

CARBONIFEROUS FORAMINIFERA OF WESTERN AUSTRALIA, WITH DESCRIPTIONS OF NEW SPECIES.

By WALTER HOWCHIN, F.G.S.

[Read August 6, 1895.]

Plate X., figs. 1-8.

Some time ago I asked Mr. H. P. Woodward, Government Geologist of Western Australia, if he could procure any material of Carboniferous age that was likely to contain microzoa. Not having any of the argillaceous shales on hand, he kindly sent me a few brachiopod shells of this age which contained a little soft matrix in their interiors. Small as was the amount of material thus obtained, it has yielded three species of foraminifera which are of more than ordinary interest, not only as undescribed forms, but they are amongst the firstfruits of an old fauna in the Palæontology of Australia, of which we know but little at present.

The shells from which the material was gathered were obtained by Mr. Woodward from the Carboniferous shales of the Irwin River, about 200 miles north of Perth. With regard to these beds Mr. Woodward says—"The Lower Carboniferous outcrops upon the Irwin River, where there are a series of shales, fire-clays, sandstones, and limestones, with coal-seams. This formation extends north in a narrow strip to the Lyons River."*

The only other locality in Australia where foraminifera of this age are known to occur is in the Permo-Carboniferous Rocks of Tasmania,† but the species of the two localities, so far as recognised, are distinct.

The Western Australian material came to hand shortly before the Adelaide meeting of the Australian Association for the Advancement of Science, and the writer was able to report the occurrence and generic positions of these foraminifera in a paper read before the Association on "A Census of the Fossil Foraminifera of Australia."‡ For remarks on the distinctive features of the Australian Carboniferous foraminifera, as compared with

* Geolog. Mag. Dec. IV., vol. I., p. 545, Dec., 1894.

† "The Occurrence of Foram. in the Permo-Carb. Rocks of Tasmania," W. Howchin, Report of Fifth Meeting of Aus. Asso. for Adv. of Science, Adelaide, 1893, p. 344, pl. X., XI.

‡ *Op. cit.*, p. 348.

those of presumably the same age in the Northern Hemisphere, see the article just mentioned.

In addition to the forms described in this paper, there is also present in the material a parasitic organism of doubtful relationship. It is not clear from the few examples obtained whether the object belongs to the foraminifera or annelida. This is held over for further investigation.

CORNUSPIRA SCHLUMBERGI, *sp. nov.* Pl. x., figs. 1-3.

Ref.—*Cornuspira Schlumbergi*, How., MS., Report of Fifth Meeting of Aus. Ass. for Adv. of Science, Adelaide, 1893, p. 366.

Test discoidal, flat or biconvex, convoluted; consisting of a non-septate tube, slightly increasing in diameter, but with varying dimensions. Initial end of chamber spherical, and of greater diameter than the tube. Convolution, about five in number, more or less asymmetrical, particularly in the earlier growth. Test-walls investing, each successive whorl enclosing all the preceding by alar extensions over the lateral surfaces of the shell. Periphery rounded, and somewhat irregular in outline. Septation obscured exteriorly by lamination of shell-walls, except near the orifice, where a sutural depression is visible for about half the length of the final convolution. Transverse section of tube round, or with slight vertical compression. Aperture formed by the open end of tube, more or less constricted at vent.

Diameter, $\frac{1}{40}$ in.

This is an interesting species, and diverges from the normal characteristics of the genus in two particulars—the irregular coiling of the earlier convolutions of the tube, and also in the lamination of the test-walls. The former of these features is subject to considerable variation. Some transparent sections show but slight divergencies of the spiralline arrangement of the chamber from one plane, whilst in others the tube has apparently coiled upon itself at almost right angles, as shown in fig. 3, plate x. Again, unlike other members of the genus, there is a complete investment of the earlier convolutions by successive layers of shell substance, obscuring the septation, and giving the shell a lenticular outline in transverse section. The irregular coiling of the tube in this species makes it isomorphic with *Ammodiscus gordialis* (P. & J.) in the arenaceous series. The duplication of the test-walls is a still more eccentric feature of this species. The thickening of the test in the umbilical region is produced, not by an excrescence of shell substance, which not unfrequently occurs in certain species of foraminifera, but by an extension of the lateral flaps of the chambers in a similar manner to the nummulitic method of growth. This is shown in the transparent section, fig. 2, plate x.

In the lamination of the shell-walls, the present species shows a closer likeness to the genus *Planispirina* than *Cornuspira*, but the absence of segmentation in the chamber cavity fixes its position with the last-named genus.

Representatives of this genus have been observed in most geological formations of Europe, dating from the Lias, and it also occurs in rocks of Permo-Carboniferous age in Tasmania.*

It affords me much pleasure to associate the name of Mons. Schlumberger of Paris with this interesting species, not only because the transparent sections of this form now figured were kindly supplied by this eminent specialist, but the author has been laid under repeated obligation for services he has cheerfully rendered towards the working out and determination of obscure species.

NODOSARIA IRWINENSIS, *sp. nov.* Pl. x., fig. 7-8.

Ref.—*Nodosaria* species, Report of Fifth Meeting of the Aus. Ass. for Adv. of Science, Adelaide, 1893, p. 366.

Test elongate, straight or very slightly arcuate, tapering. Segments about eight in number. The shell either slightly inflated near the centre or gradually increasing in size. Chambers of greater width than length. Sutural lines straight, thick, and slightly depressed. Surface of test ornamented with numerous, closely set, longitudinal, and continuous costæ.

Length, $\frac{1}{3}$ in.

This is a Nodosarian of very short length, narrow chambers, banded sutures, and finely costated surface. It does not appear to agree with any previously described species. A finely ribbed Nodosarian shell has been figured from the Permian of Durham by Mr. T. Rupert Jones† and the late Dr. H. B. Brady,‡ and referred by the latter to *Nodosaria (Dentalina) multicostata*, d'Orb. But this is a very different species from the one now described, being markedly dentaline, with subglobular chambers that rapidly increase in size with the stages of growth. Messrs. Jones and Parker have also figured§ two fragments of a costated Nodosarian from the Triassic beds of Chellaston, near Derby, which are referred by the author to *N. lineolata*, Reuss. This is, however, a much larger shell than the one found in the R. Irwin beds, and has elongated elliptically-shaped chambers. The broad banded constrictions which mark the septation in

* *Op. cit.*, vol. V., p. 344.

† *Dentalina Kingii*, Monograph of the Permian Fossils of England, by W. King, Palæontog. Soc., 1850, pl. vi., figs. 2, 3.

‡ Monograph of Carboniferous and Permian Foraminifera, by H. B. Brady, Palæontog. Soc., 1876, pl. x., fig. 19.

§ Quart. Jour. Geo. Soc., vol. XVI. (Nov., 1860), pl. xix., figs. 11, 12.

N. Irwinensis may be compared with a similar feature in *N. vertebralis*, Batsch.; but the examples now under consideration do not exhibit the transparent shell substance in the septal bands which gives the vertebral appearance to Batsch's species. How far this feature may have been modified by age in the Western Australian species it is impossible to say. In other respects there is but slight similarity between the two species.

The genus *Nodosaria* (including *Dentalina*) is but sparingly represented in rocks of Palæozoic age. In Brady's "Monograph of the Permian and Carboniferous Foraminifera"* only three species are recorded, and the whole of these belong to the Permian or newest member of the division. A true *Nodosaria* was discovered by the present writer in one of the minor limestones of the lower Carboniferous series of Northumberland,† and a member of the same genus occurs in the Permo-Carboniferous rocks of Tasmania.‡ In the Carboniferous Limestone of the Northern Hemisphere its place seems to be taken by *Nodosinella*, a group of foraminifera with finely arenaceous tests, and which in form are to some extent isomorphic with the hyaline *Nodosariæ* of newer formations.

FRONDICULARIA WOODWARDI, *sp. nov.*

Ref.—*Frondicularia* species, Report of Fifth Meeting of the Aus. Ass. for Advancement of Science, Adelaide, 1893, p. 366.

Test elongate, tapering, compressed, and subject to considerable variation in external form. Oral end broad, rounded, and regularly curved. Aboral extremity obtusely pointed. Peripheral margins rounded. Segments from seven to ten in number, gradually increasing in size, acutely arched. Final chamber relatively large, inflated, and lobulated. Sutures flush, marked by clear shell substance. Length of shell equals twice or three times the breadth.

Length of fine example, $\frac{1}{30}$ in.

This pretty little shell somewhat resembles *Frondicularia complanata*, Defr., but differs from that species in its elongate contour, fewer chambers, and conspicuous final segment. The segmentation is also less acute, particularly in the later chambers, which approach to a regular curve. A somewhat similar example to our species was figured by Messrs. Jones and Parker§ from the Upper Trias of Chellaston, Derbyshire. The authors referred to designate the form figured by them as a "variety" of *Frondicularia complanata*, Defr., but without further description. The

* Palæontographical Society, vol. XXX., 1876, pl. x., figs. 6-19.

† Jour. Royal Microscopic Society, 1888, part IV., plate ix., fig. 21.

‡ Report of Fifth Meeting Aus. Ass. for Adv. of Science, Adelaide, 1893, p. 347.

§ Quart. Jour. Geo. Soc., vol. XVI. (Nov., 1860), pl. XIX., fig. 19.

reasons which have led me to distinguish the present species from the one described by DeFrance have already been stated. I have great pleasure in recognising the services of Mr. H. P. Woodward, F.G.S., Government Geologist of Western Australia (to whom I am indebted for the material that has supplied the foraminifera described in the present paper), by naming the present species after one who has done much valuable pioneer work in a country which, geologically, is but imperfectly known.

Until the present discovery the occurrence of *Frondicularia* in the Chellaston beds, referred to above, was the earliest record for the genus. The Western Australian examples carry the geological history of the genus back to the Upper Palæozoic.

TWO NEW SPECIES OF CRETACEOUS FORAMINIFERA.

By WALTER HOWCHIN, F.G.S.

[Read August 6, 1895.]

Plate X., figs. 9-13.

The southern limit of the great Cretaceous formations of Central Australia passes a little south of Hergott Springs on the main North line, 441 miles from Adelaide. At Hergott two bores, 150 yards apart, have been put down by the S.A. Government, and in No. 2 Bore a very strong artesian spring has been tapped. The beds passed through in these operations, and which in No. 2 Bore extend to a depth of 342 feet, appear to be of marine origin throughout. They consist of dark-colored mud shales and thin limestones. The section is only sparingly fossiliferous, and the foraminifera are relatively scarce. The material, however, being soft, and in a very fine state of division, can be easily reduced by washing and the microzoa concentrated. Fifty-six species in all have been noted from the bore material. A description of the microzoa of No. 1 Bore will be found in the Transactions of this Society, vol. VIII., p. 79; and a list of the foraminifera observed in No. 2 Bore has been given in "A Census of the Fossil Foraminifera of Australia," Aus. Ass. for Adv. of Science, vol. V., p. 362.

HAPLOPHRAGMIUM AUSTRALIS, *sp. nov.* Pl. x., figs. 12-13.

Ref.—*Haplophragmium australis*, How., M.S., Report of Fifth Meeting of Aus. Asso. for Adv. of Science, Adelaide, 1893, p. 364.

Test free, elongate, crozier shaped; earlier chambers plano-spiral, later chambers linear. Spiral portion compressed, exca

tion between the substance of the test walls and the confused shelly deposits, or even in some cases where the well-defined walls terminate and the irregular deposits begin. It would seem that the habit of the genus to produce secondary shell substance and irregular chamberlets has in the present species found its extreme development. The reticulated superficial layer appears to be a rudimentary form of "the external or reticulated chamber-layer," which is more definitely developed in the European Cretaceous species, *P. lenticularis*, Carter. The range of variation in the external form of this species is very considerable; at times it forms a symmetrical cone, but more frequently the habit of growth is marked by sudden inflation or contraction of the test as shown in fig. 9.

The geological range of the genus, so far as known, dates from the Carboniferous Limestone,* but it was during the Cretaceous and Eocene periods that it reached its greatest development, not only in size, but in the range of its species and the complex structure of its investment. Since the early Tertiary period it has gradually declined until in the present day it is only represented by one or two minute and degenerate species.

About a dozen examples were found in No. 2 Bore at Hergott, at a depth of 140-150 feet.

It is with much pleasure that I name the present species after J. W. Jones, Esq., Conservator of Water, under whose direction this very successful bore was carried out, and to whose courtesy and ready assistance I have been indebted for the material obtained from this as well as other Government borings.

EXPLANATION OF PLATE X.

Figs. 1-3.—*CORNUSPIRA SCHLUMBERGI*, *sp. nov.*

1. Lateral aspect.
2. Transparent, transverse section showing lamination of test walls.
3. Transparent, horizontal section showing irregular coiling of the chambers.

Figs. 4-6.—*FRONDICULARIA WOODWARDI*, *sp. nov.*

4. Opaque, lateral aspect. *a.* End view of same.
5. Opaque, lateral aspect of a short and broad variety.
6. Transparent, horizontal section.

Figs. 7, 8.—*NODOSARIA IRWINENSIS*, *sp. nov.* Lateral aspects of two average specimens.

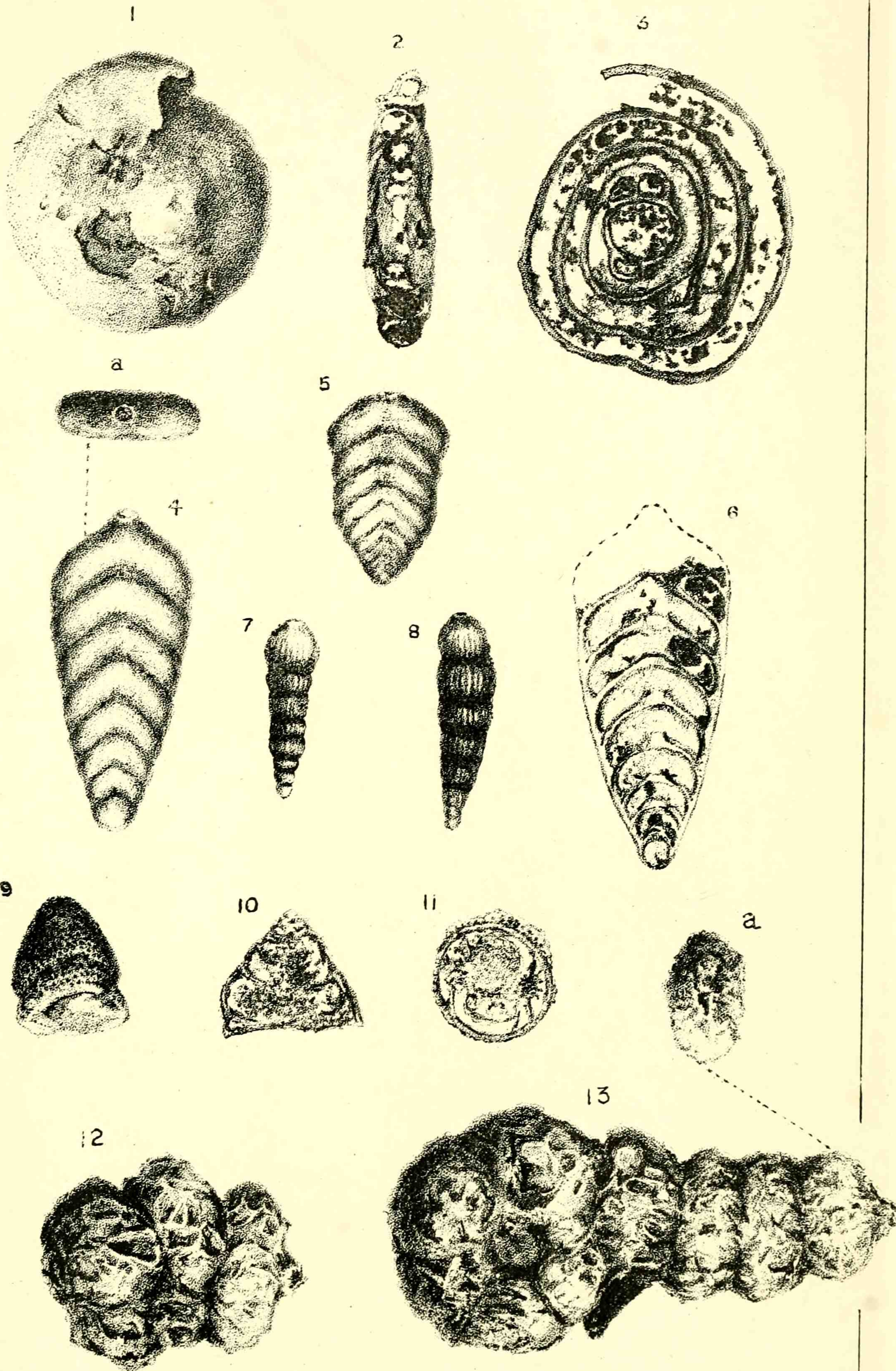
Figs. 9-11.—*PATELLINA JONESI*, *sp. nov.*

9. Lateral view.
10. Transparent, vertical section.
11. Transparent, transverse section.

Figs. 12, 13.—*HAPLOPHRAGMIUM AUSTRALIS*, *sp. nov.*

12. Few-chambered specimen.
13. Example showing rectilinear growth. *a.* Oral view of same.

* Carboniferous Foram., by W. Howchin, Jour. Roy. Micro. Soc., Aug., 1888.



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