

TWELFTH ANNUAL REPORT
OF THE
UNITED STATES
GEOLOGICAL AND GEOGRAPHICAL SURVEY
OF
THE TERRITORIES:
A REPORT OF PROGRESS OF THE EXPLORATION IN
WYOMING AND IDAHO
FOR THE YEAR 1878.
IN TWO PARTS.
PART I.

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AND GEOGRAPHICAL SURVEY.

PART I.

GEOLOGY, PALEONTOLOGY, AND ZOÖLOGY.

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CONTRIBUTIONS TO INVERTEBRATE PALEONTOLOGY, NO. 2: CRETACEOUS FOSSILS OF THE WESTERN STATES AND TERRITORIES.

By C. A. WHITE, M. D.

The present article is a continuation of the one entitled Contributions to Invertebrate Paleontology, No. 1 (and bearing the same sub-title), which was published in the Annual Report of this Survey for 1877. The material upon which this article is based, like that which formed the basis of the former one just referred to, has been collected by different persons from Cretaceous strata, at different and widely-separated localities in the western portion of the national domain.

In connection with the establishment of this series of illustrated articles, under the general title of "Contributions to Invertebrate Paleontology," the hope was entertained that the subjects which they should involve might be treated philosophically and somewhat exhaustively; and that upon those subjects some important generalizations, both stratigraphical and zoölogical, might be based. Circumstances required the publication of the former article without an opportunity for satisfactory discussion of the subjects which properly pertained to the fossil forms described and figured therein; and the abolishment by act of Congress of this Survey, as at present organized, without affording an opportunity to pursue any further studies in the field before its publications must cease, makes it necessary to publish this material, as well as that of the two following articles, in a similarly unsatisfactory manner with that of the first. The main object of this series of articles as originally planned has therefore not been attained, but as none of the species embraced in any of them have ever before been illustrated, an important object will have been accomplished by the illustration of so considerable a number of species as is here represented by figures of typical specimens.

A part of the species embraced in this article were published in different reports of the Survey by Mr. Meek, before his death; a part of them by the writer, in the Bulletin of the Survey and the Proceedings of the National Museum; and the remainder are here published for the first time. The greater part of the fossils were collected by persons connected with this Survey, but a part of them have been sent to the office of the Survey and the National Museum by private parties. Among these are the two corals which are first noticed on the following pages, and *Pinna lakesii*, which is described on a subsequent page. These three species were included in a collection of fossils which was sent for examination to the office of the Survey by Mr. Arthur Lakes, who collected them from the Cretaceous strata on Fossil Creek, 16 miles westward from Greeley, and 6 miles southward from Fort Collins, Colo. These two corals present so conspicuously a Paleozoic facies that it is proper to call especial attention to their stratigraphical position. Mr. Lakes's known

familiarity with the geology of that region would of itself incline me to refrain from questioning the correctness of his reference of these fossils to Cretaceous strata, notwithstanding their Paleozoic aspect; but, fortunately, he has made such questioning impossible, by sending pieces of rock in which both the corals and well-known forms of Cretaceous molluscan shells are imbedded together. Besides this, I have myself visited that locality and made collections from its strata, some forms of which I recognize as of the same species as a part of those sent by Mr. Lakes. I also recognize the strata there as belonging to the lower portion of the Fox Hills Group of the Cretaceous series, as that group is developed in Colorado; and they are doubtless equivalent with a portion of the Fort Pierre Group, or Cretaceous No. 4, of the Upper Missouri River region.

Remains of the Cœlenterata are exceedingly rare in all the Cretaceous rocks of Western North America, and therefore the discovery in them of any coralline form is of more than ordinary interest; but the interest concerning these two forms is greatly increased by their evident Paleozoic affinities. Being imbedded in sandstone, the condition of their preservation is not such as to give entirely satisfactory results from their study. I have therefore referred them provisionally to Paleozoic genera, because, in their visible characteristics, they correspond more nearly with those genera than with any others known to me.

Prof. H. Alleyne Nicholson, of the University of St. Andrews, Scotland, whose labors in the fossil Actinozoa and Polyzoa are so well known, has kindly examined specimens of both these forms at my solicitation, and to him I am indebted for valuable notes concerning them, from which I have drawn in the following remarks embraced in the descriptions of the species.

Several years ago, while examining the conglomerate beds of the Dakota Cretaceous Group in Western Iowa, I found among the pebbles, of which those beds are so largely composed, some fragments of Paleozoic corals. These coral-pebbles were water-worn like the others, and like them they were also siliceous. That region was traversed by the eastern shore-line of the earlier intercontinental Cretaceous sea, the waters of which washed the whole series of Paleozoic strata there. The fossils of those strata, especially the corals of Devonian and Upper Silurian age, are often silicified, and they doubtless reached that condition before Cretaceous times. It is, therefore, easy to understand that the corals found in the pebble-beds referred to are really Paleozoic corals which were redeposited in Cretaceous strata, and not Cretaceous corals of Paleozoic types.

The case, however, is quite different with the corals sent by Mr. Lakes from the Cretaceous strata of Northern Colorado. These corals are calcareous and not siliceous, and they are also comparatively fragile. They present no appearance of having ever been water-worn, nor does the stratum in which they were found, an ordinary slightly calcareous and slightly muddy sandstone, contain any water-worn masses of any kind larger than the grains of coarse sand. We therefore necessarily reach the conclusion that these corals are really of Cretaceous age, although having so much the aspect of Paleozoic forms.

I am indebted to the late Prof. B. F. Mudge for the types of two new forms from the Dakota Cretaceous of Kansas; and a very interesting part of the following described species have been received from the Cretaceous strata of Texas, having been collected at different localities and forwarded by Mr. D. H. Walker, Mr. G. W. Marnoch, and Mr. S. W. Black,

whose names are referred to in connection with the respective descriptions.

It has not been thought necessary to rewrite, nor in many cases to revise, the descriptions of the fossils embraced in these articles which were formerly published by Mr. Meek in the publications of this Survey; and I have, therefore, here copied his descriptions, and, to a great extent, tacitly followed his classification.

ACTINOZOA.

Genus CHÆTETES Fischer.

CHÆTETES ?? DIMISSUS White.

Plate 12, fig. 14 a.

Chaetetes ?? dimissus White, 1879, Bull. U. S. Geol. Sur. Terr., vol. v, p. 220.

Corallum ramose, dichotomously branching at irregular intervals; branches cylindrical or subcylindrical, solid, the successive branches diminishing in size; corallites small, not exceeding $\frac{1}{5}$ millimeter in diameter, closely compacted together, diverging from the axis of the corallum at an acute angle with it, and describing a slight upward curve as they are projected towards the surface. Character of the surface and of the corallites unknown, the specimens being firmly imbedded in sandstone. One corallum, at least, seems to have consisted of a central or basal mass, from which several stems diverged irregularly, each stem bearing several branches.

Diameter of the stems and branches varying from 2 millimeters to 6 millimeters.

While this coral has all the outward appearance, and apparently the general structure, of the ramose forms of *Chaetetes* or *Monticulipora* the corallites seem to be entirely destitute of tabulæ, even when viewed under the microscope in the section prepared for that purpose by Professor Nicholson. If the tabulæ are really absent, as they appear to be, this coral cannot be properly referred to *Chaetetes*, nor to any other form of the Actinozoa, but it probably belongs to the Polyzoa. If it really belongs to the latter class, I do not know any genus to which it can be referred; and as the specimens are not sufficiently perfect to warrant a new generic diagnosis, I assign them provisionally to *Chaetetes*.

Only two examples of this coral have been discovered, and, like all other coralline forms in the Cretaceous rocks of the West, it is doubtless a rare one. The rarity of the remains of Cœlenterata in those rocks is no doubt due, not to a universal suppression at that time of those forms of life, but to the local or regional physical conditions which prevailed at the time those Western North American strata were deposited. It is a well-known fact that coral polyps require pure waters for vigorous and abundant growth; and as the Cretaceous strata of the West consist so largely of sand, it is evident that the waters in which they were deposited could not have been congenial for a large development of any of the forms of Cœlenterate life.

Position and locality.—Strata of the Fox Hills Group, of the Cretaceous series, at Fossil Ridge, 16 miles westward from Greeley, and 6 miles southward from Fort Collins, Colo., where it is associated with the coral next described, and also with various Cretaceous molluscan forms.

Genus BEAUMONTIA Edwards & Haime.

BEAUMONTIA ? SOLITARIA (sp. nov.).

Plate 12, figs. 13 *a*, *b*, and *c*.*Beaumontia ? solitaria* White, 1879, Bull. U. S. Geol. Sur. Terr., vol. v, p. 221.

Corallum massive, compact; corallites prismatic, readily cleaving from each other in the specimens discovered, unequal in size and also in the shape of the transverse section, some of them being more than twice as large as others, and the longer diameter of some being more than twice as great as the short diameter of the same; average diameter of the corallites not exceeding one millimeter; their walls thin, apparently marked only by the ordinary lines of growth; tabulæ plain, numerous, variously flexed, but never to a great degree. No trace of radiate septa or of longitudinal striation of the corallites has been detected.

This coral much resembles *Favosites* in the character of the corallum and the aspect of the corallites, but no traces of mural pores have been detected, not even in the section prepared by Professor Nicholson, when viewed under the microscope. In consequence of this, and of the irregular or flexed character of the tabulæ, I refer it to *Beaumontia*. Apparently the only known fact that suggests a doubt of the correctness of such a reference is that *Beaumontia* has hitherto been known only in Paleozoic rocks. This is also a rare form, and doubtless so for the reasons explained in connection with the description of the foregoing species.

Position and locality.—Associated with the preceding and various molluscan forms in Cretaceous strata of the Fox Hills Group, Northern Colorado.

ECHINODERMATA.

Genus OPHIODERMA.

OPHIODERMA ? BRIDGERENSIS Meek.

Plate 12, fig. 12 *a*.*Ophioderma ? bridgerensis* Meek, 1873, An. Rep. U. S. Geol. Sur. Terr. for 1872, p. 475.

The type specimen from which Mr. Meek drew his description, and from which the figure on plate 12 is drawn, is the only example of the species that has ever been discovered. Therefore nothing more is known of it than was published (*loc. cit.*) by Mr. Meek. It was obtained by one of the parties of the Survey from the "last foot of Bridger Peak, 4 miles north of Fort Ellis, Mont.," where it is reported to be associated with certain imperfect molluscan remains, among which Mr. Meek recognized the following genera, namely: *Gryphæa*, *Avicula*, *Pinna*, *Inoceramus*, *Crassatella*, *Pholadomya*, *Turritella*, and *Gyrodes*.

The following is Mr. Meek's brief description: "A small Ophiuran, with disk depressed, nearly circular, and only 0.17 inch in breadth, showing on the dorsal side ten ovate-subtrigonal radial plates that are joined together over the inner ends of the arms, so as to form five pairs; arms small, only about 0.75 inch in length, and at their inner ends 0.06 inch in breadth; middle row of arm-pieces on the dorsal side slightly wider than long, and hexagonal in form; marginal pieces about as large as the middle ones,

seen somewhat edgewise from above, and bearing a row of very small short spines. Ventral side unknown. The specimen is not well preserved; perhaps I should call it *Ophiolepis bridgerensis*."

CONCHIFERA.

Genus OSTREA Linnæus.

OSTREA SOLENISCUS Meek.

Plate 11, figs. 2 *a* and *b*.

Ostrea soleniscus Meek, 1873, An. Rep. U. S. Geol. Sur. Terr. for 1872, p. 487.

The name of this species was given by Mr. Meek in a catalogue of fossils, on page 276 of the Annual Report of this Survey for 1871, but as no description or diagnosis then accompanied it, the name can date only from 1873, when his description was first published (*loc. cit.*). The following is Mr. Meek's diagnosis of the species, together with his remarks upon it:

"Shell attaining a large size, becoming rather thick in adult examples, generally straight, greatly elongated, and comparatively very narrow, with parallel lateral margins. Lower valve with moderate internal cavity, and having the appearance of a little gutter or elongated trough; beak usually nearly straight, rather obtusely pointed, and more or less distorted by the scar of attachment; ligament-area of moderate size, strongly striated transversely, and provided with a large, deep, longitudinal furrow; surface apparently only with moderately distinct marks of growth. Upper valve almost flat externally, but nearly as concave as the other within; beak usually a little truncated; ligament-area marked with strong transverse striæ, and having its mesial ridge very prominent, and occupying as much as one-third its breadth. Surface as in the other valve, or perhaps a little smoother.

"Length of adult examples about 18 inches; breadth of the same about 2.50 to 3 inches.

"Although not a very uncommon species, I have seen no entire specimens of this remarkable shell. It will be readily known by its unusually narrow, elongated, and generally straight form. The shell is usually found broken into several pieces, but casts of the internal cavity are not unfrequently met with entire. One of these now before me is nearly one foot in length and only two inches in breadth. It often had a curious habit of growing in groups of three shells, attached to each other by the backs of their beaks. I have seen large numbers of them closely arranged, or nearly in contact with each other, at Coalville, all with their beaks downward, or at right angles to the plane of the sandstone strata. When found where it has grown isolated, the shell is sometimes arched to one side.

"*Locality and position.*—This species ranges through nearly the whole thickness of the Cretaceous sandstones near Coalville, Utah, and is also found in the Cretaceous coal-bearing sandstones at Bear River City, Wyo., as well as in the sandstone ridge of the same age on the Union Pacific Railroad, a few miles east of the latter locality."

I have frequently collected specimens of this species in the region indicated by Mr. Meek, and have verified all his observations as given above, but no specimens more perfect than his types have ever been discovered. While a large majority of the specimens have the long slender

form described by Mr. Meek, there are many also which are not so much elongated, but which are evidently of the same species. This remark applies not only to the young, which were proportionally short, as shown by the lines of growth upon the anterior portion of adult shells, but also to many that are massive and evidently of adult growth. Still, the species has always much more than the average proportionate length. The habit of this oyster, mentioned by Mr. Meek, of uniting its shells in groups of three, by their deeper valves, is not confined to this species alone. I have often observed it in the case of *O. glabra* M. & H. of the Laramie Group. I suppose it to have been a not uncommon habit with oysters that lived on sandy bottoms, because, in all the cases I have observed, the specimens were collected from soft sandstone strata; and yet in all these cases the majority of their associates of the same species were free. It is a common habit with oysters to attach themselves together, but why they should so often have been attached together in the manner described is not easy to understand.

Considerable variation in form is very common in all species of *Ostrea* proper, and some very elongate examples of the living *O. virginica* are occasionally brought into the markets from various places along the Atlantic coast. This fact was illustrated by a large labeled series prepared at the Smithsonian Institution by Mr. W. H. Dall for the Centennial Exposition in 1876. In reply to some inquiries, Mr. Dall writes me: "In the case of *O. virginica* there is no doubt that a position where it is subjected to currents, and especially if the water carries a little sediment, will induce a long, thin growth, with parallel sides; while still waters tend to produce a rounded form. The normal is between the two. But there are normally long species and normally round, besides twig-climbing species, all of which, in a state of nature, may be differently affected from thinned and planted oysters."

There is no room for doubt that *Ostrea soleniscus* is a normally long and slender species. That its elongate form is not due to the same cause which elongates the specimens of *O. virginica* before referred to is shown by the fact that so many of the longest of them are found in a vertical position, evidently their natural one, in relation to the plane of the strata containing them, as mentioned by Mr. Meek, and also observed by myself. It is also contra-indicated by the fact that so many of them grew in clusters of three, attached together by their larger valves, and by the absence of any evidence in the character of the strata that they were deposited in water having a current of sufficient strength to produce such a result.

I know of no other American oyster, either fossil or recent, that need be confounded with this species. The anterior portions of many of the specimens, as they are often found broken off, resemble corresponding portions of *O. longirostris* Lamarck, as figured by Goldfuss; but although that species is an elongate one, *O. soleniscus* is constantly a much more slender species.

OSTREA ANOMIOIDES Meek.

Plate 11, figs. 4 *a* and *b*.

Ostrea anomioides Meek, 1873, An. Rep. U. S. Geol. Sur. Terr. for 1872, p. 488.

No other examples of this species besides those of the original collection have ever been obtained. The figures on plate 11 are drawn from Mr. Meek's types, and the following is his description of the species, together with his remarks upon it:

"Shell rather small, very thin, depressed-plano-convex, and without

any visible scar of attachment, varying from ovate to circular; rounded or sometimes a little straightened on the hinge-margin; beaks hardly projecting beyond the outline of the cardinal margin. Lower valve very shallow; cartilage-pit unusually small, shallow, and short. Upper valve almost perfectly flat; cartilage attachment even shorter than that of the other valve, and slightly convex on its inner margin. Muscular scars unknown; surface of both valves with small, regular concentric wrinkles most distinctly marked on the central region.

"Greatest diameter of one of the largest oval specimens, 1.70 inches; breadth, 1.40 inches; convexity, 0.23 inch.

"This species is remarkable for the thinness of the shell, the slight convexity of the under valve, and the flatness of the upper, as well as for its rounded or slightly straightened cardinal margin, and the absence of any scar of attachment, or of any traces of muscular impressions within. These external characters, and the regular small concentric wrinkles, give the exterior of lower valves of circular specimens somewhat the appearance of a *Lucina* or *Dosinia*, while in other individuals it looks more like an *Anomia* or *Placuna*.

"*Locality and position*.—Missouri River, below Gallatin City, Mont. Cretaceous."

The comparative smoothness of these shells is so unusual with mature shells of any of the *Ostreidæ* as to suggest the possibility that they are immature examples; but their considerable abundance, and the nearly uniform size of all the specimens, seems to indicate that they are adult shells. If so, they evidently do not belong to the typical section of the genus *Ostrea*; but without some knowledge of the character of the muscular markings, it is unprofitable to offer any suggestions as to their true generic affinities.

Subgenus ALECTRYONIA Fischer.

OSTREA (ALECTRYONIA) BLACKII White.

Plate 14, figs. 1 *a* and *b*; and Plate 17, fig. 4 *a*.

Ostrea blackii White, May, 1880, Proc. U. S. National Museum, vol. ii, p. 293.

Shell irregularly subovate in marginal outline, moderately capacious; beaks small, sometimes obscure and sometimes moderately prominent, pointing a little backward, but not conspicuously so. Lower valve usually moderately deep and capacious, its convexity being more prominent about the middle than elsewhere, often subalate, but the latter feature is usually obscure; scar of attachment at the beak usually present, and often moderately large; ligament-area usually short and rather small, but sometimes comparatively large and laterally extended; ligament-furrow well defined, and of the usual character. Upper valve nearly flat, and corresponding with the lower in other respects, except that it is not so broad at the hinge border, and never has there the subalations which sometimes mark the lower valve. The adductor scars are moderately large, and of the form common to *Alectryonia*, namely, curved-spatulate. Surface of both valves marked by concentric lines and strong imbrications of growth, and each by a dozen or more radiating ribs or plications, which constitute a conspicuous feature of the shell, but they are usually somewhat less distinct upon the upper than upon the lower valve.

Length, 68 millimeters; greatest breadth, 62 millimeters; thickness, 32 millimeters.

In form and general aspect this shell approaches that of a typical *Ostrea*, but in the character of its adductor scars, the extent of its plications, and the subulation of its cardinal border, it is properly referable to the section *Alectryonia*. The only shell with which it need be compared is that of *O. bellaplicata* Shumard, also from Texas. It differs from that shell in being constantly larger, proportionally less capacious, broader towards the base, and in having its hinge-border longer and more oblique.

Locality and position.—Cretaceous strata, Collin County, Texas, where it was collected by Mr. S. W. Black, and sent by him to the Smithsonian Institution. The specific name is given in his honor.

Genus EXOGYRA Say.

EXOGYRA WINCHELLI White.

Plate 13, figs. 1 *a*, *b*, *c*, and *d*.

Exogyra winchelli White, May, 1880, Proc. U. S. National Museum, vol. ii, p. 294.

Shell of medium size, irregularly subovate in marginal outline; sessile, or attached by a large part of the surface of the lower or left valve, being obliquely inclined so that the anterior border is very much higher than the posterior. Lower valve massive, moderately deep, its front side nearly perpendicular and of considerable height vertically; umbo vertically flattened continuously with the front side, and broadly curving backward; beak closely incurved under the posterior border and concealed; ligamental groove long and narrow, occupying the whole curvature of the umbo. Upper valve nearly flat, thick, the anterior part being much thicker than the posterior; beak vertically thin or compressed, closely coiled in a plane with that of the valve, making a little more than one entire volution. Surface marked by coarse lines of growth, and, near the anterior borders of both valves, especially the upper, it is usually deeply laciniate.

Length, 90 millimeters; breadth, 66 millimeters; height in front, 55 millimeters.

This species belongs to the same section of the genus *Exogyra* with *E. haliotoidea* Sowerly sp. and *E. walkeri* White. The latter species is larger and proportionally broader than *E. winchelli* and not properly sessile, as the latter species is. *E. haliotoidea*, as figured by d'Orbigny in Pal. Française, t. iii, pl. 478, differs from *E. winchelli* in being proportionally higher in front and narrower in transverse diameter, and in not having the beak so much incurved. *E. interrupta* Conrad, from Mississippi, also belongs to the same section, but that species is described as having radiating ribs, which *E. winchelli* has not.

Position and locality.—Cretaceous strata, Collin County, Texas, where it was collected and sent to the Smithsonian Institution by Mr. S. W. Black. The collections of the Institution also contain a fine example sent by Prof. A. Winchell many years ago from Prairie Bluffs, Ala., which is believed to be specifically identical with the form here described, but it is proportionally more elongate, has a larger muscular scar, and the umbonal curve is a little more abrupt. The specific name is given in honor of Professor Winchell.

EXOGYRA FORNICULATA White.

Plate 14, figs. 2 *a* and *b*.*Gryphæa pitcheri* Marcou, 1858 (not Morton), Geol. of N. A., pl. iv, figs. 5 and 6.*Gryphæa navia* Gabb, 1861 (not Conrad), Proc. Acad. Nat. Sci. Philad., p. 22; ib., Paleont. California, vol. ii, p. 273.*Exogyra forniculata* White, May, 1880, Proc. U. S. National Museum, vol. ii, p. 293.

Shell of moderate size, subtrihedral in lateral outline, somewhat compressed vertically; under or left valve thick, especially its umbonal half; beak curved strongly towards the posterior border and in the plane of the free margins of the valve, not forming so much as one complete revolution, its point being free but closely approaching the posterior border of the valve; ligament-area irregularly triangular, moderately large, extending to the apex of the beak, its sulcus well developed; interior surface having the usual characteristics of the genus. A faint, illy-defined sulcus is apparent on the posterior portion of the surface, extending from the umbo to the basal border, between which sulcus and the laterally flattened-concave posterior border of the valve there is an equally undefined radiating curved ridge. The anterior portion of the valve is marked by a strong, angular, rough carina, or ridge, which extends from the beak to the basal border. The prominence of this ridge gives a flattened aspect to the outer surface of the valve and also produces a flattened space of considerable width between it and the anterior margin. Surface marked by the ordinary coarse lines and imbrications of growth common to the Ostreidæ, and upon the ridge just described there are occasional nodes, or vaulted projections of portions of the shell. Upper valve flattened and having much the aspect of that of a *Gryphæa*.

Length, 70 millimeters; breadth across the base, where it is widest, 50 millimeters.

This shell is much like a *Gryphæa* in general aspect, but it is referred to *Exogyra* because of its laterally-curved umbo and beak. It is often difficult to point out clear distinctions between these two genera, but the lateral curvature of the beak appears to be the most constant and important characteristic of *Exogyra*, distinguishing it from *Gryphæa*. Specifically, this shell is well marked by the strong, rough, angular carina, its free beak, narrow umbonal region, and broad base. In these respects it differs too much from any described species except a variety of *Gryphæa pitcheri*, to make detailed comparison necessary.

Morton's *Gryphæa pitcheri* has, unfortunately, been the cause of much controversy among paleontologists, in which the species here described has been involved because of some general resemblance which it bears to some varieties of the former. It is not my purpose to add anything to that controversy, but to endeavor, by the following remarks, to free *Exogyra forniculata* from necessary connection with it.

Professor Marcou (*loc. cit.*) referred this species to *G. pitcheri*, and gave excellent figures of it, but it differs materially from any of the several varieties of *G. pitcheri* in (not to mention other features) the invariable lateral deflection of the beak. If *Gryphæa* be distinct from *Exogyra*, then this is a generic character; and, in any case, it is at least a strong specific one, and one which is constant and readily recognizable.

Mr. Gabb (*loc. cit.*) referred this species to *G. navia* Conrad; and on p. 274 of the last-cited work he gave a new name, *G. mucronata*, to the true *G. navia*, or to a form that its author cited as such. Mr. Conrad

appears never to have known *E. forniculata*. His original figures, in Emory's Mex. Bound. Report, of *G. navia*, which he properly regarded as only a variety of *G. pitcheri*, are unmistakable in their identity, and illustrate a well-known form which, although in a general way resembling, is distinctly different from *E. forniculata*. Besides this, Mr. Conrad, in his accompanying description, refers, as already intimated, to Rømer's figures in Kreid. von Texas, pl. ix, fig. 1 *a*, *b*, and *c*, as excellent representations of his *G. navia*, which are also very different from *E. forniculata* in their long *vertically* arched beaks. Mr. Gabb also refers to those figures of Rømer as illustrations of his *G. mucronata*; and there is, therefore, no room for doubt as to the mutual identity of the forms to which these two names were respectively applied by Mr. Conrad and Mr. Gabb. The latter author discriminated correctly between the true *G. navia*, as represented by Conrad's and Rømer's figures respectively, and *E. forniculata*, and he possibly intended to give a new name to the latter form instead of the former; but he did not, and the latter has gone without a correctly-applied name until I published it as *E. forniculata* in Proc. U. S. Nat. Museum, vol. ii, p. 293.

Position and locality.—Cretaceous strata, Bexar County, Texas, where it was collected by G. W. Marnoch, esq., together with many well-known Cretaceous species of that region. It is also found at numerous other Texan localities.

Genus ANOMIA Linnæus.

ANOMIA PROPATORIS (sp. nov.).

Plate 12, figs 15 *a* and *b*.

Shell rather small, irregularly and a little obliquely subovate or sub-circular in marginal outline; test pearlaceous and moderately thin, as is usual in *Anomia*. Upper valve convex; beak small, depressed, not quite marginal; surface marked by somewhat coarse, irregular wrinkles of growth, by a few radiating wrinkles in the umbonal region, and by fine, close-set, raised, radiating striæ, the latter appearing more distinctly on the forward part of the shell than elsewhere. Under valve unknown.

Length of the most perfect example in the collection, 11 millimeters; breadth, 10 millimeters; convexity, 5 millimeters.

This shell resembles *A. gryphorhynchus* Meek, the typical examples of which are from the Laramie strata of the Bitter Creek series, Southern Wyoming, but it differs from that species in having a less prominent and rounded umbo; in possessing radiating and concentric wrinkles and radiating raised striæ, while that species is an unusually smooth one. In the possession of the radiating raised striæ it corresponds closely with *A. micronema* Meek, which is so commonly distributed throughout the Laramie Group. As this striation constitutes a more important characteristic than mere form, which is always variable in this genus, it strongly suggests an intimate genetic relation for our shell with *A. micronema*.

This species is a member of the estuary fauna which was discovered several years ago by Mr. Meek in the Cretaceous series of strata at Coalville, Utah, and which is more particularly mentioned on a subsequent page, in remarks which follow the description of *Cyrena carletoni*. Although all the species of that Cretaceous estuary fauna are different from any yet found in the Laramie Group, several of them are so closely related to certain Laramie forms as to strongly suggest the idea that

the molluscan fauna of the Laramie period had mainly its genetic derivation from the estuary faunæ that were established along the continental shores of marine waters during the previous Cretaceous epochs. In view of what we already know of the history of the great Laramie deposit, this view of the genetic derivation of its molluscan fauna would seem to be the most natural one, even without the paleontological hints here mentioned.

In the marine strata of the Cretaceous series at Coalville examples of an *Anomia* are not unfrequently met with which closely resemble this one, and which may really belong to the same species. All the examples from the marine strata there which have come under my observation are, however, too imperfect to show the surface markings, and thus an important specific characteristic is wanting.

Position and locality.—The specimen figured on plate 12 is one which Mr. Meek obtained from the estuary strata of the Cretaceous series at Coalville, Utah.

Genus PTERIA Scopoli.

PTERIA ?? STABILITATIS (sp. nov.).

Plate 17, fig. 3 a.

Shell adherent by the whole surface of the right valve, suborbicular or transversely suboval in marginal outline; hinge-line straight, less in length than the breadth of the shell. Right valve thin, especially at, and near the margins; beak minute, hardly raised above the cardinal border; ears minute or obsolete; hinge-area narrow, ending somewhat acutely both anteriorly and posteriorly, its inner border prominent but plain; cartilage-pit small, pyramidal, turned obliquely forward. Upper or right valve unknown.

Breadth of the largest example discovered, 34 millimeters; height of the same from base to cardinal border, 26 millimeters. Three or four of the examples are not above $1\frac{1}{2}$ millimeters in diameter.

The only known representatives of this species are one adult and several small examples of the right valve adhering to the surface of a fragment of the shell of a large *Inoceramus*. It evidently belongs to the Aviculidæ, but in being adherent by the whole surface of the right valve it differs from all other known members of that family, and when perfect examples of both valves are discovered it will probably be found to represent an unpublished genus. The shell-substance of the thin marginal portion of all these examples is loosely cellular, which condition is possibly due to some malady which affected the mollusk while living, but it seems to be connected with a prismatic-cellular structure of the thicker portion, such as is common to the Aviculidæ.

Position and locality.—Cretaceous strata, Collin County, Texas, where it was collected by Mr. S. W. Black, and sent by him to the Smithsonian Institution.

Subgenus OXYTOMA Meek.

PTERIA (OXYTOMA) SALINENSIS White.

Plate 16, figs. 2 a and b.

Pteria (Oxytoma) salinensis White, May, 1880, Proc. U. S. National Museum, vol. ii, p. 296.

Shell rather large for a Cretaceous *Pteria*; the body, exclusive of the wings, being obliquely subovate, broad at base, moderately gibbous, dis-

tinctly but not very greatly inequivalve; the left valve, as usual, more convex than the right, and its beak more prominent than the other; the convexity of the surface of the valves somewhat uniform, but increasing toward the umbonal region, where it is greatest; anterior wing moderately large, defined from the body of the shell by being laterally compressed, but not by any distinct auricular furrow; the byssal sinus under the anterior wing of the right valve having the usual size and shape common to *Oxytoma*; posterior wing not proportionally large, and not distinctly defined from the body of the shell except by a somewhat gradual lateral compression; its posterior angle not greatly produced; hinge-line less than the axial length of the shell; posterior adductor scars not distinct; anterior scars distinct for a shell of this genus, placed immediately in front of the beaks, that of the left valve being more distinct than the other.

This, like the following described species, is known only from natural casts in brown hematite of the interior of the shell, the imperfection of which will not allow of an accurate measurement of all its proportions. It is, however, known to have reached an axial length of more than 60 millimeters, a transverse width near its base of at least 50 millimeters, and a thickness of about 25 millimeters, when both valves were in natural position.

The character of the surface is not known, but it was evidently nearly smooth, as is usual with its congeners. It is related to *Pteria* (*Oxytoma*) *nebrascana* Evans & Shumard, but it is a larger and more robust shell, having a proportionally larger anterior wing, more prominent beaks, and broader base.

Position and locality.—Strata of the Dakota Group, Saline County, Kansas, where it was discovered by Prof. B. F. Mudge, associated with the next following described species, and also with *Cyrena dakotaensis* Meek & Hayden and *Cardium kansasense* Meek.

Genus GERVILLIA Defrance.

GERVILLIA MUDGEANA White.

Plate 14, figs. 3 *a* and *b*.

Gervillia mudgeana White, May, 1880, Proc. U. S. National Museum, vol. ii, p. 295.

This shell, like the last described, is known only from natural casts in brown hematite of the interior and of a few adhering fragments showing the character of the test. It is moderately large, laterally distorted; hinge-line comparatively long, very oblique with the axis of the shell, producing a somewhat prominent posterior alation, which is not distinctly defined from the body of the shell; cartilage-pits in the area of each valve six or seven, as shown by undulations upon the cast; beaks placed very near the anterior end, beyond which there appears to have been no distinct anterior ear; beak of the right valve more prominent than the other, although the right valve is less convex transversely than the left; right valve having a somewhat regular and strong longitudinal convexity, but its transverse convexity is very slight in the anterior half, while that of its posterior half is nearly flat; left valve nearly straight or even slightly concave longitudinally along the axis, but very strongly convex transversely in all parts, this convexity being more abrupt along the axis than elsewhere, but there is between the axis and the hinge-margin a slightly raised rounded fold which extends from behind the beak to the posterior margin; adductor muscular impression large and

distinct in each valve. A few fragments show the surface to have been marked by the ordinary concentric lines of growth, and also that the test, although firm, was not massive.

The dimensions cannot be definitely given, but the largest example discovered indicates a length of at least 80 millimeters.

This shell differs too much from any of the few known Cretaceous species of the genus to need detailed comparison, but it is related to *G. sub-tortuosa* Meek & Hayden, which it resembles in being tortuous. It differs, however, from that species in being a proportionally much shorter shell, in the shape and position of the adductor scars, and in the relative position and arrangement of the cartilage-pits. It is less tortuous than *G. tortuosa* Sowerby, and its proportions are different.

Position and locality.—Strata of the Dakota Group, Saline County, Kansas, where it was discovered, associated with the preceding species, by Prof. B. F. Mudge, in whose honor the specific name is given.

Genus PINNA Linnæus.

PINNA LAKESII White.

Plate 11, figs. 1 *a* and *b*.

Pinna lakesii White, 1879. An. Rep. U. S. Geol. Sur. Terr. for 1877, p. 181.

Compare with *Pinna restituta* Høeninghaus.

Shell rather large, slender anteriorly but becoming quite broad and somewhat compressed posteriorly; sides not angular or otherwise conspicuously marked along the median line, nor very convex except near the anterior end, where the transverse thickness of the shell is about equal to its height from base to dorsal border; dorsal margin broadly concave from front to rear and longer than the basal margin; posterior border convex, or rather truncated obliquely downward and a little backward from the dorsal border to a point a little below the median line, where it is abruptly rounded, and, by a long forward slope, blends with the basal border, which border is slightly convex or nearly straight. Surface marked by the usual lines of growth and by some concentric wrinkles, which latter are more distinct below than above the median line. It is further marked by numerous slender, slightly raised, radiating ribs, which extend continuously from the anterior to the posterior end of the shell. Seven or eight of these ribs mark the whole space above the median line, and three or four are seen below it, leaving the lower half of the space below the median line free from ribs. The ribs are merely close-set raised lines upon the narrow front end of the shell but become stronger farther backward. They are there much narrower than the intervening spaces, because the width of the latter increases posteriorly much more rapidly than that of the ribs.

Full length of the specimen figured on plate 11, about 280 millimeters; width (vertical) of the same at the widest part, about 83 millimeters.

This species is in no danger of being confounded with any other described and figured form from American rocks, but it somewhat resembles the *P. decussata* Høeninghaus as figured by Goldfuss. It differs from that species, however, by increasing more rapidly in size from front to rear, by the much less convexity of its basal margin, and by the character and direction of the posterior and postero-basal borders as described above.

Position and locality.—No examples of this species have been satisfactorily identified from any other region than that of Northern Colorado,

east of the Rocky Mountains. The type specimens were obtained from Fossil Ridge, about 16 miles westward from Greeley, and about 6 miles southward from Fort Collins, Col. The best examples yet discovered, one of which is figured on plate 11, were obtained at that locality by Mr. A. Lakes, by whom they have since been sent to Princeton College, New Jersey.

Genus VOLSELLA Scopoli.

Subgenus BRACHYDONTES Swainson.

VOLSELLA (BRACHYDONTES) MULTILINIGERA Meek.

Plate 11, fig. 3 a.

Modiola pedernalis Meek (not Rømer), 1871, An. Rep. U. S. Geol. Sur. Terr. for 1870, p. 297.

Modiola (Brachydontes) multilinigera Meek, 1873, An. Rep. U. S. Geol. Sur. Terr. for 1872, p. 492.

In a catalogue of Cretaceous fossils, published in the Annual Report of this Survey for 1870, Mr. Meek (*loc. cit.*) referred this species to the *Modiola pedernalis* of Rømer, but he afterward gave it the new specific name as above, together with the following description and remarks:

“Shell rather above medium size, obliquely arcuate-subovate; valves strongly convex along the umbonal slopes, thence cuneate posteriorly and abruptly curved inward below the middle in front; posterior margin forming a broad, regular convex curve from the end of the hinge downward to the anterior basal extremity, which is very narrowly and abruptly rounded; anterior margin ranging obliquely backward and downward to the narrow basal extremity, and strongly sinuous along the middle, above which it projects more or less beyond the umbonal ridge, so as to form a moderately prominent, somewhat compressed, protuberance; hinge margin nearly or quite straight, ranging at an angle of 50° or 60° above an imaginary line drawn from the beaks to the most prominent part of the basal outline, and equaling about one-half the greatest oblique length of the valves; beaks nearly terminal, rather compressed, very oblique, and scarcely rising above the hinge margin; umbonal slopes prominent and more or less strongly arcuate. Surface ornamented with fine lines of growth, crossed by regular radiating lines that are very fine and crowded on the anterior part of the valves, but become coarser above and behind the umbonal ridge, the largest being near the dorsal side, where they bifurcate so as to become very fine, and curve more or less upward before reaching the cardinal margin.

“Greatest length, measuring from the beaks obliquely to the most prominent part of the basal margin of a large specimen, 1.90 inches; greatest breadth at right angles to the same, 1 inch; convexity, 0.76 inch.

“On first examining some imperfect casts of this shell brought by Dr. Hayden from near Coalville, Utah, I was led to think it probably the form described by Dr. Rømer from Texas under the name *Modiola pedernalis*, to which I referred it provisionally in making out the list of Cretaceous fossils for Dr. Hayden's report for 1870. Further comparisons of better specimens collected at the same locality during the past summer, however, have satisfied me that it presents well-marked and constant differences from the Texas shell. In the first place it is distinctly more arcuate, so much so that when placed with its hinge line in a horizontal position, the outline of its posterior margin, instead of form-

ing an oblique, backward-descending curve, ranges nearly vertically. Again, the most prominent part of its posterior basal margin is very narrowly rounded, instead of forming a regular curve. Its umbonal ridges are likewise more prominent, more arched, and extend down to the narrowly-rounded posterior-basal extremity. The lobe-like projection of the upper part of its anterior margin, under the beaks and in front of the umbonal ridge, also differs in being proportionally much smaller than in Dr. Rømer's species, in which it forms about one-third of the entire valve, as seen in side view, while in our shell it scarcely forms more than one-sixth. Of course the specimens are more or less variable in these characters, but the two forms can always be readily distinguished when good examples can be had for comparison.

"In its more arcuate form our shell agrees more nearly with *Modiola ornata* Gabb, from the Cretaceous rocks of California; but that shell differs very markedly in having its beaks decidedly less nearly terminal, and a more decided and much more prominent lobe in front of them. Another important difference is to be observed in the radiating striæ, which on the anterior side of our shell are very minute and closely crowded, while on that part of Mr. Gabb's species they are as large and distant from each other as on any other part of the valves.

"If Scopoli's name, *Volsella*, should be adopted for this genus, as there are some reasons for believing may be the case, this change would require the name of this species to be written *Volsella multilinigera*.

"*Locality and position*.—Cretaceous sandstones near Coalville, Utah."

Genus BARBATIA Gray.

BARBATIA BARBULATA (sp. nov.).

Plate 11, fig. 5 a.

Shell small, longitudinally oblong or subrhomboidal, a little more than twice as long as high; cardinal and basal margins nearly parallel, the former straight and the latter nearly so; anterior side short, rounded up obliquely from the base, and meeting the cardinal margin at an obtuse or bluntly rounded angle; posterior side, long; posterior margin, truncate obliquely downward and backward from the cardinal margin to the base, which it meets at a blunted angle, or it is there abruptly rounded; beaks distinct, but somewhat depressed and incurved, placed about one-fifth the length of the shell from the front; cardinal area narrow, but it is not well shown in our examples. Surface showing fine crowded, raised, rounded, radiating striæ, which are crossed by fine lines of growth and also by numerous sharply raised concentric lines, some of which are more conspicuous than the radiating lines.

Length, about 25 millimeters; height, about 11½ millimeters.

Only two or three imperfect examples of this species have been discovered, but in its shape and surface markings it presents such differences from any known form as to warrant the foregoing description under a new specific name.

Position and locality.—Cretaceous strata, apparently of the age of the Fox Hills Group, at Cimarron, New Mexico, where it was found by Prof. St. John, associated with *Crassatella cimarronensis* White, and other forms, some of which were described and figured in Contributions to Invertebrate Paleontology No. 1, and published in the Annual Report of this Survey for 1877.

Genus CYRENA Lamarck.

CYRENA CARLETONI Meek.

Plate 12, figs. 16 *a* and *b*.*Cyrena carletoni* Meek, 1873, An. Rep., U. S. Geol. Sur. Terr. for 1872, p. 495.

The following is Mr. Meek's description of this interesting species, together with his remarks upon it:

"Shell small, thin, subcircular or with length a little greater than the height, moderately convex; anterior and posterior margins rounded from above regularly into the rounded basal outline, or with the posterior sometimes slightly straightened, both rounding more abruptly to the hinge above; beaks rather depressed, small, abruptly pointed, incurved, nearly contiguous, and placed slightly in advance of the middle; hinge line sloping very gradually from the beaks. Surface marked with moderately distinct concentric lines and furrows.

"Length of a medium-sized specimen, 0.55 inch; height of same, 0.49 inch; convexity, 0.32 inch.

"This shell is so very thin, and so nearly resembles a rather large *Sphaerium* in form and surface characters that I certainly should have referred it to that genus had not a lucky blow separated the hinge of a right valve from the matrix in such a manner as to expose the teeth quite satisfactorily. This shows its hinge to have the characters of a true *Cyrena*. For so thin a shell it has quite a stout hinge. Its cardinal teeth are rather diverging, the posterior two being well developed, and each a little furrowed along the middle, while the anterior one (in this right valve) is much smaller and conical in form. The lateral teeth are of moderate size, and certainly smooth, the posterior being remote from the cardinal teeth, and the linear anterior extending back to the latter. Internal casts show the muscular and pallial impressions to be well defined, and the latter to be a little straightened, or showing a very faint tendency to form a small sinus under the posterior (adductor scar).

"This is a rather small and an unusually thin shell for the genus *Cyrena*, being, as already remarked, much more like a *Sphaerium* in these characteristics. It is quite abundant at the locality, but, as it is only found in an indurated clay matrix, good specimens are with difficulty obtained, and from these the thin shell is very liable to break and scale off, leaving only the internal cast remaining.

"Among the specimens collected there are some of a more transversely oval form and somewhat larger size than those I have regarded as the types of the species here described. These may belong to a distinct species, but they agree so nearly in all other known characters that I am at present inclined to regard them as merely a variety of the same.

Locality and position.—Carleton's coal mine, Coalville, Utah."

This species is one of an interesting estuary fauna which was discovered by Mr. Meek in connection with a portion of the coal-bearing strata in the Cretaceous series at Coalville, Utah. The figures on plate 12 have been drawn from his types, which are among the only examples that have ever been collected.

One of the species of this peculiar estuary fauna, namely, *Physa carletoni*, was illustrated on plate 7, fig. 12, of Contributions to Invertebrate Paleontology No. 1, in the Annual Report of the Survey for 1877, and all the remaining species of that estuary fauna which have yet been described are illustrated upon plate 12 of this article. They embrace the following

species: *Anomia propatoris*, *Corbicula carletoni*, *Melampus? antiquus*, *Neritina bannisteri*, *Neritina (Velatella) bellatula*, *N. (V.) carditoides*, *Turritella spironema*, *Eulimella? inconspicua*, *E.? chrysallis*, and *Valvata nana*. The fauna also contains another *Turritella*, a *Unio*, and two or three other undetermined species. For Mr. Meek's remarks upon this fauna see the Annual Report of this Survey for 1872, pp. 442-445.

Peculiar interest attaches to this estuary fauna in different ways, but especially because some of its species indicate the existence of types at that early period which are found to characterize the fossil molluscan faunæ of later epochs as represented by North American strata; and of some that are also common among living North American forms. Especial reference is had in this remark to the fresh-water and land mollusca. The strata containing the fossil fauna in question were evidently deposited in the estuary of a stream, which, during at least a portion of the Cretaceous period, flowed into the sea from the narrow continental region of Mesozoic time, the eastern shore of which was evidently near that locality. There were doubtless other similar estuaries along that and other shores of the Cretaceous seas, but little is yet actually known of them. Unfortunately, also, the excavations which exposed the strata bearing the fauna in question, at Coalville, have been discontinued and covered with débris, and none of its species have yet been found elsewhere. Our present knowledge of this deposit is therefore confined to that one limited locality.

Genus PHARELLA Gray.

PHARELLA? PEALEI Meek.

Plate 11, figs. 6 a and 6 b.

Pharella? pealei Meek, 1873, An. Rep. U. S. Geol. Sur. Terr. for 1872, p. 496.

No other than the type specimens of this species have ever been discovered; the best one of which, although only a cast, is figured on plate 11. The following is Mr. Meek's description of it:

"Shell elongate or subrhombic, the length being about twice and a half the height, rather compressed; anterior margin slightly sinuous just in advance of the beaks above, and somewhat narrowly rounded below this faint sinuosity; posterior margin truncated, with a convex outline, very obliquely downward and backward from the posterior extremity of the hinge to the prominent and very narrowly-rounded or angular posterior basal extremity; hinge-line proper, apparently comparatively short, and not forming any angularity of outline at its connection with the sloping posterior dorsal margin; beaks rising a little above the hinge margin, but rather depressed and placed about one-fifth the entire length of the valves from the anterior margin; basal margin long, slightly sinuous along most of its length; posterior dorsal slopes rather prominently rounded from the beaks obliquely to the posterior basal extremity. Surface only showing obscure lines of growth.

"Length, 1.20 inches; height, 0.48 inch; convexity, 0.28 inch.

"Knowing nothing of the hinge of this shell I only refer it provisionally to *Pharella*. It does not seem to have had the extremities gaping as in that genus, but the specimen has evidently been accidentally compressed, and this may have given the valves the appearance of being closed. In general appearance it resembles *Solen guerangeri* d'Orbigny, which seems to belong to the genus *Pharella*. Our shell, however, evidently differs from d'Orbigny's specifically, at least, in not having the posterior margins of

its valves near so abruptly truncated, but rounding and sloping forward gradually into the dorsal outline above. Possibly, I should call it *Modiola pealei*.

"*Locality and position*.—Missouri River, below Gallatin City, Mont. Cretaceous."

Genus TAPES Mühlfeldt.

TAPES HILGARDI Shumard.

Plates 16, figs. 3 *a*, *b*, and *c*.

Tapes hilgardi Shumard, 1860, Trans. St. Louis Acad. Sci., Vol I, p. 601.

The following is Dr. Shumard's description of this species (*loc. cit.*).

"Shell ovate, transversely elongate, valves compressed, convex; extremities rounded, the anal end narrower than the buccal, and in adult specimens approaching to subtruncate; cardinal border long, curving gently from the beaks posteriorly; basal margin very gently convex; beaks situated about one-third the length of the shell from the anterior margin, rather short, nearly in contact; ligament area depressed, narrow-lanceolate; pallial sinus linguæform, extending above the middle of the height of the shell. The surface markings are not well preserved in any of the specimens before me. They show merely fine concentric lines of growth near the basal margin.

"Length, 2 inches; width, 1.27; thickness, 0.66.

Locality.—Bluffs of Red River, Lamar and Fannin counties (Texas), occurring in septaria of the marly clay, near the base of the Lower Cretaceous."

In the collections of the National Museum are some examples which I refer to this species, one of which is represented by fig. 3 *b* and another by fig. 3 *c*, plate 16. These examples were sent by Mr. D. H. Walker, from Bell County, Texas, with other Cretaceous species. Fig. 3 *a* of the same plate is from a photograph of Dr. Shumard's original drawing which he had given to the late Mr. Meek before his death. This species perhaps belongs to the genus *Baroda* Stoliczka, but as nothing is yet known of its hinge or interior markings I prefer to leave it where Shumard placed it.

Genus PACHYMYA Sowerby.

PACHYMYA? COMPACTA White.

Plate 17, figs. 4 *a* and *b*.

Pachymya? compacta White, Jan., 1880, Proc. U. S. National Museum, vol. ii, p. 297.

Shell small, narrower posteriorly than anteriorly, slightly gaping behind; beaks depressed, approximate, incurved, directed forward, their position being very near the front; basal margin broadly convex; posterior margin narrowly rounded; postero-dorsal margin forming an oblique downward and backward truncation of that part of the shell; cardinal margin nearly straight, subparallel with the basal margin, much shorter than the full length of the shell; ligament short, its area depressed and sharply defined; front very short, depressed beneath the beaks and narrowly rounded below; umbonal ridges prominent, angular or subangular; the space above and behind them moderately broad and flattened; the remainder of the valve somewhat regularly convex. Hinge and interior markings unknown. Surface marked by the ordinary concentric lines of growth.

Length, 29 millimeters; height, 18 millimeters; thickness, both valves together, 14 millimeters.

This species is evidently congeneric with the shell which, in the An. Rep. U. S. Geol. Sur. Terr. for 1877, p. 298, I described as *Pachymya herseyi* and also with the *Cypricardia texana* of Roemer; but knowing nothing of the hinge of either of these forms I am not satisfied that they are properly referable to *Pachymya*. They are, however, here referred to that genus because of the agreement of their external characteristics with those of *Pachymya*.

Position and locality.—Cretaceous strata, Bell County, Texas, where it was collected by Mr. D. H. Walker.

Genus THRACIA Leach.

THRACIA MYÆFORMIS White.

Plate 17, figs. 2 *a* and *b*.

Thracia myæformis White, Jan., 1880, Proc. U. S. National Museum, vol. ii, p. 297.

Shell transversely subovate in marginal outline; valves nearly equal; anterior end regularly rounded; wider and thicker anteriorly than posteriorly; posterior portion narrowed vertically and somewhat compressed laterally, but gaping at the extremity; basal border broadly convex; posterior border abruptly rounded; cardinal margin slightly convex; but the prominent umbones give the shell a concave appearance behind the beaks; a distinct linear depression is seen in the natural cast, on each side of the ligament; beaks prominent, incurved, and directed a little forward; muscular impressions not distinctly shown in our examples, which are natural casts in chalky limestone, but the pallial sinus appears to have been large and subangular at its anterior end. Surface marked by the ordinary lines of growth, and also by more or less distinct irregular concentric wrinkles.

Length, 57 millimeters; height, from base to umbo, 37 millimeters; thickness, both valves together, 24 millimeters.

This shell in general aspect, approaches *T. prouti* Meek & Hayden, from the Upper Fox Hills Group of the Upper Missouri River region; but it differs in being proportionally narrower and more produced behind the beaks than that species, and in the greater prominence of the umbones.

Position and locality.—Cretaceous strata of Bell County, Texas, where it was collected by Mr. D. H. Walker.

GASTEROPODA.

Genus MELAMPUS Montfort.

MELAMPUS? ANTIQUUS Meek.

Plate 12, figs. 11 *a b, c*, and *d*.

Melampus antiquus Meek, 1873, An. Rep. U. S. Geol. Sur. Terr. for 1872, p. 507.

The following is Mr. Meek's description of this species, together with his remarks upon the same:

"Shell subovate, thin; spire moderately prominent, conical, and abruptly pointed; volutions about eight; those of the spire very short

and nearly flat; last one large, widest above and tapering below; suture shallow, with a slightly impressed line a little below it, around the upper margin of each volution; aperture narrow; columella and inner lip provided with four very prominent laminae or folds, with sometimes one or two smaller ones above these, near the top of the aperture; outer lip thin, and strengthened by a few transverse ridges within. Surface showing only fine obscure lines of growth and presenting a somewhat polished appearance.

“Height of a small specimen 0.43 inch; breadth, about 0.27 inch.

“I have only seen very imperfect specimens of this shell, but, taken together, they give a correct idea of nearly all of its characters. Some of them are three or four times the linear dimensions of that from which the above measurements were taken.

“Among the specimens from the same locality and bed there are some very large broken examples, too imperfect for detailed description, that seem to belong to a more elongated species, with a more produced spire than that described above. This form, however, as far as its characters can be made out, appears to agree with the foregoing in nearly all other respects. If distinct, it may be called *M. elongatus*.

“*Locality and position.*—Carleton’s coal-mine, near Coalville, Utah. Cretaceous.”

After a full examination of all the specimens collected by Mr. Meek, I am inclined to believe them to represent only one species, and that the differences which exist are due only to interspecific variation. Figures 11 *a* and 11 *b*, on plate 12, are drawn from the most perfect example discovered, although it is not more than one-third the size of some individuals which are represented in the collection by badly broken specimens.

The four folds upon the inner lip, mentioned by Mr. Meek, vary in size and character. The two middle ones are stronger and more prominent than the other two. The anterior one is narrow and ridge-like, and is not so distinctly seen from without as the others are, and it appears to be absent in the earlier stages of growth of the shell. The third one from the anterior end of the aperture, including the less conspicuous one just mentioned, is more transverse in its position than the others, and it is also hollowed upon its anterior side and a little flattened upon its outer side in shells of fully adult growth. They all rest upon a layer of callus, which forms the inner lip, and constitute an unusually conspicuous armature of the aperture. Figure 11 *d*, plate 12, shows this armature of a much broken, but very large example, natural size.

Upon carefully cutting the indurated clay matrix from around the spire of several of the specimens of the collection, I find the first volution of the minute apex to be reversed; or rather its axis is so turned as to have a different direction from that of the axis of the body of the shell. Usually the two axes are nearly at right angles. The reversed portion is very minute, and may easily escape detection, even under an ordinary lens. Figure 11 *c*, plate 12, represents an enlarged view of the apex. This is an important feature, and suggests possible relationship of this shell to the Pyramidellidae, with some members of which family it is faunally associated; but its form, as well as most of its other characteristics, are much more like those of the Auriculidae. Instead, however, of regarding it as a true *Melampus*, I am more disposed to regard it as congeneric with *Rhytophorus* Meek, the type-species of which is found in the Bear River Laramie strata. The longitudinal varices, occupying the space immediately in advance of the narrow groove near the distal border of the volutions of the type of that genus, were regarded as of generic importance by Mr. Meek, and suggested the name which

he gave to the genus. These varices are not present on the shell here discussed; but to my mind the narrow groove situated near the distal border of the volutions in both shells is of greater generic value than the varices. Of equal or greater generic value also is the reversed apex of our shell, which is evidently a constant characteristic; but it is not yet known whether the apex of the type of *Rhytophorus* is also reversed. Until this question can be decided I prefer to leave this species where Mr. Meek originally placed it, in the genus *Melampus*, although it is quite certain that it does not strictly belong there, rather than to formally transfer it to *Rhytophorus*, or to propose a new generic name.

MELAMPUS ? — ?

Plate 12, fig. 6 a.

Melampus — ? Meek, 1873, An. Rep. U. S. Geol. Sur. Terr. for 1872, p. 439.

Mr. Meek obtained from the marine strata at Coalville a single example of a shell, which is evidently congeneric with the *Melampus antiquus*, from the estuary beds there, and which has just been described. It is too imperfect to base a specific description upon; but it is probably distinct from the last-described species. All its associates are marine forms, and if it is a littoral pulmonate Gasteropod, as it is supposed to be, it was probably drifted to its marine entombment from an adjacent shore, just as the *Physa* probably was, which was found in the same or associated strata, and which is figured on plate 7, fig. 13, of Contributions to Invertebrate Paleontology No. 1, in the annual report of this survey for 1877. The character of the specimen here referred to *Melampus* is well shown by fig. 6 a, plate 12, but it is thought best to wait for better examples before giving it a specific name.

Genus NERITINA Lamarck.

NERITINA BANNISTERI Meek.

Plate 12, figs. 10 a, b, and c.

Neritina (*Neritella*) *bannisteri*, Meek, 1873, An. Rep. U. S. Geol. Sur. Terr. for 1872, p. 499.

This species is one of the estuary Cretaceous fauna before referred to, which was discovered by Mr. Meek, at Coalville, Utah. The figures of it on plate 12 have been drawn from one of Mr. Meek's types, and the following is his description of the species, together with his remarks upon the same:

"Shell, subglobose; spire much depressed, or with its apex scarcely rising above the body-whorl; volutions three or four, rapidly increasing in size, so that the last one comprises nearly the entire shell, more or less flattened, and sometimes provided with an obscure linear revolving furrow above; aperture large, subovate, approaching semicircular, being a little straighter on the inner side; outer lip beveled to a thin edge; inner lip of moderate breadth, slightly concave, and flattened, with a steep inward slope, entirely smooth. Surface polished, and marked by crowded zigzag vertical bands of brown and light-yellowish colors; lines of growth moderately distinct.

"Height of a nearly medium-sized specimen 0.40 inch; breadth, 0.43 inch. Some examples are as much as twice these dimensions.

"Although the specimens show the pattern or style of the original coloration of this shell quite distinctly, the colors themselves may, of course, have been different in the living shell. Usually the zigzag markings are quite distinct on the specimen as found, but on some examples the bands are blended, and become fainter, so that the surface merely presents a light brownish tinge. It is always polished, however, on all the specimens seen.

"This species seems to be more nearly allied to *N. nebrascensis* M. & H., from the Jurassic beds, near the head of Wind River, than to any other form with which I am acquainted. It may be readily distinguished, however, by its more depressed spire, and the slight flattening of its volutions above, as well as by its more flattened and more concave inner lip. It likewise attained a larger size than any of the specimens of that species I have seen. It is one of the most abundant shells observed at the locality, and is usually found in a better state of preservation than any of its associates.

"*Position and locality.*—Carleton's coal mine, Coalville, Utah."

This species is closely related to *N. incompta* White, from marine Cretaceous strata at Hilliard Station, about 40 miles northward from Coalville, and which is figured on plate 7 of Contributions to Invertebrate Paleontology No. 1, Annual Report of this Survey for 1877; but its differences are pointed out in connection with the accompanying description of that species.

NERITINA PISIFORMIS Meek.

Plate 12, figs. 9 a, b, and c.

Neritina pisiformis Meek, 1873, An. Rep. U. S. Geol. Sur. Terr. for 1872, p. 500.

This shell is found associated with *N. pisum* Meek, which is figured on plate 7, accompanying Contributions to Invertebrate Paleontology No. 1, in the Annual Report of this Survey for 1877, and also with many other forms in the marine Cretaceous series of strata exposed at Coalville, Utah. The figures on plate 12 have been drawn from one of Mr. Meek's types, enlarged two diameters, while those of *N. pisum*, just referred to, are of natural size. In size and general aspect the two species are closely alike, as may be seen by comparing the figures of both, and as has also been pointed out by Mr. Meek. The following is his description of this species:

"Shell small, subglobose, or obliquely rhombic, the height being slightly less than the oblique breadth; spire rather prominent for a species of this genus; volutions three to three and a half, convex; aperture subovate, considerably contracted by the flattened, moderately wide inner lip, which is nearly straight on its inner margin, and provided there with four small denticles, the upper one of which is largest; surface smooth.

"Height, 0.30 inch; greatest oblique breadth, 0.32 inch.

"This little shell agrees so nearly in size and form with the described species (*N. pisum*) that they may be readily confounded, as they are found with the aperture filled with rock.

"A fortunate fracture of one of the specimens exposed the inner edge of its flattened columella, however, and thus enabled me to see that it is denticulated, and in this respect differs from *Neritina pisum*, which seems to be entirely without teeth. Further comparisons also show the two shells to differ in form, that under consideration having a more prominent spire and a more globose outline, being less oblique.

"In size and general appearance it also closely resembles small examples of *Neritina compacta* Forbes, from the Cretaceous rocks of India, but it is less oblique, or more globose in form, and has four denticles instead of only three on its columella. It is possible that I should call it *Nerita pisiformis*, as the denticulations of its columella are rather strongly developed for a *Neritina*, in which genus the columella is usually smooth, or only finely crenate. Its general aspect, however, is more like species of the latter group.

"*Locality and position.*—Coalville, Utah, from the Cretaceous beds below the lower heavy bed of coal mined there.

Subgenus VELATELLA Meek.

No diagnosis of this type having yet been published, although Mr. Meek proposed a name for it on p. 499 An. Rep. U. S. Geol. Surv. Terr. for 1872, I propose the following diagnosis, which is drawn from all the yet known forms belonging to it, namely: *Neritina* (*Velatella*) *bellatula* and *N.* (*V.*) *carditoides* Meek, from the estuary Cretaceous strata at Coalville, Utah; *N.* (*V.*) *patelliformis* Meek, and var. *weberensis* White, from the marine Cretaceous strata at the same place; and *N.* (*V.*) *baptista* White from the Laramie Group at Black Buttes Station, Wyoming.

Shell resembling both *Dostia* and *Velates*, suboval in outline, depressed convex above, flattened beneath; beak minute, incurved, turned a little to one side, and depressed nearly or quite to the posterior margin; inner lip large, flattened or slightly convex, its border smooth or crenulate; outer lip usually a little thickened and sometimes crenulate within, and more or less continuous with the inner lip; aperture comparatively small; surface smooth or radiately ribbed; usually polished. It differs from *Dostia* in its more nearly perfect bilateral symmetry and its minute apex; and from *Velates* in having its apex always depressed to the posterior border.

NERITINA (VELATELLA) BELLATULA Meek.

Plate 12, figs. 8 *a* and *b*.

Neritina (*Dostia*?) *bellatula* Meek, 1873, An. Rep. U. S. Geol. Surv. Terr. for 1872, p. 497.

The type which in this article is represented by the two following described forms, while it is closely related to *Dostia* Gray, and *Velates* Montfort, is doubtless worthy of the subgeneric distinction suggested for it by Mr. Meek in connection with his specific description of them in the Annual Report of this Survey for 1872, pp. 197 and 198. The publication of a diagnosis of the type being necessary for its proper recognition, and Mr. Meek having failed to publish one, I have drawn the foregoing one from the characteristics presented by all the known forms which are referable to this type.

The two forms described in this article were discovered by Mr. Meek associated together, and forming a part of the estuary Cretaceous fauna at Coalville, Utah, which has already been mentioned. Another species of the same type *N.* (*V.*) *patelliformis* is found in the marine Cretaceous strata of the same neighborhood, and the only other known species belonging to it was discovered by the writer in the upper strata of the Laramie Group at Black Buttes Station, Wyoming. The latter form is figured, on plate 29; and *N.* (*V.*) *patelliformis*, together with a variety of the same, is figured on plate 7, accompanying Contributions to Inverte-

brate Paleontology No. 1, in the Annual Report of this Survey for 1877. The following is Mr. Meek's description of this species, together with his remarks upon the same:

"Shell small, depressed-ovate, or broad slipper-shaped; apex very small, and depressed to the posterior margin, where it forms one or two minute, slightly oblique, compact turns, that do not project beyond the margin, but are sometimes even slightly overlapped by it; inner lip very broad, or shelf-like, and occupying more than half the under side, convex, and more or less thickened, with the inner margin concave in outline at the middle, and provided with a slight projection on each side, but not properly crenate or dentate; outer lip rather thick, obtuse, nearly or quite smooth, and continuous around the margins with the inner one; aperture small and transversely semicircular. Surface polished, and ornamented by from fifteen to twenty light yellowish or cream-colored simple radiating costæ, separated by shallow, light brownish furrows of about the same breadth;* lines of growth moderately distinct.

"Length, 0.31 inch; breadth, 0.25 inch; convexity, 0.12 inch.

"I am in some doubt in regard to the proper disposition to make of this little shell. In most of its characters it seems to conform pretty nearly with *Dostia* Gray, generally regarded as a subgenus under *Neritina* Lamarck (= *Neritella* Humphrey). It has a much smaller and less prominent spire, however, and a more convex and broader inner lip than the type of that group, and also wants the crenulations of the inner lip seen in the same. In its limpet-like form, tumid, greatly developed inner lip, and minutely coiled apex, it approaches *Velates* Montfort, and I am not quite sure that it would not be nearer right to call it *Velates bellatula*. Still it differs from the typical form of that genus in having its apex depressed to the posterior margin, instead of being elevated and nearly central, while the margin of its inner lip wants the distinct denticulations seen in that of that shell.

"Of course if Humphrey's catalogue genera are to be adopted on account of priority of date over those of Lamarck and others that were accompanied by diagnoses, the name of this shell, supposing the view here adopted in regard to its affinities to be correct, would become *Neritella* (*Dostia*) *bellatula*.

"*Locality and position*.—Carleton's coal mine, Coalville, Utah."

NERITINA (VELATELLA) CARDITOIDES Meek.

Plate 12, fig. 7 a.

Neritina (*Dostia*?) *carditoides* Meek, 1873, An. Rep. U. S. Geol. Sur. Terr. for 1872, p. 499.

This form certainly belongs to the same type as the preceding, and there appears to be some ground for suspecting them to belong to one and the same species. All the specimens in the collection of both this and the other form are more or less imperfect, however, and I therefore prefer to treat them as separate species in this article, as Mr. Meek has done. The following is his diagnosis of this form:

"Shell attaining a moderately large size, broad, oval and depressed in form, apex posterior and nearly or quite depressed to the margin, apparently subspiral; inner lip very broad or forming more than half the under side, rather thick, smooth, and nearly flat, or somewhat convex, with its straight inner margin sharp and without teeth or crenulations;

* "Of course the colors mentioned are not known to present the same *tints* in the fossil shells that ornamented them when the animal was alive."

outer lip thick, very obscurely crenate within, and apparently continuous with the margins of the inner one around behind; aperture transversely semicircular, and less than half the size of the under side of the shell. Surface ornamented by about fifteen simple, narrow, sharp, and subcrenate radiating costæ, separated by wider, rounded intermediate furrows; lines of growth distinct.

"Length about 0.87 inch; breadth, 0.70 inch; convexity, 0.35 inch.

"This is another curious form allied to the little species I have described under the name *N. bellatula*. When viewed from the dorsal side, as seen lying with the aperture downward, its form and strong radiating costæ give it much the appearance of the left valve of a *Cardita* or *Cardium*. The only specimen of it in the collection has its apex and posterior and lateral margins broken away, and its broad, smooth, shelf-like inner lips broken by pressure inward. Still, however, it gives a tolerably correct idea of the characters of the shell. In several respects it agrees with *Velates*, and possibly might without impropriety be called *Velates carditoides*. I suspect, however, that when better specimens can be examined it will be found typical of an undescribed section, including also the little species *N. bellatula*. If so, I would propose for the group the name *Velatella*. I know of no nearly allied type.

"*Locality and position*.—Carleton's coal-mine, Coalville, Utah. Cretaceous."

Genus EUSPIRA Agassiz.

EUSPIRA UTAHENSIS White.

This species was erroneously mentioned and described in the An. Rep. U. S. Geol. Sur. Terr. for 1877, under the name of *E. coalvillensis*. (See pages 237, 253, and 310; and also explanation of plate 4 of that volume.

Genus TESSAROLAX Gabb.

TESSAROLAX HITZII (sp. nov.)

Plate 15, fig. 2 a.

Shell rather small; length of the spire about one-half that of the whole body of the shell exclusive of the canals; its apex a little blunted; volutions about five, that of the body bearing two revolving angles or narrow ridges which apparently end respectively upon the two slender spines of the outer lip; the whole spire covered with a layer of callus which obscures the sutures, and also the original surface of the volutions upon which there are apparently some revolving lines; outer lip bearing two long slender spines projecting from its border, each being grooved upon its under surface; the anterior labial spine directed outward and forward, and having near its middle a moderate enlargement, where it is also bent a little downward; the posterior labial spine gradually and uniformly tapering from base to point, directed outward and slightly curved backward; anterior canal long slender and spine-like, flexed a little downward and to the left, its grooves being very narrow and linear; posterior canal also slender, its grooves being narrow and linear like that of the canal and the labial spines, extending from the aperture close alongside of the spire and projecting as a slender spine much beyond its apex, from which it gently curves to the right; the

callus which covers the shell apparently little if any thickened upon the inner lip.

Length, from the base of the anterior canal to the apex of the spire, 19 millimeters; breadth of body-volution, exclusive of the aperture and outer lip, 9 millimeters; breadth, including the aperture and outer lip, but excluding the labial spines, 14 millimeters.

The apices of both the anterior and posterior canals, and also of the posterior labial spine are broken off in the type specimen, but the anterior spine is entire, and the others are evidently nearly so, the anterior spine being 19 millimeters in length. The portion remaining of the posterior canal projects 5 millimeters beyond the apex of the spire, and that of the anterior canal projects 7 millimeters beyond the anterior border of the aperture. The anterior and posterior canal-spines and the posterior labial spine are each about $1\frac{1}{2}$ millimeters in diameter, the anterior labial spine being about double that width at its mid-length where it is broadest.

This shell appears to have borne no varices or tubercles upon the callus-covering of the body-volution such as characterizes the type species of *Tessarolax*. Mr. Gabb appears to have regarded that feature as of generic importance, but I am disposed to consider it as only a specific character.

Perhaps no family of shells with which the paleontologist has to deal is more in need of careful revision than the Aporrhaidæ. Of the various genera and subgenera which have been proposed by different authors, some doubtless ought to be rejected, but that all should be discarded and the species all referred to *Aporrhais*, as is the custom of some authors, appears to be unadvisable. The covering of the whole shell with callus, as in *Lispodesthes* and *Tessarolax* seems necessarily to have been correlated with characters in the animal which would separate it generally from such forms as those which American authors generally refer to *Anchura*. The character of the anterior and posterior canals and labial spines of such forms as *Tessarolax distorta* and *T. hitzii*, seem also sufficient to separate them generically from *Anchura*, *Lispodesthes*, and other proposed genera of the Aporrhaidæ.

Tessarolax and *Lispodesthes* are both entirely callus-covered forms, and both are yet known only in Cretaceous strata; to which also other forms of the Aporrhaidæ seem to be restricted. Aside from zoölogical considerations, perhaps the strongest conventional reason for retaining the generic distinctions which have been recognized in at least a part of the Cretaceous forms of this family lies in the fact that they seem to be characteristic of the Cretaceous period.

Position and locality.—The species here described was obtained, according to the records of the United States National Museum, by Dr. R. B. Hitz, from the Fort Pierre Cretaceous Group, at Fort Shaw, near Muscleshell River, Montana. The specific name is given in his honor.

Genus LISPODESTHES White.

LISPODESTHES? OBSCURATA (sp. nov.)

Plate 11, figs. 7 *a* and *b*.

Shell subfusiform; spire rather short, tapering with nearly straight sides to the apex; volutions six or seven, convex; last or body volution rather large, without a revolving angle; suture impressed; outer lip or wing comparatively small, as indicated by all the known specimens, its

outer border bearing a slender, tongue-like projection, which extends outward and forward from the anterior portion of the wing margin. The posterior portion of the wing is not accurately known, as all the specimens are more or less imperfect in that respect, but it seems not to have been prolonged backward in the form of a pointed projection, as it is in *Anchura* and the typical forms of *Lispodesthes*. That portion of the wing apparently formed a broad, short, blunt projection, which was broadly concave beneath, posteriorly; but there is in our examples no appearance of a true posterior canal such as characterizes the typical forms of *Lispodesthes*. Anterior canal comparatively broad and long; beak moderately broad, rounded at the anterior end, but with a shorter curve at the left side than at the right. Shell (the callus being removed) thin and delicate, its whole surface marked by very fine lines of growth, and also by very fine crowded raised revolving lines, which are a little more conspicuous than the former, but they all need a lens to render them distinctly visible. There is also a narrow, square shouldering of the distal border of the volutions of the spire at the suture.

Length, from the apex to the end of the anterior canal, 37 millimeters; breadth, across the body volution and wing, 18 millimeters.

Fig. 7 *a*, plate 11, represents a specimen with the entire callus removed, but with the shell proper remaining. Fig. 7 *b*, of the same plate represents an imperfect example with the spire, and a portion of the body volution still covered with callus. The indications furnished by the other specimens of the collection, all of which are imperfect, are that the whole shell, when adult, was covered with callus, as in *Lispodesthes* White and *Calyptraphorus* Conrad. This shell certainly does not belong to the latter genus, and it also presents some important differences from the typical forms of *Lispodesthes*. For example, it has evidently no posterior canal hollowed out of the callus and extending along the spire nearly or quite to the apex, as in the latter genus. This seems to be an important difference. A lesser one is the apparent absence of a falciform projection of the posterior portion of the wing. It agrees with *Lispodesthes* in general form, in the callus-covering of the whole shell, and the anterior tongue-like projection from the wing. I therefore refer it provisionally to that genus, notwithstanding the differences before mentioned, because no other one of the numerous established genera of the Aporrhaidæ will receive it; and because the examples yet known will not warrant a full generic diagnosis. For some general remarks on related genera, see paragraph following description of the preceding species.

Position and locality.—The only specimens yet known, which are certainly referable to this species, were collected by Dr. Hayden at “Dodson’s Ranch, near Pueblo, Colorado”; apparently from strata of the Fox Hills Group. A few imperfect examples found in the Cretaceous strata at Bear River City, Southern Wyoming, perhaps belong to this species, but they were found only in the condition of casts of the internal cavity.

Genus TURRITELLA Lamarck.

TURRITELLA SPIRONEMA Meek.

Plate 12, fig. 3 *a*.

Turritella spironema Meek, 1873, An. Rep. U. S. Geol. Sur. Terr. for 1872, p. 503.

“Shell rather small, or scarcely attaining a medium size, elongate-conical; volutions about fifteen, increasing very gradually in size, mod-

erately convex, last one rounded in the middle; aperture apparently ovate; columella rather regularly arcuate. Surface ornamented by squarish, rather regular, revolving, thread-like lines, with nearly equal furrows between; about five to seven or eight of the lines and furrows are seen on each of the turns of the spire, and nearly twice as many on the body-whorl, where those below the middle become abruptly smaller and more crowded than those above; lines of growth obscure and gently arched in crossing the volution; suture moderately distinct.

"Length of the largest specimen found, 0.82 inch; breadth of body-volution, 0.23 inch; spire nearly regular, divergence of its slopes, about 17° .

"There is a slightly polished appearance of the surface of this shell that is not often seen in true *Turritella*, and gives origin to some doubts whether it may not belong to some group allied to *Aclis* or *Menestho*. As in size and general appearance, however, it seems to correspond more nearly to *Turritella*, I have concluded to refer it provisionally to that genus until better specimens can be obtained for study and comparison. None of those yet seen show satisfactorily the exact form of the aperture.

"*Locality and position.*—Carleton's coal-mine, Coalville, Utah. Cretaceous."

The foregoing is Mr. Meek's description of, and remarks upon, this species, to which no material addition can be made, because no other examples have ever been discovered. As already shown, in remarks following the description of *Cyrena carletoni* on a previous page, and also by Mr. Meek (*loc. cit.*), the estuary Cretaceous fauna at Coalville, Utah, contains some forms that must be regarded as marine, as well as some that we must necessarily regard as of fresh-water origin. It is also worthy of remark that some of the species of that fauna, whose living representatives usually characterize brackish waters, have congeneric representatives in the marine Cretaceous strata of the same neighborhood. In this remark more especial reference is made to the Neritidæ, but it may be suggested that the fauna of those strata was to some extent affected or modified by its proximity to the then existing coast. On the other hand, it is not quite so easy to account for the existence of so many forms that are regarded as wholly marine among the estuary forms, unless we assume that all the fresh-water and a part of the brackish-water forms were drifted from fresh and less saline waters to those in which the deposit was made.

Genus EULIMELLA Forbes.

EULIMELLA? CHRYSALLIS Meek.

Plate 12, fig. 4 a.

Eulima? chrysallis Meek, 1873, An. Rep. U. S. Geol. Sur. Terr. for 1872, p. 506.

No other examples of either this or the following species than those collected by Mr. Meek have ever been discovered. Therefore no material addition can be made to his description, which is as follows:

"Shell small, elongate-subconoid, or subfusiform; spire-conical; volution about eight, flattened nearly to the slope of the spire; suture nearly linear; aperture subovate; inner lip a little reflected and moderately arched; outer lip unknown; surface smooth.

"Length about 0.29 inch; breadth 0.12 inch.

"I am by no means sure that this is a true *Eulima*, not having seen

any specimen showing very clearly the form of the aperture or the nature of the outer lip. It has the general aspect of that genus, however, and may be placed there provisionally for the present until better specimens can be obtained for study. It will be at once distinguished from the last* by a less produced spire, less numerous volutions, and proportionally larger body-whorl.

“*Locality and position.*—Carleton’s coal-mine, near Coalville, Utah. Cretaceous.”

Among a considerable number of examples of the *Eulima?* *funicula* of Meek, which have been collected from the marine Cretaceous strata both at Coalville and at the North Fork of Virgin River, Utah, are some which indicate a nearer relation to *Eulimella* than to *Eulima*. I have, consequently, in other writings,† referred that species provisionally to the former rather than to the latter genus. The two species from the estuary beds at Coalville, described and figured in this article, seem to be congeneric with *E. funicula*, and I therefore refer these also to *Eulimella*, with similar doubt.

EULIMELLA? INCONSPICUA Meek.

Plate 12, fig. 5 a.

Eulima? *inconspicua* Meek, 1873, An. Rep. U. S. Geol. Sur. Terr. for 1872, p. 507.

“Shell small, conoid-subovate; spire conical; volutions eight or nine, a little convex, compactly coiled; suture distinct; aperture apparently subovate; surface smooth.

“Length 0.17 inch; breadth 0.07 inch; spire with straight slope that diverges at an angle of about 22°.

“This is another form that I only refer with great doubt to *Eulima*, the specimen not being in a condition to show the exact form and nature of the aperture. It will be readily distinguished from the last by its more convex volutions, proportionally shorter spire, and more expanded body-whorl. It is probably not a *Eulima*.

“*Locality and position.*—Carleton’s coal-mine, near Coalville, Utah. Cretaceous.”

See remarks following the description of the preceding species.

Genus VALVATA Müller.

VALVATA NANA Meek.

Plate 12, figs. 17, a and b.

Valvata nana Meek, 1873, An. Rep. U. S. Geol. Sur. Terr., for 1872, p. 507.

This also is one of the species embraced in the estuary fauna of the Cretaceous strata at Coalville, the only known examples of which were discovered by Mr. Meek. It seems to be a true *Valvata*, and as such its discovery adds another fact to those already known concerning the early differentiation of certain molluscan types which characterize more recent fossil, as well as existing, fresh-water faunæ. The following is Mr. Meek’s description:

“Shell small, depressed subglobose, or subdiscoidal; spire depressed; volutions three and a half, rounded, suture deep; umbilicus compara-

* *E. funicula*, which is figured on plate 9, Cont. Pal. No. 1, An. Rep. for 1877.

† See Expl. and Sur. West of the 100th Merid. (Wheeler), vol. iv, p. 197, pl. xviii, fig. 6. Also, An. Rep. U. S. Geol. Sur. Terr. for 1877, p. 316, pl. 9, fig. 10.

tively small; aperture rounded-suboval; surface nearly smooth, or only showing fine, obscure lines of growth under a magnifier.

"Breadth of largest specimen, 0.12 inch; height about 0.08 inch.

"Compared with *V. subumbilicata* M. & H., from the Tertiary lignites of the Upper Missouri country, this little shell will be readily distinguished by its smaller umbilicus, more prominent spire, and more oval aperture. It has also a smaller umbilicus and a less rounded aperture than the recent *V. sincera*. Its spire is more depressed, its aperture more oval, and umbilicus rather smaller than the living species, *V. tricarinata*, var. *simplex* Say.

"*Locality and position*.—Carleton's coal-mine, Coalville, Utah. Cretaceous."

Genus FUSUS Lamarck.

FUSUS ? UTAHENSIS Meek.

Plate 12, fig. 2 a.

Fusus (*Neptunea*) *utahensis* Meek, 1873, An. Rep. U. S. Geol. Sur. Terr., for 1872, p. 505.

"Shell of moderate size, short fusiform; spire rather depressed, conical; volutions four; those of the spire a little convex; last one large and ventricose, rounded or very slightly flattened around the middle, and contracted rather rapidly below into a narrow canal that is longer than the spire, and more or less bent to the left; aperture rhombic, angular above and narrowed and prolonged into the canal below surface, as determined from a cast in sandstone, with obscure vertical ridges, about twelve of which may be counted on the penultimate volution, while on the last or body-whorl they become nearly or quite obsolete. Revolving lines probably also marked the surface of the shell, though no traces of anything of the kind are seen on the cast, except a shallow furrow above the suture on the volutions of the spire.

"Length, including canal, about 1.90 inches; breadth, 0.91 inch; angle of spire, about 67°.

"As in the last,* we have not the means of determining the generic characters of this species with any degree of certainty, and merely place it provisionally in the genus *Fusus* with *Neptunea* in parenthesis, to indicate that it may be found to belong to that group. It is a rather decidedly larger shell than the last (*F. gabbi*), with a distinctly less elevated spire, and more obscure vertical ribs or varices.

"*Locality and position*.—Coalville, Utah; from 'Chalk Hill,' considerably above the heavy bed of coal mined there. Cretaceous."

Only a single example, the one figured on plate 12, was found among the collections obtained and studied by Mr. Meek, but this was labeled in his handwriting, and is evidently his type. It is a well-marked species, but it is known only by imperfect casts in sandstone.

Genus FASCIOLARIA Lamarck.

Subgenus PIESTOCHEILUS Meek.

FASCIOLARIA (PIESTOCHEILUS) ALLENI (sp. nov.)

Plate 12, fig. 1 a.

Shell slender, fusiform; spire, from the distal end of the aperture to the apex, one-third longer than the aperture; volutions about eight,

* *F. gabbi*, figured on plate 9 of Contributions to Paleontology No. 1, published in the Annual Report of this Survey for 1877.

moderately convex, increasing uniformly in size; last volution not expanded disproportionately with the other volutions, tapering gradually forward into a moderately long and somewhat stout beak, which is a little deflected to the left; aperture narrow, lance-ovate in outline, acutely angular at its distal end, and ending anteriorly in the canal formed by the beak before mentioned; columella nearly straight, its folds not seen; outer lip gently sinuous, its general direction approximately parallel with the axis of the shell. Surface, especially that of the last volution, marked by strong lines of growth and also by faint revolving lines. The distal border of the volutions is also marked by a ridge or narrow shoulder adjacent to the suture, which has the appearance of consisting of one or more strongly raised revolving lines.

Length, 80 millimeters; breadth of last volution, 20 millimeters; length of aperture, including canal, 33 millimeters.

This species is closely related to *F. (P.) culbertsoni* Meek & Hayden, but it differs in the much greater proportionate length of the spire, and in the elevation or shouldering of the distal border of the volutions, upon the proximal side of the suture.

Position and locality.—Cretaceous strata, valley of Yellowstone River, Montana, where it was collected by Mr. J. A. Allen, and in whose honor the specific name is given.

CEPHALOPODA.

Genus PRIONOCYCLUS* Meek.

PRIONOCYCLUS WYOMINGENSIS Meek.

Plate 15, figs. 1 *a*, *b*, *c*, *d*, and *e*.

Ammonites (Pleuroceras) serrato-carinatus Meek, 1871, An. Rep. U. S. Geol. Sur. Terr. for 1870, p. 298.

Prionocyclus wyomingensis Meek, 1876, U. S. Geol. Sur. Terr., vol. ix, p. 452.

Shell discoidal; umbilicus broad; volutions very slightly embracing or sometimes merely in contact, comparatively slender, the vertical diameter of the outer volutions about one-third greater than the transverse diameter, but this difference between these dimensions of the inner volutions is greater than that of the outer; outer sides of the volutions flattened, convex, and abruptly rounded to both the peripheral and umbilical sides, the former side bearing along the median line a sharply-raised, strong carina, the edge of which is studded with more or less distinct small tubercles or serrations; sides of the volutions marked with numerous transverse sharply-raised costæ, which become obsolete upon the umbilical side, and upon reaching the peripheral side they all bend abruptly forward, and become obsolete before quite reaching the carina. These costæ are small and of nearly uniform size in very young examples, but they gradually increase in size with the growth of the shell, and a part of them become stronger than the others, and usually every third or fourth costa is strengthened towards its inner end, and occasionally towards its outer end also, by the coalescence there with the adjacent costa in front of it.

At the points of the coalescence and also upon some others of the larger costæ, more or less distinct but somewhat irregular tubercles are

* For generic diagnosis of this genus and a subgenus *Prionotropis*, see U. S. Geol. Sur. Terr., vol. ix, pp. 452-455.

formed in rows, one being near the outer and the other near the inner border of the side of the volution. Upon the outer volution of very large shells the stronger costæ become still stronger, the intermediate ones comparatively less distinct, and the plain space at each side of the carina becomes a narrow depression. Septa having complex sutures, showing one peripheral and two lateral lobes, besides the crenulations of the auxiliary series and the secondary lobe of the outer lateral cell; also two full lateral cells, one being large and double and the other small; peripheral lobe narrow, rudely wedge-shaped, the point being directed backward; first lateral cell broad, and made almost double by the presence of a secondary lobe at its middle; median or first lateral lobe large, but not so broad as the first lateral cell, including both its divisions; second lateral cell somewhat smaller than either of the divisions of the first lateral cell; second or inner lateral lobe smaller than second lateral cell, and scarcely larger than the secondary lobe at the middle of the first lateral cell; third or inner lateral cell not distinct as such except upon the side adjacent to the second lateral lobe, its outer end being continuous with the auxiliary series, which consists of an irregular crenulated suture, extending not only to the next volution within, but also to the inner median line, the latter part of it, however, being covered by the embraced periphery of the next volution within.

The borders of both lobes and cells are studded with short branches, serations, and crenulations as shown in fig. 1 *c*, plate 15. The first lateral cell might with propriety be regarded as two separate cells, and its secondary lobe as a small primary one, but I have followed this method of their description, because it is the one adopted by Mr. Meek, the author of the genus, in his description of species under it. The siphuncle is of ordinary size, and is placed at the base of the peripheral carina, having a part of its diameter projecting within the base of the carina, which it so weakens that the latter is usually broken off in the imbedding rock.

This shell often reached a large size, some of the examples indicating a diameter of coil little if any less than twenty-five centimeters.

Although Mr. Meek made this species the type of his genus *Prionocyclus*, he never either described or figured it. The identity of the specimens upon which this description is based, and a part of which are represented by figures upon plate 15 is, however, unquestionable, because he placed them in my hands as his types before his death. The specimens are somewhat numerous, but none of them are in a very satisfactory condition of preservation. No attempt will now be made to discuss the relation of this type to other proposed genera of Ammonitidæ, the principal object being, so far as practicable, to illustrate all the forms among the collections of the survey that have hitherto been described but not figured.

Position and locality.—Cretaceous strata; probably of the Colorado Group; Valley of Medicine Bow River, Wyoming.

ARTICULATA. CRUSTACEA.

Genus PARAMITHRAX Milne-Edwards.

PARAMITHRAX ? WALKERI Whitfield.

Plate 16, fig. 1 *a*; and Plate 17, fig. 1 *a*.

Both description and figures of this Brachyuran have been furnished by Prof. R. P. Whitfield for this report, for which he is sole authority. It is an exceedingly interesting addition to our knowledge of the Cretaceous Crustacea; and especially so because remains of this class are so rare in American Cretaceous rocks.

"This species is represented only by the claw and part of the penultimate joint of the right anterior limb. The specimen is of a short, rather compact and robust form, and somewhat triangular in transverse section. The length of the hand, from its articulation with the preceding joint to the base of the fixed mandible, bears the proportion to the height and thickness that seven does to five and four; the latter measurement being exclusive of the nodes. The mandibles, both fixed and movable, are distinctly round, without any flattening or carination; are gently and nearly equally curved throughout their length, and the articulating processes strong and robust. The hand is somewhat flattened on the inside and angular on the outer surface; the angulation being rather below the middle of the height, giving it the triangular form. The next preceding joint is only preserved in part; it is strong, obliquely ovate in form, and provided with a large flattened basal projection near the inferior articulation.

"Surface of the specimen, with the exception of the inner face of the mandible, marked by numerous strong spine-like nodes or tubercles, which have probably been spines on the surface of the shell (the specimen being an internal cast). These nodes are arranged in longitudinal lines on the outside of the claw, and partly so on the inside; but on the latter there is also a line of large nodes extending obliquely downward from the upper edge, parallel to the margin of the socket of the movable mandible, and at a short distance from it, and continuing upon the mandible. The preceding joint is also marked by lines of strong nodes; a double transverse line on the inside parallel to the anterior margin, but divided from it by a broad, rounded channel, and a single line of stronger nodes on the outside. The flattened area forming the basal projection of the joint is also bordered by nodes.

"The specimen, being an internal cast only, does not furnish the exact features of the shell itself, and as there is only a part of the limb known it is difficult to determine the generic characters in a satisfactory manner. There would appear to be but little reason to doubt, from its spiny character and the round claws, its relations to the group commonly called spider-crabs. Still there are some features which seem to differ from those of the generality of the species of that group, and it is therefore with some hesitation that I have referred it to the family Maiadæ, and still more doubtfully to the genus *Paramithrax*; but I am not able to find any genus of strictly fossil crustaceans to which it

seems so nearly allied. The specimen is of interest on account of its large size, and also as being the first of this group of crustaceans yet recognized from the Cretaceous formations of this country.

“*Locality and formation.*—The specimen here described and figured was obtained from the Cretaceous rocks near San Antonio, Texas, by Mrs. N. S. Walker, of that place, and in honor of whom the specific name is given.”

APPENDIX TO CONTRIBUTIONS TO INVERTEBRATE PALEONTOLOGY, NO. 2.

The late Dr. B. F. Shumard had, before his death, prepared drawings of a part of the fossils which he had from time to time previously published in the Trans. Saint Louis Acad. Sci. and the Proc. Bost. Soc. Nat. Hist. These drawings were never published by him, but he procured photographic copies of a part of them for the late Mr. F. B. Meek. The last-named gentleman, at the time of his death, left these copies in possession of this Survey. A few of them were reproduced among the illustrations of Cretaceous fossils in the annual report of this Survey for 1877. It is deemed of importance that the public should have, as far as possible, the means for identifying the species that have been described by Dr. Shumard, and therefore all the remaining figures that are available, as just stated, which represent Cretaceous species, are reproduced in this report. All the figures on plate 18 are thus reproduced, besides one of those on plate 16.

It is not deemed expedient at this time to either republish Dr. Shumard's descriptions of these fossils, or to enter into any discussion of the subjects which they may suggest. Therefore, only a list of the names he gave them will be here given, together with references to the figures and to the places where the descriptions are published.

CIDARIS HEMIGRANOSUS Shumard.

Plate 18, figs. 2 *a* and *b*.

For description see Trans. Saint Louis Acad. Sci., vol. i, p. 609.

GERVILLIA GREGARIA Shumard.

Plate 18, fig. 3 *a*.

For description see Trans. Saint Louis Acad. Sci., vol. i, p. 606

NUCULA BELLASTRIATA Shumard.

Plate 18, figs. 5 *a*, *b*, and *c*.

For description see Proc. Bost. Soc. Nat. Hist., vol. viii, p. 202.

NUCULA HAYDENI Shumard.

Plate 18, figs. 6 *a* and *b*.

For description see Trans. Saint Louis Acad. Sci., vol. i, p. 602.

CARDIUM CHOCTAWENSE Shumard.Plate 18, figs. 7 *a*, *b*, and *c*.

For description see Trans. Saint Louis Acad. Sci., vol. i, p. 599.

CYTHERIA LAMARENSIS Shumard.Plate 18, figs. 4 *a* and *b*.

For description see Trans. Saint Louis Acad. Sci., vol. i, p. 600.

ANCYLOCERAS ANNULATUM Shumard.Plate 18, figs. 10 *a* and *b*.

For description see Trans. Saint Louis Acad. Sci., vol. i, p. 595.

SCAPHITES VERMICULUS Shumard.Plate 18, fig. 8 *a*.

For description see Trans. Saint Louis Acad. Sci., vol. i, p. 594.

AMMONITES GRAYSONENSIS Shumard.Plate 18, figs. 9 *a* and *b*.

For description see Trans. Saint Louis Acad. Sci., vol. i, p. 593.

AMMONITES SWALLOVII Shumard.Plate 18, fig. 1 *a*.

For description see Trans. Saint Louis Acad. Sci., vol. i, p. 591. See also Expl. and Sur. West of the 100th Meridian, vol. iv, p. 202, pl. XX, fig. 1 *a*, *b*, and *c*.

THE HISTORY OF THE

REIGN OF KING CHARLES THE FIRST

IN THE YEAR 1649

BY JOHN BURNET, BISHOP OF SALISBURY

IN TWO VOLUMES

LONDON

Printed by J. Sturges, at the Angel in St. Dunstons Church-yard

1724

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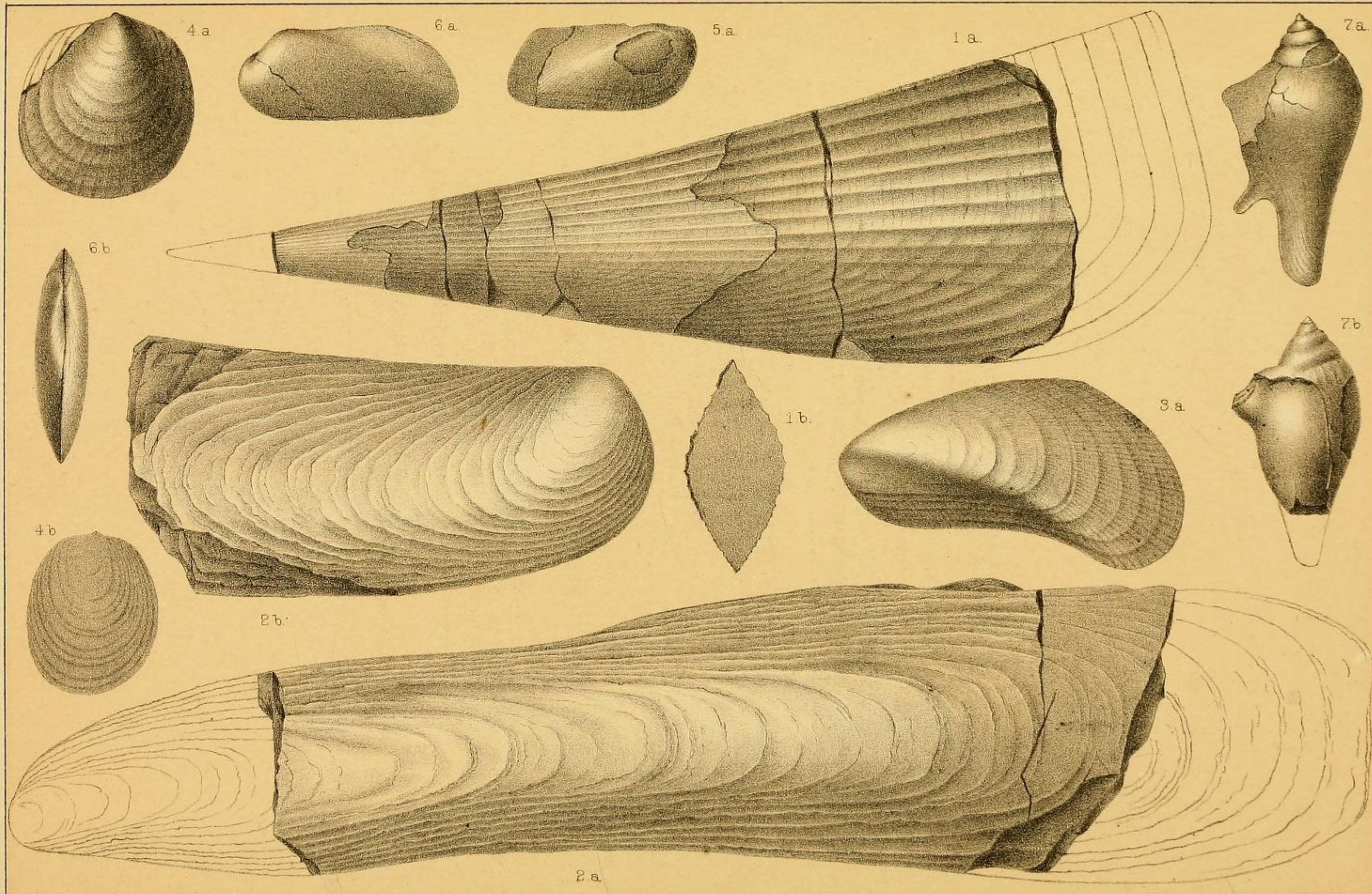
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IN TWO VOLUMES

THE HISTORY OF THE
REIGN OF KING CHARLES THE FIRST
IN THE YEAR 1649
BY JOHN BURNET, BISHOP OF SALISBURY

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THESE PAPERS WERE FOUND IN A BOX
CONTAINING A NUMBER OF OTHER
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AND WERE FOUND IN THE
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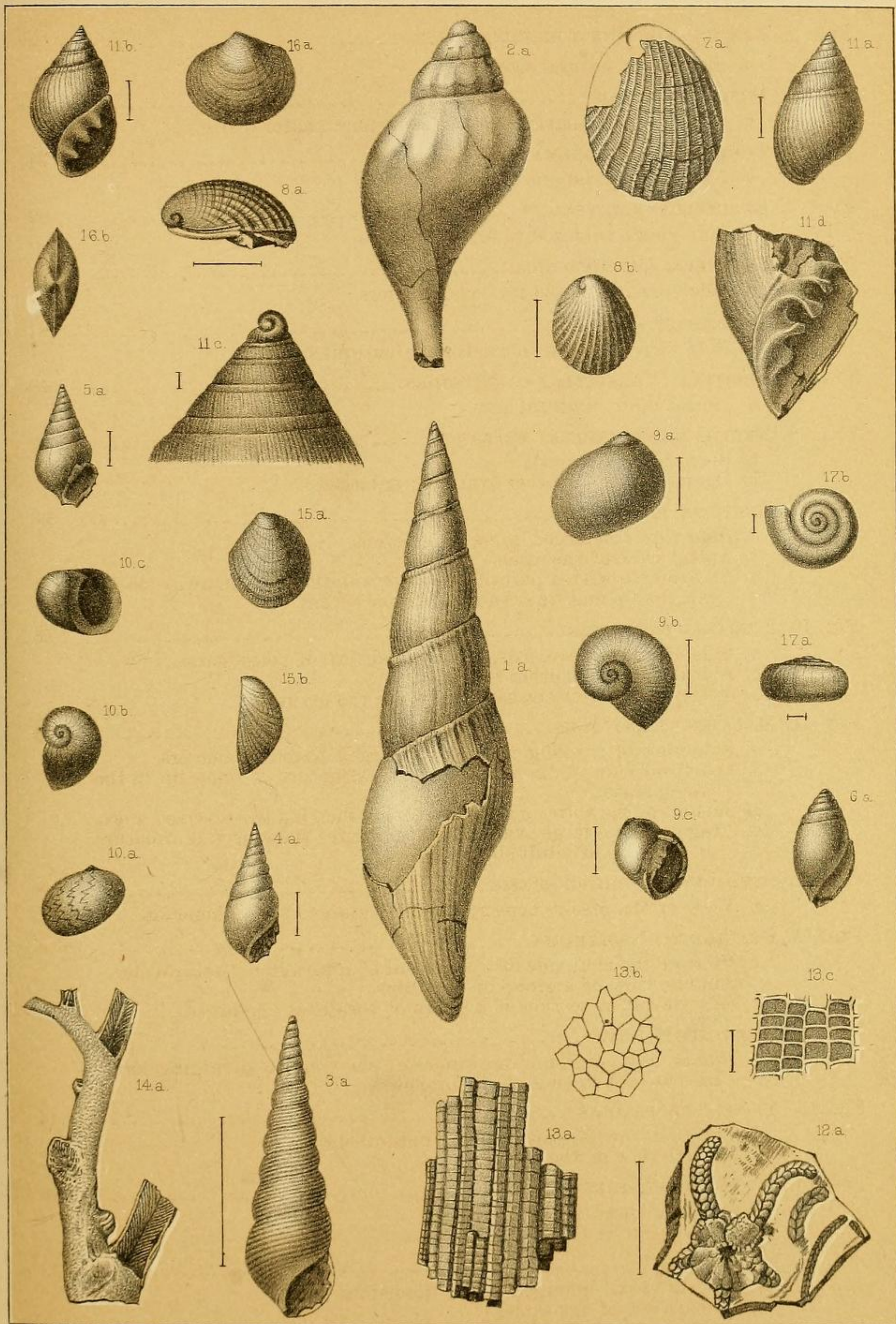


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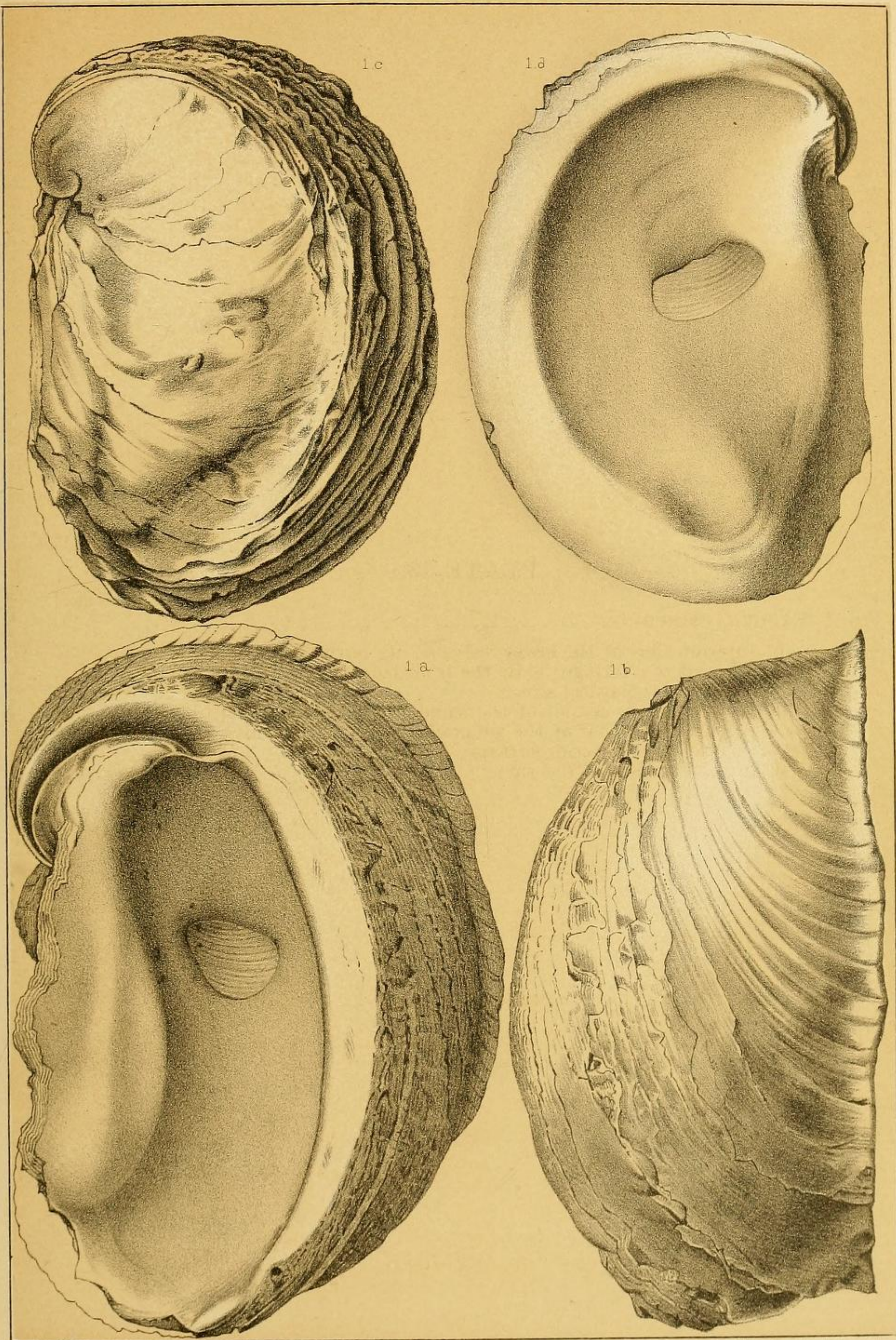


PLATE II

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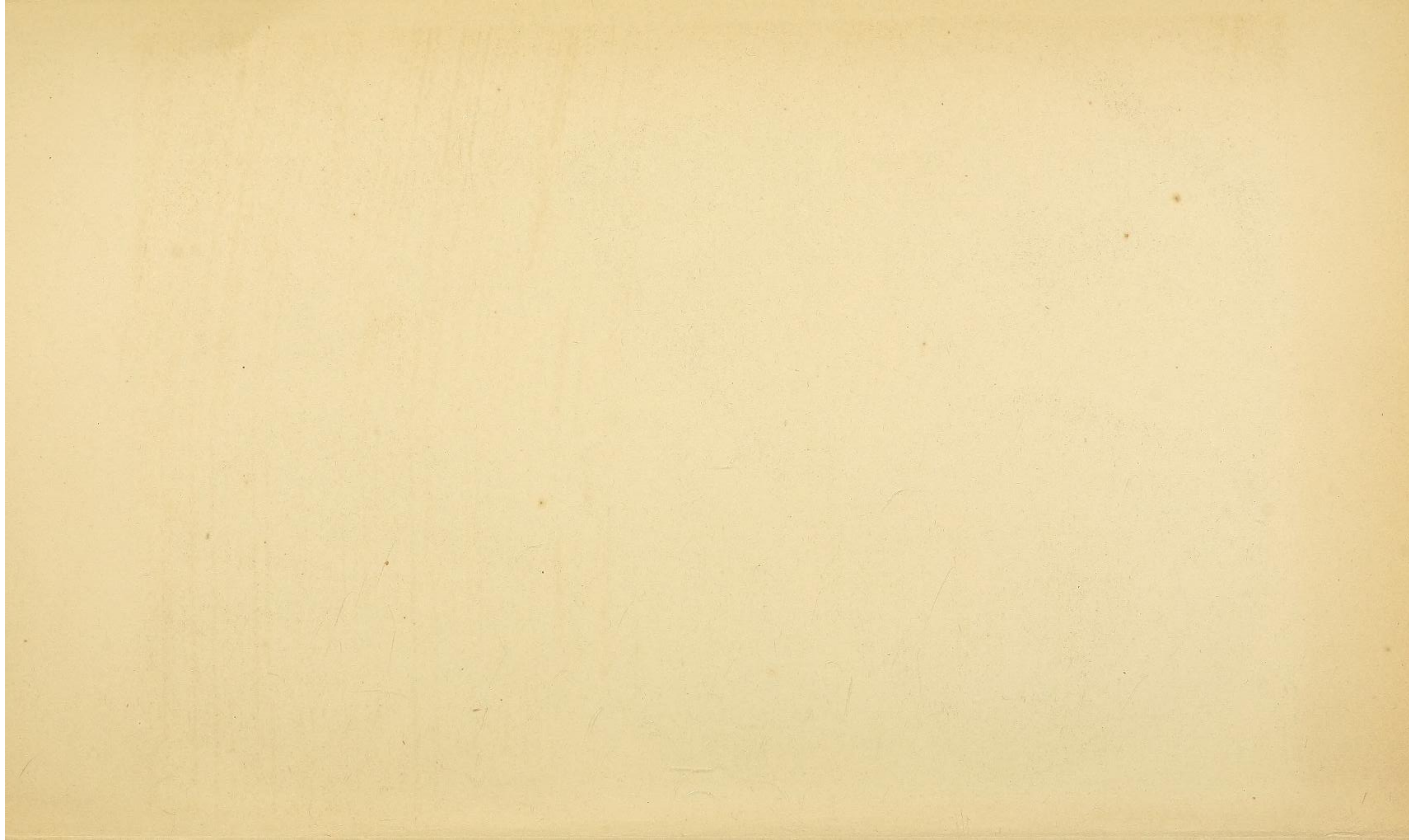


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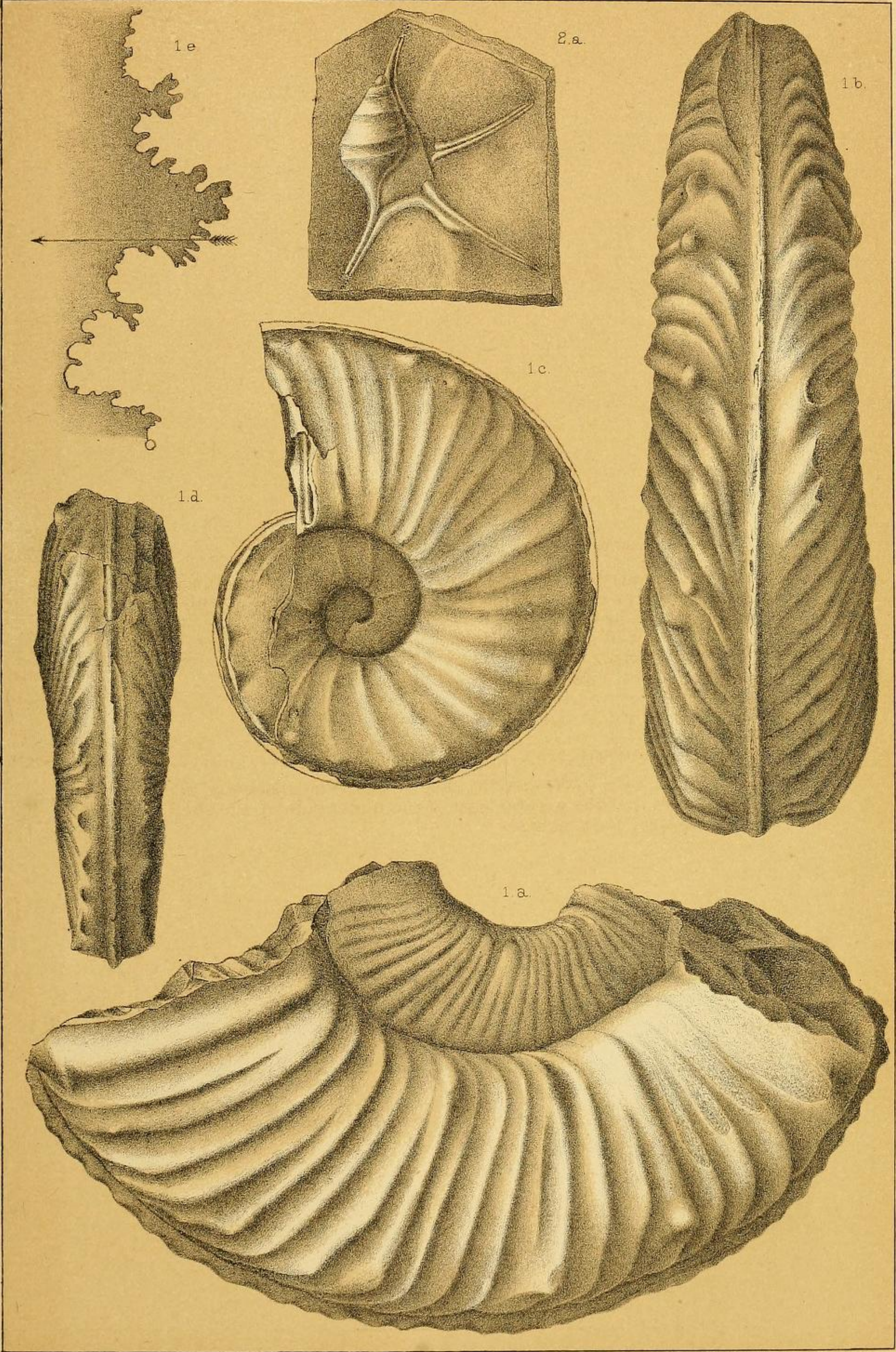


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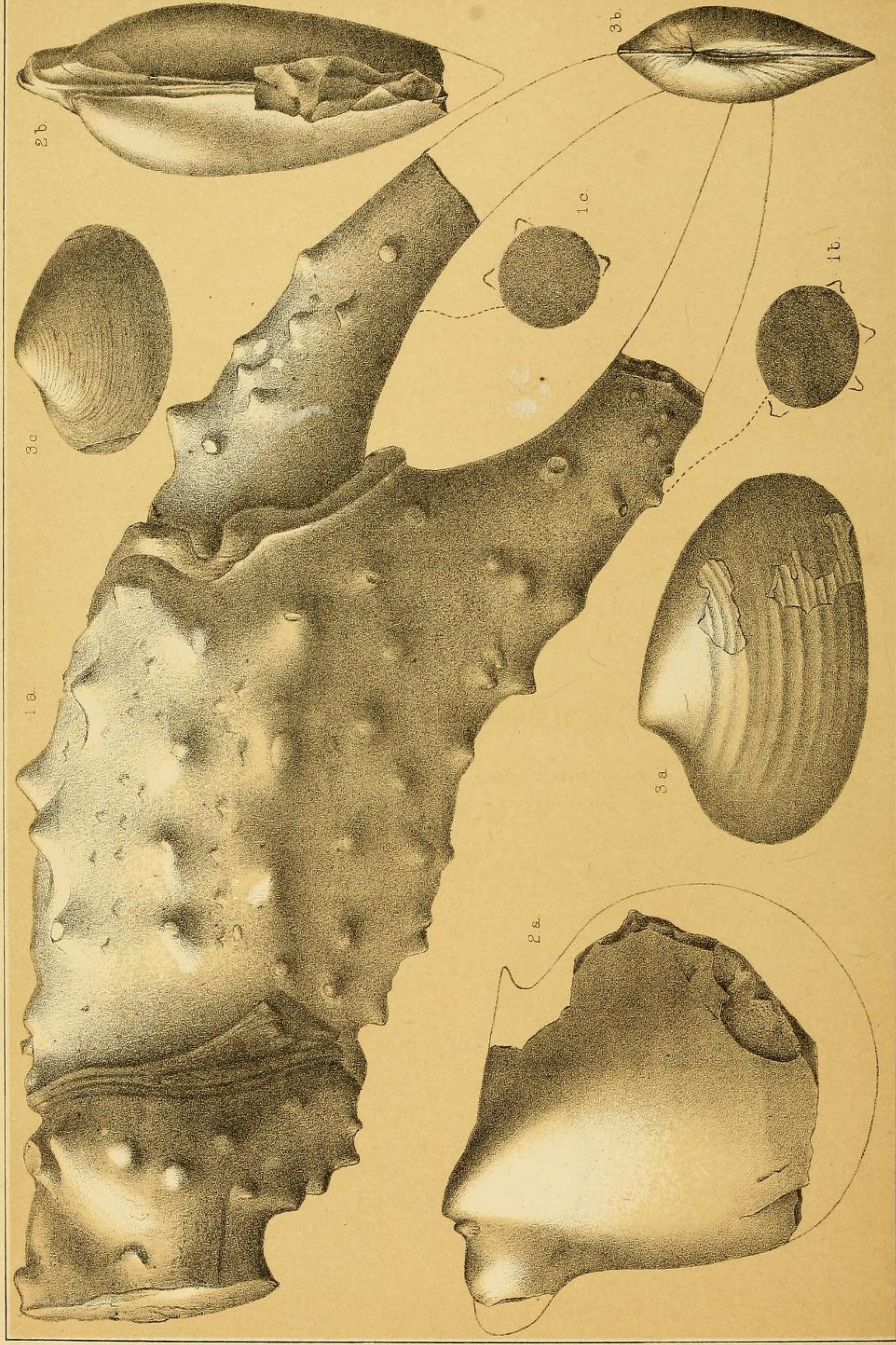


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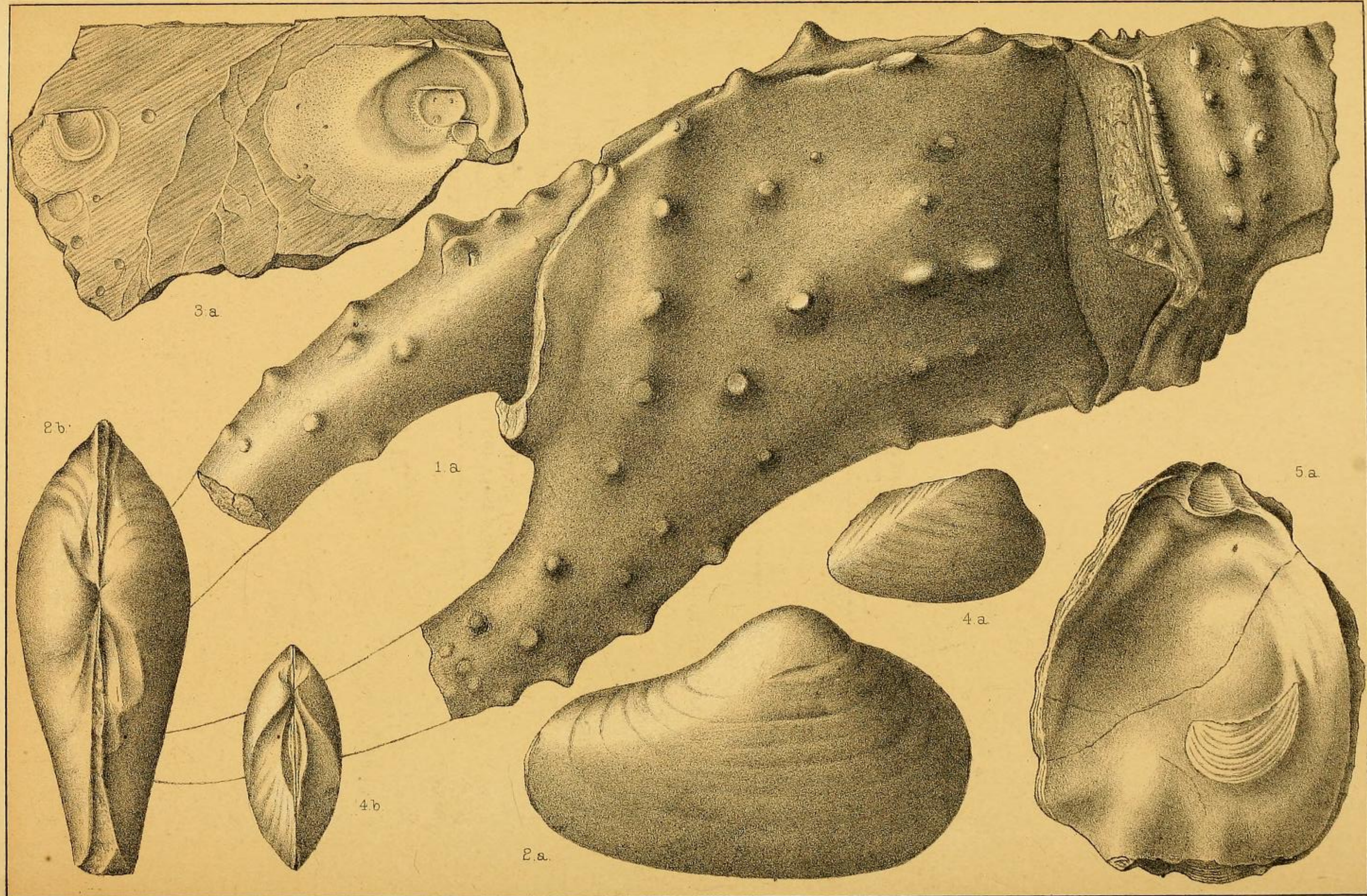


PLATE 18.

[Illustrating species published by Dr. B. F. Shumard.]

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