TERTIARY NAUTILOIDS OF THE AMERICAS: SUPPLEMENT
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ABSTRACT—Representatives of Eutrephoceras are described from the Paleocene and the Eocene of California; Cimomia from the Paleocene of Colombia and Trinidad and the Eocene of Washington; Hercoglossa from the Paleocene of Baja California and the Eocene of Peru; Deltoidonautilus from the Eocene of Peru; and Aturia from the Eocene of Texas, California, Washington, and Peru, and Oligocene of Oregon and Washington, and the Miocene of California, Florida, and Cuba. All of these specimens that merit illustration are figured. A representative of Aturia from the Miocene of Sinai is discussed in an appendix, and illustrations of it are included.

Late in 1947 The Geological Society of America published a monograph of the “Tertiary nautiloids of the Americas” by the senior author of the present report. Since that time, various paleontologists have sent in additional specimens from widely separated localities. We propose to treat all of this material in a single publication, which can therefore be regarded as a supplement to the recently published monograph.

The specimens on which this report is based became available to us through the courtesy of the following persons: Dr. P. J. Bermúdez of the Creole Petroleum Corporation (Caracas); Professor Bernardo Boit of the Universidad de San Marcos; Professor J. Wyatt Durham of the University of California (Berkeley); Dr. Julia Gardner of the United States Geological Survey; Dr. A. Myra Keen of Stanford University; Dr. H. G. Kugler of the North Venezuelan Petroleum Company, Limited (Caracas); Mr. Chas. R. Locklin of Union Lake (near Pontiac), Michigan; Professor Norman D. Newell of The American Museum of Natural History and Columbia University; Professor W. P. Popenoe of the University of California (Los Angeles); Dr. H. H. Renz of the Mene Grande (Gulf) Oil Company (Caracas), and Sr. Pedro Verástegui M. of Stanford University. Special acknowledgment is also due to Professor Don L. Frizzell of the Missouri School of Mines and Metallurgy for advice in regard to certain Peruvian strata, and especially to Mr. Howard Webster of Iowa City who retouched the photographs and made the drawings which accompany this study. The completion of the report was made financially possible by the Graduate College of the State University of Iowa.

Much of the material discussed in this supplement is from the collections of the University of California at Berkeley, and it came from various horizons and localities in our Pacific coast Tertiary. It should perhaps be mentioned in this connection that Professor J. Wyatt Durham has informed us that it is now generally believed that all of the Paleocene Martinez formation of California is as old as the Midway group.
of the Gulf Coastal Plain, and that some of it may be older. If this belief is correct *Aturia*, and possibly also *Aturoidea*, were almost certainly represented on our west coast long before they appeared on our Atlantic-Gulf coast. Professor Ewart M. Baldwin of the University of Oregon has written us that the formation at Dallas, Oregon, which yielded the holotype of *Eutrephoceras oregonense* Miller, is not Oligocene in age (as stated in the original description of the species) but is Eocene, "probably equivalent to the Domengine stage of California. Similar limy beds nearby, which also contain what I [Baldwin] believe to be these same nautiloids, contain large Foraminifera assigned to *Pseudophragmina psila* (Woodring), which tends to support the older Eocene age." Both Professors Durham and Baldwin have assured us that no Plio-cene strata are known in the coastal area west of Eugene from which Dall (1909, p. 21) stated that Thomas Condon had collected a "fine" nautiloid. Professor Baldwin adds that the "rock that would come the closest to being called Pliocene is that at Newport, where Dr. Condon spent many of his vacations. This is now considered to be a part of the Astoria formation of approximately middle Miocene age. The only marine Pliocene that we know of in Oregon is the Empire formation at Coos Bay and the Empire and Port Orford formations at Cape Blanco."

A discussion of a few sporadic specimens is also included in this report. One of these, which represents a new species of *Hercoglossa*, is the first Tertiary nautiloid to be recorded from the Pacific coast region of Mexico—it came from the Paleocene of Baja California. Another is an exceptionally well preserved internal mold of *Aturia brazoensis* Stenzel from the lower part of the Eocene Claiborne group of east Texas. Two others are delicate testiferous representatives of *Aturia curvilineata* Miller and Thompson from the Miocene Chipola formation of the Florida panhandle. A fifth is a representative of the rare species *Aturia cubanensis* (Lea) of the Miocene of Cuba; and along with the discussion of it is included some data on the occurrence in Cuba of other congeneric forms. A sixth is a small fragment of a conch from the Paleocene at a locality in northern Colombia from which no nautiloids had previously been recorded in the literature. A seventh is an essentially complete internal mold from the Paleocene in the Marac quarry of Trinidad, and it is probably referable to *Cimomia subrecta* Miller and Thompson, which was originally described from the Midway group of our Gulf Coastal Plain. An eighth is an exceptionally fine large internal mold of *Hercoglossa peruviana* Berry from the Eocene of Peru. A ninth is a small representative of the genus *Aturia* from the Miocene of Sinai.

The other material described in this report is a collection made by Sr. Pedro Verástegui M. from the Salina formation and the Lomitos sandstone (which was formerly regarded as a member of the lower Talara shale) in northwestern Peru. It consists of an immature representative of *Deltoidonautilus* from the Salina, and *D. haughti* (Olsson) and *Aturia peruviana* Olsson from the Lomitos. The occurrence of the genus *Deltoidonautilus* in South America is being recognized for the first time.

Altogether, we are describing (and in most cases illustrating) representatives of the following genera: *Eutrephoceras* from the Paleocene (Martinez) and the Eocene (Capay) of California; *Cimomia* from the Paleocene of Colombia and Trinidad (Sol-
dado) and the Eocene (Cowlitz) of Washington; Hercoglossa from the Paleocene of Baja California and the Eocene of Peru; Deltoiodonaulitus from the Eocene of Peru; and Aturia from the Eocene of Texas, California, Washington, and Peru, the Oligocene of Washington and Oregon, and the Miocene of California, Florida, Cuba, and Sinai.

SYSTEMATIC PALEONTOLOGY

Eutrephoceras aff. E. stephensoni (Dickerson)
Plate 1, figures 4, 5


When Vokes discussed Eutrephoceras stephensoni in 1937, he stated: “There is in the collections at the University of California a fragment of a very large specimen from the Martinez formation near Selby Station, California, which may represent this species. The greatest width of the conch was 85 mm., and the distance from the venter to the base of the impressed area over 30 mm. It is too globose to be referable to E. hallidayi, but is too imperfect to permit definite specific determination.”

This specimen represents parts of two (or more) volutions of a phragmacone, the preserved portion of which is estimated to have been a little less than 100 mm. in diameter. The shape of the cross section of the conch is elucidated by figure 4 on plate 1. The surface of the test of at least the penultimate of the volutions represented is reticulate as it is marked by moderately coarse longitudinal and transverse lines, which are of about equal size and prominence. The transverse ones, growth lines, indicate that the conch bore a broad rounded hyponomic sinus. The siphuncle is small and is located moderately close to the dorsal wall of the conch. Where the distance between the dorsum and the venter measures about 20 mm., the siphuncle is about 2 mm. in diameter, and its center is about 6 mm. from the dorsum and 14 mm. from the venter.

Remarks.—The large size and particularly the reticulate surface ornamentation of the test of this specimen indicate that it is almost certainly not referable to E. stephensoni; and as Vokes stated, its conch is relatively wider than that of E. hallidayi (Waring), the only other congeneric form known from the Martinez formation. It probably represents an unnamed species, but it would not make a satisfactory holotype.

Occurrence.—Martinez formation about 200 ft. northwest of the south portal of the Southern Pacific railroad tunnel near the smelter at Selby station, Contra Costa County, California.

Repository.—University of California, Berkeley.

Eutrephoceras sp.
Plate 1, figures 1-3

In June of 1938 Miss Herdis Bentzon found the only nautiloid known from the Eocene Capay shale of California. It is an internal mold that is septate throughout and is about 26 mm. in diameter—its maximum width of conch measures about 19 mm. The umbilicus is small and inconspicuous, and in one of the umbilical depressions (pl. 1, fig. 2) there is a “plug” of shell material which indicates that the conch, when complete, consisted of at least one more full volution. The external sutures are essentially straight and directly transverse, and the camerae are of about average length. A structure that appears to represent the siphuncle is small and is subcentral in position.

Remarks.—Clearly this specimen belongs in the genus Eutrephoceras. However, its preservation leaves much to be desired, and its small size and general physiognomy indicate that it probably represents only the immature portion of the conch. Therefore, we are reluctant to express an opinion in

EXPLANATION OF PLATE 2

Figs. 1, 2—Cimomia subrecta Miller and Thompson. Lateral and apertural views of a specimen, from the Paleocene Soldado formation in Marac quarry, southern Trinidad, British West Indies, very slightly less than X1.
regard to its specific affinities, but it may well be referable to *E. hannai* Vokes.

**Occurrence.**—Capay shale (65–90 feet stratigraphically below the Pliocene conglomerate contact) at the Fenn Ranch locality, just above the stream bottom, about 4 miles west of Winters, Yolo County, California—it was found in association with brachiopods and *Venericardia*—[loc. A3073].

**Repository.**—University of California, Berkeley.

**Cimomia hesperia** M. & D., n. sp.
Plate 3, figures 3, 4

The holotype of this species is an internal mold which represents much of four camerae of a phragmacone. Its whorls are helmet-shaped in cross section as they are broadly rounded ventrally, flattened laterally, and impressed dorsally. Clearly, the conch, when complete, was subglobular, The over-all length of the holotype measures about 66½ mm.; and at the uncrushed septum which forms its adapical end its height and width of conch measure approximately 38 mm. and 45 mm., respectively, and the depth of the impressed zone is about 12½ mm. The umbilical shoulders are rounded, and apparently the umbilicus is small.

Fragments of the test which adhere to this specimen are thin. Traces of the growth lines that are preserved on them show that there was a broad shallow rounded hyp诺mic sinus.

The camerae are moderately long. Each suture forms a low broad rounded ventral saddle and on either side of it a similar but smaller lateral lobe, a small but rather prominent saddle on the umbilical shoulder, a slight lobe on the umbilical wall, and a low broadly rounded internal lateral saddle which extends to the similar but medianly flattened dorsal lobe.

The siphuncle is small, and is subcentral in position, but is located considerably closer to the dorsum than the venter. At the adapical end of the holotype, the siphuncle is about 2 mm. in diameter and its center is about 10½ mm. from the dorsum and 15 mm. from the venter. It appears to be composed of cylindrical segments and presumably is orthochoanitic in structure as in other congeneric species.

**Remarks.**—This form is the first representative of the genus *Cimomia* to be recorded from the Pacific coast region of North America. Its most distinctive characters seem to be the shape of its cross section and its sutures. It is not particularly close to any of the congeneric species that have been described from our Atlantic-Gulf Coastal Plain or from South America, probably because most of them are from older (that is, Paleocene) strata.

**Occurrence.**—Type section of the upper Eocene Cowlitz formation at the big bend in the Cowlitz River (a well-known locality), Lewis County, Washington.

**Holotype.**—University of California, Berkeley.

**Cimomia subrecta** Miller and Thompson
Plate 2, figures 1, 2


Dr. H. G. Kugler recently sent us for study a rather large specimen from the Paleocene of Trinidad that should probably be referred to Miller and Thompson's species. However, as explained below, it may well be specifically distinct.

This specimen is an essentially complete internal mold which is only slightly distorted. Its maximum diameter is about 140 mm., and near its adoral end the maximum height and width of its conch measure about 83 mm. and 88 mm., respectively. The umbilicus, though deep, is small and inconspicuous, and the umbilical shoulders are rounded and indefinite. No trace of the surface markings of the test is preserved. The nature of
Remarks.—It is clear from a direct comparison of this specimen with the holotype of *C. subrecta* that the saddles on the umbilical shoulders are much less prominent on the Trinidad individual. However, in the extreme adoral portion of the phragmacone of the holotype, those saddles become relatively low. In both specimens the adoral camera is considerably shorter than the preceding one, indicating that we are dealing with fully mature individuals in each case; but the Trinidad specimen is about 20 per cent larger than the holotype. Nevertheless, most of the other characters of the two do not seem to differ materially, and therefore we are tentatively regarding them as conspecific.

**Occurrence.**—Soldado formation (Paleocene) in the Marac quarry in the south-central part of Trinidad, British West Indies. All of the specimens that have previously been referred to this species came from the Clayton formation (the basal part of the Paleocene Midway group) of Mississippi.

**Repository.**—Museum of Natural History at Basel, Switzerland.

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**HERCOGLOSSA PERUVIANA Berry**

**Plate 6, figures 1, 2; Plate 7, figure 2**

An exceptionally fine large representative of this species was sent to us for study through the courtesy of Professor Norman D. Newell, who borrowed it from the Engineering School in Lima, Peru. This specimen is an internal mold to which a considerable portion of the test (or a replacement of it) adheres. It is preserved in mottled light brown limestone and is only slightly distorted. Inasmuch as it is septate throughout, it represents only phragmacone. When complete, the conch was at least another half-volution in extent.

The maximum diameter of this individual, measured from the adoral end of the venter across the umbilicus to the opposite side of the specimen, is about 225 mm. The maximum height and width of the preserved part of the conch measure about 140 mm. and 150 mm., respectively; and near the adoral end of the specimen the impressed zone is almost 50 mm. deep. The diameter of the complete shell is estimated to have been more than 400 mm.

The test of the adapical portion of the outer volution is about 1 mm. thick. On the surface of the test there are numerous fine growth lines. Each of these forms a deep rather narrowly rounded ventral or hypomonic sinus and on either side of it a broad rounded asymmetrical lateral salient that extends clear to the umbilicus. No trace of the growth lines is discernible on the internal...
mold, but along its venter there is a rather prominent raised line.

There are some 20 camerae in the outer volvation of this specimen. The sutures and the siphuncle appear to be typical of the species. At its passage through the adoral septum, the siphuncle is about 8 mm. in diameter.

Remarks.—Recently, Miller (1947, pp. 58–59, pl. 23, fig. 2; pl. 24, figs. 1, 2; pl. 25, figs. 1, 2; pl. 89, figs. 1, 2; pl. 90, fig. 4) described this species in detail, listed its complete synonymy, and indicated how it can be distinguished from the very similar form, H. ulrichi (White). There is of course no need to duplicate that work here.

Occurrence.—Near Lobitos, Peru presumably from the Talara formation. Olsson (1928, p. 96) has stated that this species is "strictly limited" to one "horizon" and is "quite common" in it; and Frizzell has recently written us that it occurs "in the lower part of the Talara formation in beds that... are near the top of the middle Eocene." Furthermore the lithology and preservation of the specimen, which are very distinctive, are precisely like those of conspecific individuals near Lobitos.

Repository.—School of Engineering, Lima, Peru.

HERCOGLOSSA POPENOEI M. & D., n. sp.

Plate 5, figures 1, 2

On February 14, 1948, Professor W. P. Popenoe (and party) found a large well preserved representative of Hercoglossa in the northern half of Baja California and kindly loaned it to us for study. This form is not referable to any described species, and we propose to name it in honor of its discoverer.

The holotype of the new species appears to be fairly complete, and it attains a maximum diameter of about 270 mm. Its adoral half-voluation is non-septate and presumably therefore represents living chamber. Near the junction of the phragmacone and the living chamber, the conch is essentially free from distortion and it is about 108 mm. wide and 100 mm. high. The whorls are rather narrowly rounded ventrally, strongly flattened (but very broadly rounded) laterally, and deeply impressed dorsally. The lateral zones converge ventrally, and therefore the maximum width of conch is attained at the umbilical shoulders. These shoulders are rounded, and the umbilicus is small, closed, and inconspicuous.

The test is fairly thick, and at the junction of the phragmacone and the living chamber its thickness along the ventrolateral zone measures almost 3 mm. For the most part, only the inner layers of the test are retained on the holotype. However, from preserved portions of the outer layer, it can be ascertained that the surface bears small low inconspicuous ribs and fine growth lines which are parallel to them. Each of these forms a broad deep rather narrowly rounded ventral sinus and on either side of it a low broad rounded lateral salient which extends to the umbilicus.

The length of the adoral camerae of the holotype, measured along the venter, varies from about 19 to 23 mm. The adoral camera of this specimen is distinctly longer than the preceding one. As shown by text figure 1, each external suture forms a broad high rounded ventral saddle, and on either side of it a deep rather narrowly rounded lateral lobe and a high rounded lateral saddle which extends to the umbilical shoulder.

EXPLANATION OF PLATE 3

Figs. 1, 2—Aturia sp. Two views of an internal mold, from the Vacaville shale member of the Eocene Capay formation about half a mile north of "Black Rocks" in Putah Creek, Yolo County California, X1. (p. 15)

3, 4—Cimomia hesperia M. & D., n. sp. Lateral and apical views of the holotype, from the Eocene Cowlitz formation at the big bend in the Cowlitz River, Lewis County, Washington, X1. (p. 4)

5, 6—Aturia cf. A. myrlae Hanna. A small specimen, from the Eocene Arroyo Hondo formation north of Coalinga, California, X3. (p. 15)

7—Cimomia? sp. A fragment of a moderately small conch of uncertain affinities, from a limestone bed in a brown Paleocene shale about 12 km. northeast of Hato Nuevo, Departamento de Magdalena, Colombia, X2. (p. 5)

8—Aturia angustata (Conrad)? An incomplete internal mold, from the Miocene Temblor formation in Kern County, California, probably near Mt. Poso oil field, X1. (p. 9)
Miller and Downs, Tertiary nautiloids
Miller and Downs, Tertiary nautiloids
Remarks.—This specimen is the first nautiloid to be recorded from the Paleocene of Baja California. The matrix in which it is preserved is a dark-gray fine-grained calcareous sandstone. In the filling of the living stream divides, in sea cliff on south side of valley of Arroyo Santa Catarina, about 200 feet above sea level and perhaps an eighth of a mile inland at unnamed point about 2½ miles northwest of Punta Canoas, Santa Catarina Landing, Baja California (U. C. L. A. loc. 2372).

Holotype.—University of California, Los Angeles, 10655.

**DELTOIDONAUTILUS HAUGHTI** (Olsson)

Plate 4, figures 1–3, 7, 8


*Cimomia haughti* Miller and Thompson, 1933, Jour. Paleontology, vol. 7, p. 305; Miller, 1947, Geol. Soc. America, Mem. 23, pp. 6, 10, 42–43, 43, 46, pl. 16, figs. 1, 2; pl. 64, fig. 3.

Professor Bernardo Boit of the Universidad de San Marcos kindly sent in for study 14 nautiloids that Sr. Pedro Verástegui M. had collected from the Lomitos sandstone at a single locality near Cabo Blanco in northwestern Peru. Eleven of these appear to represent one species, though they vary in diameter from about 39 mm. (pl. 4, figs. 1–3) to approximately 172 mm. (pl. 4, figs. 7, 8). The smaller ones seem to resemble

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**EXPLANATION OF PLATE 4**

*Figs. 1–3—Deltoiodonautilus haughti* (Olsson). A small well preserved internal mold (representing the adolescent portion of the conch), from the Eocene Lomitos sandstone at Cerro Organos, 6 miles northeast of Cabo Blanco, Provincia de Paita, Departamento de Piura, Peru, X1½ (p. 7)

*4—Aturia sp.* A small specimen, from the lower Miocene on the south side of the mouth of Wadi Gharandel some 2 or 3 miles north of Hammam Faraun, Sinai, X2. (p. 17)

*5, 6—Aturia peruviana* Olsson. A small internal mold from the same horizon and locality as figures 1–3, X1½. (p. 14)

*7, 8—Deltoiodonautilus haughti* (Olsson). An internal mold of a large mature phragmacone, from the same horizon and locality as figures 1–3, X1¼. (p. 7)
in all significant particulars the holotype of *Eutrephoceras [Cimomia] haughti* Olsson, which came from the Talara formation at a nearby locality in northwestern Peru and which is therefore of about the same age. However, the larger individuals possess all of the characteristics of the genus *Deltoidonautilus*, and the intermediate ones are gradational between these two extremes. It therefore seems to us that almost certainly Olsson’s species was based on an adolescent specimen, the fully mature portion of which would have revealed that its generic affinities are with *Deltoidonautilus*. In view of the fact that this genus is believed to have evolved from *Eutrephoceras* through *Cimomia*, it is not surprising that the inner volutions of its conch resemble those of mature representatives of these genera.

The material now available for study shows that the phragmacone of this species attained a diameter of at least 172 mm., and a corresponding height and width of conch of some 115 mm. and 120 mm., respectively. At full maturity, the ventral zone of the conch becomes so narrowly rounded as to be almost subangular, the lateral zones are greatly flattened and converged ventrally, and therefore the volutions are subtriangular in cross section, dorsal impressed zone disregarded. Only the adoral half volution of our largest specimens (for example, pl. 4, figs. 7, 8) have this more or less deltoid cross section, for the rest of the conch is not as narrowly rounded ventrally or as strongly flattened laterally. The living chamber attains a length of more than half a volution.

The umbilicus is small but moderately prominent, and the umbilical shoulders are fairly distinct. The test seems to be of about average thickness except in the region of the umbilicus where it is greatly thickened to form a callus. Its surface is marked by numerous very fine faint transverse lines which form broad rounded lateral salients and a moderately deep ventral sinus. On well preserved internal molds, there is a rather prominent raised line along the venter (pl. 4, figs. 1, 2).

At full maturity, each suture forms a high very narrowly rounded ventral saddle, and on either side of it a rather deep broadly rounded lateral lobe, a smaller prominent saddle which centers well outside the umbilical shoulder, apparently a lobe on the umbilical wall, and a broad rounded internal lateral saddle, which extends to a rather deep narrowly rounded dorsal lobe. The sinuosity of the sutures seems to increase progressively throughout ontogenetic development. The fact that the shape of the sutures changes rapidly in the outer volution of the small specimen represented by figures 1–3 on plate 4, indicates that it represents only the immature portion of the conch.

The siphuncle is moderately small and is located fairly close to the dorsum. Where the conch is about 53 mm. high and is impressed to a depth of about 23 mm., the siphuncle is about 4 mm. in diameter and its center is about 8 mm. from the dorsum and 22 mm. from the venter.

Remarks.—In both the holotype and the small specimen which Miller (1947, p. 43, pl. 16, figs. 1, 2) doubtfully associated with it, the siphuncle is also dorsad in position. In the genotype of *Deltoidonautilus* it is similarly located, but its position in the genotype of *Cimomia* is unfortunately not known. Nevertheless it seems probable that the dorsad position of the siphuncle is one of the best ways to distinguish immature equal-sized specimens of *Cimomia* and *Hercoglossa*.

It should perhaps be mentioned that the genus *Deltoidonautilus* has not been recognized previously in South America. Only one representative of it is so far known from North America, *D. elliotti* Stenzel of the middle Eocene Reklaw formation of Texas. That species seems to be very close to the one under consideration, and, like it, is a rather primitive form of the genus. The specimen described below, which is also from northwestern Peru seems to be an immature representative of a more advanced form.

Occurrence.—All 11 of the specimens in the collection under consideration came from the Lomitos sandstone (which until recently was regarded as a member of the Talara shale) at Cerro Organos, about 6 miles northeast of Cabo Blanco, Provincia de Piata, Departamento de Piura, Peru. The holotype is from the Talara formation at a nearby locality in northwestern Peru, that is, near Lagunitas, Piura; and the
specimen, mentioned above, which Miller questionably associated with it, came from the same formation at a nearby locality.

Repository.—State University of Iowa, 9537 (pl. 4, figs. 1–3, 7, 8) and 9538 (9 unfigured specimens).

DELTOIDONAUTILUS sp.
Plate 10, figures 1–3

Through the courtesy of Dr. A. Myra Keen and Sr. Pedro Verástegui M., we were loaned for study a small representative of Deltoïdonautilus from the lower Eocene Salina formation of northwestern Peru—its generic affinities had already been recognized by Sr. Verástegui. This specimen is a well preserved completely septate internal mold that is only about 23 mm. in diameter. Near the adapical end of its outer volution, the conch is rather narrowly rounded ventrally and is much wider than high. However, adorally its ventral zone is progressively narrowed and gradually becomes subangular, and the conch increases in height more rapidly than in width. At the adoral end of the specimen, the width and height of conch measure about 15½ and 14½ mm., respectively. The maximum width is attained at or just outside the umbilical shoulders, which are fairly distinct. The umbilicus is small and apparently open but not perforate.

A small portion of the test (or rather a replacement of it) is preserved in one of the umbilical depressions. It shows that the test is quite thin. No trace of growth lines can be discerned on the specimen.

The camerae are rather long, but they become progressively shorter orad. In the adapical half of the outer volution of this specimen there are only about five camerae, whereas there are eight in the adoral half of the same volution.

On the adapical portion of the outer volution, the external sutures are essentially straight and directly transverse, though they seem to form an incipient ventral saddle. Throughout the length of that volution this saddle becomes higher. Also, umbilical saddles are developed in the outer volution, and they increase in prominence relatively rapidly. As a result, the adoral suture of this specimen consists of a low broad subangular ventral saddle and on either side of it a shallow broad rounded lateral lobe, a small but rather prominent very narrowly rounded umbilical saddle, a small rounded lobe on the umbilical wall, and apparently a slight internal lateral saddle which extends to a similar dorsal lobe.

The siphuncle is small and is dorsal but not quite marginal in position. At the adoral end of the specimen, it is almost 1 mm. in diameter and is about half a millimeter from the dorsum.

Remarks.—As a result of its small size and particularly because the form of the conch and the shape of the sutures change rapidly throughout the length of the outer volution, we believe that this specimen represents only the immature inner portion of a conch. However, its generic affinities are almost certainly with Deltoïdonautilus, and it appears to be a rather well developed representative of that genus. That is, in spite of its small size and presumed immaturity, its ventral zone is subangular, and in that respect it is farther advanced than is D. haughti (Olsson) at full maturity. Nevertheless, the beds which carry that species are considerably younger than are those which yielded the specimen under consideration.

Occurrence.—This specimen was secured by Sr. Pedro Verástegui M. from the lower Eocene Salina formation south of the village of Yasila, Provincia de Paita, Departamento de Piura, Peru (approximately at latitude 5° 08' S. and longitude 81° 10' E.).

Repository.—Stanford University.

ATURIA ANGUSTATA (Conrad)?
Plate 1, figures 6–8; Plate 3 figure 8; Plate 9, figures 1, 2

The collections of the University of California at Berkeley contain four specimens which are probably referable to this species and which have not been mentioned in the literature. These were made available to us for study by Professor J. Wyatt Durham.

The one illustrated by figures 6 and 7 on plate 1 represents only the inner volutions of the phragmacone. Its maximum diameter is about 24 mm., and the maximum width of the preserved portion of its conch measures about 12 mm. This specimen shows
that during rather early ontogenetic development, the conch is relatively wide, the sutures are moderately far apart, and the lateral lobes of the sutures are bluntly pointed and are not in contact with the preceding suture. It was found by Professor Durham in the upper Oligocene Twin Rivers formation about an eighth of a mile east of the city of Twin Rivers on the coast of the Straits of Juan de Fuca, Clallam County, Washington (locality A3678 of Durham, 1944, p. 131).

The individual illustrated by figure 8 on the same plate is from the same formation at a nearby locality, that is, in a sea cliff inshore from conglomerate and shale on the beach just east of the first Geodetic Survey mark east of the mouth of East Twin River, Clallam County, Washington. This specimen is very incomplete, and it is not at all well preserved. It is septate throughout, and its maximum diameter measures about 62 mm. In the adapical portion of the outervolution, the shape of the lateral lobes of the sutures can be seen quite clearly.

Figures 1 and 2 on plate 9 represent a well preserved early mature portion of a phragmacone that Professor Durham secured from a nodule in the upper Oligocene Blakeley formation at Bean Point on Bainbridge Island, Washington (Univ. Calif. loc. C-X-3). The maximum diameter of this specimen is about 36 mm., and near its adoral end its conch is about 17 mm. wide and 22 mm. high. Attention should perhaps be called to the fact that the conch is rather broadly rounded ventrally, and the lateral lobes of the sutures, which are pointed, are in contact with the preceding sutures. Portions of the test which are preserved show that its surface is marked by numerous fine but quite distinct growth lines which form broad rounded lateral salients that extend from a presumed hyponomic sinus clear to the umbilicus.

The other specimen that we are illustrating (pl. 3, fig. 8) and referring to this species is from the Miocene Temblor formation at some unrecorded locality in Kern County, California, probably near the Mt. Poso oil field. The adoral portion of this specimen is essentially free from distortion and represents the complete circumference of the conch. Near its adoral end, the maximum height and width of conch measure about 57 mm. and 37 mm., respectively. As shown by the accompanying figure, the shape of the sutures is also elucidated by this portion of the specimen.

Remarks.—Miller (1947, pp. 85-88) has recently published the extensive synonymy of this species and a detailed discussion of it. Inasmuch as his report is readily available, there is no need for us to duplicate his work.

Occurrence.—This species is known to range from the middle (lower?) Oligocene to the middle Miocene in the Coast Ranges of Washington, Oregon, and California, where it has been found at many localities. The precise horizon and locality of each of the specimens discussed above is given in the preceding paragraphs.

Repository.—University of California, Berkeley.

**Aturia brazoensis** Stenzel
Plate 9, figures 5, 6

Miss Julia Gardner recently sent us for study a fine representative of the genus *Aturia* that was found April 16, 1941, in the lower portion of the Claiborne group in East Texas. It is a well preserved internal mold that is completely septate. Its maximum diameter measures about 104 mm., and the portion of its conch that is represented attained a maximum height of about 67 mm. and a corresponding width of a little more than 50 mm. (estimated). Its general physiognomy and the nature of its umbilicus, septa, etc. are elucidated by the accompanying photographs.

This specimen is of almost exactly the same size, shape, and proportions as the holotype of *A. brazoensis* Stenzel (a testiferous specimen), and there is no doubt in our
Miller and Downs, Tertiary nautiloids
mind that the two are conspecific. That species has previously been found to occur at several horizons and localities in the Eocene Claiborne group, that is, in the Stone City beds of central Texas, the Tyus and Viesca members of the Weches formation of central and east Texas, and possibly the Cook Mountain formation of south Texas. Miller (1947, pp. 88-90, pl. 69, figs. 1-4; pl. 70, figs. 1, 2; pl. 71, figs. 1, 2; pl. 72, figs. 6, 7; pl. 73, fig. 7) has recently discussed the species in detail and listed its complete synonymy.

Occurrence.—"Probably rather low in the Claiborne group" on the east side of the Chireno road directly south of the San Augustine-Nacogdoches highway, Nacogdoches County, Texas.

Repository.—U.S. National Museum.

**Aturia cubaensis** (Lea)

Plate 9, figures 3, 4

*Nautilus cubaensis* LEA, 1841, Am. Phil. Soc., Tr., n. ser., vol. 7, p. 259, pl. 10, fig. 15.


*Aturia cubaensis* MILLER, 1947, Geol. Soc. America, Mem. 23, pp. 7, 8, 10, 92, pl. 83, figs. 4-6.

All that Miller was able to ascertain in regard to the derivation of the holotype of this species is that it was obtained long ago by Louis Vanuxem from a "white limestone of Matanzas," Cuba. Dr. Pedro J. Bermúdez who is thoroughly familiar with the geology of Cuba, and particularly that of the Matanzas area, has recently written us that in "the vicinity of Matanzas city there is a good exposition of Tertiary sediments with beds of lower Eocene, upper Oligocene, Miocene, and Pliocene. The locality most visited by geologists and fossil collectors is the Yumuri Gorge very close to the city. In this place the river cuts the sediments very deeply. The Tertiary is well exposed in this cut" and consists of the following formations: Universidad radiolarian earth (lower Eocene), Cojimar marl (upper Oligocene), Güines limestone (lower Miocene), Canimar marly limestone (middle Miocene), El Abra sandstone and conglomerate (upper Miocene), and Matanzas marly limestone (Pliocene). "In this section the only beds which really are of limestone belong to the lower Miocene, Güines formation. This cavernous limestone is characterized by the abundance of macrofossils but shows very poor conditions of preservation. Below this limestone there is a good marl formation (upper Oligocene, Cojimar formation) with abundant microfauna. It is possible that the type locality of *Aturia cubaensis* is in the Güines formation rather than in the Cojimar formation."

Dr. Bermúdez also kindly loaned us for study a portion of an internal mold of a phragmacone of an *Aturia* which many years ago was given to him by a friend who lives in Matanzas and who informed him that it came from "the Güines limestone, exposed in the Yumuri Gorge of Matanzas." He adds that its preservation is "very similar to the fossils of the Güines formation." This specimen, like the holotype of *A. cubaensis*, is preserved in "hard fine-grained white limestone," and the two most probably came from the same formation and represent only one species. However, Dr. Bermúdez's specimen is somewhat crushed, and its proportions can therefore not be determined accurately. Its general physiognomy and the shape of its sutures are elucidated by the accompanying figures. It should perhaps be stated that the maximum height of the portion of the conch that is represented measures about 41 mm., and no trace of any markings other than the sutures can be discerned on the specimen.

Furthermore, Dr. Bermúdez called our attention to the fact that in 1880 Salterain had listed "*Aturia zig-zag* (Sow.)" from Cantera (quarry) La Criolla, Habana, Cuba. According to Dr. Bermúdez, the age of the beds exposed at "this locality is upper Oligocene and lower Miocene." This form may therefore well be referable to *A. cubaensis*.

It should also be mentioned in this con-

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**EXPLANATION OF PLATE 6**

Figs. 1, 2—*Hercoglossa peruviana* Berry. Lateral and ventral views of a large completely septate individual, from the Eocene Talara formation near Lobitos, Peru, X2. Same specimen as figure 2 on plate 7. (p. 5)
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connection that Mrs. Katherine V. W. Palmer has written us that in one of the notebooks of the late Dorothy K. Palmer, the genus *Aturia* is stated to be represented in the type section of the Jicotea, that is, in "gray lime ss., side of Carretera Central in Jicotea." Provincia Santa Clara, Cuba (Palmer, R. H., 1948, p. 12—locality 114). According to Bermúdez (1938) the age of the Jicotea is middle Eocene, and its type section has yielded *Globorotalia centralis* Cushman and Bermúdez, which Mrs. Dorothy K. Palmer considered characteristic of that age. It is therefore rather doubtful that this form is very closely related to *A. cubaensis*, which presumably is typical of much younger beds.

**Occurrence.**—Güines limestone (Lower Miocene) in the Yumuri Gorge near Matanzas, Cuba.

**Repository.**—Private collection of Dr. Pedro J. Bermúdez of Caracas, Venezuela.

**Aturia curvilineata** Miller and Thompson

Plate 10, figures 4–7


*Aturia curvilineata* Miller and Thompson, 1937, Eclogae geol. Helvetiae, vol. 30, pp. 61, 69–70, pl. 9, figs. 1–4; pl. 10, figs. 1, 2; Miller and Furnish, 1938, Jour. Paleontology, vol. 12, pp. 150, 151, fig. 1G; Miller, 1947, Geol. Soc. America, Mem. 23, pp. 7, 10, 11, 40, 86, 93–94, 106, 110, 111, pl. 73, figs. 3, 4; pl. 84, figs. 1, 2, 5–8; pl. 85, figs. 4–6.

*Aturia* sp. Miller, 1947, Geol. Soc. America, Mem. 23, pp. 7, 8, 110–111, pl. 88, figs. 2, 3.

Two exquisite but slightly broken aturias were recently collected from the Miocene of Florida by Mr. Chas. R. Locklin and sent to Miss Julia Gardner, who kindly forwarded them to us for study. Both are testiferous and are septate throughout.

The maximum diameter of the more nearly complete individual (pl. 10, figs. 4, 5) measures about 54 mm., and the corresponding height and width of its conch are approximately 37 mm. and 21½ mm., respectively. The maximum width of conch is attained just outside the umbilical shoulders, the lateral zones are almost flat and are distinctly converged ventrad, and the ventral zone is rather narrowly rounded. The umbilicus is small and inconspicuous, and the umbilical shoulders are low, rounded, and indefinite.

The test, which in both of the specimens under consideration is iridescent, is thin except in the umbilical region where it forms a callus. Its surface is marked by numerous fine but very distinct growth lines, each of which forms a deep narrowly rounded ventral sinus and on either side of it a broad rounded lateral salient which extends clear to the umbilicus.

The sutures are not well exposed, but they do not seem to differ in any available particular from those of other representatives of this species. The spacing of the septa also is typical of the species.

The specimen represented by figures 6 and 7 on plate 10 (the preserved portion of which is about 55 mm. in diameter) reveals the siphuncle particularly well. It is located close to the dorsum in adapical infundibular inflections of the septa which are telescoped to a considerable extent.

**Remarks.**—Clearly these two specimens are specifically identical with the similar but somewhat smaller one from the same general horizon and locality described and illustrated by Miller in 1947 as "*Aturia sp.*" Also, as noted by that author, it is quite likely that the specimens which in 1902 Maury listed as "*Nautilus (fragments)*" are conspecific, but they seem to have been lost.

However, the relationship of the Floridian specimens to those from South America that have been referred to this species is not quite as certain. The holotype, which came from the Miocene of northwestern Venezuela, is relatively large and is somewhat distorted and laterally compressed, but other Miocene South American specimens (from the same and different localities) have slightly but distinctly narrower conchs. Opinions of various authors in regard to the taxonomic value of such variations differ, but we are inclined to believe that for the present, at least, they should not be regarded as of sufficient importance to justify specific separation.

**Occurrence.**—Both of the specimens we are studying came from the lower part of the Miocene Chipola formation at Ten Mile Creek on the Chipola River, about 18 miles south of Marian and 2 miles west of the McCelland farm, Calhoun County, Florida.
The specimen which Miller described and illustrated in 1947 came from the same formation at or near the same locality, whereas those listed by Maury in 1902 were from Bailey's Ferry, also in Calhoun County, Florida. In South America, specimens that are tentatively being regarded as conspecific are known from the Miocene of Venezuela, Trinidad, and Ecuador.


*Auria cf. A. grandior* Schenck
Plate 7, figure 1; Plate 8, figures 1, 2

The collections of the University of California at Berkeley contain seven specimens that may belong in this species, and Professor J. Wyatt Durham kindly loaned them for study. Two of them merit illustration and all seven at least brief description.

The largest (pl. 7, fig.1) is unfortunately somewhat crushed, but it appears to be essentially complete. It is testiferous and, except in size, seems to resemble the holotype rather closely so that the two may well be conspecific, though this one came from the Eocene Cowlitz formation whereas the type is from an Oligocene tuff—both were found in western Washington. The maximum diameter of this specimen, in its present crushed state, is about 235 mm.—that of the holotype is about 160 mm. Because of the distortion which the conch has undergone other measurements would have little significance. As in the holotype, the living chamber is a little more than half a volutin in length, and the surface of the test is marked by fine but very distinct growth lines each of which forms a deep ventral sinus and on either side of it a broad rounded lateral salient that extends to the umbilicus. In the adoral portion of this specimen the test is approximately 1 mm. thick, except in the umbilical region, where it forms a callus. The shape of the adoral sutures is revealed, and they do not seem to differ materially from those of the holotype.

The lower Oligocene Keasey shale (or its stratigraphic equivalent) in northwestern Oregon has also yielded a specimen which may be related to the holotype of this species. However, it represents only the umbilical and lateral portions of a little more than half of one side of a volutin of a phragmacone (and the crushed inner whorls) and it is so distorted and fragmentary that its specific affinities are very uncertain. The preserved portion of this incomplete specimen is estimated to have attained a diameter of some 150 mm. The lateral lobes of the sutures are asymmetrically attenuate, and at least these lobes and the lateral saddles are very similar to those of the holotype.

The collections under consideration also contain three large fragmentary specimens from the equivalent of the Keasey in southwestern Washington. None of these is sufficiently well preserved or nearly enough complete to be identified specifically, but all three appear to represent portions of phragmacones of the same general size and proportions as typical *A. grandior*. We are therefore comparing them with that species.

The specimen illustrated by figures 1 and 2 on plate 8 is from the Oligocene Quimper sandstone of northwestern Washington. It is primarily an internal mold of the outer volutin of a moderately large specimen, but considerable portions of the test adhere to it. The adoral part of this specimen represents living chamber. The phragmacone attained a maximum height of conch of about 95 mm., and the corresponding width of conch and over all diameter are estimated to have been 65 mm. and 150 mm., respectively. The lateral zones of the whorl are strongly flattened and are distinctly converged ventrad, and the maximum width of conch is therefore attained slightly ventrad of the low rounded indefinite umbilical shoulders. The ventral zone of the conch is rather broadly and evenly rounded. The umbilicus is small and inconspicuous and seems to be filled with a callus—elsewhere the test is less than 1 mm. thick. The shape of the sutures is elucidated by the accompanying illustrations, and they seem to be essentially the same as those of the holotype. All in all, we believe that this specimen can be referred to *A. grandior* with a reasonable degree of assurance.

The remaining specimen that we are associating with this species is from the Oligocene Lincoln "formation" on Marrowstone Island of northwestern Washington.
It represents about a quarter of each of two successive volutions of a phragmacone which is estimated to have attained a diameter of more than 200 mm. The test (or rather a replacement of it) of the outer volution of this specimen is crushed and is broken into a number of fragments, but it appears to be very thick. The preserved part of the penultimate volution (unlike that of the outer volution) is largely free from distortion, and it shows that the cross section of the conch and the size and position of the siphuncle are essentially the same as in typical representatives of this species. Nevertheless, this specimen is so crushed and fragmentary that its specific affinities are uncertain.

Remarks.—Miller (1947, pp. 97–98, pl. 93, fig. 5; pl. 94, figs. 1, 2) has recently published a detailed description and illustrations of the type specimens of this species, together with a synonymy, and since his work is readily available there is no need to duplicate it. However, attention should be called to the fact that he did not note that Durham (1944, pp. 120, 121, 192) had referred to the species three (or more) specimens from the Oligocene of northwestern Washington—two of these are described above.

Occurrence.—The seven specimens under consideration are from the following horizons and localities: (1) Cowlitz formation (upper Eocene) on Olequah Creek, just below the falls and above the grits, Lewis County, Washington (presumably equivalent to Univ. Washington loc. 301); (2) Keasey shale, or its equivalent, (lower Oligocene) in south bank of Rock Creek just west of highway and railroad bridges (which are side-by-side), 1.9 miles east of Keasey post office and 0.2 mile west of Tara station, Columbia County, Oregon; (3) Keasey equivalent in high bluff along Willapa River at Big Bend about 1 1/2 miles due north of Hanan foot bridge across river north of Holcomb, Pacific County, Washington (loc. A64 of Durham, 1944, p. 130); (4) Keasey equivalent in high bluff along Willapa River at Big Bend about 1 1/2 miles due north of Holcomb, Pacific County, Washington (loc. A64 of Durham, 1944, p. 130); (5) concretion in Molopophorus gabbi zone of Quimper sandstone (lower Oligocene) along beach close to Willamette Meridian line, center NE 1/4 SE 1/4 sec. 1, T. 29 N., R. 1 W., Jefferson County, Washington (loc. A3702 of Durham 1944, p. 132); and (6) Turritella porterensis zone of Lincoln “formation” (middle Oligocene), 100 feet stratigraphically below sandy shales of Marrowstone shale in sea cliff, center NE 1/4 sec. 32, T. 30 N., R. 1 E., Marrowstone Island, Jefferson County, Washington (loc. A3696 of Durham, 1944, p. 132). Durham (1944, p. 121) indicates that this species also occurs in the Turritella porterensis zone of the Marrowstone shale (middle Oligocene) in the NW 1/4 NE 1/4 sec. 32, T. 30 N., R. 1 E., Marrowstone Island (loc. A3695 of Durham, 1944, p. 132). Both the holotype and the paratype came from the Oligocene of western Washington.

Repository.—University of California, Berkeley.

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ATURIA PERUVIANA Olsson
Plate 4, figures 5, 6

A collection of cephalopods made by Sr. Pedro Verástegui M. at Cerro Organos, near Cabo Blanco in northwestern Peru, and sent to us by Professor Bernardo Boit of the Universidad de San Marcos contains three small completely septate internal molds that are most probably referable to this species. All of these are of about the same general size. The best one is represented by figures 5 and 6 on plate 4. It is about 32 1/2 mm. in diameter and near its adoral end, its conch is about 20 mm. high and 18 mm. wide. The maximum diameter of the other two specimens measures about 33 mm. and 35

EXPLANATION OF PLATE 7

Fig. 1—Aturia cf. A. grandior Schenck. An essentially complete crushed testiferous individual, from the Eocene Cowlitz formation just below the falls and above the grits on Olequah Creek, Lewis County, Washington, X4. (p. 13)

2—Hercoglossa peruviana Berry. Apertural view of a large completely septate individual, from the Eocene Talara formation near Lobitos, Peru, X4. Same specimen as figures 1 and 2 on plate 6. (p. 5)
mm. The general physiognomy of the conch and the nature of the sutures are elucidated by the accompanying illustrations.

Remarks.—These three specimens are of about the same size and shape as one from the same general horizon and locality that was figured by Miller (1947, pl. 83, figs. 1–3). A direct comparison of it with those now under consideration leaves no doubt in our mind that all four are conspecific. Miller's report, which is readily available, contains a detailed description and a complete synonymy of this species.

Occurrence.—All three of the specimens we are studying were found in association with Deltidonautilus haughti (Olsson) in the Lomitos sandstone at Cerro Organos, 6 miles northeast of Cabo Blanco, Provincia de Piata, Departamento de Piura, Peru. This species, as now interpreted, also occurs in the upper Eocene Saman formation in the same general region and in the upper Eocene of southwestern Ecuador, Panama, northern Colombia, and northwestern Venezuela. Furthermore, some of the paratypes of it came from the Oligocene of northwestern Peru, and the middle Eocene of that area has yielded a single small immature specimen that is probably conspecific.

Repository.—State University of Iowa, 9539 (pl. 4, figs. 5, 6) and 9540 (2 unfigured specimens).

Aturia spp.

Plate 1, figure 9; Plate 3, figures 1, 2, 5, 6

The collections under consideration contain a few Pacific Coast Eocene aturias of which we are unable to determine the specific affinities. These came from two localities in California and one in Washington, and they were loaned to us for study by Professor J. Wyatt Durham.

One of them (pl. 1, fig. 9) is from the Crescent formation of northwestern Washington. It is a rather poorly preserved testiferous specimen which is about 54 mm. in diameter. It appears to have been slightly crushed and flattened laterally, but its present maximum width measures about 20 mm. It is rather narrowly rounded ventrally, and its flattened lateral zones converge ventrad rather strongly. The surface of its test is marked by numerous fine growth lines, each of which forms a deep narrowly rounded ventral sinus and on either side of it a broad rounded lateral salient which extends clear to the closed umbilicus. Only small portions of the sutures are visible, but they do not seem to differ materially from those of similar congeneric forms. This specimen came from a black fine-grained sandstone layer (with abundant Loxotrema) about 16 to 20 feet stratigraphically below the contact with the basalt, in the Eocene Crescent formation near the base of the sea cliff on a small point about 250 yards west of the beacon shown on the west side of Crescent Bay on the Port Crescent quadrangle, Clallam County, Washington.

At one locality, the Vacaville shale of central California has yielded three aturias that are crushed and rather poorly preserved. Presumably all are conspecific, but their preservation leaves so much to be desired that we are uncertain in regard to their precise affinities. All are internal molds that are largely septate. The best one is represented by figures 1 and 2 on plate 3. One of the others seems to represent a slightly larger individual, whereas the third is only a very small segment of a phragmacone of uncertain size. Because of the distortion which all three of these have undergone, precise measurements of them would have little significance. The spacing and the shape of their sutures, and particularly the form of the lateral lobes of those sutures (see pl. 3, fig. 1) indicate that this form is a rather primitive representative of the genus. All three of these specimens are from the lower Eocene Vacaville shale member of the Capay formation about half a mile north of "Black Rocks" in Putah Creek, 1280 feet east and 1302 feet north of the southeast corner of sec. 23, T. 8 N., R. 2 W. (Mount Diablo Meridian), Yolo County, California.

Explanation of Plate 8

Figs. 1, 2—Aturia grandior Schenck. Ventral and lateral views of a specimen from a concretion in the Oligocene Quimper sandstone along the beach close to the Willamette Meridian line, center NE 1/4 SE 1/4 sec. 1, T. 29 N., R. 1 W., Jefferson County, Washington, X 1/4.
The specimen represented by figures 5 and 6 on plate 3 is the one from the Arroyo Hondo formation of west-central California that was illustrated and briefly described by Vokes (1939, p. 107, pl. 16, fig. 36). It is a completely septate internal mold which has a maximum diameter of only about 12½ mm. Its small size, and particularly the wide spacing of its septa indicate that it representation may well be correct, but it is difficult to substantiate. This specimen came from the Eocene Arroyo Hondo formation in the SW¼ NW¼ sec. 15, T. 18 S., R. 14 E., 100 feet up the fourth small draw from west end of ridge, immediately opposite the place where Urruttia Canyon enters Salt Creek, north of Coalinga, Fresno County, California (Univ. Cal. loc. 1817).

FIG. 2—Diagrammatic cross section and representation of an adoral suture of a small specimen belonging in the genus *Aturia*, from the lower Miocene of the west-central portion of the Sinai Peninsula, both ×4.

sents only the immature portion of a phragmacone. This belief is strengthened by the fact that the lateral lobes of the sutures are rather bluntly pointed. Vokes states that this specimen was found associated “with abundant fragments of the outer shell of much larger individuals,” and he referred it to *Aturia myrlae* Hanna; that identification may well be correct, but it is difficult to substantiate. This specimen came from the Eocene Arroyo Hondo formation in the SW¼ NW¼ sec. 15, T. 18 S., R. 14 E., 100 feet up the fourth small draw from west end of ridge, immediately opposite the place where Urruttia Canyon enters Salt Creek, north of Coalinga, Fresno County, California (Univ. Cal. loc. 1817).

**Occurrence.**—One of the forms described above is from the Crescent formation of northwestern Washington, another is from the Vacaville shale (Capay) of central California, and the third is from the Arroyo Hondo formation of west-central California. The precise horizon and locality is given along with the discussion of each.

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**Explanation of Plate 9**

Figs. 1, 2—*Aturia angustata* (Conrad)? A small well preserved internal mold, from a nodule in the Oligocene Blakeley formation at Bean Point on Bainbridge Island, Washington, ×2. (p. 9)

3, 4—*Aturia cubaensis* (Lea)? A crushed fragment of an internal mold, from the lower Miocene Guînes limestone in the Yumuri Gorge, near Matanzas, Cuba, ×1. (p. 11)

5, 6—*Aturia brazoensis* Stenzel. A well preserved internal mold, from the lower part of the Eocene Claiborne group on the east side of the Chireno road directly south of the San Augustine-Nacogdoches highway, Texas, ×1. (p. 10)
Miller and Downs, Tertiary nautiloids
Miller and Downs, Tertiary nautiloids
Repository.—All are in the paleontological collections of the University of California at Berkeley. The one from the Arroyo Hondo formation is numbered 15877.

APPENDIX

AN ATURIA FROM THE Miocene OF SINAI

Through the courtesy of Dr. A. Myra Keen of Stanford University, we were kindly loaned for study a small representative of the genus *Aturia*, which seems to merit special consideration because of the locality from which it came. This specimen was secured in March of 1921 by Mr. Robert van Vleck Anderson from the "lower beds of [the] Miocene series" in a prominent bluff on the south side of the mouth of Wadi Gharandel on the Gulf of Suez coast of Sinai, some two or three miles north of Hammam Faraun. The label which accompanies it shows that it was identified by H. G. Schenck as *Aturia aturi* (Basterot), and it may well be the basis for his indication (Schenck, 1931, map on p. 437) that the genus occurs on this peninsula.

This specimen is partially imbedded in a block of light-colored (white mottled with brown) crystalline limestone which contains some rather poorly preserved gastropods and other small fossils. Its general physiognomy is elucidated by the accompanying illustrations (pl. 4, fig. 4; and text fig. 2); but attention should perhaps be called to the fact that its maximum diameter is only about 23 mm., and therefore we are of the opinion that it represents the adolescent or early mature portion of a conch that was much larger at full maturity. At least its adoral sutures are so closely spaced that the adapical portions ("tips") of the lateral lobes are in contact with the adoral portions (ventrolateral shoulders) of the ventral saddles of the preceding sutures. The lateral lobes of the sutures seem to be rather primitive for a Miocene representative of this genus, which strengthens our conviction that we are not dealing with a fully mature phragmacone.

Although this specimen may well belong in *Aturia aturi*, which was originally described from the Miocene of France, we hesitate to refer it definitely to any species. It is the property of the Paleontological Museum of Stanford University, where its catalogue number is 7993 (type collection).

REFERENCES


SCHENCK, H. G., 1931, Cephalopods of the genus

EXPLANATION OF PLATE 10

FIGS. 1–3—*Deltoidonautilus* sp. A small immature specimen from the Eocene Salina formation south of the village of Yasila, Departamento de Piura, Peru, ×1.4. (p. 9)

4–7—*Aturia curtisineata* Miller and Thompson. Two exceptionally well preserved testiferous specimens, from the Miocene Chipola formation at Ten Mile Creek on the Chipola River, Calhoun County, Florida, ×1.4. 4, 5, USNM specimen. (p. 12)


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