

SOME UPPER CRETACEOUS SHELLS OF THE RUDISTID GROUP FROM TAMAULIPAS, MEXICO.

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OCCURRENCE.

In March, 1920, the writer, while in the employ of the Mexican Gulf Oil Co. (through the courtesy of whose officials this paper is now published), discovered a few rudistids, representing several species, associated with several other invertebrate species, in strata of Upper Cretaceous age on two American-owned haciendas known, respectively, as Chocoy and Las Flores (or Manuel), on the line of the National Railways of Mexico between Tampico and Monterrey, in the State of Tamaulipas, Mexico. Chocoy is owned by Mr. A. W. Beckley, of Tampico, and Chocoy station is about 71 kilometers northwest of Tampico. Las Flores is owned by Smith, Newell, and Bishop, of Tampico, and Manuel station is 81 kilometers northwest of Tampico.

Subsequent to my first visit to these haciendas additional discoveries of rudistids and a few other invertebrates were made on Las Flores hacienda by Mr. R. A. Bishop and on Chocoy hacienda by Mr. Beckley and myself, as explained on subsequent pages. It is my pleasure at this place to express my appreciation to the owners of these properties for the courtesies which they extended to me on the occasion of each of these visits.

Two specimens of rudistids belonging to separate genera, found on Chocoy hacienda in 1919 by Messrs. A. E. Fath and Eugene Stebinger, have been kindly placed at the writer's disposal, and one of the specimens has been made the type of the new species *Sauvagesia coloradensis*.

The fossils were found in part in the uppermost beds of the San Felipe formation, which is brought to the surface in this area by broad anticlinal folds, and in part in the overlying Mendez formation. The San Felipe formation consists of 700 or 800 feet (200-250 meters) of regularly bedded platy limestone with subordinate interbedded seams and thin layers of calcareous shale, there being, how-

ever, some thicker bedded layers of shale in the upper part of the formation. The Mendez formation conformably overlies the San Felipe formation, and in this part of Mexico consists of about 800 feet (250 meters) of calcareous shale or marl ranging in color from gray or greenish gray through pale pink to rather strong red. The thickest and most persistent bands of red are in the upper part of the shale. The dividing line between the Mendez shale and the underlying San Felipe limestone has been arbitrarily taken to be the top of the uppermost layer of limestone, but there are some rather thick layers of Mendez-like shale interbedded with thinner beds of limestone below this uppermost limestone layer. The Mendez shale is unconformably overlain in the easternmost part of Chocoy hacienda by marine strata of Tertiary age.

The topography in the vicinity of Manuel and Chocoy stations is rather strongly rolling and prairie-like, and the surface is drained by arroyos which are dry except during rainy periods. The fossiliferous outcrops examined were in the beds and banks of these arroyos, in gullies, and in railroad cuts. Most of the fossils collected on my first visit were found loose in the beds of the arroyos, but some of them contained attached portions of matrix, which showed them to have been derived from the shale and limestone cut by the arroyos, and some fragments of *Inoceramus* and *Ostrea* were found definitely in place in the shale. Subsequently Mr. Bishop found crinoid stems in place in layers of San Felipe limestone at two localities, and he also found in the Mendez shale the colony of rudistids described on pages 6 to 8 as *Tampsia bishopi*. Mr. Beckley and the writer also found the colony of rudistids described on pages 8, 9 as *Tampsia choceyensis* virtually in place in the Mendez shale.

THE FOSSILS AND THEIR SIGNIFICANCE.

The fossils found in the upper part of the San Felipe formation on Las Flores and Chocoy haciendas include: Foraminifers; an organism whose zoological affinities have not yet been determined, perhaps a hydroid or a coral; stems of crinoids belonging to the genus *Balanocrinus* in the family Pentacrinidae; an undescribed brachiopod; numerous fragments of the shells of one or more large species of *Inoceramus*; *Ostrea plumosa* Morton; *Ostrea congesta* Conrad (?); representatives of the family Radiolitidae, including *Sawagesia degolyeri* Stanton (?), *Durania manuelensis* Stephenson, and poorly preserved fragments probably representing several other species of *Sawagesia*.

Outside of these haciendas fossils were found in the San Felipe limestone at two localities in the State of Tamaulipas. One of these was on the road leading from Ciudad Victoria eastward to Soledad,

about 10 kilometers west of Soledad and 3 kilometers east of the crest of Tamaulipas range. The fossils were in a white, rather soft limestone and included fragments of a large species of *Inoceramus* comparable with *I. deformis* Meek; to these fragments were attached many small, irregular oysters which, though poorly preserved, have the general appearance of *Ostrea congesta* Conrad. The exact stratigraphic position of this fossil layer could not be determined, but it is probably not less than 200 or 300 feet (60 to 90 meters) below the top of the formation.

The second locality was at the village of Santa Isabel, 21 or 22 kilometers east of Forlon station on the National Railways of Mexico; this station is 167 kilometers northwest of Tampico. Numerous fragments of large *Inoceramus* shells with *Ostrea congesta* Conrad(?) attached and one poorly preserved rudistid were observed in characteristic San Felipe rocks composing a fence, the stones of which were obtained from outcrops of San Felipe limestone in the immediate vicinity of Santa Isabel; the stratigraphic position of these outcrops is thought to be about the middle of the formation.

The fossils found in the lower part of the Mendez shale include: Foraminifers; stems of crinoids of the genus *Balanocrinus*; echinoid spines; fragments of *Inoceramus*; *Ostrea plumosa* Morton; representatives of the family Radiolitidae, including *Sauvagesia belti* Stephenson and unidentified fragments of *Sauvagesia*.

The upper part of the Mendez yielded: Foraminifers; a few crinoid stems of the genus *Balanocrinus*; a few plates of an echinoid test; representatives of the family Radiolitidae, including *Tampsia bishopi* Stephenson, *T. chocoyensis* Stephenson, and *Sauvagesia coloradensis* Stephenson.

On the basis of the large fragments of *Inoceramus* and of *Ostrea congesta* Conrad (?), the San Felipe formation is correlated with the Austin chalk of Texas and with the Niobrara chalk of the western interior of the United States.

Ostrea plumosa Morton, which occurs in both the upper part of the San Felipe limestone and the lower part of the overlying Mendez shale, has a stratigraphic range in the Atlantic and Gulf Coastal Plain of the United States from the horizon of the upper part of the Austin chalk to the top of the Cretaceous.

Sauvagesia belti Stephenson, which is represented by one specimen from the lower part of the Mendez shale, is closely related to and perhaps specifically identical with a species of *Sauvagesia* that occurs in the Brownstown marl near White Cliffs, Arkansas. Since the Brownstown marl corresponds in age to the lower part of the type Taylor marl, *S. belti* affords a basis for regarding the Mendez shale as approximately equivalent to the Taylor marl.

So far as my present knowledge of the subject goes, the San Felipe limestone appears to correspond approximately in age to the San Juan limestone of Dumble.¹ The Mendez shale undoubtedly corresponds to at least a part of the Papagallos shale of Dumble, but there appear to me to be good reasons for believing that the Papagallos includes beds that are stratigraphically higher than the typical Mendez as it is developed in the southeastern part of the State of Tamaulipas.

Future critical study of the foraminifera which abound in both the San Felipe and Mendez formations will in my opinion result in the discrimination of faunal zones that will make possible a close correlation of these formations with beds of corresponding age in northern Mexico and in Texas. Inasmuch as the Mendez shale and the Taylor marl were laid down under similar conditions of deposition, a comparison of the foraminiferal faunas of these two formations ought to be particularly fruitful of results.

The crinoids from the upper part of the San Felipe formation and from the lower and upper parts of the Mendez shale are described and their significance discussed by Dr. Frank Springer in Article 5 of this volume of the Proceedings. The crinoid stems are all referred to the genus *Balanocrinus* in the family Pentacrinidae, and are described under the new specific name *B. mexicanus*.

DESCRIPTIONS OF NEW FORMS.

TAMPسيا, new genus.

The two forms described below under the specific names *Tampسيا bishopi* and *T. chocoyensis* present generic characters which apparently have not been heretofore described. The lower valve is large, elongate, conical, and thick shelled. In both species the close crowding of the individuals in the colonies has caused irregularities of growth and coarse scars and imperfections of greater or less size. The shell structure of the outer shell layer, which alone is preserved, is very fine as compared with that of the genera *Sauvagesia* and *Durania*, and the polished cross section exhibits numerous fine, continuous, concentric growth lines. These growth lines inclose rows of small cells which vary greatly in size and shape due to the irregularities of growth; many of the cells are squarish or rectangular, but some of them are irregular in shape and are five or six sided. (See pl. 3, fig. 2, and pl. 4.)

There is no internal ligamental ridge, nor is there any trace in the cell structure of a feature corresponding to this ridge. The inner

¹ Dumble, E. T., Geology of the northern end of the Tampico embayment area: Proc. Cal. Acad. Sciences, vol. 8, No. 4, pp. 125-133, 1918.

shell layer had entirely disappeared before fossilization, so that no trace remains of the hinge mechanism, adductor scars, or other internal features; with the inner shell layer gone the interior of the lower valve, after the removal of the matrix, is a nearly circular cavity which gradually decreases in diameter from above downward.

The upper rim of the shell into which the upper valve fits is steeply inclined, forming a flaring aperture; the surface of the rim is slightly undulating and bears a few faint impressions of radial vessels, some of which are branching; these are spaced 5 to 20 mm. apart; this surface is also covered with numerous very fine, faint, radiating striæ, and portions of the surface are finely pitted; the inner margin of the rim is bordered by a slightly raised sharp ridge which is closely paralleled by a narrow channel.

The outer surface of the shell bears two siphonal channels (E and S, pl. 1), which vary somewhat in character on different individuals in the two species described in this paper. Where the incremental lines cross these channels they bend downward toward the base of the shell.

The anterior siphonal channel is shallow and is marked along the bottom throughout its length by the trace of a narrow sinus which, in the form of a closely pressed slit, cuts back through the shell at right angles to the surface, extending to within 3 or 4 mm. of the inner surface (pl. 4, *a*); this is a line of weakness along which the shell easily breaks and splits apart (see pl. 8, *a*); the sinus is sometimes a little open, admitting a thin seam of matrix. Where this sinus intercepts the upper rim of the shell it forms a distinct slit, generally slightly gaping, which is bordered by a narrow carina (pl. 2, *a*).

Both in front and behind the sinus the surface of the rim exhibits broad, shallow depressions, each of which is roughly a right-angle triangle with its base resting on the margin of the inner cavity of the shell. The two triangular areas are connected with each other by a flat uncarinated space between the inner end of the sinus and the inner margin of the shell (pl. 2). A polished cross section (pl. 4) shows that all the growth layers bend sharply inward as they approach this sinus. The hypotenuse of each of the triangular areas is also marked in the polished cross section by the disposition of the growth lines which along the trace of the triangle bend obliquely outward, due to the thinning or entire disappearance of the intermediate cells for a distance of 1 to several millimeters (pl. 4). This modification in the growth lines doubtless resulted from the contractile movements of the ventral siphon.

The upper rim of the shell between the posterior siphonal channel and the margin of the inner cavity is also marked by a broad, shal-

low depression which is, as a rule, less strongly impressed than the triangular depressions on either side of the sinus.

A sinus or slit cutting the shell along the bottom of the anterior siphonal channel in the manner just described, and depressions on the upper rim of the shell adjacent to the siphonal channels are features which, so far as I am aware, have not been found in any genus heretofore described. Perhaps the nearest approach to features of this kind is to be found in the genus *Lapeirousia*. This genus, according to the diagrams illustrating it,² bears two similar so-called pseudo-pillars forming a part of the inner wall of the outer shell layer and corresponding respectively to the two siphonal areas. Each of these pseudo-pillars is joined to the outer surface of the shell by a so-called suture, which is perhaps comparable to the slit or sinus in *Tampsia*, but *Tampsia* has only the one sinus and lacks the pseudo-pillars.

The genera *Biradiolites*, *Bournonia*, and *Durania*, which, like *Tampsia*, lack an internal ligamental ridge, present no features comparable to the sinus or slit *a* or the depressions on the upper rim of the shell adjacent to the siphonal areas.

Type of the genus.—*Tampsia bishopi* Stephenson.

TAMPSIA BISHOPI, new species.

Plates 1-4.

Discovery and occurrence.—This species is based upon a colony of rudistids discovered early in 1921 in reddish shale of the Mendez formation by Mr. R. A. Bishop, part owner and manager of Las Flores hacienda. On the basis of the rather pronounced red color of the shale containing the colony, it is believed to belong to the upper part of the Mendez, as that formation is developed in the southern part of the State of Tamaulipas; on this assumption the bed is 700 or 800 feet (200-250 meters) above the base of the Mendez. Since, however, the Mendez shale exhibits reddish bands at other lower levels, and only a relatively small thickness of the shale is exposed in this arroyo, the position of this bed in the upper part of the Mendez can scarcely be regarded as conclusively established. However, it is probably well above the middle of the formation.

Dr. John M. Muir, chief geologist of the Corona Oil Co., visited the locality in company with Mr. Bishop before the specimens were collected from the matrix, and he says that the largest part of the colony, the individuals of which still remain attached to each other, was standing upright in the shale, apparently in place. Smaller groups of attached individuals, separate individuals, and fragments

² Douvillé, Henri. Études sur les Rudistes. Mem. de la Soc. Géol. de France, Paléontologie, No. 41, pp. 25-27, pl. 1, figs. 9-12, 1910.

had fallen down into the talus, and some fragments had even been washed out into the bed of the creek for a distance of a rod or two. Evidently there must have been 30 or more individuals in the colony before it was disturbed by erosion. Most of the material collected by Messrs. Bishop and Muir is shown artificially assembled in plate 3, figure 1; a few pieces had already been given away to interested persons before the photograph was taken. The locality was subsequently visited by Mr. Bishop and the writer, and a few additional fragments were found in the talus in the gully and in the bed of the adjacent arroyo.

The second largest group of attached individuals in the colony, shown in plate 1, is here designated the type of the species. It includes 6 moderately well preserved lower or right valves, none of which, however, is perfect. No upper valves were found. The material illustrated in plates 1, 2, 4, and figure 2 of plate 3 has been donated to the United States National Museum by Smith, Newell, and Bishop, the owners of Las Flores hacienda.

Description.—The lower valve is large, elongate, conical, nearly circular in cross section, slightly curved, slightly sinuous, or nearly straight, depending upon the position of growth. All the individuals in the colony are incomplete, a considerable portion of the lower ends of the lower valves having failed of preservation.

The dimensions of the largest lower valve in the group of type individuals are: Length, 270 mm.; diameter of upper end, 125 mm.; of lower end, 70 mm.; diameter of upper end of inner cavity, 65 mm.; of lower end of inner cavity, 35 mm.

The structural features which characterize the thick outer shell layer are included in the description of the genus on pages 4-6.

The outer surface of the shell is nearly smooth with the exception of distinct incremental lines, 15 or 16 weakly developed longitudinal ribs or undulations of irregular width, and two longitudinal siphonal channels separated by a prominent rib; the anterior siphonal channel (E) is shallow and narrow as compared with the broad deeply excavated posterior one (S); both the channels and the separating rib are simple, smooth undulations; some individuals are nearly smooth with the exception of the siphonal areas.

The posterior siphonal channel is a broad, even fold, and, though somewhat variable in strength on different individuals, is as a rule deeply excavated.

This species differs from *Tampsia chocoyensis* in the markedly smoother character of the outer shell surface and in the more deeply excavated, smoother, and more constant posterior siphonal channel.

Locality.—From an arroyo tributary to Arroyo el Capitán, on Las Flores hacienda about 9½ kilometers north of Manuel station, near the junction of the corners of haciendas Las Flores, Carrizal, and

Gonzalez, in the State of Tamaulipas, Mexico. Discovered by Mr. R. A. Bishop and collected by Messrs. Bishop and John M. Muir.

Type.—Donated to the United States National Museum by the firm of Smith, Newell, and Bishop, owners of Las Flores hacienda. Cat. No. 32499, U.S.N.M.

Geologic position.—Upper part of Mendez shale, which is an Upper Cretaceous formation corresponding in age approximately to the Taylor marl of Texas.

TAMPسيا CHOCOYENSIS, new species.

Plates 5-8.

Discovery and occurrence.—This species is based upon a colony of rudistids found in April, 1921, by A. W. Beckley and the writer in reddish shale in the upper part of the Mendez formation. The colony had been eroded from its position in the shale and was badly shattered. All the fragments that could be found were collected, and when as many of these as possible were fitted together they were found to include two attached lower valves, well preserved though incomplete at their lower extremities, and a dozen or more less complete lower valves and fragments. The two attached individuals (pl. 5) are here designated the type. A portion of the shell of one individual (pl. 8), perhaps belonging to this same colony, was found at this locality in 1919 by A. E. Fath and Eugene Stebinger.

Description.—In general form and in all the characters that may be regarded as generic this species is identical with that of *Tampsia bishopi*. The principal features which distinguish it from that species are (1) the coarser and rougher character of the growth lamellae, which tend to form irregular imbricating layers; (2) the sharper and somewhat stronger longitudinal undulations or ribs, which, however, are very irregular in their development; (3) the greater breadth of the anterior siphonal channel (E), the sides of which are also rougher and sometimes marked by faint longitudinal folds; and (4) the pronounced irregularity in the development of the posterior siphonal channel (S), which in some individuals is very shallow and in others is broken into a main and a subordinate channel by an intermediate rib. In one of the individuals of the type pair the bottom of the broad posterior siphonal channel is cut by a narrow, deep subordinate channel (pl. 6), in front of which is another narrow but shallow subordinate channel.

The largest of the two attached shells of the type pair exhibits the following maximum dimensions: Length, 200 mm.; diameter at top, 130 mm.; diameter at the incomplete bottom, 90 mm.; diameter of inner cavity, 63 mm. at top and 43 mm. at bottom.

Locality.—Found in red shale in a gully known as El Colorado, on Chocoy hacienda or ranch, 1½ kilometers northwest of Omaha

station, near the northeast corner of fraction 101, about 64 kilometers northwest of Tampico, State of Tamaulipas, Mexico. Collected by A. W. Beckley and the writer.

Type.—Cat. No. 32500, U. S. N. M.

Geologic position.—Upper part of Mendez shale, an Upper Cretaceous formation corresponding in age approximately to the Taylor marl of Texas.

SAUVAGESIA DEGOLYERI Stanton (?).

Plates 9-10.

Sauvagesia degolyeri STANTON, Proc. U. S. Nat. Mus., vol. 59, No. 2379, pp. 453-454, pls. 96-97, 1921.

Description.—Fragments of Radiolitidae which closely resemble *Sauvagesia degolyeri* Stanton, recently described from the San Felipe formation near Puente Diablo between Valles and El Abra, in the eastern part of the State of San Luis Potosi, Mexico, were found by the writer in the upper part of the San Felipe formation at three localities on Las Flores hacienda and at one locality on Chocoy hacienda. These fragments exhibit numerous moderately rounded to rather sharp crested, irregularly developed longitudinal ribs separated by deep V-shaped channels, and the cell structure is very similar to that of *S. degolyeri*. The portion of the surface shown in plate 9, figure 1, is back of the posterior siphonal area.

On one incomplete young specimen, which was flattened by lateral compression before the internal cavity had an opportunity to become filled with matrix, the surface sculpture is preserved practically all the way around the shell (pl. 10); the anterior siphonal band E is somewhat distorted by the compression to which the shell was subjected, but it is flat, about 12 mm. wide, and marked by 6 or 7 small longitudinal ribs separated by deep, sharp channels a little narrower than the ribs; the posterior siphonal band (S) is also flat, 12 to 20 mm. wide, broadening upward, and is ornamented by 7 to 12 small ribs which increase in number from below upward by bifurcation; two ribs, a larger and a smaller, separated by deep V-shaped cavities occupy the area between the two siphonal bands.

The ligamental ridge (L) which characterizes the genus is clearly though imperfectly preserved on several of the fragments.

Owing to the poorly preserved condition of the ribs on Stanton's type specimen it is impossible to refer these fragments to his species with confidence. De Golyer states in the quotation given by Stanton that he found the type specimen in a bed 80 to 100 feet (25 to 30 meters) above the base of the San Felipe formation. I have recently visited the locality, and in my opinion the containing stratum is not in the lower part of the formation, but is above the middle, and is

probably within 200 feet (60 meters) of the top of the formation. In other words, the stratigraphic position of the type is not very different from that of the fragments here described, a fact which lends strength to the assumption that the fragments represent the same species as the type.

The species is closely related to *Sauvagesia belti*, but differs from that species in the absence of minor ribbing on the major ribs.

Localities.—State of Tamaulipas, District del Sur: Las Flores hacienda (Manuel ranch), in an arroyo $3\frac{1}{2}$ kilometers west by north of Manuel station (M. G. O. Acq. No. 135), in an arroyo 6 kilometers west by south of Manuel station (M. G. O. Acq. No. 138), and in an arroyo about $1\frac{1}{2}$ kilometers west by south of Manuel station (M. G. O. Acq. No. 139); Chocoy hacienda or ranch, in an arroyo about 3 kilometers north-northwest of Chocoy station (M. G. O. Acq. No. 143).

Type.—The type specimen is in the United States National Museum at Washington as Cat. No. 32482.

Geologic position.—The specimens from Chocoy and Manuel haciendas occur in the upper part of the San Felipe formation, which is correlated approximately with the upper part of the typical Austin chalk in the vicinity of Austin, Texas.

SAUVAGESIA BELTI, new species.

Plate 11.

Occurrence.—This species is represented by one incomplete individual found by the writer near the railroad about $1\frac{1}{2}$ kilometers northwest of Chocoy station. The specimen is a portion of the lower valve on the side opposite to that which bears the siphonal areas and includes less than half the circumference of the shell. The length of this fragment as preserved is 87 mm., and the shell flares from a width of about 20 mm. at the base to a width of 75 mm. on corresponding costae at the top.

The surface of the fragment is ornamented with 8 major costae which increase in size away from the base and which differ considerably in size; each of the major costae is ornamented with numerous minor irregular costae which differ somewhat in size from the base upward; the effect of complexity is further increased by a tendency of the growth layers to form imbricating lamellae.

The inner shell layer is not preserved. The outer shell layer is thick and exhibits the rather coarse cell structure which characterizes the genus; the ligamental ridge (L) is strongly developed though imperfectly preserved along the entire length of the shell; the inner surface of the shell is finely cancellated due to the crossing of the fine growth lines and a series of fine longitudinal lines.

The species is closely related to fragments of *Sauvagesia* found in the United States in the upper part of the Brownstown marl, just

below the Annona tongue of Austin chalk, a mile northwest of White Cliffs, Sevier County, Arkansas. The latter represent an older stage of growth, but they exhibit minor ribbing on the major ribs, which strongly suggests specific identity.

The species is named in honor of Mr. Ben C. Belt, who was chief geologist of the Mexican Gulf Oil Co. at the time the fossils described in this paper were collected.

Locality.—In a gully on the west side of the track of the National Railways of Mexico, $1\frac{1}{2}$ kilometers northwest of Chocoy station, about $72\frac{3}{4}$ kilometers northwest of Tampico (M. G. O. Acq. No. 141), State of Tamaulipas, Mexico.

Type.—Cat. No. 32504, U.S.N.M.

Geologic position.—Lower part of Mendez shale in beds which probably correspond approximately in age to the lower part of the Taylor marl in its type region in central Texas.

SAUVAGESIA COLORADENSIS, new species.

Plates 12-14.

Discovery and occurrence.—The specimen on which this species is based was found in 1919 by Messrs. A. E. Fath and Eugene Stebinger in reddish shale in the upper part of the Mendez formation, at the series of gullies $1\frac{1}{2}$ kilometers northwest of Omaha station, known as El Colorado, where the colony of rudistids described on pages 8 and 9 as *Tampsia chocoyensis* was obtained.

Description.—The lower valve is large, elongate, thick shelled, and slightly curved. The specimen was apparently nearly circular in cross section, but the weaker side of the shell has been longitudinally crushed and is now nearly flat. Both the lower and upper ends are incomplete, having suffered fracture and partial destruction. The inner shell layer is wanting and the cavity is filled with red calcareous clay matrix containing many small foraminifers.

As preserved the dimensions of the shell are: Length, 155 mm.; diameter of upper end, 90 mm.; of lower end, 65 mm.; diameter of upper end of inner cavity, 58 mm.; of lower end of inner cavity, 40 mm.

The cell structure is only moderately coarse and in cross section the cells are partially arranged in rows roughly parallel to the undulations caused by the costate surface. The ligamental ridge (pl. 12, fig. 2, L) is prominently developed, projecting 4 to 6 mm. into the inner cavity; it is less than a millimeter thick except near its crest, where it flares to a thickness slightly exceeding a millimeter.

The surface of the shell has been somewhat marred by corrosion, and one side has been flattened by compression. Most of the features are, however, preserved well enough for description. The two si-

phonal bands are broad and shallow and are separated by a ribbed band about 20 mm. wide at the base and broadening to about 35 mm. at the top. The anterior siphonal area (E) forms a shallow channel broadening from a width of 17 mm. at the base to about 25 mm. at the top and is ornamented by 12 or more low, rounded, rather indistinct, irregular ribs. The posterior siphonal channel (S) is shallower, flatter, and a little narrower than the anterior one and is ornamented by 9 or 10 similar small ribs. The band between the siphonal areas exhibits two bordering rather prominent, though poorly preserved, ribs, separated by a deep, broadly flaring, V-shaped channel, on the front side of which is one subordinate rib and on both sides of which are fine indistinct longitudinal lines.

The rest of the surface of the shell is marked by about 12 unequal, angular, more or less prominent ribs, separated by rounded to angular channels, the sides of most of which are ornamented with several indistinct minor longitudinal ribs. The major ribs are largest on that part of the surface behind the posterior siphonal area and smallest on the half of the surface which lies in front of the anterior siphonal area.

Locality.—From gullies, known as El Colorado, on Chocoy hacienda, 1½ kilometers northwest of Omaha station, near the northeast corner of fraction 101, State of Tamaulipas, Mexico. Collected by Messrs. A. E. Fath and Eugene Stebinger.

Type.—Donated to the United States National Museum by the collectors, A. E. Fath and Eugene Stebinger. Cat. No. 32505, U.S.N.M.

Geologic position.—Upper part of Mendez shale, which is an Upper Cretaceous formation corresponding in age approximately to the Taylor marl of Texas.

DURANIA MANUELENSIS, new species.

Plate 15.

Description.—This species is based upon one relatively small, incomplete lower valve which is perhaps a young individual. Originally the shell was doubtless elongate, conical, and roughly circular in cross section; as preserved, however, it presents an elongated oval cross section due to mechanical compression. Only the outer shell layer is preserved, and the internal cavity left by the removal of the inner shell layer is filled with a calcareous shale matrix.

The cell structure is rather coarse, and the cells are polygonal and in cross section show only a slight tendency to form concentric rows; this is perhaps due to the fact that the growth layers were added almost horizontally one upon the other. The upper rim of the shell is nearly flat, though very slightly undulating, and bears faint, widely spaced impressions of radial vessels. A low, narrow carina

bounds the inner margin of the rim. No ligamental ridge can be detected, for which reason the species is classed with the genus *Durania* rather than with *Sauvagesia*.

The exterior of the shell is marked by about a dozen major, broadly rounded, low longitudinal ribs of somewhat irregular width and by two siphonal areas; each of the major ribs bears 6 or 8 minor ribs, and the bottoms of the depressions between the major ribs is cut by a narrow, sharply defined channel.

The anterior siphonal area (E) is broad, flat, and scarcely excavated and is ornamented by about a dozen minor ribs. The posterior siphonal area (S) is only about half as wide as the anterior one, is deeply excavated, and bears 9 or 10 narrow, distinct ribs. The longitudinal band between the siphonal areas is also marked by minor ribs and is split by a central narrow, sharp channel. Over the entire outer surface the growth lines are fine, distinct, and sharply wavy where they cross the minor ribs.

Locality.—Found in an arroyo $3\frac{1}{2}$ kilometers west by north of Manuel station (M. G. O. Acq. No. 135), which is about 81 kilometers northwest of Tampico, in the State of Tamaulipas, Mexico.

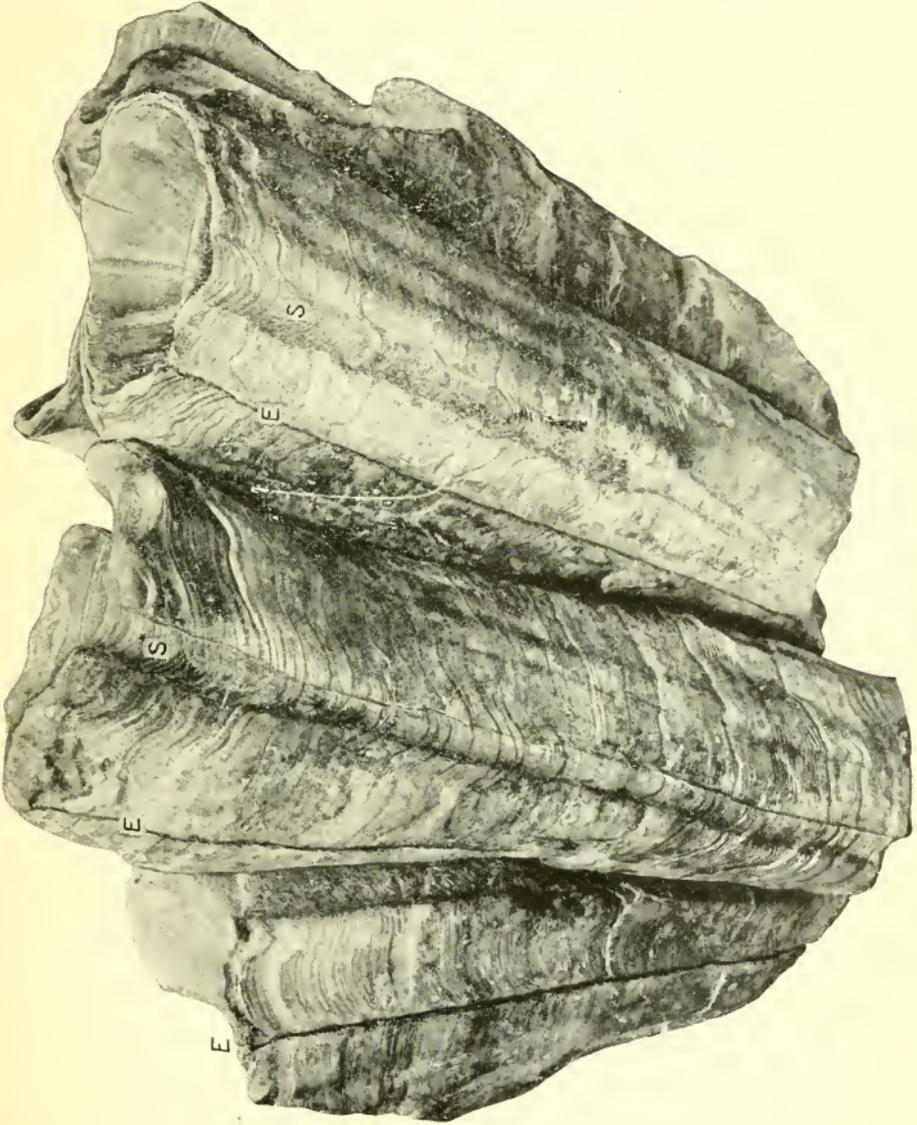
Type.—Cat. No. 32506, U.S.N.M.

Geologic position.—Upper part of San Felipe formation, corresponding in age approximately to the upper part of the type Austin chalk at Austin, Texas.

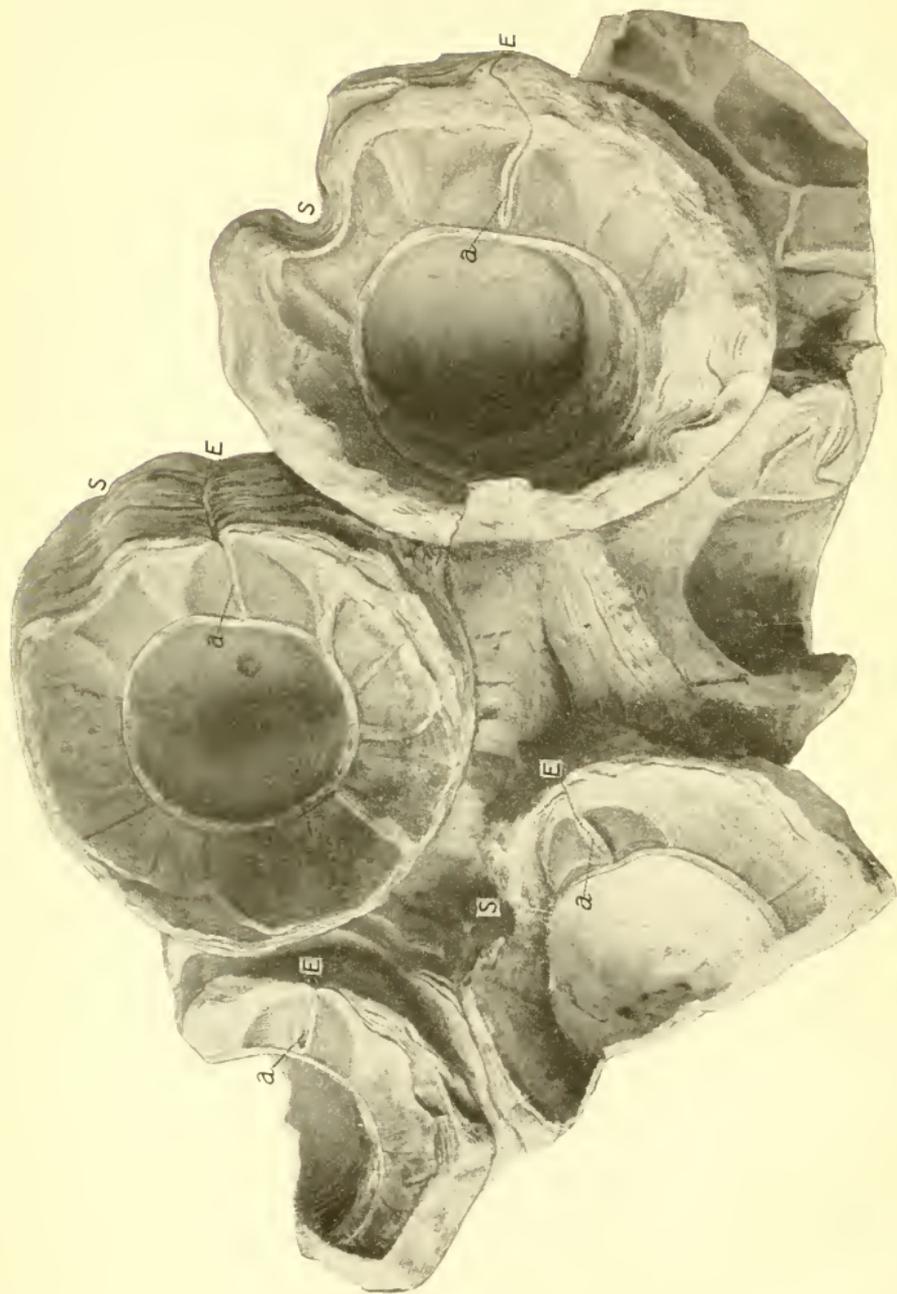
EXPLANATION OF PLATES.

PLATE 1.

Tampsia bishopi Stephenson. Side view of the type group a little less than half natural size, from the upper part of the Mendez shale on Las Flores hacienda, 9½ kilometers north of Manuel station, State of Tamaulipas, Mexico. (E), shallow anterior siphonal channel, and the trace of a narrow sinus along its bottom. (S), posterior siphonal channel. Cat. No. 32499, U.S.N.M. Page 6.



TAMPSIA BISHOPI STEPHENSON.
FOR EXPLANATION OF PLATE SEE PAGE 14.



TAMPSIA BISHOPI STEPHENSON.

FOR EXPLANATION OF PLATE SEE PAGE 15.

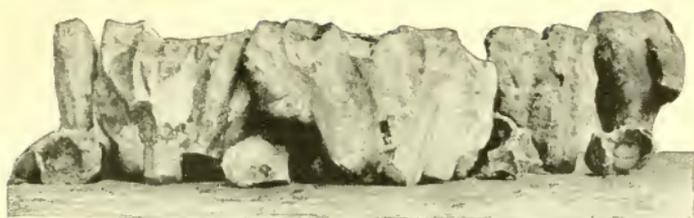
PLATE 2.

Tampsia bishopi Stephenson. Top view of the type group of individuals, about eleven-twentieths natural size. Shows the features that characterize the upper rim of the lower valve, including the slit or sinus (*a*) which cuts into the shell along the anterior siphonal channel (E), the triangular depressions which border the slit on either side, the broad, shallow depression between the edge of the posterior siphonal notch (S) and the margin of the inner cavity, and the impressions of the radial vessels. Cat. No. 32499, U.S.N.M. Page 6.

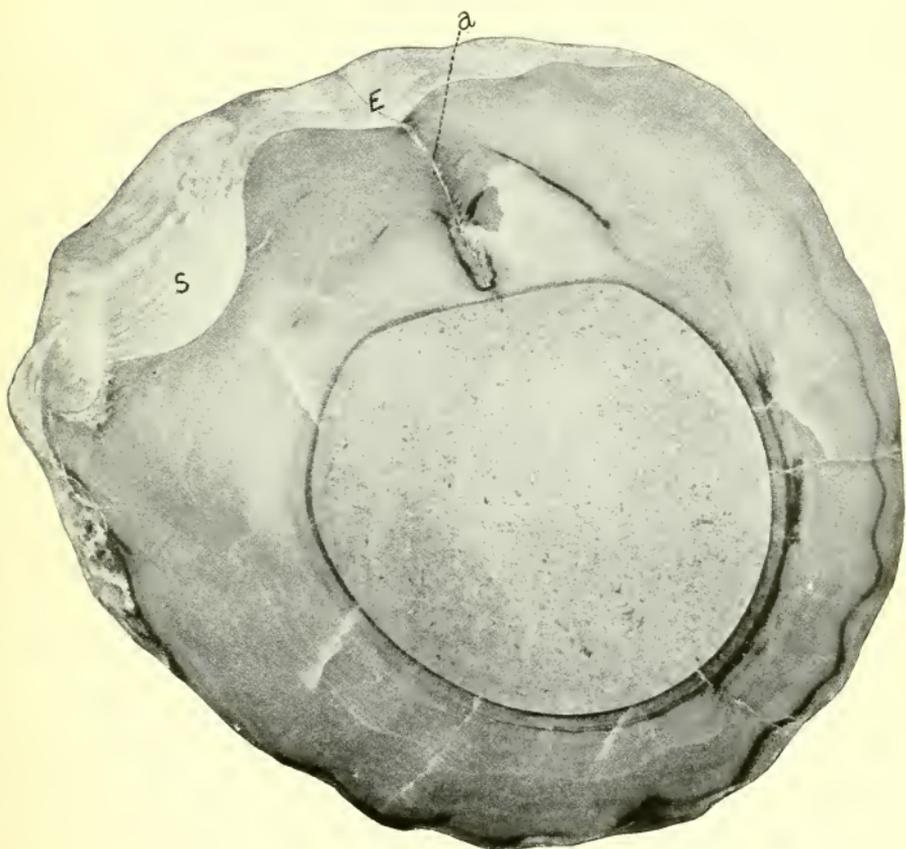
PLATE 3.

FIG. 1. Most of the material composing the type colony of *Tampsia bishopi*, artificially assembled, about three-fortieths natural size. Several individuals of the colony had already passed into other hands when the picture was taken. Page 6.

FIG. 2. *Tampsia bishopi* Stephenson. Cross section of one of the loose individuals of the type colony, slightly enlarged, showing the notches of the siphonal channels (E) and (S); the slit or sinus (a) which cuts into and nearly through the shell along the bottom of the anterior siphonal channel, and the fine wavy growth lines. Cat. No. 32499, U.S.N.M. Page 6.



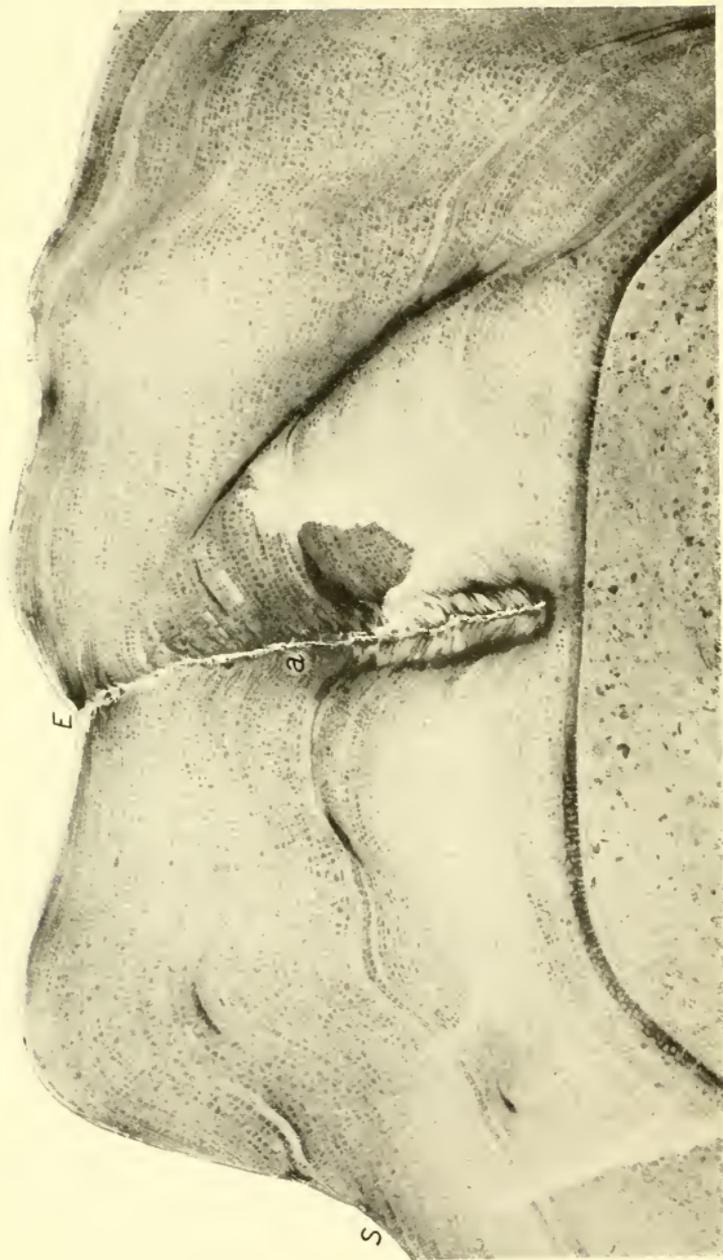
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TAMPSIA BISHOPI STEPHENSON.

FOR EXPLANATION OF PLATE SEE PAGE 16.



TAMPSIA BISHOPI STEPHENSON.
FOR EXPLANATION OF PLATE SEE PAGE 17

PLATE 4.

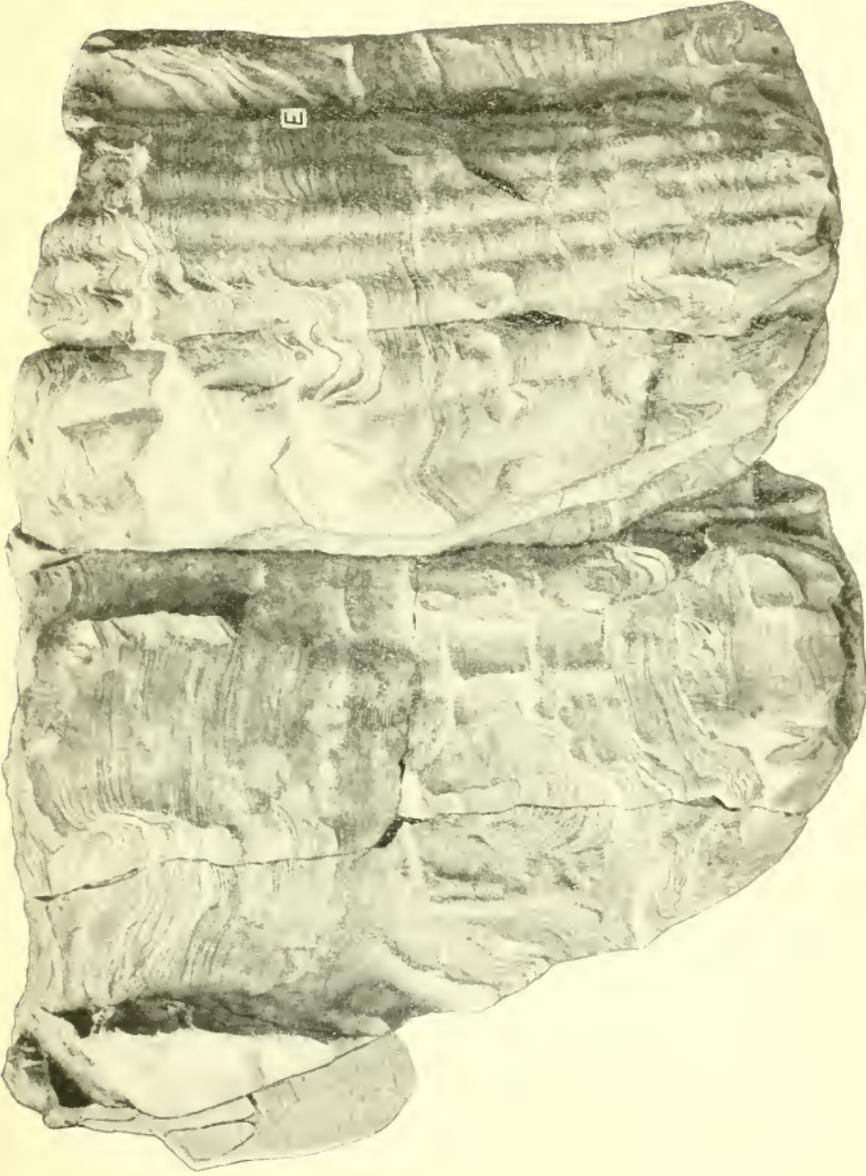
Tampsia bishopi Stephenson. A portion of the cross section shown in plate 3, figure 2, magnified three times to show the shell structure in the region of the anterior siphonal channel. Page 6.

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PLATE 5.

Tampsia chocoyensis Stephenson. Side view of the type pair of individuals about three-fifths natural size, from the upper part of the Mendez shale on Chocoy hacienda, $1\frac{1}{2}$ kilometers northwest of Omaha station, State of Tamaulipas, Mexico. (E), anterior siphonal channel. The part of the surface shown on the left-hand specimen is nearly the same as that shown on the right-hand specimen, indicating considerable individual variation in the strength of the surface features. Cat. No. 32500, U.S.N.M. page 8.



TAMPSIA CHOCOYENSIS STEPHENSON.

FOR EXPLANATION OF PLATE SEE PAGE 18



TAMPSIA CHOCOYENSIS STEPHENSON.

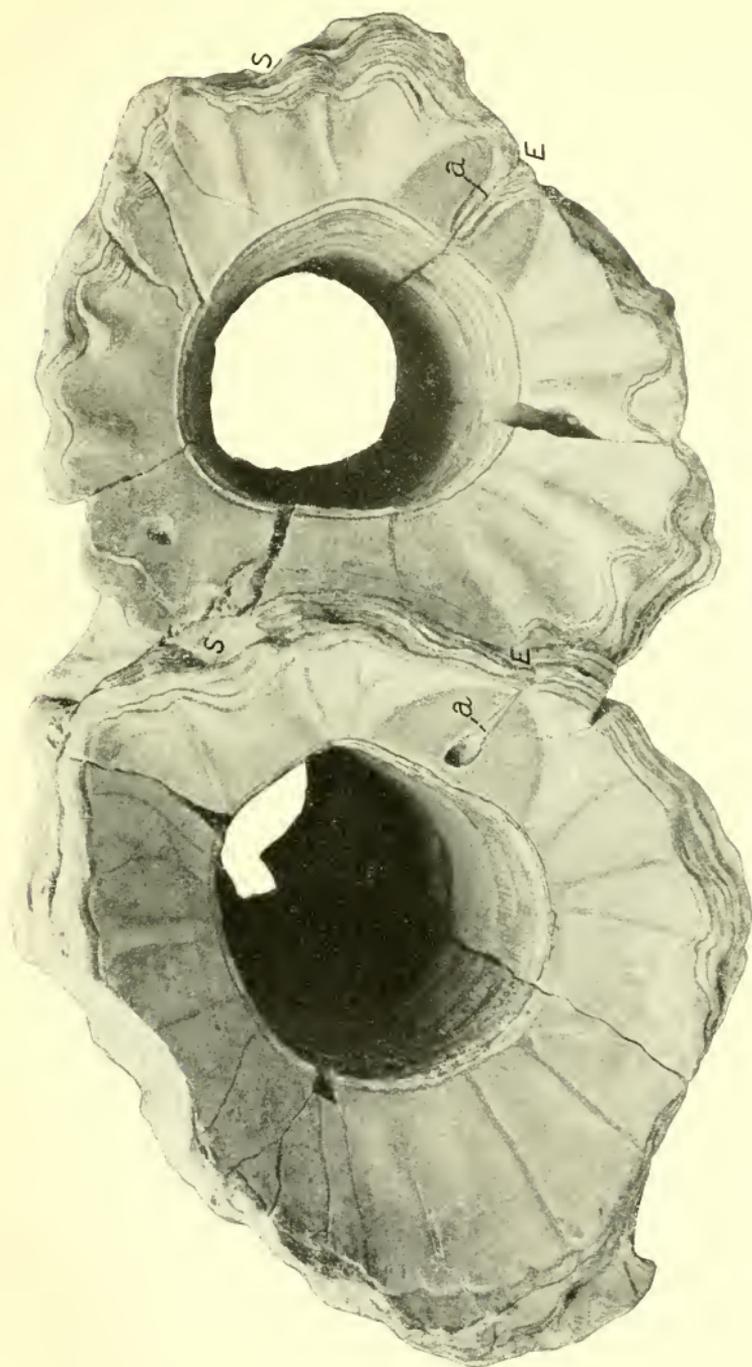
FOR EXPLANATION OF PLATE SEE PAGE 19

PLATE 6.

Tampsia chocoyensis Stephenson. View of the siphonal channels of the right-hand individual shown in plate 5, about three-quarters natural size. (E), anterior siphonal channel, and the slit or sinus *a* at the bottom of the channel. (S), the broad posterior siphonal channel and the narrow, deep, subordinate channel along its center. Page 8.

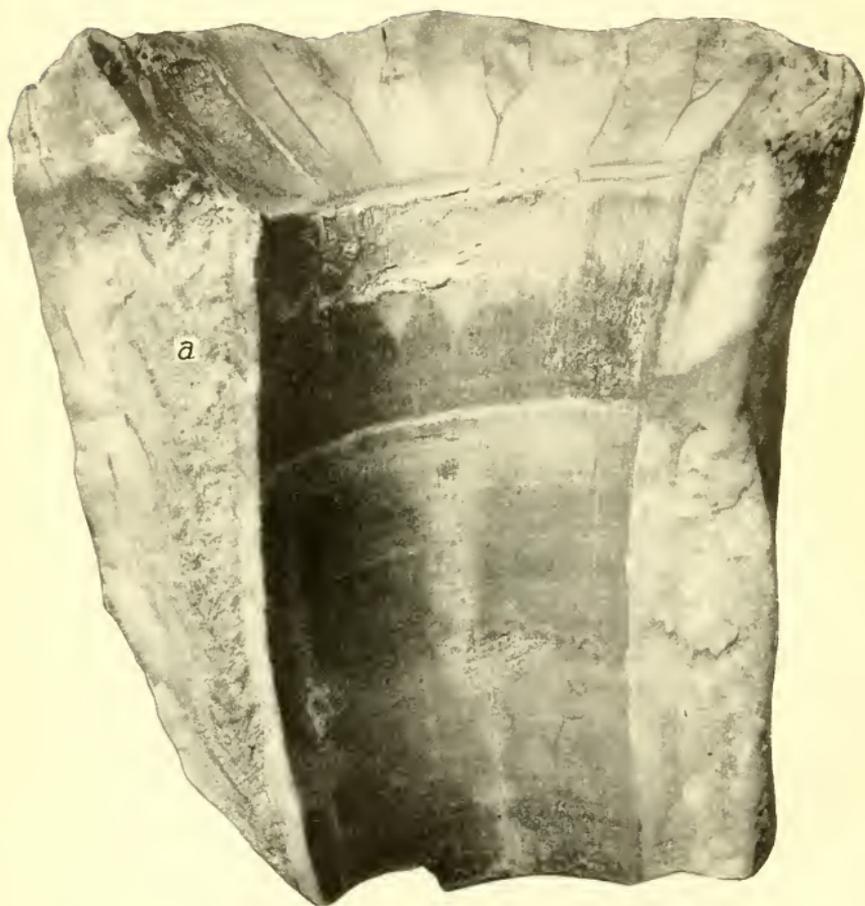
PLATE 7.

Tampsia chocoyensis Stephenson. Top view of the type pair of individuals, about four-fifths natural size, showing the slit or sinus cutting the shell at the bottom of the anterior siphonal area, the depressions in the rim in the region of the siphonal channels, and the radial vessels. Page 8.



TAMPSIA CHOCOYENSIS STEPHENSON.

FOR EXPLANATION OF PLATE SEE PAGE 20



TAMPSIA CHOCOYENSIS STEPHENSON.

FOR EXPLANATION OF PLATE SEE PAGE 21

PLATE 8.

Tampsia chochoyensis Stephenson. Internal view of one of the loose individuals of the colony, natural size, showing especially the edge of the shell on the left, broken along the line of weakness caused by the sinus or silt (*a*) at the bottom of the anterior siphonal channel. Cat. No. 32501, U.S.N.M. Page 8.

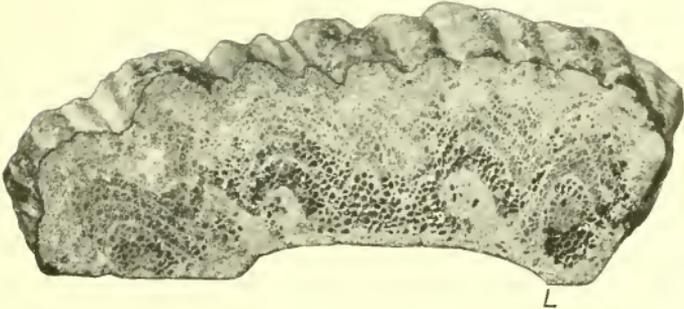
PLATE 9.

FIG. 1. *Sauvagesia degolyeri* Stanton(?). Exterior view, natural size, of a fragment from the upper part of the San Felipe formation, Las Flores hacienda, from an arroyo $3\frac{1}{2}$ kilometers west by north of Manuel station. The surface shown is on a part of the shell back of the posterior siphonal area. Cat. No. 32502, U.S.N.M. Page 9.

FIG. 2. Cross section of the fragment shown in figure 1, showing the shell structure. Page 9.



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SAUVAGESIA DEGOLYERI STANTON?

FOR EXPLANATION OF PLATE SEE PAGE 22.



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SAUVAGESIA DEGOLYERI STANTON?

FOR EXPLANATION OF PLATE SEE PAGE 23.

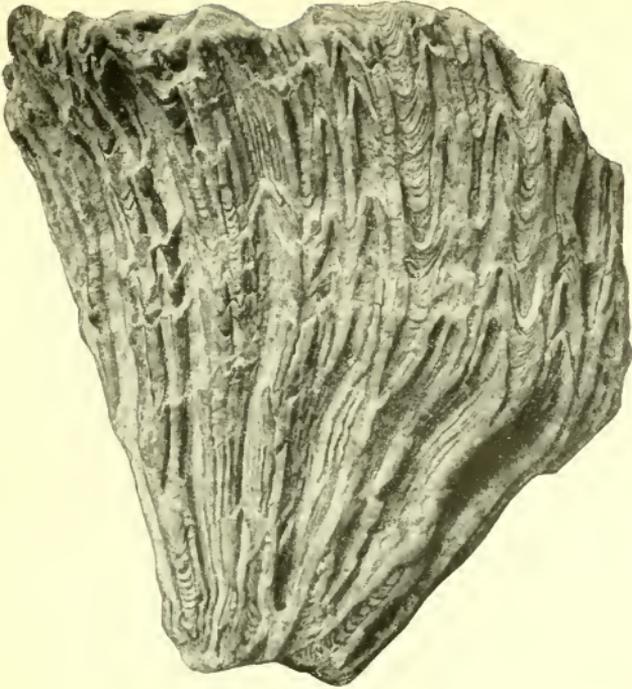
PLATE 10.

- FIG. 1.** *Sauvagesia degloyeri* Stanton(?). View, natural size, of surface sculpture opposite the siphonal areas, of a specimen from the upper part of the San Felipe formation, Las Flores hacienda, from an arroyo 6 kilometers west by south of Manual station. Cat. No. 32503, U.S.N.M. Page 9.
- FIG. 2.** View of the specimen shown in figure 1, on the side bearing the siphonal areas (E) and (S). Page 9.

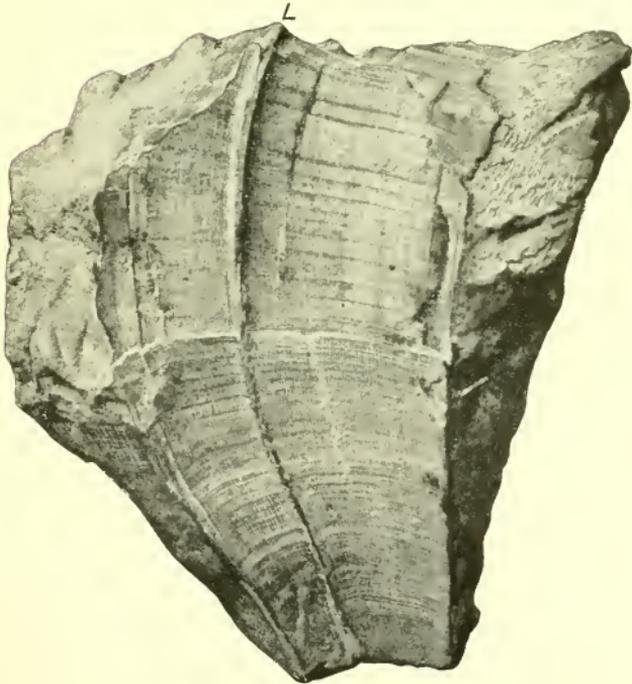
PLATE 11.

FIG. 1. *Sauvagcsia belli* Stephenson. Exterior view, natural size, of the type, a fragment from the lower part of the Mendez shale, Chocoy hacienda, from gullies west of the track of the National Railways of Mexico, $1\frac{1}{2}$ kilometers northwest of Chocoy station, State of Tamaulipas, Mexico. The part of the surface shown is back of the posterior siponal area. Cat. No. 32504, U.S.N.M. Page 10.

FIG. 2. Interior view of the specimen shown in figure 1, showing especially the imperfectly preserved ligamental ridge (L). Page 10.



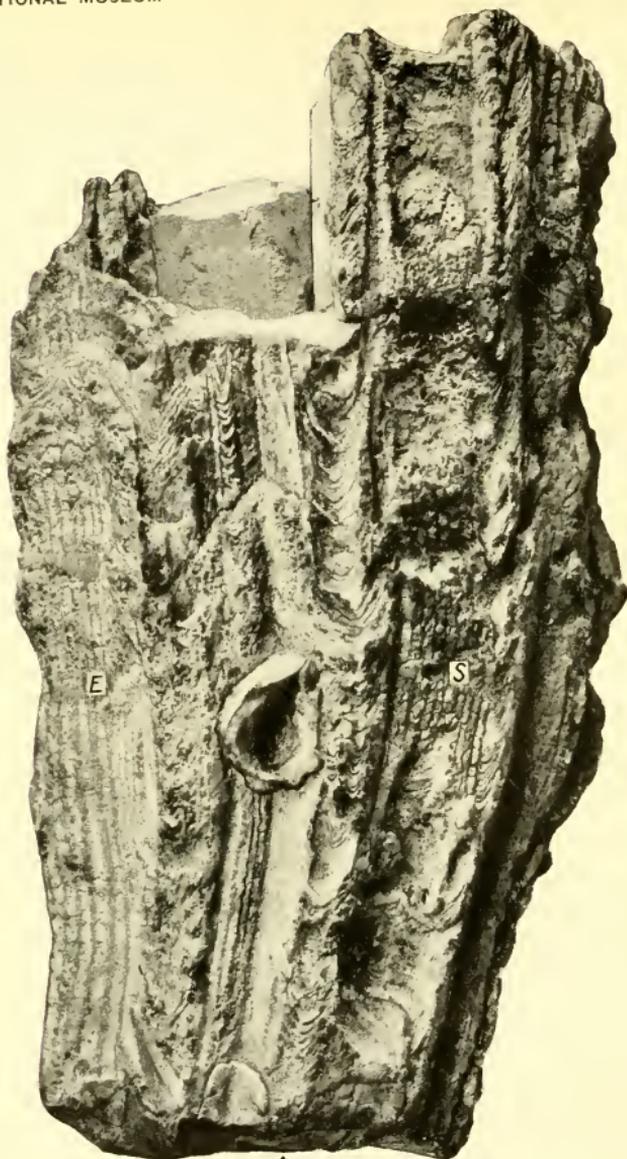
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SAUVAGESIA BELTI STEPHENSON.

FOR EXPLANATION OF PLATE SEE PAGE 24



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SAUVAGESIA COLORADENSIS STEPHENSON.

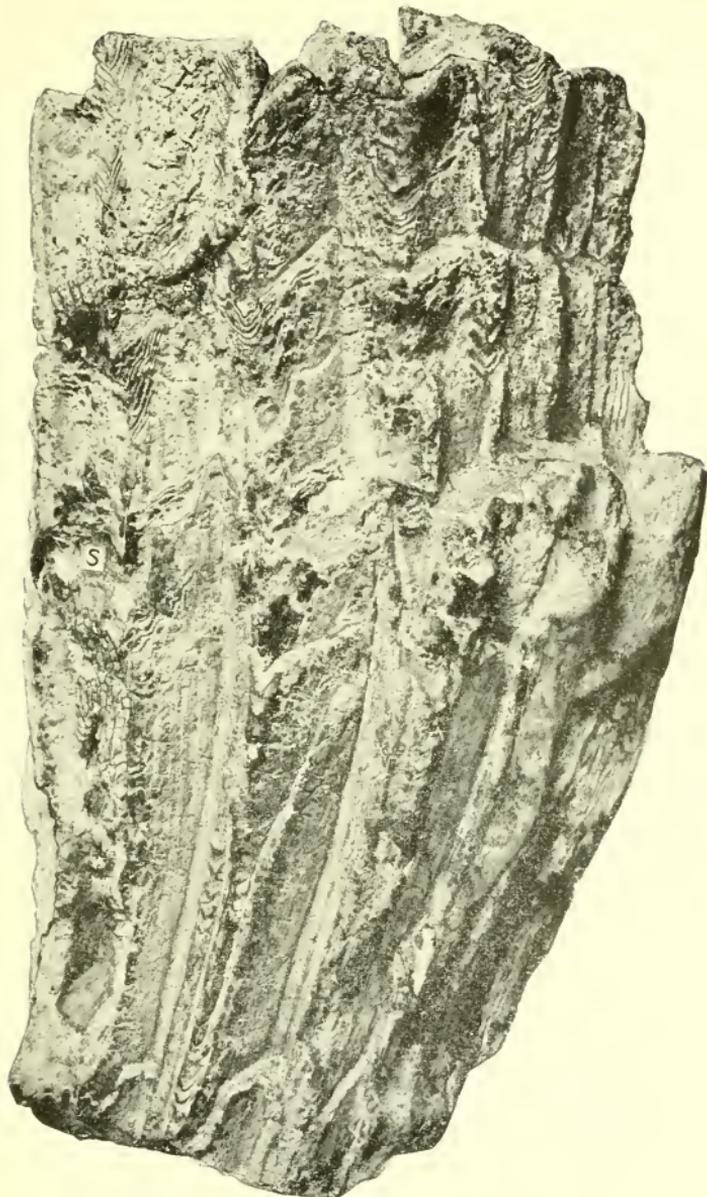
FOR EXPLANATION OF PLATE SEE PAGE 25

PLATE 12.

- FIG. 1. *Sauvagesia coloradensis* Stephenson. View, natural size, of the type specimen on the side bearing the siphonal areas (E) and (S), from the upper part of the Mendez shale, Chocoy hacienda, from gullies $1\frac{1}{2}$ kilometers northwest of Omaha station. The surface has been roughened and considerably damaged by corrosion, and a small unidentified oyster is attached to the shell. Cat. No. 32505, U.S.N.M. Page 11.
- FIG. 2. Diagram of a portion of the lower broken edge of the type specimen of *S. coloradensis*, showing the ligamental ridge (L) in cross section. Page 11.

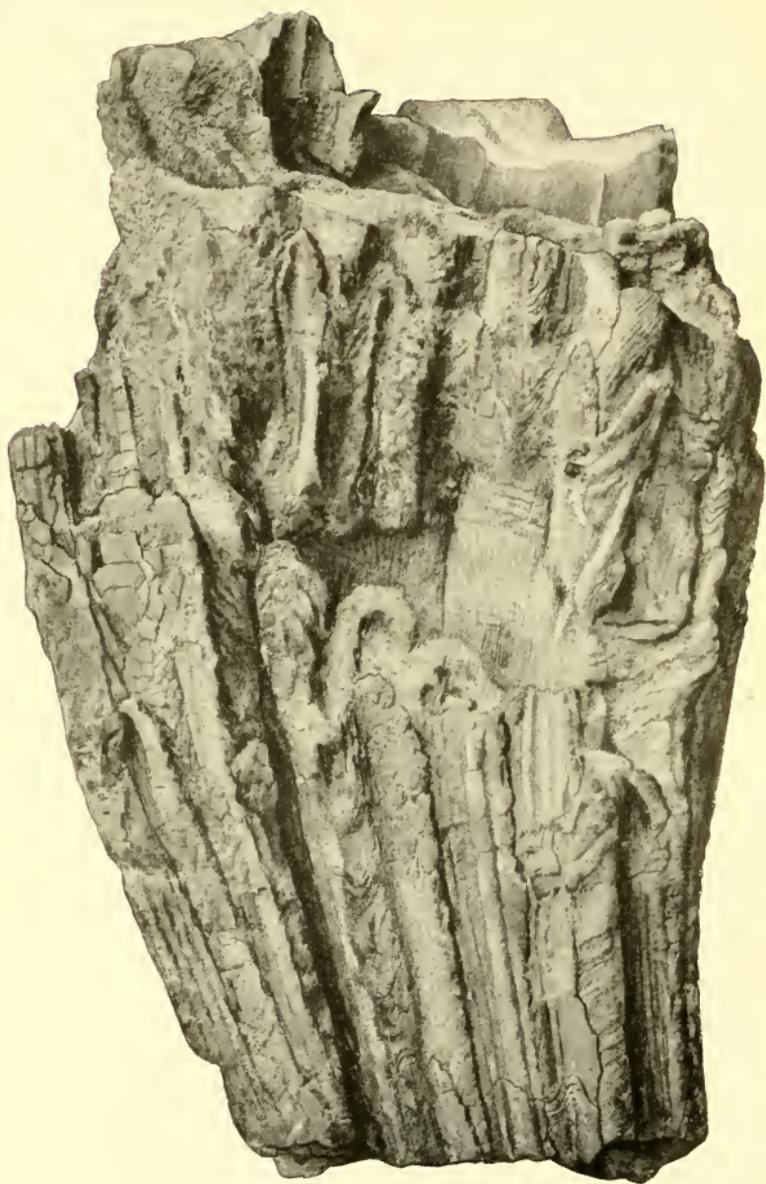
PLATE 13.

Sauvagesia coloradensis Stephenson. View of the type specimen, natural size, showing the posterior siphonal area (S), and the character of the surface sculpture back of that area. Page 11.



SAUVAGESIA COLORADENSIS STEPHENSON.

FOR EXPLANATION OF PLATE SEE PAGE 26.



SAUVAGESIA COLORADENSIS STEPHENSON.

FOR EXPLANATION OF PLATE SEE PAGE 27.

PLATE 14.

Sauvagesia coloradensis Stephenson. View of the type specimen, natural size, showing the character of the surface sculpture in front of the anterior siphonal area. This side of the shell has been mechanically crushed and flattened. Page 11.

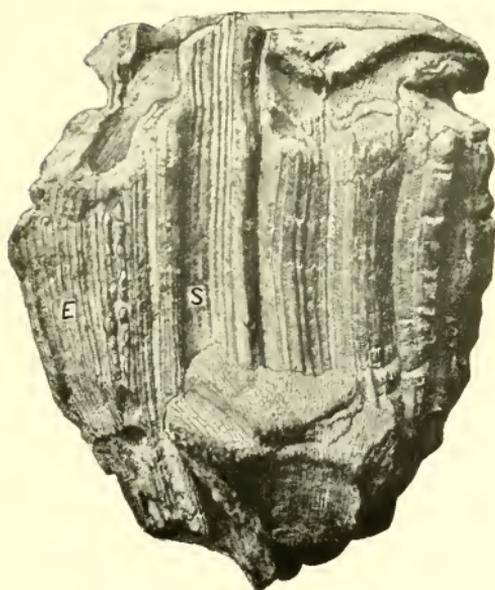
PLATE 15.

FIG. 1. *Durania manuelensis* Stephenson. View of the type specimen, natural size, from the upper part of the San Felipe formation, Las Flores hacienda, from an arroyo $3\frac{1}{2}$ kilometers west by north of Manuel station, showing the surface sculpture on the half of the shell in front of the anterior siphonal area. Cat. No. 32506, U.S.N.M. Page 12.

FIG. 2. View of the type specimen of *D. manuelensis*, showing the siphonal areas (E) and (S) and the surface sculpture back of these areas. Page 12.



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DURANIA MANUELENSIS STEPHENSON.

FOR EXPLANATION OF PLATE SEE PAGE 28.