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Artikel: The larger foraminifera of the Atascadero Limestone of Northwest Peru, South America
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The Larger Foraminifera of the Atascadero Limestone of Northwest Peru, South America.

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With 1 figure and 2 plates (XIV, XV).

In 1927 while making an inland trip from Negritos, Peru towards the town of Tumbez I was struck by the sink hole topography of the country around the head waters of Qubrada Parinas. Following the north extention of the valley to the small village of Atascadero I had plenty of opportunity to examine the rocks and to collect specimens. The rock there is in the most part organic limestone containing many orbotoidal foraminifera and a great number of *Lithothamnium* (algae) as well as other fossils. Messers C. BARRINGTON BROWN and R. A. BALDRY visited the locality in 1925 and collected from it. The Echinoids were described in 1926 by Dr. A. G. BRIGHTON[2]) of the Sedgwick Museum where the collection of the above men is deposited. The first collectors suggested the name Atascadero limestone for the formation. In this connection I propose that the name be retained but only in as a horizonal name. I propose this change because of the limited extent of the limestone and because it constitutes only a horizon in a larger formation. At this locality it represents the horizon called by IDDINGS and OLSON[3]) the Saman Conglomerate horizon of the Saman Shale. The 250 feet of green sandstone with *Nautilus «Hetroglossa restinensis* BERRY(?)» is the Restin formation of IDDINGS and OLSON.

The Sedgwick Museum has very kindly lent me their two samples from this locality and after careful comparison I am certain they are from the same horizon as I collected from. Their material consists

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[1]) Work carried out under a Grant from the National Research Council, Washington, D. C., U. S. A.

[2]) A. G. BRIGHTON: Eocene Echinoids from N. W. Peru; Geol. Magz. vol. LXIII, pp. 359—371, 1926.

[3]) A. IDDINGS & A. OLSON: Geol. of N. W. Peru; Bull. A. A. P. G. vol. 12, pp. 1—39, 1928.

of two irregular, hand specimens. One is broken out of the solid limestone and the other, (Fig. 1) a slightly larger piece with a weathered surface covered with orbitoidal foraminifera. The material I collected consists of several pieces of partially weathered material and abord a pound of well weathered material from which I took the forms herein described.

Fig. 1. Hand specimen of Atascadero Limestone in the Sedgwick Museum, Cambridge, England. (Natural size.)

Due to the extreme hardness of the unweathered limestone it is nearly impossible to obtain correctly orienanted sections for identification, and also due to the thinness and delicacy of the specimens I could use only those which were weathered out. Many sections were ground before I obtained any suitable for close study.

The fauna is small in species altho there is an abundance of specimens. In all there are 5 *Lepidocyclina* and 2 *Operculina* all of which are new to science. The noticable abundance of microspheric *Lepidocyclina* over megalospheric forms is striking as compared to their relative lack in the previously described *Lepidocyclina* fauna from Peru[1]). On the other hand the small fauna exibits some simi-

[1]) Willard Berry: The Larger Foraminifera From the Verdun Formation, Northwestern Peru; Johns Hopkins University Studies in Geol. No. 9, 1929.

larities to the as yet undescribed collection of larger Foraminifera from the Saman formation from around Lagunitos, Peru. Of the *Operculina* I have not as yet studied those I have from other areas of Peru so cannot draw any evidence.

The limestone contains much very fine (less than 200 mesh) dark clastic material, seemingly a fine clay or salt. When digested in acid the residual mass is plastic and difficult to get into suspension. I examined it for radiolaria but failed to find any. The residue is all of about the same degree of fineness and does not contain, as far as I could acertain, any heavy minerals, the whole mass being too fine to effect a separation. From the occurrence and character of the limestone, from the foraminiferal fauna, and from the *Lithothamnium* (algae) which are of at least two kinds (biscuit and branching types) I think that this limestone was formed in shallow, warm-water embayments. There must have been a little drainage into these embayments as evidenced by the clastic material in the limestone. This lack of great run off may be accounted for by low shores with abundant vegitation which would retain the water and so prevent great amounts of sediment; by aridity; and by having here and there embayments which lacked any great amount of run off due to the stream capture or reverse slope along the shores. From the great thickness of the Tertiary sediments (25,000 ft.) I do not believe that the first two causes can be taken into account and so hold that the last cause must have been effective at that time. From the character of what clastic material we have I do not believe that the region suffered from floods which are often so characteristic of tropical regions due to the great seasonal differences of rainfall. It seems to me that at this locality the run off was very much reduced by stream capture or reverse slope and the great amount of rainfall which in running off at other places built up from 1 to 200 feet of conglomerate was absent here due to those causes.

The fauna seems to be indemic but such would be expected under the conditions outlined above. The species may be described as follows:—

Genus Lepidocyclina.

Lepidocyclina atascaderensis n. sp.

Plate XIV, Fig. 3; Plate XV, Fig. 6.

Test discoidal, equilateral, small, 1.7 mm. in diameter, 0.75 mm. thick, ratio of diameter to thickness 2.2 : 1. Test thins evenly from the center to the periphery, there is no flange developted. Surface papillated with small irregular scattered papillae. The lateral chambers at the surface are 78 microns in diameter and have walls 39 microns thick.

In equatorical section the nucleoconch is composed of two subequal chambers separated by a thin, straight wall. The width of the nucleoconch is 132.6 microns and the diameter is 195.0 microns with walls 11.7 microns thick; the ratio of the width to the diameter is 1.47 : 1. The equatorial chambers are open arcuate and are arranged in circles, these chambers are 78 microns in diameter radially and 85.8 microns in diameter tangentially with walls 15.6 microns thick.

In vertical section the walls between the equatorial chambers and the lateral chambers is 15.6 microns thick. The vertical diameter of the equatorial chambers is 46.8 microns at the center and they increase evenly in diameter to 66.3 microns at the periphery. The lateral chambers are arranged in columns. In the center near the periphery they are 27.3 microns in vertical diameter with walls 11.7 microns thick. There is a total of from 8 to 12 lateral chambers on the sides of the equatorial chamber layer near the center of the test.

Cotypes.

Occurrence: Atascadero, Peru.

L. atascaderensis does not seem to have a close relation to any of the associated microspheric forms, except *L. carmani* which has the same type of equatorial chambers, altho their interior ratios are not the same; and in having the same ratio of the thickness of the walls of the equatorial chambers to the thickness of the walls between the equatorial and lateral chambers, namely 1 : 1; and in having the same thickness in the horozontial walls of the lateral chambers. The nearest species to which it is at all comparable is *L. despobladensis* W. BERRY of the Verdun formation (oligocene?). It is like *L. despobladensis* in having the same ratio of diameter to width of the nucleoconch but is smaller in external size and has larger equatorial chambers with the longest direction at right angles to those of the described form *(L. despobladensis)*. The ratio of diameter to thickness is also about the same. It can easily be recognized in thin section by the very thin, delicate walls of the equatorial chambers.

Lepidocyclina columna n. sp.

Plate XIV, Figs. 4, 7.

Test discoidal, slightly saddle shaped, small, thin, 2.00 mm. in diameter, 0.45 mm. thick, ratio of diameter to thickness 4.4 : 1. Test thins nearly regularly from the center to the periphery, there is no flange developed. Surface papillated, papillae small and unevenly spaced. The lateral chambers at the surface are 19.5 microns in diameter with walls 7.8 microns thick.

In equatorial section the nucleoconch is composed of two subequal chambers separated by a thin, straight wall. The width of the nucleo-

conch is 136.5 microns and the diameter is 210.6 microns with walls 15.6 microns thick. The ratio of the diameter to the thickness is 1.54 : 1. The subequatorial chambers are open arcuate to hexagonal and are arranged more or less in columns; these chambers are 65 microns in diameter radially and 84 microns in diameter tangentially with walls 6 microns thick.

In vertical section the walls between the equatorial chambers and the lateral chambers are 15.6 microns thick. The vertical diameter of the equatorial chambers is 31.2 microns at the center and they increase evenly in diameter to 46.8 microns at the periphery. The lateral chambers are arranged in columns. In the center near the periphery they are 15.6 microns in vertical diameter with walls of the same thickness (15.6 microns). there is a total of 12 lateral chambers on the sides of the equatorial chamber layer near the center of the test.

Cotypes.

Occurrence: Atascadero, Peru.

L. columna from the arrangemant of the equatorial chambers seems to be the megalospheric generation of *L. brightoni* with which it is associated. The number of lateral chambers is the same for each and the equatorial chambers are nearly the same shape. The ratio of the diameter to thickness is quite different however. This species does not seem to be closely related to any others found in the area.

Lepidocyclina brightoni n. sp.

Plate XIV, Fig. 2; Plate XV, Fig. 4.

Test discoidal, equilateral, small, very thin, 3mm. in diameter, 0.50 mm. thick, ratio of diameter to thickness 6 : 1. Test thins more or less evenly from the center to the periphery, there is no flange developted. Surface papillated, small and closely spaced. The lateral chambers at the surface are 83.5 microns in diameter and have walls 16.7 microns thick.

In equatorial section the species is shown to be microspheric. The equatorial chambers are hexagonal and are arranged in columns, these chambers are 58.5 microns in diameter radially and 89.7 microns in diameter tangentially with walls 7.8 microns thick.

In vertical section the walls between the equatorial chambers and the lateral chambers is 7.8 microns thick. The vertical diameter of the equatorial chambers is 33.4 microns at the center and they increase evenly in diameter to 83.5 microns at the periphery. The lateral chambers are arranged in columns. In the center near the periphery they are 24 microns in vertical diameter with walls 8 microns

thick. There is a total of 12 lateral chambers on the sides of the equatorial chamber layer near the center of the test.

Cotypes.

Occurrence: Atascadero, Peru.

L. brightoni is the microspheric generation of *L. columna* with which it is associated and where the relationship is discussed. This species is not closely related to any species described from outside this area. It is easily recognized by its extreem thinness.

Lepidocyclina carmani n. sp.

Plate XV, Fig. 5.

Test discoidal, equilateral, small, thin, 1.9 mm. in diameter, 0.67mm. thick, ratio of diameter to thickness 2.8 : 1. Test thins evenly from the center to the periphery, there is no flange developted. Surface covered with small irregular papillae. The lateral chambers at the surface are 93.6 microns in diameter and have walls 15.6 microns thick.

In equatorial section the species is shown to be microspheric. The equatorial chambers are open arcuate and are arranged in circles, these chambers are 46.8 microns in diameter radially and 58.5 microns in diameter tangentially with walls 11.7 microns thick.

In vertical section the walls between the equatorial chambers and the lateral chambers is 11.7 microns thick. The vertical diameter of the equatorial chambers is 33 microns at the center and they increase evenly in diameter to 89.7 microns at the periphery. The lateral chambers are arranged in columns. In the center near the periphery they are 23.4 microns in vertical diameter with walls 11.7 microns thick. There is a total of 18 lateral chambers on the sides of the equatorial chamber layer near the center of the test.

Cotypes.

Occurrence: Atascadero, Peru.

L. carmani is the microspheric form of *L. atascaderensis* as compared under that species. Both species are extremely thin and rather difficult to study for that reason. *L. carmani* is not comparable to any microspheric forms described from northern Peru.

Lepidocyclina nuttali n. sp.

Plate XV, Fig. 1.

Test discoidal, equilateral, small, thin, 3.51 mm in diameter, 1.17 mm. thick, ratio of diameter to thickness 3 : 1. Test thins evenly from the center to the periphery, there is no flange developted. Surface papillated with small closely spaced papilla. The lateral chambers

at the surface are 97.5 microns in diameter and have walls 46.8 microns thick.

In equatorial section the species is shown to be microspheric. The equatorial chambers are open arcuate to hexagonal, these chambers are 78 microns in diameter reaially and 109.2 microns in diameter tan gentially with walls 19.5 microns thick.

In vertical section the walls between the equatorial chambers and the lateral chambers are 16.7 microns thick. The vertical diameter of the equatorial chambers is 15.6 microns at the center and they increase evenly in diameter to 100.2 microns at the periphery. The lateral chambers are arranged in columns. In the center near the periphery they are 19.5 microns in vertical diameter with walls 15,6 microns thick. There is a total of 24 lateral chambers on the sides of the equatorial chamber layer near the center of the test.

Cotypes.

Occurrence: Atascadero, Peru.

L. nuttali is the largest *Lepidocyclina* found in the formation and differs in all respects, except the thickness of the horizontal walls of the lateral chambers near the center of the test, from all the others. It is also quite different from any of the microspheric forms described from Peru. It is easily recognized by its large size and relatively great thickness as well as its finely papillated surface.

Genus Operculina.

Operculina atascaderensis n. sp.

Plate XIV, Figs. 1, 5; Plate XV, Figs. 2, 3.

Test medium to large, 3.5 mm. in diameter and 0.75 mm. thick, ratio of diameter to thickness 4.4 : 1. Entire test about the same thick, ness. Surface nearly smooth except for a few irregular lines which may be slighly raised sutures. The test starts with a well defined nucleoconch then makes 3 gradually increasing coils, the last coil containing about 24 chambers, the septa are curved convexly outward; in this last coil there are several septa which are compound on the inward end and single on the outward end.

Cotypes.

Occurrence: Atascadero, Peru.

This species of which I have figured several specimens is very common in the limestone at Atascadero does not seem to resemble any of the described forms. It seems to be related to *O. peruviana* with which it is associated. It is easily recognized in thin section by the deviding devided inward portions of some of the septa. The external appearence is rather indefinite tho some of the better preserved specimens show some evidence of raised sutures. (Plate XV, Fig. 3.)

Operculina peruviana n. sp.

Plate XIV, Fig. 6; Plate XV, Fig. 7.

Test small, 2.5 mm. in diameter and 0.6 mm. thick, ratio of diameter to thickness 4.1 : 1. Test of about the same thickness through out. Surface rough a few deep indentations at the margin where the sutures are depressed. The test starts with a definite nucleoconch and makes 3 plus coils, there are about 21 chambers in the last formed coil, the septa are convex outward often strongly curved backward at the outside end.

Cotypes.

Occurrence: Atascadero, Peru.

O. peruviana is the smallest Operculina found in this area. It is not comparable with any of the freviously described forms. It is fairly common. *O. peruviana* is quite like *O. atascaderensis* but differs in being smaller and in lacking the charterictic devided sutures of *O. atascaderensis*. It is easily recognized in thin section.

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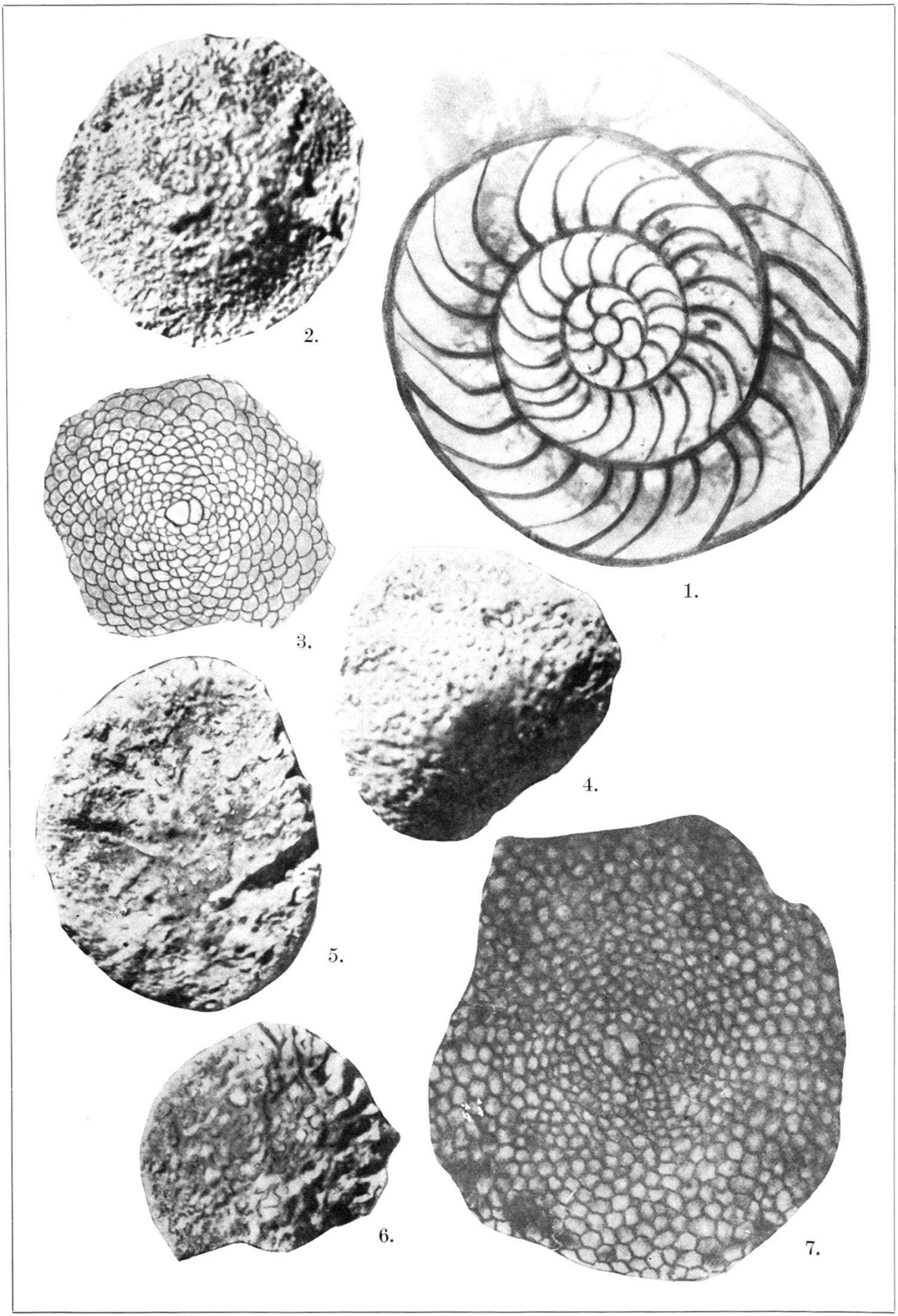

Fig. 1. *Operculina atascaderensis n. sp.*, equatorial section. — Fig. 2. *Lepidocyclina brightoni n. sp.* — Fig. 3. *Lepidocyclina atascaderensis n. sp.*, equatorial section. — Fig. 4. *Lepidocyclina columna n. sp.* — Fig. 5. *Operculina atascaderensis n. sp.* — Fig. 6. *Operculina peruviana n. sp.* — Fig. 7. *Lepidocyclina columna n. sp.*, equatorial section.

Note: Entire specimen enlarged about 14 1/2 times; sections enlarged about 25 times.

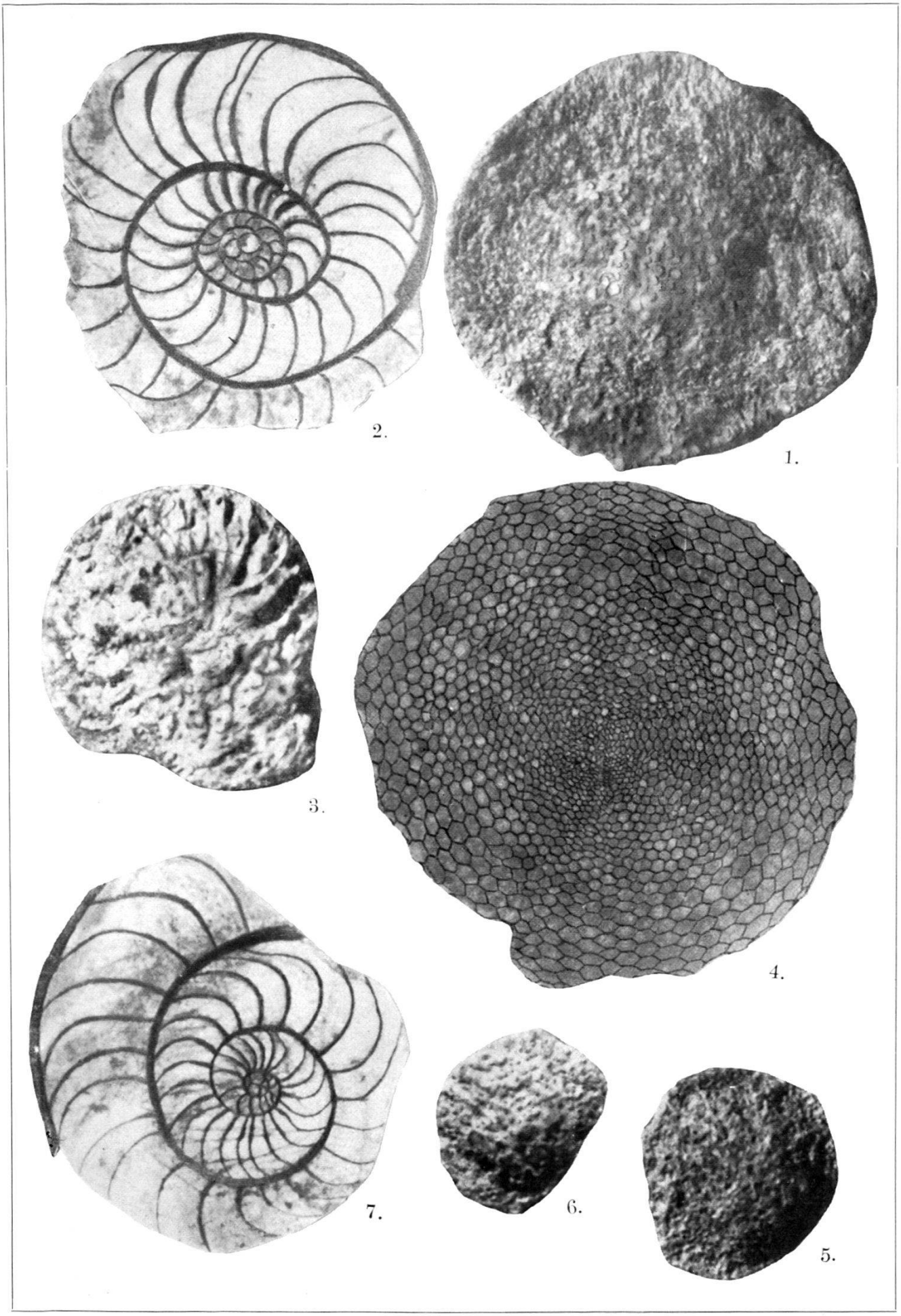

Fig. 1. *Lepidocyclina nuttali n. sp.* — Fig. 2. *Operculina atascaderensis n. sp.*, equatorial section of medium sized specimen. — Fig. 3. Same as number 2 but not is section. — Fig. 4. *Lepidocyclina brightoni n. sp.*, equatorial section. — Fig. 5. *Lepidocyclina carmani n. sp.* — Fig. 6. *Lepidocyclina atascaderensis n. sp.* — Fig. 7. *Operculina peruviana n. sp.*, equatorial section.

Note: Entire specimen enlarged about 14½ times; sections enlarged about 25 times.