12.—*Foraminifera and Ostracoda from the Upper Cretaceous of Need's Camp, Buffalo River, Cape Province.*—By Frederick Chapman, A.L.S., F.R.M.S., etc.

With two Plates, XIV, XV, and Text-figure.

Some little time since, I was favoured by Dr. L. Péringuey, Director of the South African Museum, with samples of fossiliferous rock from both the Upper and Lower Quarries at Need's Camp, Buffalo River, with the request that I should examine them for microzoa.

Although the material did not promise to yield a large number of the smaller organisms other than the polyzoa, after a lengthy search a small but interesting series was obtained, the results of an examination of which are now given.

LIMESTONE FROM THE UPPER QUARRY.

General Characters.—This rock is a fairly compact polyzoal limestone with a crystalline matrix (see Text-figure 18). The polyzoa forming the rock constitute about 50 per cent. of the whole, and there are a few foraminiferal tests present. These can only be examined in thin sections of the rock, owing to the compact structure of the limestone, which prevents the extraction of the small shells by fracture or pulverisation.

The following Foraminifera were met with in thin slices of this rock:

Miliolina *cf.* circularis, Bornemann sp.

Sections cut in various directions point to a comparison with this species. It is a shallow water form, and has an extensive geological range.

Miliolina *cf.* ferussacii, d'Orb. sp.

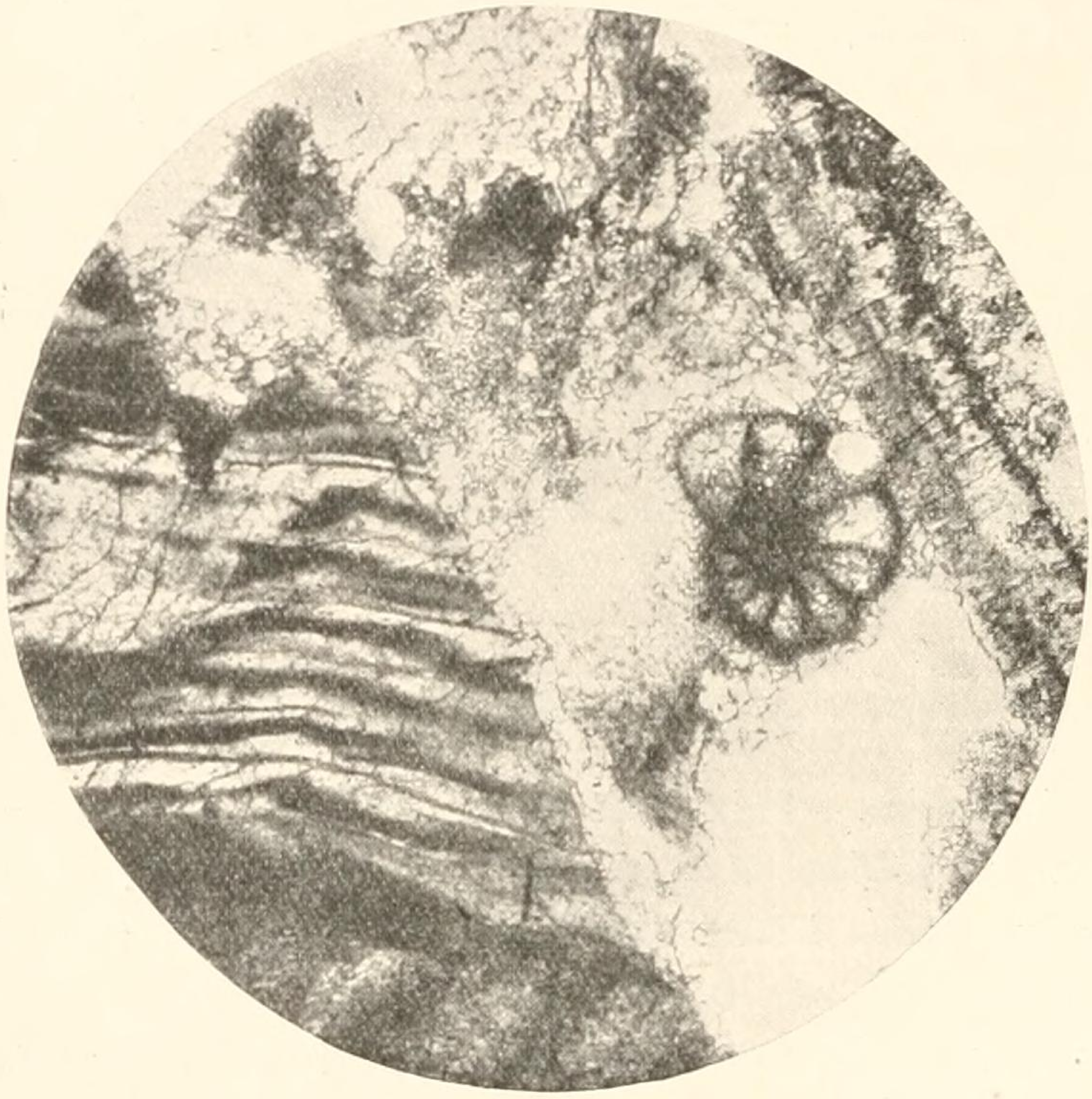
An oblique section of what appears to be the test of this or a related species occurs in the limestone. The chambers are evidently arranged on the quinqueloculine plan. Foraminifera of this type are found in all deposits ranging from the Lias to Recent.

TEXTULARIA *cf.* GRAMEN, d'Orbigny.

The test is thin, arenaceous, and the septa alternate and strongly arched. The aboral end shows no tendency towards the spiral arrangement as in *Spiroplecta*, so that the above reference to d'Orbigny's textularian species seems most applicable. A widely distributed form.

Cf. ANOMALINA sp.

A thin-walled shell in median section of a form common in shallow water sands of Cretaceous and Tertiary times (see Text-figure 18).



F. C. Photo.

FIG. 18.—Thin slice of limestone from the Upper Quarry, Need's Camp, Buffalo River, showing fine-grained calcitic matrix with Polyzoa and Foraminifera (*cf.* Anomalina sp.). × 28 diameters.

PULVINULINA sp. (of the *P. elegans* group).

Vertical and tangential sections. The test shows redundant shell-growth, as in some Cretaceous forms.

THE MICROZOA FROM THE LIMESTONE OF THE NEED'S CAMP LOWER QUARRY.

General Characters of the Rock.—The rock from this locality is a white, friable limestone, almost chalky in parts. Amongst the finer crushings of the rubble occasional specimens of foraminifera may be detected. Their tests are, in many cases, badly corroded, but a sufficient number of specimens could be secured to obtain the diagnostic characters for the determination of the species.

FORAMINIFERA.

Family LITUOLIDAE.

Genus HAPLOPHRAGMIUM, Reuss.

Haplophragmium neocomianum, Chapman.

(Plate XIV, fig. 1.)

Haplophragmium neocomianum, Chapman, 1894, Quart. Journ. Geol. Soc., vol. l, p. 695, pl. xxxiv, figs. 2*a*, *b*.

Idem, 1904, Annals S. African Mus., vol. iv, pt. v, p. 223; pl. xxix, fig. 1.

One well-defined specimen occurs in the limestone from Need's Camp. It has been previously recorded from the Rhaetic, Aptian, and Cretaceous beds of Europe, and more recently from the Cretaceous of Pondoland.

Family TEXTULARIIDAE.

Genus SPIROPLECTA, Ehrenberg.

Spiroplecta anceps, Reuss sp.

(Plate XIV, figs. 3, 4.)

Textularia anceps, Reuss, 1845, Verstein. d. böhm. Kreideform., vol. i, p. 39, pl. viii, fig. 79; pl. xiii, fig. 2.

Idem, 1860, Sitz. d. k. Akad. Wiss. Wien, vol. xl, p. 234, pl. xiii, figs. 2*a*, *b*.

Spiroplecta anceps, Rss. sp., Chapman, 1892, Journ. R. Micr. Soc., p. 751, pl. xi, fig. 6.

This species is perhaps the most abundant foraminifer in the Need's Camp limestone. It is subject to great variation. Some of the short and wide forms resemble *S. gramen*, d'Orb. sp., but for their more numerous septation. In the majority of cases the spiroplectine commencement is almost concealed, as in fig. 3; whilst in others it is partially unrolled and conspicuous, as in fig. 4.

S. anceps is a well-known Cretaceous species, occurring in the Chalk of England, Westphalia, and Bohemia, and in the Gault of Folkestone.

Spiroplecta anceps, Reuss sp., var. infracta, var. nov.

(Plate XIV, fig. 5.)

Description.—Test formed in two stages, the first with an inconspicuous spiroplectine commencement and a short textularian series, as in *S. anceps*, from which proceeds an irregularly septate and coarsely formed test with rougly dentate margins.

Total length, 1·175 mm.; length of primary test, 0·351 mm.; width of test at oral extremity, 0·675 mm.

Spiroplecta deflata, sp. nov.

(Plate XIV, fig. 2.)

Description.—The test of this species is rather irregularly constructed of arenaceous particles, but the general plan of structure can be made out, especially when moistened; it then shows the textularian series with chambers much deflated and with a rude spiral series at the aboral end of the test.

Two specimens were found, of nearly equal size. The figured specimen has a length of ·919 mm.

This species bears the same relationship to *S. praelonga*, Reuss sp.* that *Gaudryina dispansa*, Chapman † does to *G. pupoides*, d'Orb.

Family NODOSARIIDAE.

Genus NODOSARIA, Lamarck.

Nodosaria zippei, Reuss.

(Plate XIV, figs. 6, 7.)

Nodosaria zippei, Reuss, 1845, Verstein. böhm. Kreideform., pt. i, p. 25, pl. viii, figs. 1–3.

N. zippei, Rss., Chapman, 1904, Annals S. African Mus., vol. iv, pt. v, p. 226, pl. xxix, fig. 6. (For further references see that article.)

The present examples are fragmentary but show sufficient characters to justify their reference to the above species. The costation is rather close and more numerous than is generally the case with the European

* *Textularia praelonga*, Reuss. Verstein. böhm. Kreideform., vol. i, 1845, p. 39, pl. xii, fig. 14.

† Journ. Roy. Micr. Soc., 1892, p. 753, pl. xi, figs. 10*a*, *b*.

Chalk specimens; although Reuss figures one example more comparable with the present in this respect.

N. zippei is recorded from the chalk of Bohemia, Westphalia, the Upper Bavarian Alps, Maestricht, and the Isle of Rügen; also from the Gault (Albian) of France and England, and in the Cambridge Greensand (Albian in part).

NODOSARIA SULCATA, Nilsson.

(Plate XIV, fig. 8.)

Nodosaria sulcata, Nilsson, 1825 (1826), K. Vet. Ak. Handl., p. 341.
Idem, 1827, Petrif. Suecana, p. 8, pl. ix, figs. 1*a*, *A*, *B* (error for 19).
N. sulcata Nilsson, Hisinger, 1837, Lethaea Svecica, p. 33, pl. x, figs. 4*a*, *b*.
Reuss, 1845, Verstein. böhm. Kreideform., pt. i, p. 26, pl. xiii, fig. 17,
Idem, 1855, Zeitschr. deutsch. geol. Gesellsch., vol. vii, p. 269, pl. viii. fig. 14*b*.
Sherborn and Chapman, 1889, Journ. Roy. Micr. Soc., p. 486, pl. xi, fig. 24.
Egger, 1899, Abhandl. k. bayer. Akad. Wiss., Cl. ii, vol. xxi, Abth. i, p. 75, pl. viii, fig. 24.

This is a form resembling the more extensively ranging *Nodosaria obliqua*, L. sp., but with the striate-costate ornament disposed vertically instead of obliquely. It is almost essentially an Upper Chalk species, but has also been found in the Lower Tertiary (London Clay).

The Cretaceous localities for this form are the Chalk of the Paris Basin, Lemberg, Rügen, the Upper Bavarian Alps, and Bohemia.

GENUS CRISTELLARIA, Lamarck.

CRISTELLARIA PARALLELA, Reuss.

(Plate XIV, fig. 9.)

Cristellaria parallela, Reuss, 1862 (1863), Sitzungsb. d. k. Akad. Wiss. Wien, vol. xlvi, p. 67, pl. vii, figs. 1, 2*a*, *b*.
Berthelin, 1880, Mém. Soc. Geol. France, ser. 3, vol. i, Mém. v, p. 56.
Chapman, 1894, Quart. Journ. Geol. Soc., vol. l, p. 712.
Idem, 1894, Journ. Roy. Micr. Soc., p. 647, pl. ix, figs. 5*a*, *b*.

This elongate and parallel-sided variation of the *C. crepidula* type is well known from Cretaceous strata. It has occurred in the Lower Greensand (Aptian) of Surrey, also in the Gault (Albian) of Folkestone, France and Germany.

Cristellaria intermedia, Reuss.

(Plate XV, fig. 10.)

Cristellaria intermedia, Reuss, 1845, Verstein. böhm. Kreideform., pt. i, p. 33, pl. xiii, figs. 57, 58 ; pt. ii, p. 108, pl. xxiv, figs. 50, 51.
Alth, 1850, Haidinger's Naturw., Abhandl. iii (ii), p. 267, pl. xiii, fig. 23.

An interesting species of the vaginuline or compressed forms of *Cristellaria*, but having acute, or even keeled, margins. This is typically a Cretaceous form, found in the Lemberg and Bohemian Chalk; variations of this species have been recorded by Reuss * from the Greensand (Cenomanian) of New Jersey, and by Deecke † from the Oxfordian of Montbeliard, France. In the former the test is inflated and the segments higher as in Reuss' *C. planiuscula*, whilst the latter has the series of chambers more closely inrolled.

Cristellaria secans, Reuss.

(Plate XV, figs. 11*a*, *b*.)

Cristellaria secans, Reuss, 1860, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xl, p. 214, pl. ix, figs. 7*a*, *b*.

Cristellariae of the above type, with prominent and parallel sutural ribs, are fairly common in the washings of the limestone from the Lower Quarry, but in many cases so corroded that they can only be generally identified as probably belonging to this species. The figured specimen is a good example of Reuss' *C. secans*, which that author found in the Gault Clay of the Rhine. A variety of this species, *angulosa*, has also occurred in the Folkestone Gault.

Family ROTALIIDAE.

Genus DISCORBINA, Parker and Jones.

Discorbina pileolus, d'Orbigny sp.

(Plate XV, figs. 13*a*, *b*.)

Valvulina pileolus, d'Orbigny, 1839, Foram. Amér. Mérid., p. 47, pl. i, figs. 15–17.
Discorbina pileolus, d'Orb. sp., Parker and Jones, 1865, Phil. Trans.,

* Sitzungsb. d. k. Ak. Wiss. Wien, vol. xliv, 1861 (1862), p. 336, pl. viii, figs. 2*a*, *b*.

† Mém. Soc. d'Emulation de Montbeliard, vol. xvi, 1886, p. 30, pl. ii, figs. 19, 19*a*.

vol. clv, p. 385; Brady, 1884, Rep. Chall., vol. ix, p. 649, pl. lxxxix, figs. 2–4; Chapman, 1894, Quart. Journ. Geol. Soc., vol. l, p. 719; Idem, 1896, Journ. Roy. Micr. Soc., p. 591, pl. xiii, figs. 14*a*, *b*.

The figured specimen is practically identical with those of the Cretaceous and Neocomian in England. It is also found in Tertiary strata, and persists to the present day.

Genus TRUNCATULINA, d'Orbigny.

Truncatulina schloenbachi, Reuss sp.

(Plate XV, figs. 12*a*, *b*.)

Rosalina schloenbachi, Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, Abth. i, p. 87, pl. xi, figs. 5*a–c*.

Discorbina schloenbachi, Reuss sp., Egger, 1899, Abhandl. k. bayer. Akad. Wiss., Cl. ii, vol. xxi, Abth. i, p. 164, pl. xviii, figs. 19–21.

Chapman, 1904, Annals S. Afr. Mus., vol. iv, pt. v, p. 229, pl. xxix, figs. 16, 16*a*.

In some respects, as in the embracing character of the last whorl of chambers on the inferior face, this species resembles a discorbine form, but as already pointed out (see this publication, 1904, p. 230), it appears naturally to belong to the genus *Truncatulina* on account of its finely perforated or smooth test. It is a typical Cretaceous form.

Truncatulina ungeriana, d'Orbigny sp.

(Plate XV, figs. 16*a*, *b*.)

Rotalina ungeriana, d'Orbigny, 1846, Foram. Foss. Vienne, p. 157, pl. viii, figs. 16–18.

Truncatulina ungeriana, d'Orb. sp., Brady, 1884, Rep. Chall. vol. ix, p. 664, pl. xciv, figs. 9*a–c*.

Egger, 1899, Abhandl. k. bayer. Ak. Wiss., Cl. ii, vol. xxi, Abth. p. 150, pl. xix, figs. 4–6.

Chapman, 1912, Mem. Nat. Mus. Melbourne, No. 4, p. 43, pl. vi, figs. 2*a–c*.

Amongst the many modifications of this species, which ranges from the Lower Cretaceous to recent deposits, the present examples agree most nearly with the figured Chalk specimens in having a thicker test and more umbonate facial aspect.

Genus ANOMALINA, Parker and Jones.

Anomalina ammonoides, Reuss sp.

(Plate XV, fig. 14.)

Rosalina ammonoides, Reuss, 1845, Verstein. böhm. Kreidef., pt. i p. 36, pl. xiii, fig. 66; pl. viii, fig. 53.

Anomalina ammonoides, Rss. sp., Perner, 1897, Foraminifery Vrstev Bělohorských (Palaeontographica Bohemiae, No. iv), p. 72.

Chapman, 1898, Journ. Roy. Micr. Soc., p. 4, pl. i, figs. 5*a–c*. (For extended synonymy see last quoted paper.)

This species has been recorded from beds as old as the Neocomian. It is one of the commonest of Cretaceous rotalines, and is found in dredgings at the present day. The specimen before us is a perfect and well-developed shell.

Genus PULVINULINA, Parker and Jones.

Pulvinulina karsteni, Reuss sp.

(Plate XV, figs. 15*a–c*.)

Rotalia karsteni, Reuss, 1855, Zeitschr. d. deutsch. geol. Gesellsch., vol. vii, p. 273, pl. ix, fig. 6.

Pulvinulina karsteni, Rss. sp., Chapman, 1892, Quart. Journ. Geol. Soc., vol. xlviii, p. 517.

Egger, 1899, Abhandl. d. k. Akad. bayer. Wiss., Cl. ii, vol. xxi, Abth. i, p. 161, pl. xx, figs. 32–34.

A very common species in the present collection from the Lower Quarry. It is characteristically an Upper Chalk form, but is also known from the Lower Cretaceous and a few Tertiary deposits. In recent seas a more biconvex variety is known from widely separated areas, both in the northern and southern hemispheres. The specimens now dealt with are most comparable with those figured by Reuss from the Upper Cretaceous of Europe.

OSTRACODA.

Family BAIRDIIDAE.

Genus BAIRDIA, McCoy.

Bairdia subdeltoidea, Münster sp.

Cythere subdeltoidea, Münster, 1830, Jahrb. für Min. etc., p. 64, No. 13; 1835, p. 446.

Cytherina subdeltoidea, Münst. sp., Römer, 1838, Jahrb. für Min. etc., p. 517, pl. vi, fig. 16.

Reuss, 1845, Verstein. böhm. Kreideform., pt. i, p. 36, pl. v, fig. 38; pt. ii, p. 104.

Bairdia subdeltoidea, Münst. sp., Rupert Jones, 1889 (1890), Mon. Cret. Entom., Suppl. (Pal. Soc.), p. 5, pl. ii, figs. 31–34.

Examples of the above species in the Need's Camp washings exactly compare with the types figured from the Cretaceous of England and North Germany. One of the species shows a deep sinus on the ventral side of the valves similar to that figured by Rupert Jones (*loc. cit.* 1890) on pl. ii, fig. 34.

B. subdeltoidea is also met with in Tertiary strata in Europe, and a near relative is the living *B. foveolata*, G. S. Brady,* from Australia, the West Indies, Crete, Serpho, Hongkong Harbour, Admiralty Islands, etc.

Bairdia subdeltoidea, Münster sp. var. aequalis, var. nov.

(Plate XV, figs. 17*a*, *b*.)

Description.—This variety is distinguished from the type form in its more ovate shape, as seen from the side of the valve; the anterior part being less broadly rounded and the posterior extremity less prolonged. It thus comes nearer to *B. amygdaloides*, G. S. Brady,† a Miocene to Recent species.

Bairdia africana, sp. nov.

(Plate XV, figs. 19*a*–*c*.)

Description.—Carapace ovoid or pear-shaped, moderately tumid. Valves seen from the side highest above the middle, anteriorly truncately rounded towards the dorsal margin; posteriorly tapering and sub-acuminate; ventral border widely curved and with a steep face. Edge view of carapace subovate and with a steep face, thickest about the middle. End view subcordate. Surface smooth or faintly pitted.

Dimensions.—Length, ·702 mm.; height, ·439 mm.; thickness of carapace, ·358 mm.

The nearest form to the above is the before-mentioned *B. amygdaloides*, G. S. Brady, but which differs from *B. africana* in having a more salient dorsal border.

* *B. foveolata*, G. S. Brady, Les Fonds de la Mer, vol. i, 1867, p. 56, pl. vii, figs. 4–6. Id., Rep. Chall. Zool. vol. i, pt. iii, Ostracoda, 1880, p. 55, pl. viii, figs. 8*a*–*f*, and figs. 2*a*–*f*.

† Rep. Chall. tom. cit., p. 54, pl. ix, figs. 5*a*–*f*; pl. x, figs. 2*a*–*c*.

Fam. CYTHERIDAE.

Genus CYTHERE, Müller.

Cythere postcultrata, sp. nov.

(Plate XV, figs. 18*a*, *b*.)

Description.—Valve subrhomboidal, rounded in front, tapering behind to the acuminate extremity; dorsal edge straight, ventral obliquely truncated. Surface higher at the post-ventral region, and sloping away to the front and dorsal border. Near the ventral edge in the posterior region is a keel-shaped prominence curving inwards and merging into the surface about the middle of the ventral edge of the valve. Surface relieved with a few irregularly disposed pittings.

Dimensions.—Length, ·527 mm.; height, ·3 mm.; depth of valve ·08 mm.

Relationships.—There appear to be no closely related forms, either fossil or recent, with the exception of Dr. G. S. Brady's "Challenger" species, *Cythere cytheropteroides*,* a form dredged at 150 fathoms from the Cape of Good Hope. The present species, however, is more pyriform in outline.

SUMMARY OF RESULTS.

Upper Quarry.

The meagre series of Foraminifera obtained from this locality does not afford any data which can be used to decide the age of the deposit. The genera found, viz. *Miliolina*, *Textularia*, *Anomalina*, and *Pulvinulina*, are all widely distributed at the present day, and the species, where they could be determined, denote moderately shallow water conditions. Further than this, they are components of similar faunas as far back as the Cretaceous and even earlier Mesozoic strata. In thin sections the particular types of polyzoa appear to indicate a relationship to the like fauna of the Lower Quarry.

Lower Quarry.

The following list of species of Foraminifera and Ostracoda throws a decided light on the age of this bed.

Foraminifera:

Haplophragmium neocomianum, Chapm.
Spiroplecta anceps, Reuss sp.

* Rep. Chall., vol. i, Zool., pt. iii, Ostracoda, 1880, p. 78, pl. xv, figs. 5*a–d*.

Spiroplecta anceps, var. *infracta*, nov.
,, *deflata*, sp. nov.
Nodosaria zippei, Reuss.
,, *sulcata*, Nilsson.
Cristellaria parallela, Reuss.
,, *intermedia*, Reuss.
,, *secans*, Reuss.
Discorbina pileolus, d'Orb. sp.
Truncatulina schloenbachi, Reuss sp.
,, *ungeriana*, d'Orb. sp.
Anomalina ammonoides, Reuss sp.
Pulvinulina karsteni, Reuss sp.

Ostracoda:
Bairdia subdeltoidea, Münster sp.
,, ,, var. *aequalis*, nov.
,, *africana*, sp. nov.
Cythere postcultrata, sp. nov.

Amongst the Foraminifera of generally Cretaceous aspect may be noted *Haplophragmium neocomianum* and *Spiroplecta anceps.* The species which lend to the deposit an Upper Cretaceous appearance are *Nodosaria zippei* (a quite restricted form), *N. sulcata* (almost invariably Upper Cretaceous), *Cristellaria parallela*, *C. intermedia*, and *C. secans*. This latter species is in exactly the condition of growth and size as found in the typical Chalk faunas of Europe, and is one of the commonest species in the limestone from Need's Camp Lower Quarry. All the rotalines, whilst having an extensive geological range, from the Cretaceous to the present time, are typical of the Upper Cretaceous also, and their present occurrence as to size and development favours the idea of their Cretaceous age.

Of the Ostracoda only one species, *Bairdia subdeltoidea*, is available for comparison, as the remainder are new forms. The examples referred to the above-named specific form (a Cretaceous and early Tertiary species) are those of typical Cretaceous valves.

EXPLANATION OF PLATES.

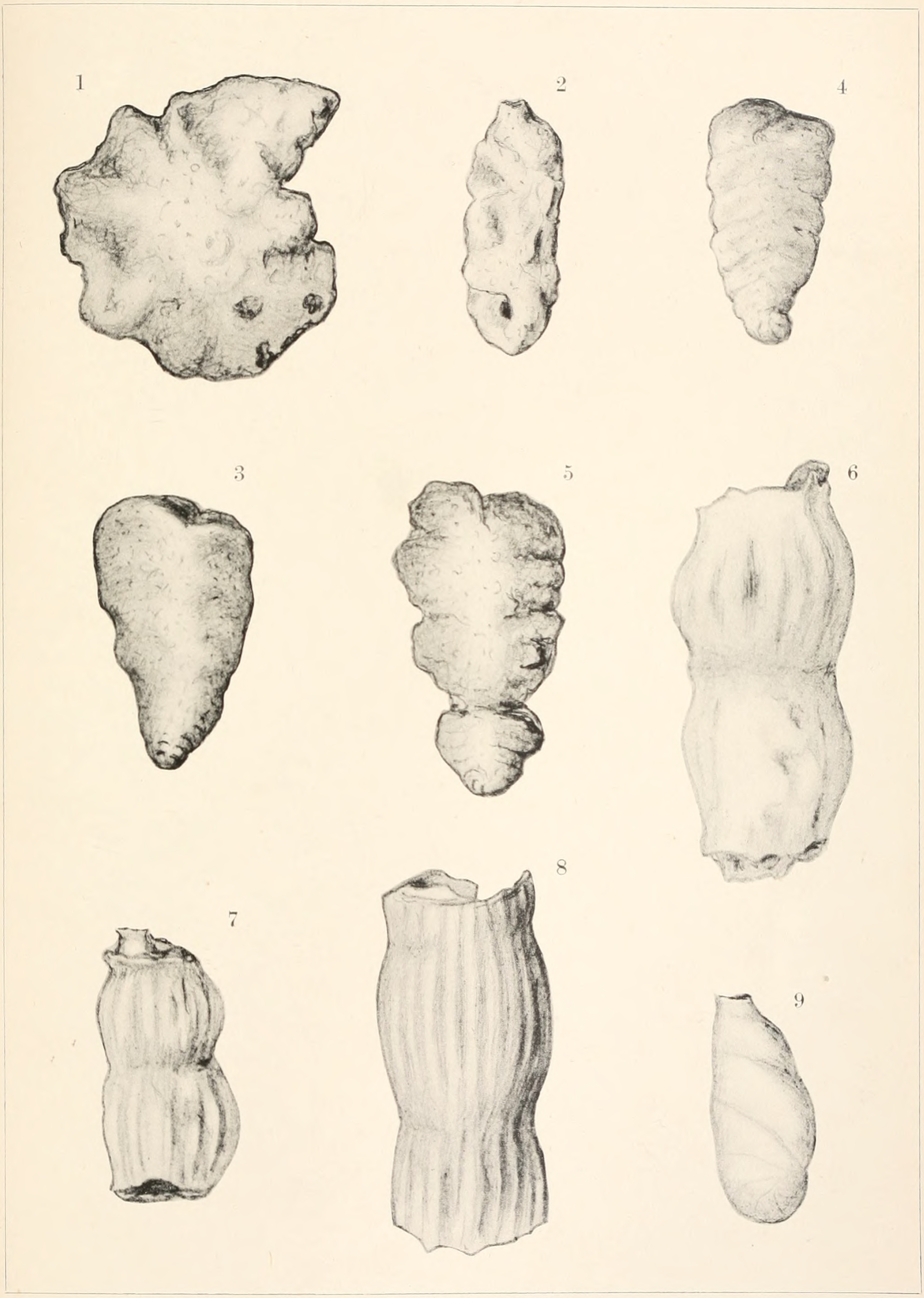
(All figures magnified 36 diameters.)

Plate XIV.

Fig. 1.—*Haplophragmium neocomianum*, Chapman.
,, 2.—*Spiroplecta deflata*, sp. nov.
,, 3.— ,, *anceps*, Reuss sp.
,, 4.— ,, ,, ,, An example with a well-developed aboral extremity.
,, 5.— ,, ,, ,, var. *infracta*, var. nov.
,, 6.—*Nodosaria zippei*, Reuss.
,, 7.— ,, ,, ,,
,, 8.— ,, *sulcata*, Nilsson.
,, 9.—*Cristellaria parallela*, Reuss.

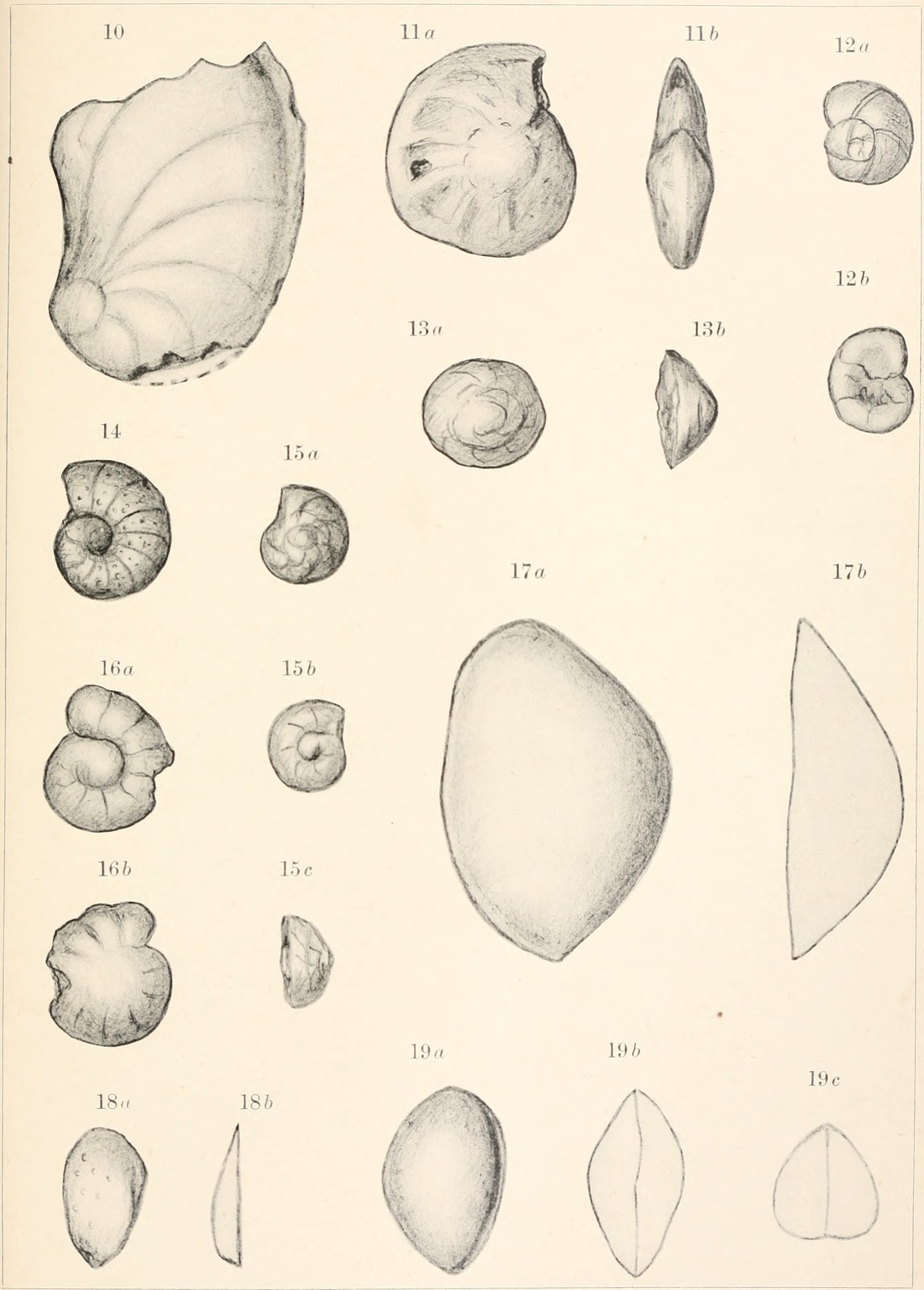
Plate XV.

Fig. 10.—*Cristellaria intermedia*, Reuss.
,, 11.— ,, *secans*, Reuss: *a*, lateral aspect; *b*, oral aspect.
,, 12.—*Truncatulina schloenbachi*, Reuss sp.: *a*, superior aspect; *b*, inferior aspect.
,, 13.—*Discorbina pileolus*, d'Orb. sp.: *a*, superior aspect; *b*, inferior aspect.
,, 14.—*Anomalina ammonoides*, Reuss sp.
,, 15.—*Pulvinulina karsteni*, Reuss sp.: *a*, superior aspect; *b*, inferior aspect; *c*, peripheral aspect.
,, 16.—*Truncatulina ungeriana*, d'Orb. sp.: *a*, superior aspect; *b*, inferior aspect.
,, 17.—*Bairdia subdeltoidea*, Münster sp., var. *aequalis*, var. nov.: *a*, left valve, lateral aspect; *b*, edge view, ventral aspect.
,, 18.—*Cythere postcultrata*, sp. nov.: *a*, carapace from right side; *b*, edge view.
,, 19.—*Bairdia africana*, sp. nov.: *a*, carapace from right side; *b*, edge view, ventral aspect; *c*, end view of carapace.



FORAMINIFERA. NEED'S CAMP, BUFFALO R.

F.C. del. Adlard & West Newman.



Foraminifera: Figs. 10–16. Ostracoda: Figs. 17–19. Need's Camp, Buffalo R.

F.C. del. *Adlard & West Newman.*

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