary.

SPECIES DESCRIBED IN THIS PAPER.

1. *Miliolina circularis* (Bornemann). Libyan Series: Jebel Krer.
2. *Alveolina Bosei* (Defrance). Libyan Series: Jebel Krer.
3. *A. decipiens*, Schwager. Libyan Series: Jebel Krer.
4. *Textularia agglutinans*, d'Orbigny. Libyan Series: junction of Wadi Baba and Wadi Shellál.
5. *Bigenerina nodosaria*?, d'Orb. Libyan Series: Jebel Krer.
6. *Bolivina punctata*?, d'Orb. Mokattam Series: Jebel Abyad.
7. *Globigerina bulloides*, d'Orb. Bartonian or top of Mokattam Series: Jebel Abyad.
8. *G. conglobata*, Brady. Mokattam Series: Jebel Abyad.
9. *G. cretacea*?, d'Orb. Mokattam Series: Jebel Abyad. Also Libyan Series: Jebel Krer.
10. *Discorbina rugosa* (d'Orb.). Mokattam Series: Jebel Abyad.
11. *D. globularis* (d'Orb.). Mokattam Series: Jebel Abyad.
12. *Truncatulina umbonifera* (Schwager). Mokattam Series: Wadi Khadáhid.
13. *Rotalia calcariformis* (Schwager). Mokattam Series: Jebel Abyad.
14. *Operculina complanata* (Defrance), var. *canalifera*, d'Archiac. Libyan Series: junction of Wadi Baba and Wadi Shellál; Jebel Krer.
15. *O. complanata*, var. *discoidea*, Schwager. ? Bartonian or top of Mokattam Series: Jebel Abyad.
16. *Heterostegina depressa*, d'Orb. Libyan Series: Jebel Krer.
17. *Nummulites planulata* (Lamarck). ? Bartonian or top of Mokattam Series: Jebel Abyad.
18. *N. Guettardi*, d'Arch. & Haime, var. *antiqua*, De la Harpe. Libyan Series: Jebel Krer.
19. *N. Ramondi*, Defrance. Libyan Series: junction of Wadi Baba and Wadi Shellál.
20. *N. Heberti*, d'Arch. & Haime. ? Bartonian or top of Mokattam Series: Jebel Abyad. Also Libyan Series: Jebel Krer.
21. *N. variolaria* (Lamarck). ? Bartonian or top of Mokattam Series: Jebel Abyad.
22. *N. subdiscorbina*, De la Harpe. Mokattam Series: Jebel Abyad.
23. *N. Gizehensis* (Forskál), var. *Ehrenbergi*, De la Harpe. Mokattam Series: Jebel Safariat.
24. *N. Gizehensis*, var. *Lyelli*, d'Arch. & Haime. Mokattam Series: Jebel Safariat.
25. *N. Gizehensis*, var. *Pachoi*, De la Harpe. Mokattam Series: Jebel Abyad; Jebel Safariat; Wadi Khadáhid.
26. *N. curvispira*, Savi & Meneghini. Mokattam Series: Jebel Abyad; Wadi Khadáhid.
27. *N. Barroni*, sp. nov. Mokattam Series: Wadi Khadáhid.
28. *Orbitoides dispansa* (Sow.). ? Bartonian or Mokattam Series: Jebel Abyad. Libyan Series: Jebel Krer.
29. *Orbitoides papyracea* (Boubée). Mokattam Series: Jebel Abyad. Libyan Series: Jebel Krer.
30. *O. ephippium* (Schlotheim). Mokattam Series: Jebel Abyad.

EXPLANATION OF PLATE XIII.

FIG. 1.—*Nummulites subdiscorbina*, De la Harpe. Mokattam Series: in nummulitic limestone top of Jebel Abyad, Sinai. No. 4,111.  $\times 16$ .

FIG. 2a.—*Nummulites planulata* (Lam.). { ? Bartonian or ? Mokattam Series: in  
FIG. 2b.—*N. variolaria* (Lam.). { foraminiferal limestone, Jebel Abyad,  
Sinai. No. 4,112.  $\times 12$ .

FIGS. 3a, 4a.—*Operculina complanata* (Defr.), var. *canalifera*, d'Archiac. }

FIGS. 3b, 4b.—*Nummulites Ramondi*, Defrance. }  
Libyan Series: in dolomitized foraminiferal limestone, junction of Wadi  
Baba and Wadi Shellál, Sinai. Nos. 4,135 and 4,113.  $\times 16$ .

FIG. 5.—*Nummulites curvispira*, Savi & Meneghini. Wadi Khadáhid, Sinai.  
No. 3,598.  $\times 4\frac{1}{2}$ .



FIGS. 6, 7.—Libyan Series: foraminiferal limestone, Jebel Krer, Sinai. No. 3,902.  
 6a, *Alveolina Boscii* (Defrance); 6b, *Nummulites Guettardi*, d'Arch.  
 and Haime, var. *antiqua*, De la Harpe; 6c, 7c, *Orbitoides dispansa* (Sow.);  
 7a, *Heterostegina depressa*, d'Orb.; 7b, *Bigenerina? nodosaria*, d'Orb.  
 × 16.

#### EXPLANATION OF PLATE XIV.

- FIG. 1.—*Miliolina circularis* (Bornemann). Transverse section. Libyan Series: Jebel Krer, Sinai. No. 3,902. × 30.  
 FIG. 2.—*Alveolina decipiens*, Schwager. Transverse section. Libyan Series: Jebel Krer, Sinai. No. 3,902. × 15.  
 FIG. 3.—*Textularia agglutinans*, d'Orb. Longitudinal section. Libyan Series: junction of Wadi Baba and Wadi Shellál, Sinai. No. 4,113. × 15.  
 FIG. 4.—*Bolivina punctata?*, d'Orb. Longitudinal, peripheral section. Mokattam Series: Jebel Abyad, Sinai. No. 4,111. × 30.  
 FIG. 5.—*Globigerina bulloides*, d'Orb. Section of test. Mokattam Series: Jebel Abyad, Sinai. No. 4,111. × 30.  
 FIG. 6.—*Globigerina conglobata*, Brady. Section of test. Mokattam Series: Jebel Abyad, Sinai. No. 4,111. × 30.  
 FIG. 7.—*G. cretacea?*, d'Orb. Section of test. Mokattam Series: Jebel Abyad, Sinai. No. 4,111. × 30.  
 FIG. 8.—*Discorbina globularis* (d'Orb.). Section of test. Mokattam Series: Jebel Abyad, Sinai. No. 4,111. × 30.  
 FIG. 9.—*D. rugosa* (d'Orb.). Section of test. Mokattam Series: Jebel Abyad, Sinai. No. 4,111. × 30.  
 FIGS. 10a, b.—*Truncatulina umbonifera* (Schwager). Mokattam Series: Wadi Khadáhí, Sinai. No. 3,598. × 30.  
 FIG. 11.—*Rotalia calcariformis* (Schwager). Section of test. Mokattam Series: Jebel Abyad, Sinai. No. 4,111. × 15.  
 FIG. 12.—*Operculina complanata* (Defrance), var. *canalifera*, d'Archiac. Libyan Series: junction of Wadi Baba and Wadi Shellál, Sinai. No. 4,135. × 3.  
 FIG. 13.—*O. complanata* (Defr.), var. *discoidea*, Schwager. ? Bartonian or ? Mokattam Series: Jebel Abyad, Sinai. No. 4,112. × 3.  
 FIG. 14.—*Nummulites Gizehensis* (Forskål), var. *Lyelli*, d'Archiac & Haime. Section on the fifth and sixth whorls. Mokattam Series: Jebel Safariat, Sinai. No. 4,163. × 15.  
 FIG. 15.—*Nummulites Gizehensis* (Forskål), var. *Ehrenbergi*, De la Harpe. Section on the eleventh and twelfth whorls. Mokattam Series: Jebel Safariat, Sinai. No. 4,163. × 15.  
 FIGS. 16a, b, c.—*Nummulites Barroni*, sp. nov. 16a, superficial aspect of test; 16b, edge view; 16c, median section. Mokattam Series: Wadi Khadáhí, Sinai. No. 3,598. × 2.

#### NOTICES OF MEMOIRS.

THE MUSEUMS ASSOCIATION: ELEVENTH ANNUAL MEETING, CANTERBURY, JULY 9-12, 1900. President, Henry Woodward, LL.D., F.R.S., F.G.S., V.P.Z.S., P. Pal. Soc., of the British Museum (Natural History); Treasurer, Alderman W. H. Brittain, J.P., F.R.G.S. (Museum, Sheffield); General Secretary, E. Howarth, F.R.A.S., F.Z.S. (Museum, Sheffield).

THIS useful and deservedly successful Association—supported by the presence of the Right Rev. the Bishop of Dover; the Very Rev. the Dean of Canterbury; the Rev. Canon Routledge; the Worshipful the Mayors of Canterbury and of Dover; the Deputy-Mayor, Mr. Alderman Mason, J.P.; by F. Bennett-Goldney, Esq. (Hon. Curator of the Royal Museum, Canterbury); Mr. Sebastian Evans, M.A., LL.D.; Mr. Stephen Horsley,



# THE GEOLOGICAL MAGAZINE

OR,  
*Monthly Journal of Geology.*

WITH WHICH IS INCORPORATED

“THE GEOLOGIST.”

EDITED BY

HENRY WOODWARD, LL.D., F.R.S., F.G.S., &c.

ASSISTED BY

ROBERT ETHERIDGE, F.R.S. L. & E., F.G.S., &c.,

WILFRID H. HUDLESTON, M.A., F.R.S., F.L.S., F.G.S., &c.,

GEORGE J. HINDE, Ph.D., F.R.S., F.G.S., &c., AND

HORACE BOLINGBROKE WOODWARD, F.R.S., F.G.S.

---

AUGUST, 1900.

---

## C O N T E N T S.

### I. ORIGINAL ARTICLES.

PAGE

1. On the Fauna of the Upper Cassian Zone in Falzarego Valley, South Tyrol. By M. M. OGILVIE GORDON, D.Sc. .... 337
2. The Geology of Bad Nauheim and its Thermal Salt-Springs. By A. VAUGHAN JENNINGS, F.L.S., F.G.S. (With six Illustrations.) .. 349
3. Foraminiferal Limestones from Sinai By FREDERICK CHAPMAN, A.L.S., F.R.M.S. (Plates XIII and XIV.) Concluded from p. 316 ..... 367

### II. NOTICES OF MEMOIRS.

PAGE

- Museums Association: Eleventh Annual Meeting, Canterbury, July 9–12, 1900. Presidential Address by Dr. H. Woodward, F.R.S. .... 374

### III. REVIEWS.

1. Eighth International Geological Congress: Paris, August, 1900. 378
2. Dr. J. W. Gregory's Catalogue of Fossil Bryozoa. Vol. I..... 380

### IV. CORRESPONDENCE.

- Mr. J. G. Goodchild, F.G.S.... 381

### V. OBITUARY.

- John Young, LL.D., F.G.S. .... 382

LONDON: DULAU & CO., 37, SOHO SQUARE.



THE  
GEOLOGICAL MAGAZINE

OR,

*Monthly Journal of Geology:*

WITH WHICH IS INCORPORATED

“THE GEOLOGIST.”

NOS. CCCCXXVII TO CCCCXXXVIII.

EDITED BY

HENRY WOODWARD, LL.D., F.R.S., F.G.S., F.Z.S., F.R.M.S.,

OF THE BRITISH MUSEUM OF NATURAL HISTORY;

PRESIDENT OF THE PALÆONTOGRAPHICAL SOCIETY,

VICE-PRESIDENT OF THE ZOOLOGICAL AND MALACOLOGICAL SOCIETIES;

MEMBER OF THE LYCEUM OF NATURAL HISTORY, NEW YORK; AND OF THE AMERICAN PHILOSOPHICAL  
SOCIETY, PHILADELPHIA; HONORARY MEMBER OF THE YORKSHIRE PHILOSOPHICAL SOCIETY;

OF THE GEOLOGISTS' ASSOCIATION, LONDON; OF THE INSTITUTION OF MINING AND

METALLURGY, LONDON; OF THE GEOLOGICAL SOCIETIES OF EDINBURGH,

GLASGOW, HALIFAX, LIVERPOOL, AND SOUTH AFRICA; CORRESPONDING

MEMBER OF THE GEOLOGICAL SOCIETY OF BELGIUM; OF THE

IMPERIAL SOCIETY OF NATURAL HISTORY OF MOSCOW; OF

THE NATURAL HISTORY SOCIETY OF MONTREAL;

AND OF THE MALACOLOGICAL

SOCIETY OF BELGIUM.

ASSISTED BY

ROBERT ETHERIDGE, F.R.S. L. & E., F.G.S., F.C.S., &c.

WILFRID H. HUDLESTON, M.A., F.R.S., F.G.S., F.L.S., F.C.S.

GEORGE J. HINDE, PH.D., F.R.S., F.G.S., &c.

AND

HORACE BOLINGBROKE WOODWARD, F.R.S., F.G.S., &c.

NEW SERIES. DECADE IV. VOL. VII.

JANUARY—DECEMBER, 1900.

L O N D O N :

MESSRS. DULAU & CO., 37, SOHO SQUARE.

1900.