ECHINOIDS OF THE GLEN ROSE LIMESTONE
OF TEXAS

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The Glenrose Limestone in Texas is the middle member of the
Lower Cretaceous Trinity Group which, in descending sequence,
consists of the Paluxy Sand, Glen Rose Limestone, and Travis Peak
Sand. It was named in 1891 by R. T. Hill for the town of Glen
Rose in Somerville County, Texas. In 1893 when he described the
invertebrate paleontology of the Trinity Division, Hill had found
only one echinoid from the Glen Rose beds. He listed it as *Epiaster*
(?) sp. indet., stating that he had submitted it to W. B. Clark of
Johns Hopkins University.

In Monograph 54 of the U. S. Geological Survey Clark and
Twitchell (1915) described six species of echinoids from the Trinity
Group of Texas. Three of them were from the Glen Rose Forma­
tion and two of the three were reported only from the Glen Rose.
Our collection contains four of the six species described by Clark
and Twitchell.

One of the early students of Texas echinoids was F. L. Whitney,
professor of geology and chairman of the geology department at
the University of Texas, who, in 1916, described the echinoidea
of the Buda Limestone. He also collected extensively from the
Glen Rose Formation, and most of the echinoids described in this
paper were in his private collection, which at present is deposited
in the Museum of Paleontology of the University of Michigan.

In 1928 W. S. Adkins, in his *Handbook of Texas Cretaceous
Fossils*, listed five species of echinoids from the Trinity Group. All
had been recorded by Clark and Twitchell in 1915, but Adkins
listed only three as being specifically from the Glen Rose: *Loriola
texana* (Clark), *Heteraster obliquatus* (Clark), *Hemiaster co-
manchi* Clark. Two of the six species which Clark and Twitchell
recorded from the Trinity are indicated by Adkins as occurring in
Fig. 1. Map of Texas showing the extent and facies of the Trinity group. Ruled area = landward margin of Glen Rose Limestone wedge; dotted area = shoreward extent of Trinity Sand (heavier dots indicate outcrop). A-A, Northern margin of Glen Rose. B-B, Northern margin of Trinity Sand.
the Fredericksburg and Washita but not in the Glen Rose; *Holecryptus planatus* Roemer and *Heteraster texanus* (Roemer); and one of the species, *Pseudodiadema texanum* (Roemer), is restricted to the Fredericksburg group.

**TABLE I**

**ECHINOIDS OF THE GLEN ROSE LIMESTONE AND TRINITY GROUP**

<table>
<thead>
<tr>
<th>Species</th>
<th>Glen</th>
<th>Trinity</th>
<th>Our Collection</th>
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<tbody>
<tr>
<td>Diplopodia texanum (Roemer)</td>
<td></td>
<td>51764</td>
<td></td>
</tr>
<tr>
<td>Hemiaster comanchei Clark</td>
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<td>x</td>
<td>51777</td>
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<tr>
<td>&quot; ? electus Cragin</td>
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<td>x</td>
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<tr>
<td>Heteraster obliquatus (Clark)</td>
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<tr>
<td>&quot; texanus (Roemer)</td>
<td></td>
<td>x</td>
<td>51779</td>
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<tr>
<td>Hol erectypus engerrandi Lambert</td>
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<td>x</td>
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<tr>
<td>&quot; ovatus Whitney and Kellum</td>
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<td></td>
<td>51771</td>
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<tr>
<td>&quot; planatus Roemer</td>
<td></td>
<td>x</td>
<td>51775</td>
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<td>Hypodiadema elegans Clark</td>
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<tr>
<td>Loriolia texana (Clark)</td>
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<td>&quot; rosana Cooke</td>
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<td>Macraster solitariensis Smiser</td>
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<td>Orthopsis comalesis Whitney and Kellum</td>
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<tr>
<td>Phyllacanthus texanus Whitney and Kellum</td>
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<tr>
<td>&quot; tysoni Whitney and Kellum</td>
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<td>Pseudodiadema elevatus Whitney and Kellum</td>
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<td>&quot; texanum (Roemer)</td>
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<td>Pyrina hancockensis Whitney and Kellum</td>
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<td>51767; 51772</td>
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<td>Salenia mexicana Schlifer</td>
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<tr>
<td>&quot; phlliopsae Whitney and Kellum</td>
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<td>51762</td>
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<tr>
<td>&quot; texana Credner</td>
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<td>x</td>
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The Glen Rose Formation varies in thickness from a few feet to 740 feet at its outcrop in Central Texas. It is composed of massive, hard limestone beds alternating with beds of softer limestone. At the outcrop, some of the softer impure limestones break down to calcareous clay and shaly limestone. The basal part of the formation contains some sandstone, and the upper 60 feet or more also is sandy. Fossils are locally abundant, chiefly in the lower Glen Rose. Although the limestone yields an abundance of fossils, few are well preserved. The fauna consists largely of pelecypods and gastropods. Echinoids are well represented but most of the species are rare. The common species are *Loriola texana* (Clark) and *Heteraster obliquatus* (Clark).
Description.—The ambulacral areas are very narrow and sinuous. At the ambitus there appear to be four rows of tubercles between the pore zone; the two inner rows are made of very minute tubercles, while the outer ones are larger. In the upper part of the ambulacral area and near the peristome there are only two rows of tubercles. In the specimen at hand there seems to be no groove between the pores. The area dwindles to a point less than 2 mm in width at the peristome and to about 1 mm in width at the discal region, but it is not more than 3 mm wide at the ambitus. The plates in the whole area are very small and narrow.

Interambulacral areas are broad and prominent, made up of very large plates which are almost equal-sided and hexagonal. The areolas are large, circular or slightly polygonal, and closely crowded. They cover almost all of the plate except for a narrow rim of large and small oval granules in two- to four-inch rows. From the margins of the plates, the rows of granules rise steeply, at angles from about 40° to 80°, to the top of the rim. On the inside of the rim the test falls sharply to the depressed areola, which in turn rises to form a large but very low boss with a sharp, smooth rim at its top. On the bosses are huge, rounded mamelons 4 mm in diameter and with a deep perforation but no crenulation. There are four plates and four very strong, prominent tubercles to each row; the plates at the peristomal region are small, and also one of the plates at the apical region may be small, rectangular to polygonal, and almost entirely covered with granules and bearing a small tubercle near the apical border; sometimes the tubercle becomes well developed. The opposite plate bears, however, the largest tubercle of the area, and from this very large tubercle at the apical region the others dwindle in size toward the peristome.
Spines are large, pyriform, 2.3 cm in length and 1.3 cm in the widest place. They are blunt at the distal end, more tapering at the proximal end, and with the greatest diameter near the distal end. They are covered with strong ridges which break up into irregular rows of granules near the proximal end.

*Phyllocanthus tysoni* differs from *P. hemigranosus* in that it has a smaller number of granules in the ambulacral area and also has no groove between the pores. There are also fewer plates in the interambulacral areas, and the areas surrounding the areolas are narrower, more crowded, and much steeper in their inner borders. Also the mamelons are much larger even though the specimen is only about one-fourth as large as the specimen of *P. hemigranosus* at hand. The bosses are not so high, nor the areolas so deep.

**Remarks.**—The specimen is so crushed that the true shape cannot be determined. The shell is of moderate size and probably would be subspherical in a well-preserved condition.

From the little that is preserved of the borders of the discal region, they seem to be smooth and without marked indentation.

The apical system is missing. The peristome is too poorly preserved to be characterized.

**Dimensions.**—Height 3 cm, diameter about 4 cm.

**Occurrence.**—About 225 feet above the base of the Glen Rose on Hancock-Cranes Mill road, Comal County, Texas.

**Holotype.**—UMMP 51768.

*Phyllocanthus texanus* n. sp.

(Pl. II, Figs. 13-14)

**Description.**—Ambulacral areas are only slightly undulating, narrow and elevated in the central portion. The plates are small and narrow. Each one is covered with two horizontal rows of minute granules of two sizes and with two to four in each group. At the outer end of the rows of granules there are larger mamelonated, scrobiculate tubercles which are still microscopic in size but occupy the whole width of the plate. The poriferous zones are in narrow, depressed areas which drop sharply from the rows of tubercles. The pores are oblique with a groove running between
them on the lower side and a small, round granule with an elongate base that extends between the pores on the upper side.

Interambulacral areas are wide, made of large plates with about 8 prominent, mamelonate tubercles with wide, rounded, polygonal, depressed areolas. The bosses are large and high with a smooth, sharp rim at the top. The mamelon is stout, flat-topped, deeply perforate and angular in profile. Areolas deep and surrounded by a high rim of small, prominent secondary tubercles that are feebly scrobiculate. Beyond the secondary tubercles there are as many as 10 rows of granules between the rows of tubercles. These granules grade upward in size from the edges of the plate to the ring of secondary tubercles. There may be as many as 12 rows of small tubercles or granules between the rows of primary tubercles, but never more than two rows between any two large tubercles in the same row or between a large tubercle and the ambulacral area except in the angles between two areolas where there may be irregular groups of large numbers of granules. The areas surrounding the areolas are low and flat, with only slight depressions between the rows of tubercles.

The peristome is crushed, with periproct and apical system wanting.

Phyllacanthus texanus resembles P. hemigranosus in the number and shape of its tubercles, in the deep areolas and the wide areas between the rows of tubercles, and in having a groove between the pores in the ambulacral areas. It differs from P. hemigranosus in the arrangement of tubercles on the ambulacral plates and between the pores, in its less sinuous ambulacral area, in its proportionately smaller tubercles, in its less elevated areolas, and in its shallower areas between the rows of tubercles.

It does not closely resemble P. tysoni, which is found in the same formation. There are twice as many tubercles on P. texanus. The areolas are deeper, smaller, and lower; the bosses are proportionately higher; the mamelons are much smaller; the ambulacral areas are less flexuous, have a different arrangement of tubercles, and have a tubercle between the pores whereas P. tysoni has none.

Remarks.—Only a fragment of the test is present, but sufficient characters remain to distinguish it from P. hemigranosus and P. tysoni. The test of this species is small and appears to be subglobose.
EXPLANATION OF PLATE I

_Saliena texana_ Credner
Figs. 1-3. Aboral, lateral, and oral views. UMMP 51761. × 1.

_Saliena phillipae_ Whitney and Kellum
Figs. 4-6. Aboral, lateral, and oral views. UMMP 51762. × 5

_Saliena mexicana_ Schlüter
Figs. 7-9. Aboral, lateral, and oral views. UMMP 51763. × 2.

_Diplopodia texanum_ (Roemer)
Figs. 10-12. Aboral, lateral, and oral views. UMMP 51764. × 1.
Walnut Clay.

_Orthopsis comalensis_ Whitney and Kellum
Figs. 13-15. Aboral, lateral, and oral views. UMMP 51765. × 2.
Crane's Mill, Hancock road, Comal County. Lower Glenrose.

_Pseudodiadema texanum_ (Roemer)
Figs. 16. Aboral view. UMMP 51766. × 1.
Figs. 17-19. Aboral, lateral, and oral views. UMMP 51766. × 2.
Bee Caves.
Dimensions.—Height about 2.5 cm, width 3.5 cm.

Occurrence.—4.3 miles west of Fischer Store, Texas.

Holotype.—UMMP 51769.

Subclass REGULARIA ECTOBRANCHIATA
Order DIADEMOIDEA
Suborder CALYCINA

Family Saleniidae Desor (emend. Duncan and Sladen)

Genus Salenia Gray

Salenia texana Credner

(Pl. I, Figs. 1-3)

Cidaris diatretum Giebel, 1853, p. 374, pl. VII, fig. 2.
Salenia texana Clark, 1891, p. 75.
Salenia texana Clark, 1893, p. 51.
Salenia texana Clark, 1893, pp. 40, 41, pl. X, figs. 1a-h.
Salenia texana Cragin, 1893, pp. 163, 164.
Salenia texana Clark and Twitchell, 1915, p. 49, pl. XII, figs. 1a-i:
pl. XIV, figs. 1a-c.
Salenia texana Adkins, 1928, p. 277, no pl.
Salenia texana, Smiser, J. S., 1933, p. 141, pl. 19, figs. 1-5.
Salenia texana, Cooke, C. W., 1946, p. 203, pl. 31, fig. 3.

Dimensions of our figured specimen.—Height 14 mm, diameter 23 mm.

Occurrence.—It is found only in a restricted zone about 275 feet above the base of the Glen Rose. The zone, which is eight feet thick, occurs in numerous places throughout central Texas. Some of the specific locations are as follows: 2.3 and 4.3 miles west of Fischer Store, 3 miles south and 1 mile east of Bandera, Texas.

Figured specimen.—UMMP 51761.
Salenia mexicana Schlüter

(Pl. I, Figs. 7-9)

Salenia mexicana Schlüter 1887, p. 41.
Salenia Prestensis, Cotteau, 1890, p. 294.
Salenia texana, 1893 in part Cragin, p. 163.
Salenia mexicana, Böse, 1910, p. 152. Lám XXXII, figs. 4-19.
Salenia mexicana, Adkins, 1928, p. 278, no pl.
Salenia mexicana, Winton, W. M., 1925; p. 50, pl. 12, figs. 6-8.

Dimensions of our figured specimen.—Height 6.7 mm, diameter 11.7 mm.

Occurrence.—1 mile east of Bandera. Salenia mexicana occurs in the Fredericksburg Division as well as in the Glen Rose.

Figured specimen.—UMMP 51763.

Salenia phillipsae n. sp.

(Pl. I, Figs. 4-6)

Description.—The test is circular, very small, low, with sides inflated, flattened below, convex above.

Ambulacral areas are short, narrow, slightly lanceolate and almost straight, made up of two rows of 5 granules each. There appear to be no smaller granules between these rows; neither are there granules between the slightly oblique pores; there is, however, a slight ridge between the pores. Pores are slightly crowded at the peristome. Interambulacral areas are broad, short, with four plates in each row and with four prominent, mamelonate, crenulate, nonperforate tubercles. The areolas are prominent under a lens and are surrounded by 6 granules.

The peristome is very large, more than one-half the diameter of the shell, circular to decagonal, incised.

The apical system is decidedly pentagonal in outline, and the sides are quite straight with only slight indentations in the middle and at the ends. Over the ambulacral areas the corners of the sides form two small scallops with a shallow indentation between. There are also two slight scallops near the ends and one in the middle of each side of the apical system. The scallops and indentations are all microscopic. The apical system consists of five genital plates, five ocular plates, and one suranal plate which is concave in the center and rises very abruptly to the rim of the oval periproct. All
Ambulacral areas are narrow and lanceolate, consisting of simple, straight, narrow plates, which show no signs of compounding. The 12 to 14 primary tubercles are made up of two plates with one plate between tubercles. Poriferous zones are straight, uniserial throughout, but crowding slightly beside the last two tubercles at the peristome. The pores in each pair are set obliquely to each other with a small, prominent tubercule between them. Primary tubercles are largest and most closely crowded below the ambitus, decreasing in size toward the mouth only very slightly up to the last two, which show a very sudden decrease in size. At the ambitus they begin to decrease in size very gradually toward the apical system. The tubercles are perforate, noncrenulate, and mamelonate, and in profile the bosses are straight-sided with prominent, relatively large, convex mamelons. The bosses are transversely oval in outline and are surrounded by narrow, shallow, groovelike areolas which are also oval in outline. Around the areola is a ring of mamelonate, secondary tubercles of two sizes, often surrounded by small granules. The general arrangement of secondary tubercles seems to be a small tubercle at the inner ends of the two plates that support the primary tubercle and a larger secondary tubercle at both ends of the interculary plates. Between these larger tubercles and beneath the primary tubercle is another smaller secondary tubercle. There are no secondary tubercles present on the exterior side of the ambulacrum in the specimen at hand, but the tubercles between the pores give the appearance of completing the ring of small tubercles around the primary tubercles. The plates in the crowded zone are short, irregular in shape and arrangement. Peristomal ends of the ambulacral area are very slightly indented in the middle and a fraction wider than the interambulacrum; the apical end is very narrow. The first three tubercles from the apical system in all of the rows, both ambulacral and interambulacral, show no sign of perforation even under high magnification, but all the other tubercles are distinctly perforate. This is probably an individual condition.

At the ambitus the interambulacral areas are almost twice as broad as the ambulacral areas and contain two complete rows of mamelonate, perforate, nonscrobiculate tubercles, usually 12 in number and slightly larger than those of the ambulacra. Bosses and narrow groovelike areolas are oval in outline. Primary tubercles are surrounded by a ring of secondary, mamelonate tubercles of two sizes. These in turn are surrounded by minute granules.
In addition to the two complete rows of tubercles that extend from the genital plates to the peristome, there are four short rows of smaller, mamelonate, perforate, noncrenulate tubercles. Two of these rows are between the long rows and extend only a short distance above and below the ambitus. There are six fairly large tubercles at the inner ends of the plates in each of these rows, and like the larger tubercles, they have rings of secondary tubercles and granules about them. At the outer edges of the areas, usually very close to the ambulacra, there is on either side a short row of small tubercles—usually six to eight in each, and the rows extend up about as far as the inner rows, approximately 6 mm from the genital plates. These tubercles are partly surrounded by secondary tubercles and granules; the primaries, however, are so close to the outer margin that they do not appear to have any secondaries on their external margins. The peristomal ends of the interambulacra are short, arcuate, deeply notched on either side; the incision is directed slightly inward, with the inner lip prominent and high. Discal ends are much broader than ambulacra and indented in the middle.

The apical system is incomplete in this specimen. Three ocular, two complete genital, and two incomplete genital plates are present. The genital plates have about six small tubercles surrounding the pore with as many as eight larger tubercles scattered over the surface. The oculars have about six closely crowded tubercles, and the pore is very near the external margin. The shape of the periproct cannot be definitely determined, but three straight sides are present which seem to diverge from one another in the manner that suggests a pentagonal outline; also a faint ridge on the cast suggests the same form. The opening, however, must not be very large in a complete test. The peristome is large and probably would be circular or decagonal in a perfect specimen.

This species resembles, in several respects, Orthopsis granulans, figured by Cotteau from the Cenomanian. The interambulacra have the same number and arrangement of tubercles. Their general shapes are similar and the presence of tubercles between the ambulacral pores also shows a similarity; however, there are many more tubercles on the ambulacral areas, and the arrangement of secondary tubercles is different in O. granulans than in O. comalensis. The shape of the genital plates is also different. One would not expect two species so widely separated in age to be very closely related, however.
There are two Comanchean species of Orthopsis figured by Clark and Twitchell, but only one, *O. planulata*, even remotely resembles *O. comalensis*, and it is so meagerly preserved that to establish any identity with *O. comalensis* would be impossible. In his short description, Clark mentions some characters that seem to differentiate this species from the one at hand. *O. comalensis* has no compound plates in the ambulacral areas and no sutures passing through the interporiferous tubercles. He also figures the tubercles as being round, whereas they are oval in *O. comalensis*. In his enlarged figure of the ambulacral area his arrangement of secondary tubercles is different, and all of these tubercles unlike those in this species, seem to be of the same size. Although he speaks of interporiferous tubercles, he shows none in the figure; finally, the arrangement of tubercles in the interambulacral area appears to be different in the two species.

**Dimensions.**—Height 5.5 mm, diameter 13 mm.

**Occurrence.**—Cranes Mill-Hancock road, Comal County, Texas. About 225 feet above the base of the Glen Rose.

**Holotype.**—UMMP 51765.

**Family Diadematidae Wright**

**Genus Pseudodiadema Desor**

*Pseudodiadema texanum* (Roemer)

(Pl. I, Figs. 16-19)

*Pseudodiadema texanum* Desor, 1858, p. 72.

*Diadema texanum* Gabb, 1859, p. 19.

*Pseudodiadema texanum* Meek, 1864, p. 2.

*Pseudodiadema roemeri* Clark, 1891, p. 75.

*Pseudodiadema texanum* Clark, 1893, p. 51.

*Pseudodiadema texanum* Clark, 1893, pp. 47, pls. XIII, figs. 2a-n; XIV, figs. 1a-g.

*Pseudodiadema texanum* Cragin, 1893, pp. 161, 162.

*Pseudodiadema texanum* Hill and Vaughan, 1898, pl. LIII, figs. 3a, 3b.

*Pseudodiadema texanum* Hill, 1901, pl. XXVII, figs. 3a, 3b.

*Pseudodiadema texanum* Clark and Twitchell, 1915, p. 55, pl. XVIII, figs. 1a-l.
Loriolia texana, Lambert, 1926, p. 266.  

Dimensions of our figured specimen.—Height 5.9 mm, diameter 14.8 mm. UMMP 51766.

Other cataloged specimens.—UMMP 51774.

**Pseudodiadema elevatus** n. sp.  
(Pl. II, Figs. 7-9)

*Description.*—The test is circular, depressed and flattened below, greatly elevated above, flattened on top, with sides inflated.

The ambulacra is narrow, lanceolate, made up of two series of long, narrow, irregular, compound plates in groups of three and sometimes four. The small plates are rarely visible. Each group is centered around a primary tubercle. There are 12 to 14 small, acrobiculate, mamelonate, perforate tubercles in each of the two rows. The tubercles decrease uniformly from the ambitus to the mouth and apical system. Each areola is partly surrounded by two sizes of small mamelonate, secondary tubercles and granules. Between the pores there is an elevated region that resembles a tubercle. The pairs of pores are uniserial, becoming crowded beside the second tubercle from the peristome. Both ends of the ambulacral area are slightly indented, peristomal, and very slightly broader than that of the interambulacrum.

The interambulacra is twice as broad as ambulacra at the ambitus, consisting of two series of broad, long plates on each of which is a small, mamelonate, scrobiculate, perforate, crenulate tubercle surrounded with a ring of minute granules around them. Between any two tubercles in the same row at or above the ambitus there is usually only one row of granules, but to both sides the granules increase so that between the two series of tubercles there are from four to six rows. The surface is entirely covered with them except for the scrobiculate areas. Below the ambitus the areolas appear to join one another without granules between. The peristomal end of the interambulacral area is straight to arcuate, narrow, and deeply incised on either side. Incisions are directed slightly toward the center of the area. The inner lip is high, prominent, and thick.
EXPLANATION OF PLATE II

**Pyrina hancockensis** Whitney and Kellum

*FIG. 1. Aboral view. UMMP 51767. ×2.*
Crane's Mill, Hancock road, Comal County. Key Clay.

*FIGS. 2 AND 3. Lateral and oral views. UMMP 51767. ×1.*

**Phyllacanthus tysoni** Whitney and Kellum

*FIGS. 4-6. Aboral, lateral, and oral views. UMMP 51768. ×1.*
Crane's Mill, Hancock road. Key Clay.

**Pseudodiadema elevatus** Whitney and Kellum

*FIGS. 7-9. Aboral, lateral, and oral views. UMMP 51770. ×1.*

**Holectypus ovatus** Whitney and Kellum

*FIGS. 10-12. Aboral, lateral, and oral views. UMMP 51771. ×2.*
Salenia texana zone. Comal County.

**Phyllacanthus texanus** Whitney and Kellum.

*FIGS. 13 AND 14. Lateral and aboral views. UMMP 51769. ×1.*
they are large at the ambitus and decrease gradually at the poles. The plates are compound, generally very irregular in shape, but tending to be long and narrow. Each primary tubercle is made up of several plates. Those on the flanks of the tubercle are normally much wider than those above and below them. The number of these plates varies in each group, usually four below the ambitus and as many as seven above it. In the latter case the tubercles are made up of three to four plates with one to three plates between each tubercle. Here the pores are bigeminal; but each plate bears only one pair of pores. Sometimes the doubling causes some pores to lie on the line between the plates. In such cases it is usually the lower pore that appears to lie between the plates, while the upper one lies midway between the sides of the plate.

The plates are grouped around the tubercles. Opposite groups fit together like single plates in the interambulacral areas. This gives them the appearance of being single large plates, sometimes separated between the pores at the outer margins. It was thus that Clark figured them. Each pair of pores, however, is borne on a separate plate which usually goes all the way to the center of the ambulacral area. There is one large tubercle and several small granules surrounding it in each group. The elevation of the tubercle causes the irregularity of the plates and gives them the appearance of radiating downward from the apex of the tubercle.

Where the plates become crowded near the mouth, there is an irregular number of plates in each group. The pattern of crowding seems to be quite constant in different individuals and differs considerably from that figured by Clark. Beginning with the fifth tubercle from the mouth and proceeding adactinally, the upper plates are normal, lining up with the long series above. The lowest plate in the group has its pair of pores much closer to the tubercle. The upper two and sometimes three pairs of pores of the fourth tubercle line up obliquely with this lowest member of the fifth group in a line directed somewhat outward toward the margin of the ambulacral area. Again the lowest member has its pores nearer to the tubercle. This same pattern is carried out beside the third tubercle. Here, however, the rows become more oblique and the crowding increases. Finally by the second tubercle the crowding has become so great that in some specimens the rows of pores stand almost horizontally. There are from three to four rows, with three pores in each row, from the third tubercle down to the peristome.
The last row has some pores cutting the margin of the peristome. Some pores anastomose. Where the crowding is great beside the first and second tubercle the plates have become so shifted in position that they lie in horizontal rather than vertical series. They have become so short that they are almost equal-sided and usually pentagonal in shape. Near the peristome the pairs of pores become so oblique that they stand almost vertically.

The ends of the ambulacral areas at the peristome are slightly indented in the middle. They are a little broader than those of the interambulacral areas.

The interambulacral areas are twice as broad as the ambulacral areas at the ambitus and are composed of four rows of primary tubercles. The outside rows gradually diminish in size below the ambitus and more or less abruptly above it. They die out long before reaching the apical system, but extend almost all the way to the peristome. The inner rows converge at the peristome and diverge above until they almost meet the poriferous zones of the ambulacral areas at the apical system. There are two primary tubercles, and scattered, irregular granules around each of these on most of the long, broad plates. Each plate is bent slightly downward in the middle.

At the mouth the interambulacral area is narrow and straight. There is a deep incision on either side directed toward the center of the area with a strong lip projecting adactinally on the inner edge of the incision. Clark mentions a broad depression in the interambulacral areas near the discal region. This depression shows up well on the Walnut specimens, but is very slight on the Glen Rose specimen. Other material, however, might show this characteristic.

The mouth is large, circular, and decagonal. The edges of the discal opening on the Glen Rose specimen are shattered, but in those found in the Walnut formation it is large and very definitely pentagonal.

The spines are long, slender, tapering, arcuate, and plain with crenulations on the articulating surface.

**Dimensions.**—Height, 9 mm, diameter 25 mm.

**Occurrence.**—Wimberly-Dripping Springs road, four miles from Wimberly, Texas.

**Figured specimen.**—UMMP 51764.
**Holectypus ovatus** n. sp.

(Pl. II, Figs. 10-12)

*Description.*—The specimen is very poorly preserved. A few characteristics, however, can be determined which distinguish it from *Holectypus planatus*.

The form is almost hemispherical. The sides slope in an even and well-rounded curve from the broadly arcuate apex to the gently rounded border. The adactinal surface is curved to the peristome, bending sharply toward the peristome for a distance of only 2 mm, only slightly concave. The periphery is circular. Whether this varies to pentagonal as does *H. planatus* is problematical, for only a few specimens have been found. The height is slightly more than one-half the transverse diameter. Most of the tubercles have been obliterated, but there appear to be four rows of perforate tubercles on the ambulacral areas. These are feebly mamelonate and scrobiculate.

The peristome presents an ovate form; hence the name *ovatus* is suggested. The peristome is also decagonal with strong incisions and prominent recurved lips. It is very large, occupying about one-half the adactinal side. Only a part of the periproct is present. It appears to be large, probably occupying most of the space between the peristome and the outer edge of the adactinal surface. The end preserved is ovate, but too much has been weathered away to make any statement concerning the general form. The long axes of the peristome and the periproct are at right angles to each other.

The apical system is too weathered to show any characters.

The plates of the ambulacral areas are very narrow and straight. The pairs of pores are oblique and appear to alternate throughout the whole area. The interambulacral plates possess the same type of bending downward in the middle as is found in *H. planatus*. The tubercles are arranged in regular rows in the interambulacral areas, but only a few faint remnants are present on this specimen.

This species differs from *H. planatus* by the following characteristics: it is about one-third higher and less acuminate; its sides are more strongly arched, its lower surface more rounded, less concave. Its peristome occupies a greater area and presents a more elongate shape. The area between the peristome and periphery is very much narrower, bending much more sharply toward the peristome. There
may be fewer tubercles in the ambulacral areas but the weathered condition prevents any definite determination of the number normally present. The pores are oblique like the younger specimens of \textit{H. plantatus}. Older specimens of the latter appear to have nearly horizontal pores except on the adactinal side. The general outline of \textit{H. ovatus} differs distinctly from that of \textit{H. planatus}.

The shape of the peristome is similar to that of \textit{Holectypus Cenomanensis} and of \textit{H. excisus}, figured and described by Cotteau in \textit{Paleontologie Francaise}. In his description of the genus \textit{Holectypus}, Cotteau states that a circular peristome is a generic character of this genus, but curiously in his description of \textit{H. Cenomanensis} a few pages farther on he speaks of the oval peristome. In this species the peristome is more rounded on the ends than is that of \textit{H. ovatus}.

\textit{Dimensions}.—Height 11 mm, tranverse diameter, 17 mm.

\textit{Occurrence}.—\textit{Salenia texana} zone, about 275 feet above the base of the Glen Rose Formation in Comal County, Texas, nine miles from Anhalt toward Boerne on the Anhalt-Boerne road.

\textit{Holotype}.—UMMP 51771.

Order \textit{ATELOSTOMATA}

Suborder \textit{ASTERNATA}

Family \textit{ECHINONEIDAE} Wright

Genus \textit{Pyrina} Desmoulins emend. De Loriol

\textit{Pyrina hancockensis} n. sp.

(Pl. II, Figs. 1-3)

\textit{Description}.—Tests are small to moderate in size, elongate, oval, rounded on the anterior end, and somewhat truncated on the posterior end. Adactinal sides are concave in the center, with abactinal side convex and the sides inflated.

Ambulacra are narrow, lanceolate, equal, prominent, composed of numerous, narrow plates. The pores are simple, oblique, in regular rows, and having a small, interporiferous tubercle in each pair. Below the ambitus the pairs of pores become somewhat irregular, in that they appear in groups of three which extend outward from the original line. The primary tubercles are in two rows near the apical system and the peristome, increasing in both direc-
tions to four rows and then six rows near the ambitus. The additional rows are added between the two continuous exterior rows. All the tubercles of the test are very small and depressed in a deep areola. They are mamelonate and perforate, scrobiculate, but not crenulate, and surrounded by small granules. Where the tubercles are close together, the granules stand up in a high ridge between them.

Interambulacra very wide, more than three times as wide as the ambulacra at the ambitus, covered with small, depressed tubercles and numerous rows of minute granules. The tubercles are most numerous at and below the ambitus. The granules are most numerous on the sides and near the apical system, in fact the whole surface between the tubercles is covered with granules.

The apical system is elongate and irregularly oval, consisting of five irregularly shaped ocular plates, the posterior pair with no genital plate between them, and four very unequal genital plates, the anterior one carrying the madreporite in the center of the system.

The peristome is small, elongate, oval, and noticeably oblique, extending to the left side of the anterior ambulacrum. The borders are smooth and inrolled. The mouth is in a depressed area.

The periproct is larger than the peristome, elongate and pyriform, with the end near the apical system quite acuminate, the other end rounded. It is located in a slightly depressed area close to the apical system.

Relationships and differences: Pyrina hancockensis resembles P. ovalis figured by d'Orbigny from the Cenomanian in the general size and shape of the test, positions and shapes of the peristome and periproct. It differs from this species, however, in that it is proportionately narrower, more truncate and of flatter curve posteriorly, and with a smaller anterior end. The apical system is of the same general plan, but the shapes of the plates are quite different, the madreporic plate being especially different from the others.

Dimensions.—Height 7 mm to 14 mm, length 16 mm to 29 mm, width 12 to 18 mm.

Occurrence.—Cranes Mill-Fischer Store road. Also 225 feet above the base of the Glen Rose on Cranes Mill-Hancock road.

Holotype.—UMMP 51767.

Other cataloged specimens.—UMMP 51772.
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