THE GENUS *TURBINELLA* (Mollusca, Gastropoda) IN THE NEW WORLD

EMILY H. VOKES
TULANE UNIVERSITY

CONTENTS

ILLUSTRATIONS

I. ABSTRACT

Two lines of *Turbinella* have developed from the ancestral Eocene species, one in the Old World and one in the New World. The evolutionary development of these has been remarkably parallel, although apparently separate. In both regions the earliest species are shouldered forms, and successive species become increasingly smooth. In the New World a secondary group developed in the lower Miocene. This branch, here called the *"angulata"* lineage, is marked by an exceedingly large nucleus, and by a noded shoulder in contrast to the smooth outline of the primary form, here termed the *"laevigata"* lineage.

In this paper the 24 known species of New World Turbinellinae are treated systematically, and one new species, *Turbinella dalli,* is described. In addition the homonym *T. praeovoidea* Maury, *non* Vredenburg, is replaced by *T. praelaevigata, nom. nov.*

II. INTRODUCTION

The oldest known species of *Turbinella* Lamarck, 1799, (type species: *Voluta pyrum* Linnaeus) appears in the uppermost lower Eocene of Peru. From this "ancestral" species, *Turbinella peruviana* (Olsson), if it is truly such, there arose a New World line and an Old World line. The earliest species known from the Old World, *Turbinella episoma* (Michelotti), occurs in the Oligocene of the Mediterranean and India. This species is the only European *Turbinella,* all of the younger Old World forms presently known are from India and adjacent areas. Vredenburg (1923, p. 120) suggested that "com-

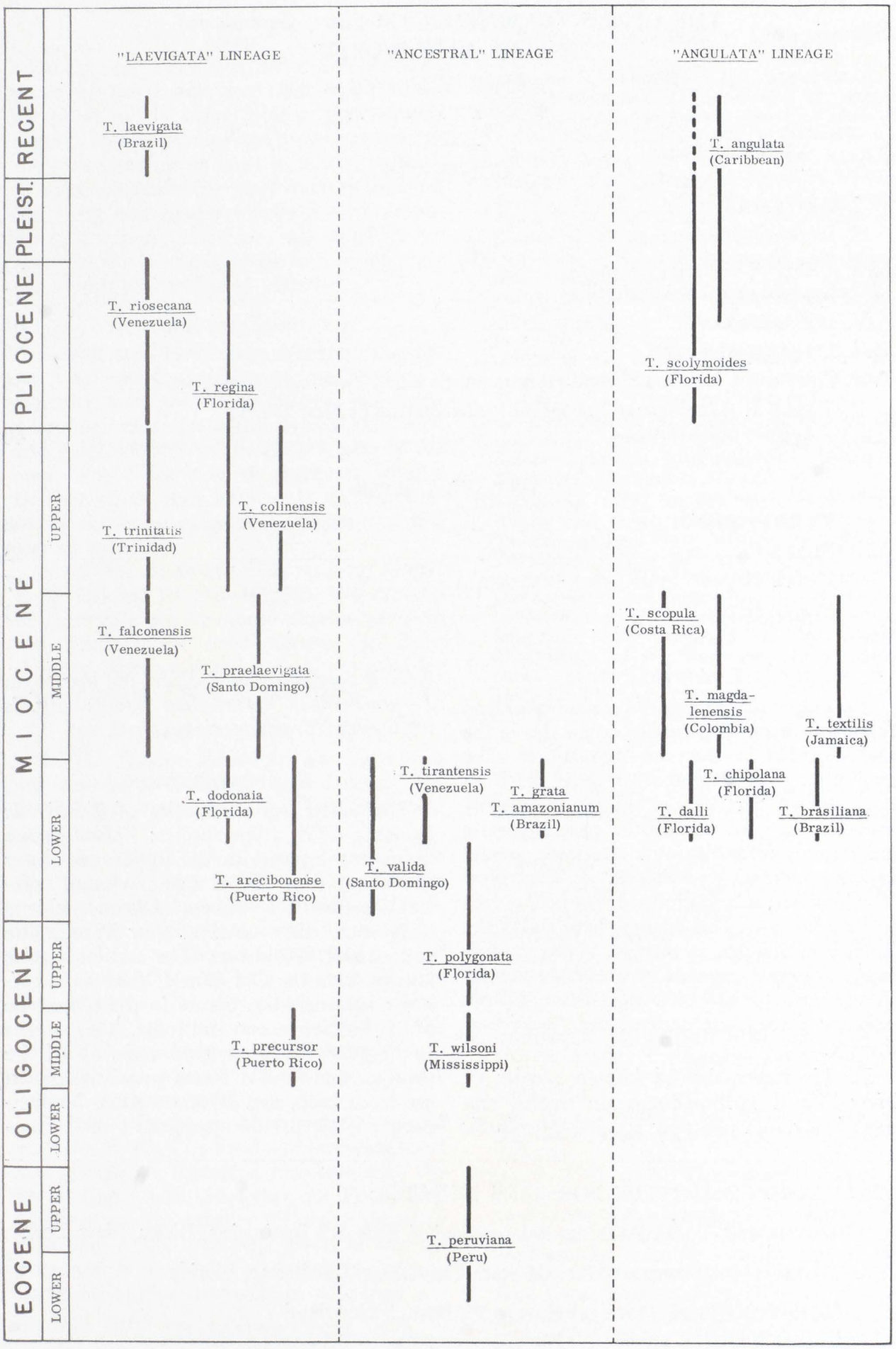


TABLE I
GEOLOGIC AND GEOGRAPHIC DISTRIBUTION OF NEW WORLD SPECIES OF *TURBINELLA*.
(Vertical scale not proportional to absolute time.)

munication between the Indian Ocean and Mediterranean became increasingly obstructed in Miocene times, so that the resemblances between the Indian and Caribbean Miocene faunas are perhaps better explained by migration across the Pacific than across the Atlantic." There is definite need to explain the strong resemblances between the Caribbean and Indian forms which are so strikingly similar, although apparently evolved separately *in situ,* that Vredenburg named a species, from the lower Miocene Gáj beds, *Turbinella praeovoidea* because he considered its descendant in the upper Miocene Mekran beds conspecific with *T. ovoidea* Kiener, the Recent Brazilian species. He subsequently recognized that the Indian line represented only a convergent resemblance and designated the upper Miocene form *T. mekranica. Turbinella praeovoidea,* "the mutation that links *T. mekranica* to the lower Miocene *T. affinis*" (*ibid,* p. 121), he proposed to rename *T. praemekranica.* While this is logical it is not nomenclatorially legal and *T. praeovoidea* must be recognized for the Indian species.

Although Vredenburg considered communication across the Pacific a possible explanation for the extraordinary resemblance between the two lines, the work of Hornell would seem to exclude this possibility. That writer, in attempting to explain variation in the *T. pyrum* group, stated that "deep water is as great a barrier to the dispersal of *Turbinella* as a land barrier, seeing that its larvae do not pass through a free-swimming stage." (1916, p. 120). In both the Old and the New World the earliest species are marked by a noded shoulder which is gradually lost until the form becomes almost smooth. In the Old World the sequence is:

Oligocene—*T. episoma* (Michelotti)
Lower Miocene (Aquitanian)—*T. affinis* J. de C. Sowerby
Lower Miocene (Burdigalian)—*T. praeovoidea* (= *"T. praemekranica"*) Vredenburg and *T. rembangensis* Pannekoek
Upper Miocene—*T. mekranica* Vredenburg
Pliocene—*T. pyrum* (Linnaeus)

In addition to this evolutionary sequence there is a Recent species, *T. fusus* Sowerby, known only from the Andaman Islands, which has retained almost unchanged the characters of its Oligocene ancestor. In Vredenburg's opinion *Turbinella pyrum,* the type of the genus *Turbinella,* does not seem to fit into the evolutionary line and he stated: "There is nothing in the characters of *T. pirum {sic}* that might indicate any close relationship to the line *episoma-mekranica,* and its ancestral predecessors, in the nearer stages at least, must have differed from those of *T. mekranica. T. pirum* is probably an immigrant which, in Pliocene times, invaded the Indian region." (1923, p. 123). However, Hornell (1916) demonstrated convincingly (to this writer, at least) that *T. pyrum* is only an extreme variant of the typical form. In his tremendous work on variation in *Turbinella* he showed that ecology can change the shape of the shell to an almost unbelievable degree. He studied thousands of specimens of *Turbinella pyrum* and found that variation was a result of "the character of the environment, particularly in regard to the degree of exposure to unfavorable conditions, such as surf action, prolonged spells of turbid, mud-laden water, and scarcity of food." (1916, p. 110-111). If this be true, then the validity of many fossil species becomes highly suspect. This fact should be kept in mind at all times. Table I shows the New World species as recognized herein by the author. Many may represent only geographic variants, but for stratigraphic purposes the distinctions will be recognized.

The genus *Turbinella* is a challenging group. Because the specimens are conspicuously large the ratio of described species to existing forms is probably higher than in most genera. It is not a big group and the fossil sequence is reasonably well known. Therefore the evolutionary gradations are indistinct and deciding what constitutes a species or a subspecies becomes particularly difficult. The choice facing the worker is either to accept each variation as a valid species, or to designate almost endless subspecies for all of the forms in each lineage. The shells of *Turbinella* are relatively unornamented and the basis for specific separation is tenuous at best; therefore this writer's decision is to consider each form as a valid species (although often with mental reservations). Vredenburg faced the same problem with the Indian sequence and he concluded: "The close similarity between successive mutations is apt to give rise to some hesitation as to the nomenclature to

be adopted. Any two immediately successive terms of the series might reasonably be treated as varieties of one species, but, if we omit one term, the preceding and the succeeding mutations unhesitatingly convey the impression of distinct species. Under the circumstances we can scarcely adopt any other practical course but to give a separate specific name to each term of the series." (1923, p. 122).

Summary

In the New World two distinct lineages have developed from the ancestral line. One is here termed the *"angulata"* stock, after the Recent representative of the line (the familiar species *T. scolymus* is now known as *T. angulata*). This form is characterized by a more-or-less strongly noded shoulder and a very large nucleus. The second stock, here termed the *laevigata* group after the Recent member of the line (the former *T. ovoidea* is now known as *T. laevigata*!), possesses an almost smooth fusiform shell, and has a relatively smaller nucleus (although still much larger than most gastropods). It is this line which bears the strong resemblance to the Indian series.

The "ancestral" group includes the early species which have a juvenile development unlike either of the above mentioned lineages, but which possess a much smaller protoconch consisting of only one to two whorls, and numerous small ornamented post-nuclear whorls. This line continued through the lower Miocene, coexisting with the two derivative lineages for a time. The genus as a whole reached its greatest development during the Miocene with the majority of the known species occurring during this period (see table I).

The recent species of *Turbinella* from both the New World and the Old World are shallow water, tropical, marine dwellers. It is apparent that the fossil species had a similar environment. The group is carnivorous, feeding on bivalves and tube worms (Hornell, 1916, p. 116; Abbott, 1950, p. 206), and therefore prefers the silty bottom inhabited by these forms. This preference is reflected in the lithology of the Tertiary formations in which the fossil species occur. The majority of these formations are fine, silty sands, clearly of shallow water origin. The most northern occurrence of the genus is in the Oligocene of Mississippi and southern Georgia, suggesting that the tropical seas extended to that latitude during Oligocene time.

III. Acknowledgments

The author would like to express her gratitude to Katherine V. W. Palmer, Director of the Paleontological Research Institution, for the generous loan of the many type specimens of *Turbinella* in the collections of that institution. In the interest of continuity, the type and figured specimens from this paper are also deposited at the Paleontological Research Institution. She thanks the following persons for information supplied on other type material: L. R. Cox, of the British Museum (Natural History); P. E. de Oliveira, of the Divisao de Geologia e Mineralogia, Rio de Janeiro, Brazil; W. Storrs Cole, of Cornell University; Horace G. Richards, of the Academy of Natural Sciences of Philadelphia; Robert Chambers, of the Wagner Free Institute of Science; and Norman D. Newell, of The American Museum of Natural History. She would also like to thank G. Arthur Cooper, of the United States National Museum, for the loan of specimens. Special thanks go to A. N. Dusenbury, Jr., who provided important information on the stratigraphic assignments of certain Venezuelan species. Finally she would like to thank the members of the editorial committee, Katherine V. W. Palmer, Norman E. Weisbord, and Rolf F. Rutsch for their assistance.

Explanation of symbols

PRI—Paleontological Research Institution

USNM—United States National Museum

USGS—United States Geological Survey

WFIS—Wagner Free Institute of Science, Philadelphia

ANSP—Academy of Natural Sciences of Philadelphia

MPEG—Museu Paraense Emilío Goeldi, Belem, Brazil

DGM—Divisao de Geologia e Mineralogia, Rio de Janeiro, Brazil

Cornell—Cornell University, Ithaca, New York

TU—Tulane University

IV. Systematic Descriptions

Phylum Mollusca

Class Gastropoda

Subclass Prosobranchia
(or Streptoneura)

Order Neogastropoda (or Stenoglossa)

Suborder Rachiglossa

Superfamily Volutacea

Family Turbinellidae

Subfamily Turbinellinae

Genus Turbinella Lamarck, 1799

Xancus Röding, 1798, Museum Boltenianum, p. 134 (placed on Official Index of Rejected and Invalid Generic Names, ICZN Opinion 489, 1957*).
Type species: *Voluta pyrum* Linnaeus, by subsequent designation, Dall, 1906, Jour. Conch., v. 11, p. 296.

Turbinella Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, v. 1, p. 73.
Type species: *Voluta pyrum* Linnaeus, by monotypy.

Turbinellus Lamarck, 1801, Système Animaux sans Vertèbres, p. 83. Emendation?

Scolymus Deshayes, 1843, Animaux sans Vertèbres, ed. 2, v. 9, p. 375. Not *Scolymus* Swainson, 1835.
Type species: *Turbinella scolymus* Lamarck (= *Murex scolymus* Gmelin) by tautonymy.

Mazza H. & A. Adams, 1853, Genera Recent Mollusca, v. 1, p. 156 (*ex* Klein).
Type species: *Voluta pyrum* Linnaeus, by subsequent designation, Abbott, 1950, Johnsonia, v. 2 (28), p. 203.

Turbofusula Rovereto, 1900, Atti R. Univ. Genova, v. 15, p. 169.
Type species: *Turbinella fusus* Sowerby, by original designation.

THE "ANCESTRAL" LINEAGE

Turbinella peruviana (Olsson)

Xancus peruvianus Olsson, 1928, Bulls. Amer. Paleont., v. 14, no. 52, p. 89 (135), pl. 21 (26), fig. 5; Olsson, 1930 *ibid.*, v. 17, no. 62, p. 47.

Xancus peruvianus Olsson. H. K. Hodson, 1931, Bulls. Amer. Paleont., v. 16, no. 59, p. 39.

Diagnosis: "Shell large or medium size, solid and heavy; spire about the length of the aperture with 4 plus whorls (the tip broken); whorls narrowly shouldered and the shoulder angle armed with numerous, feeble ribs or nodes, strongest on the spire whorls; the area between the shoulder angle and the suture is slightly concave or excavated and with an appressed band or feeble cord about the suture; below the shoulder, the sides of the spire-whorls are straight; the side of the body-whorl is straight, contracted in the region of the base and then prolonged into the long, anterior canal; sculpture as noted, consists of feeble ribs or nodes on the shoulder angle, roughly numbering about 15 to 17 on the last whorl, and weak irregular spiral threads, lacking or subobsolete from the middle and upper part of each whorl, but strong and heavy on the anterior canal; inner lip with a wide, spreading callus and the columella is provided with three strong plicae, the upper 2 being stronger.

"Height 85 mm; diameter 47 mm." (Olsson, 1928).

Holotype: PRI 3690.

Horizon: "Restin Sandstone," upper lower Eocene; Saman Formation, upper Eocene; Chira Shale, upper Eocene, Peru.

Discussion: Turbinella peruviana is the oldest known species of *Turbinella* and is clearly ancestral to *T. wilsoni* in the New World Oligocene and probably to *T. episoma* (Michelotti). This latter species occurs in the Oligocene of Italy and of India and gives rise to the species presently known from the Old World. One of these, *T. fusus* Sowerby from the Andaman Islands, is still very much like the Oligocene form, so much so that Vredenburg said: "Whilst, along the coast of western India, the descendants of *T. episoma* constituted a constantly evolving series, it would seem that, in the region of the Andamans, the descendants of *T. episoma* have maintained their original characters almost unchanged to the present day." (1923, p. 123).

The pre-Eocene ancestry of *Turbinella* is not known. Olsson (1930, p. 47) suggested that the genus "probably arose through a *Clavilithes* ancestry in the Eastern Pacific during the Middle Eocene. From this center, it spread during Oligocene and Miocene times through the Caribbean region, to Europe and as far east as India and Java."

Olsson assigned somewhat different ages to the Peruvian formations than are now generally considered correct. Stainforth (1955) summarized the currently accepted chronology and gave the ages cited above for these formations. The "Restin Sandstone" of Olsson is now included in the Cabo Blanco Formation of upper lower Eocene

* See "Appendix I: Nomenclatorial note on the name *Turbinella* Lamarck," at the end of this paper.

age, not middle Eocene as given by Olsson; the Chira Shale is now considered upper Eocene not lower Oligocene.

TURBINELLA WILSONI Conrad

Plate I, figures 1a, 1b

Turbinella wilsoni CONRAD, 1847, Acad. Nat. Sci. Phila., Proc., v. 3, p. 290; CONRAD, 1848, Acad. Nat. Sci. Phila., Jour., (ser. 2) v. 1, p. 120, pl. 12, fig. 12.
Mazza wilsoni (Conrad). CONRAD, 1865, Amer. Jour. Conch., v. 1, p. 23.
Turbinella wilsoni Conrad. DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 96.
Xancus wilsoni (Conrad). MAURY, 1902, Bulls. Amer. Paleont., v. 3, no. 15, p. 73 (383); MAURY, 1917, *ibid.*, v. 5, no. 29, p. 83 (247); MAURY, 1925, Serv. Geol. Min. Brasil, Mon. 4, p. 154-155.
Not *Xancus wilsoni* (Conrad). DALL, 1916, U. S. Natl. Mus., Proc., v. 51, p. 505 (= *T. polygonata* Heilprin).
Xancus wilsoni (Conrad). PILSBRY and JOHNSON, 1917, Acad. Nat. Sci. Phila., Proc., v. 69, p. 167.
Xancus wilsoni (Conrad). HUBBARD, 1921, N. Y. Acad. Sci., Sci. Surv. Porto Rico & Virgin Islands, v. 3, pt. 2, p. 155.
Xancus wilsoni (Conrad). COOKE, 1922, U.S.G.S. Prof. Paper 129-E, p. 83.
Turbinella wilsoni Conrad. VREDENBURG, 1923, Geol. Surv. India, Records, v. 55, pt. 2, p. 126.
Xancus wilsoni (Conrad). WOODRING, 1928, Carnegie Inst. Washington, Publ. 385, p. 252.
Xancus wilsoni (Conrad). OLSSON, 1928, Bulls. Amer. Paleont., v. 14, no. 52, p. 89 (135); OLSSON, 1930, *ibid.*, v. 17, no. 62, p. 47.
Not *Xancus wilsoni* (Conrad). TUCKER and WILSON, 1933, Bulls. Amer. Paleont., v. 18, no. 66, p. 10 (72), pl. 1 (10), fig. 10 (= *T. regina* Heilprin).
Xancus wilsoni (Conrad). MANSFIELD, 1937, Florida Geol. Surv., Bull. 15, p. 112.
Turbinella wilsoni Conrad. GARDNER, 1944, U.S.G.S. Prof. Paper 142-G, p. 440.

Diagnosis: "Fusiform; spire elevated, acute, volutions ten, angular, nodose, the larger volutions somewhat concave above; the upper volutions with revolving lines, obsolete or wanting on the lower ones; beak with coarse, slightly raised revolving lines; aperture narrow; columella with three rather distinct compressed plaits, the middle one largest; canal long. Length 5 inches.

"The young of this species has distinct lines on every part of the shell, except on the large portion of the body whorl, where they are indistinct and remote. This species is named to commemorate the scientific zeal of Dr. Thomas B. Wilson. It is rare and generally very imperfect." (Conrad, 1847).

Dimensions of lectotype: height 119.5 mm, diameter 46.5 mm.

Lectotype: ANSP 13476 (selected by Moore, 1962, after MacNeil MS).

Horizon: Vicksburg Group, Mississippi. Middle Oligocene.

Figured specimens: Fig. 1a, USNM 644-570; height 120 mm (incomplete), diameter 57 mm; locality, Vicksburg, Mississippi. Fig. 1b, USNM 644571; height 44 mm, diameter 13 mm; locality, Byram, Mississippi. Other occurrences: TU locality no. 334.

Discussion: This species from the Vicksburg beds differs from its southern ancestor, *T. peruviana,* in the greater elongation of the shell, and in having a more sloping shoulder. Although it has been reported from post-Vicksburg localities, these reports seem all to be misidentifications and it ap-

---

PLATE I

Figures

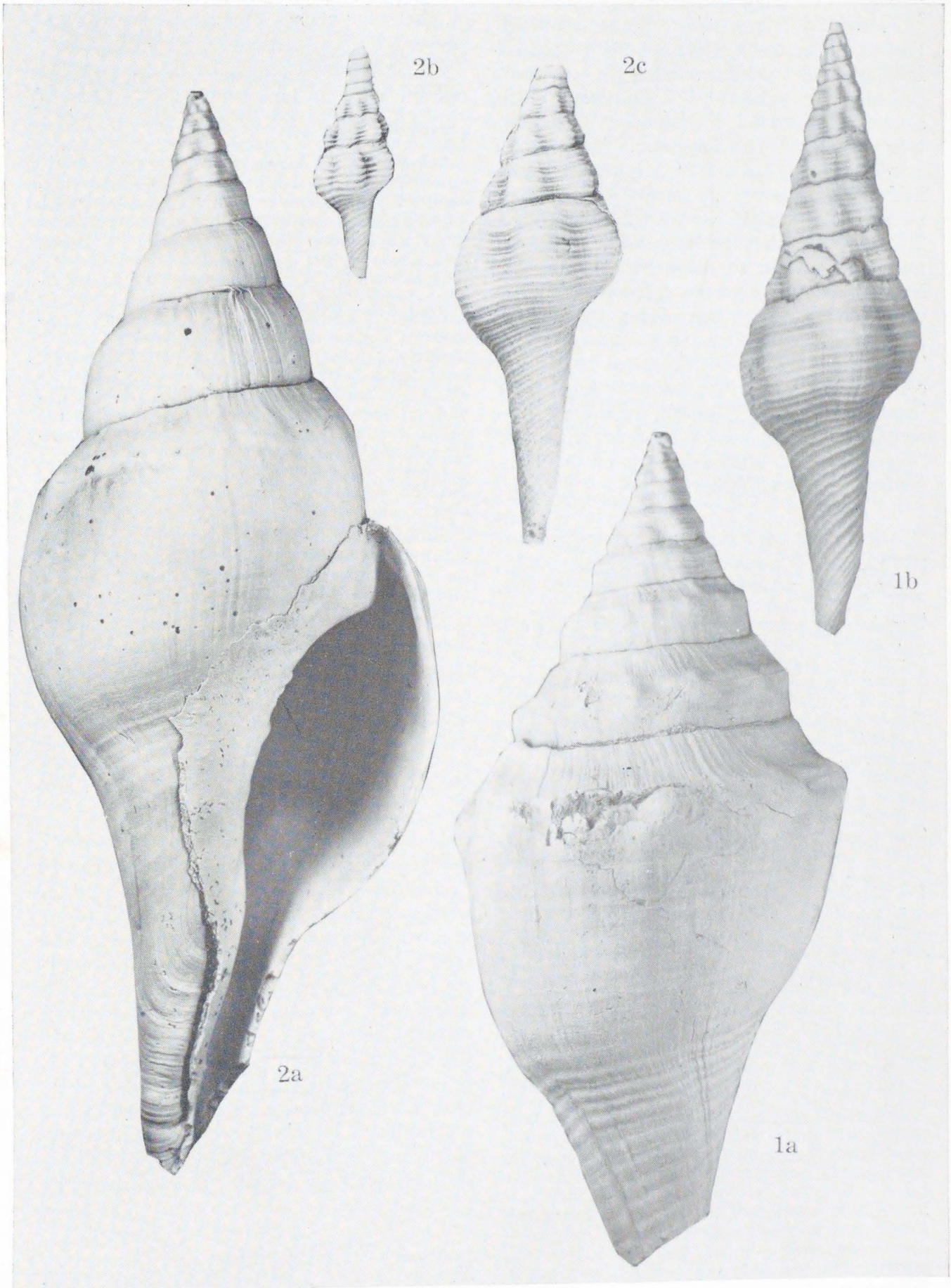


PLATE I

parently is confined to the middle Oligocene.

T. wilsoni is the oldest species of which the nature of the nuclear whorls is known. It is assumed that the older form was comparable. The nucleus of *T. wilsoni* is much smaller than either the slender *"laevigata"* type or the larger *"angulata"* type. The smooth nucleus consists of only one and one-half turns followed by several small ornamented post-nuclear whorls, about eight in 20 mm of length. The total number of post-nuclear whorls in an adult shell is about 12. Because of the extreme difference in the early development these older species are not included in either the *"laevigata"* or *"angulata"* lineage but are placed in an "ancestral" position. Presumably the slender *"laevigata"* line is more nearly a direct descendant of the ancestral type than the *"angulata"* line which would seem to be a distinct side development.

TURBINELLA POLYGONATA Heilprin

Turbinella polygonata HEILPRIN, 1887, Wagner Free Inst. Sci., Trans., v. 1, p. 108, pl. 15, fig. 43.
Turbinella polygonata Heilprin. DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 97 (in part).
Xancus polygonatus (Heilprin). DALL, 1915, U. S. Natl. Mus., Bull. 90, p. 63 (in part).
Xancus wilsoni (Conrad). DALL, 1916, U. S. Natl. Mus., Proc., v. 51, p. 505. *Not* of Conrad.
Xancus polygonatus (Heilprin). PILSBRY and JOHNSON, 1917, Acad. Nat. Sci. Phila., Proc., v. 69, p. 167.
Turbinella polygonata Heilprin. PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 343.
Turbinella polygonata Heilprin. VREDENBURG, 1923, Geol. Surv. India, Records, v. 55, pt. 2, p. 127.
Xancus polygonatus (Heilprin). MANSFIELD, 1937, Florida Geol. Surv., Bull. 15, p. 15, 111, pl. 3, fig. 8.
Xancus polygonatus suwannensis MANSFIELD, 1937, Florida Geol. Surv., Bull. 15, p. 112, pl. 3, fig. 9.
Turbinella polygonata Heilprin. GARDNER, 1944, U.S.G.S. Prof. Paper 142-G, p. 440.

Diagnosis: "Shell elevated, turreted; whorls abruptly flattened on the shoulder—rendering the spire scalariform—the upper ones gently convex, obscurely noded or costated; body-whorl quadrangular, with a broad, flat shoulder; the costae obsolete, resolved into a number (about eight) of shoulder-nodes, which break the circumferential outline into a polygon; aperture greatly exceeding the spire in length; columellar folds three, transverse, situated immediately below the body of the shell; revolving lines of surface feebly defined, almost obsolete on the body-whorls, except on the siphonal tract, where they are well-marked, and of equal significance.

"Length (of fragment, lacking probably two-thirds of an inch below, and a third of an inch above), 1.8 inch; width, .8 inch." (Heilprin, 1887)

"Shell rather large, turreted, with acute spire and large body whorl. Nucleus and earliest post-nuclear whorls not preserved. The earliest 2 or 3 preserved post-nuclear whorls are more slender than the following and show spiral sculpture. The following whorls rapidly enlarge, gently slope anteriorly from the suture, and are strongly shouldered and bear at the periphery moderately strong nodules. Body whorl weakly concave in the area of the anal fasciole, bears about 12 (estimated) nodules on the shoulder, constricted at the base and ornamented on the base and canal with spiral cords. . . . Length 125 mm; greatest diameter 65 mm." (Mansfield, 1937)

Holotype: WFIS 872 *(T. polygonata);* USNM 495943 *(T. polygonata suwannensis).*

Horizon: Flint River Formation and Suwannee Limestone, upper Oligocene; Tampa Limestone, lowermost Miocene. Florida and Georgia.

Discussion: There are no known specimens of *T. polygonata* which have the nuclear whorls preserved, so that for the present time it is also placed in the "ancestral" group with *T. wilsoni,* to which it bears a strong resemblance. It may be distinguished from *T. wilsoni* by the lower spire and slightly more inflated aspect of the younger species.

Mansfield described a subspecies of *T. polygonata* which he called *suwannensis.* Comparison of the type of his subspecies with specimens of *T. polygonata* fails to reveal any distinguishing characteristics. The type specimen of *T. polygonatus suwannensis* is much larger than any specimens yet found of *T. polygonata* s.s. but this does not seem to be a valid distinguishing criterion if the evidence from other species is reliable. It is expected that *T. polygonata* should attain a size similar to that indicated by the specimen of *T. suwannensis.* Both the species which precede it and those which succeed it reach a length of approximately 150 mm.

TURBINELLA GRATA (Maury)

Xancus gratus MAURY, 1925, Serv. Geol. Min. Brasil, Mon. 4, p. 152-153, pl. 7, fig. 4.
Xancus gratus Maury. FERREIRA and CUN-

HA, 1957, Mus. Paraense Emílio Goeldi, Bol.; Geologia No. 2, p. 35.

Diagnosis: "Shell characterized by strongly shouldered whorls with tuberculated riblets. On the last volution there are about ten of the tubercles on the shoulder. The surface of the shell is delicately spirally striated, the striae fading out towards the base. Columella with three transverse plications, the two posterior stronger, the anterior weaker. These folds appear in reverse on the mold as sharp, narrow grooves. Length 70 mm, width 27 mm." (Maury, 1925)

Holotype: DGM 569.

Horizon: Pirabas Limestone, uppermost lower Miocene. Pará, Brazil.

Discussion: From Maury's illustration this species seems to be an immature specimen closely related to *T. polygonata.* It shows a strongly noded shoulder, somewhat more sloped than that of *T. polygonata,* with a less constricted body whorl. The overall shape is more elongate, reminiscent of *T. wilsoni,* and the species probably represents a southern offshot of the original line.

TURBINELLA AMAZONIANUM (Ferreira and Cunha)

Xancus amazonianum FERREIRA and CUNHA, 1957, Mus. Paraense Emílio Goeldi, Bol.; Geologia No. 2, p. 35, pl. 2, figs. 7, 8.

Diagnosis: "Shell of large size, moderately elongated and pointed at the apex. The last whorls, just at the very end, are ornamented by very delicate, almost imperceptable striations. On the apical whorls we find insignificant nodes, or costulate tubercles, which are poorly discerned. In the general aspect, the shell is obesely fusiform, heavy, and has clear whorls with distinct sutures, as in *Xancus validus* (Sowerby, 1849), of the Miocene of Santo Domingo. The whorls are 8 to 10 in number, thickened and wide at the base, gradually becoming thinner toward the apex. They are strongly contorted, superposed, with sharp and distinctly sulcate sutures. They present a smooth slope, wider in the larger whorls, delicately diminishing to the point of disappearing when the last whorls appear. The surface of the slope shows thin axial lines, principally on the larger whorls. On the body of the whorls there is, between one suture and another, one delicate, slightly sulcate line, which accompanying the former, directs itself toward the apex." (Ferreira and Cunha, 1957, *translated*)

Holotype: MPEG 363-I.

Horizon: Pirabas Limestone, uppermost lower Miocene, Pará, Brazil.

Discussion: This species is compared, by the authors, with *T. validus* and with *T. textilis jamaicensis* "Pilsbry and Johnson." However it is not compared with Maury's *T. grata* which is also from the Pirabas Limestone. *T. amazonianum* may very well be the adult form of *T. grata.* The general outline of the shells is identical and the description of the surface ornamentation seems strikingly parallel. Because both species were described from fragmentary material absolute proof is lacking, and for this reason the two species are not placed in synonymy at this time.

TURBINELLA VALIDA Sowerby

Text figure 1

Turbinellus validus SOWERBY, 1850, Geol. Soc. London, Quart. Jour., v. 6, p. 50.

Turbinellus validus Sowerby. GUPPY, 1866, Geol. Soc. London, Quart. Jour., v. 22, p. 575; GUPPY, 1876, *ibid.*, v. 32, p. 523.

Turbinella valida Sowerby. GABB, 1873, Amer. Phil. Soc., Trans., (N.S.) v. 15, p. 218.

Turbinellus validus Sowerby. GUPPY, 1910, Agri. Soc. Trinidad and Tobago, Paper no. 440, p. 6, 9 (*ex* Harris reprint: Bulls. Amer. Paleont., 1921, v. 8, no. 35, p. 149 (297) & 151 (299).)

Xancus validus (Sowerby). MAURY, 1917, Bulls. Amer. Paleont., v. 5, no. 29, p. 83 (247), pl. 13 (39), fig. 5; MAURY, 1925, Serv. Geol. Min. Brasil, Mon. 4, p. 154-155.

Xancus rex PILSBRY, and JOHNSON, 1917, Acad. Nat. Sci. Phila., Proc., v. 69, p. 167.

? Not *Xancus validus* (Sowerby). HUBBARD, 1921, N. Y. Acad. Sci., Sci. Surv. Porto Rico & Virgin Islands, v. 3, pt. 2, p. 155 (? = *T. arecibonense* Hubbard).

Not *Xancus validus* (Sowerby). PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 342, pl. 25, fig. 3 (? = *T. textilis* Guppy).

Xancus rex Pilsbry and Johnson. PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 342, pl. 26, figs. 5, 8.

Xancus validus (Sowerby). OLSSON, 1922, Bulls. Amer. Paleont., v. 9, no. 39, p. 112 (284).

Turbinella valida Sowerby. VREDENBURG, 1923, Geol. Surv. India, Records, v. 55, pt. 2, p. 125.

Turbinella rex (Pilsbry and Johnson). VREDENBURG, 1923, Geol. Surv. India, Records, v. 55, pt. 2, p. 127.

Xancus rex Pilsbry and Johnson. WOODRING, 1928, Carnegie Inst. Washington, Publ. 385, p. 251.

Xancus validus (Sowerby). WOODRING, 1928, Carnegie Inst. Washington, Publ. 385, p. 252.

Xancus rex Pilsbry and Johnson. WEISBORD, 1929, Bulls. Amer. Paleont., v. 14, no. 54, p. 47 (279).

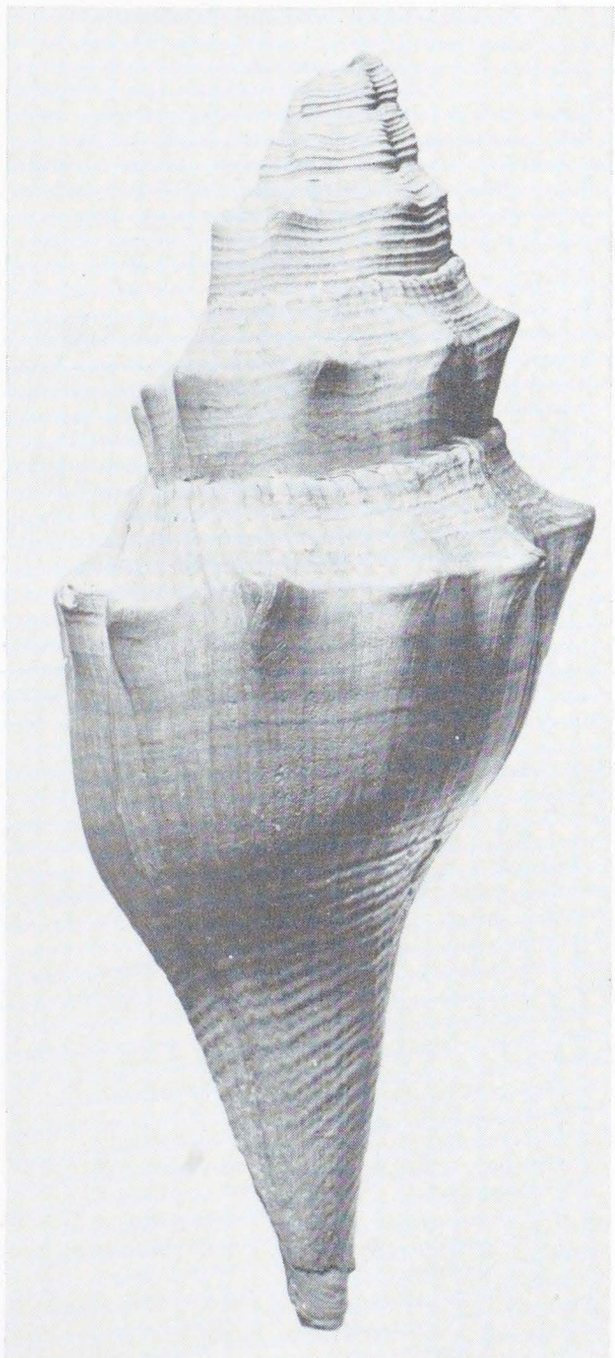
Xancus aviaguensis H. K. HODSON, 1931,

Bulls. Amer. Paleont., v. 16, no. 59, p. 38, pl. 19, fig. 2.

Xancus rex Pilsbry and Johnson. MANSFIELD, 1937, Florida Geol. Surv., Bull. 15, p. 15, 112.

Xancus validus (Sowerby). FERREIRA and CUNHA, 1957, Mus. Paraense Emílio Goeldi, Bol.; Geologia No. 2, p. 25.

Diagnosis: "Testa oblongo-subfusiformis, laevis, postice acuminata, antice coarctata, anfractibus 6 ad 8, subventricosis, spiraliter striatis, posticis transversim obtuse costatis, intermediis subtuberculatis, anticis duobus postice tuberculatis; suture canaliculata, margine levata; apertura magna, canali valido extus striato.



Text figure 1. *Turbinella valida* Sowerby (X 1).
Lectotype: British Museum (Nat. Hist.) GG. 20212.

"This species somewhat resembles *T. scolymus;* it differs, however, materially in its general form not being hexagonal; in the suture, whose margin is elevated and with a narrow channel; and in its tubercules, which are small and rounded." (Sowerby, 1850)

"The shell is biconic, large and ponderous, the periphery about median. First whorl distorted, bulbous, smooth, next whorl contracted and narrow. Succeeding whorls have massive axial folds, 6 or 7 on a whorl, traversed by about 7 spiral cords. After the mid-neanic stage the spiral sculpture weakens, and the folds gradually give place to strong tubercles at the shoulder. On the last whorl of the type there are 12 such tubercles. Above the shoulder there is a steep, slightly concave slope to the suture, the surface being conspicuously, finely plicate and having a few spiral cords, which are indistinct in the adult stage. The whorl is appressed at the suture, the axial wrinkles becoming strongly retractive laminae there. The basal half of the last whorl has many spiral cords. The inner lip is heavily calloused, columella with 3 strong plaits. (Pilsbry and Johnson, 1917 [*T. rex*])

Dimensions of lectotype: height 130 mm (incomplete), diameter 57 mm.

Lectotype (here designated, after Sherborn): British Museum (Nat. Hist.)—GG. 20212. Formerly London Geol. Soc. Coll. 12819.

Horizon: ? Baitoa Formation, lower Miocene (Woodring, 1928, p. 252). Dominican Republic.

Figured specimen: Text figure 1, GG. 20212 (lectotype); height 130 mm, diameter 57 mm. Photograph courtesy of British Museum (Nat. Hist.).

Discussion: Pilsbry (1922, p. 342) stated that the common species from the Miocene beds of Santo Domingo, referred to *T. validus* by Gabb, Maury, and other authors, was actually the species *T. rex.* This latter species, he declared, differed from *T. validus* in that the spire was more elevated and the nodes more pronounced. He also figured a specimen which he identified as *T. validus.* Comparison of that figure with photographs of syntypes of Sowerby's species shows that Pilsbry's specimen is not *T. validus,* but is a different species closely related to, if indeed not conspecific with, *T. textilis* (Guppy). The figures of the type specimen of *T. rex,* on the other hand, clearly indicate that *T. rex* is the same as *T. validus.*

No specimen of *T. validus* has ever been figured, and apparently the holotype is lost. Dr. L. R. Cox, of the British Museum (Natural History) has kindly provided the writer

with a photograph of the specimen selected by Sherborn as "lectotype," although this selection was never published as such. In the "List of Types and Figured Specimens in the Collection of the Geological Society of London," this specimen was listed as R 12819 (Blake, 1902, p. 65). The collection subsequently went to the British Museum (Natural History) and this specimen is there catalogued as GG.20212.

T. validus is much like *T. wilsoni,* differing only in a greater elongation of the shell. Therefore *T. validus* is included in the "ancestral" group. It is not in the direct line of descent toward either the *"laevigata"* or the *"angulata"* stocks, but presumably is an end member of the "ancestral" line.

T. aviaguensis Hodson was described from the "Upper Middle Oligocene" near Dabajuro, Falcón, Venezuela. The stratigraphic assignment of this species as well as all of the other Hodson species is a matter of guesswork, for in the original publication only a locality and an age assignment were given, and most of the ages must be revised upward in the light of present knowledge. A. N. Dusenbury, Jr., has been working on the problem, and has provided the information *(in litt.)* that *T. aviaguensis* apparently comes from the Cauderalito Member (Aquitanian) of the lower Miocene Agua Clara Formation. In view of the strong resemblance of the shell of *T. aviaguensis* to that of *T. valida,* combined with the almost simultaneous geologic occurrence, the two species are placed in synonymy.

TURBINELLA TIRANTENSIS (H. K. Hodson)

Xancus tirantensis H. K. HODSON, 1931, Bulls. Amer. Paleont., v. 16, no. 59, p. 39, pl. 21, figs. 1-3.

Diagnosis: "The shell is of medium size, with shouldered, straight-sided whorls. The very young stages are unknown, but the neanic whorls carry 6 or 7 longitudinal nodes and several spiral threads. The spiral threads continue a short distance beyond the nodes, but soon become obsolete. After the nodes disappear, the whorls are shouldered with a narrow presutural band, which is not excavated and only obsoletely noded, if at all; sometimes this band forms a sharp corded shoulder and sometimes a rounded shoulder. Below the shoulder, the whorls are straight-sided and almost smooth; the anterior canal carries spiral cords.

"This species resembles *X. peruvianus* Olsson, but the sutures of the Venezuelan form are more excavated, the sutural band is flatter and less noded, and the spiral cords of the anterior canal are smaller." (Hodson, 1931)

Dimensions of holotype: height 87 mm (incomplete), diameter 60 mm.

Holotype: PRI 24109.

Horizon: Agua Clara Formation, lower Miocene. Dist. of Buchivacoa, Falcón, Venezuela.

Diagnosis: The type material of this species is very poorly preserved, making it difficult to affiliate with other species. The single distinguishing characteristic seems to be a pronounced ridge at the shoulder which is similar to that of *T. valida.* As with *T. aviaguensis* the stratigraphic assignment is subject to question, however, Dusenbury places this species *(in litt.)* in the Santiago Member (Burdigalian) of the lower Miocene Agua Clara Formation. Thus *T. tirantensis* is somewhat younger than *T. aviaguensis,* presumably its nearest relative. It is possible that *T. tirantensis* is also synonymous with *T. valida,* but until better material is available little can be done with this species.

THE *"LAEVIGATA"* LINEAGE

TURBINELLA PRECURSOR Hubbard

Turbinella chipolana variety *precursor* HUBBARD, 1921, N. Y. Acad. Sci., Sci. Surv. Porto Rico & Virgin Islands, v. 3, pt. 2, 153, pl. 23, figs. 6, 7.

Xancus precursor (Hubbard). WOODRING, 1928, Carnegie Inst. Washington, Publ. 385, p. 251.

Diagnosis: "Shell small, fusiform, consisting of three and one-half nuclear whorls and three post-nuclear whorls; protoconch like *T. chipolana* Dall and *T. regina* Heilprin, in having a swollen tip, succeeded by smaller nuclear whorls. The tip consists of one and one-half volutions, is transversely ovate, and is peculiar in having a shallow median constriction. The two succeeding nuclear whorls considerably smaller in diameter, the first being gently convex, the last nearly flat. The latter is succeeded abruptly by sculptured whorls with seven rounded, not nodose ribs, and prominent spirals, of which there are four on the first two, and about twenty-three on the final whorl and pillar. The spirals are separated by wider interspaces. The whorls are marked by a prominent, narrow and wavy sub-sutural band or shoulder, sculptured with at first one and later with two spirals. The interspace immediately below the shoulder is strongly impressed. The spirals are of equal strength, except on the pillar, where faint intercalated threads appear. The entire post-

nuclear surface is marked by fine raised longitudinal growth lines, strongest in the interspaces between the spirals. Height of shell 17.5 mm, maximum diameter 7 mm; height of protoconch 3½ mm, diameter of tip of protoconch 2½ mm." (Hubbard, 1921)

Holotype: Not found.

Horizon: San Sebastion Shale, middle Oligocene. Lares Dist., Puerto Rico.

Discussion: Although Hubbard considered the type material of this species adult, it is obvious that the shell is a juvenile form. He compared both this species and the following one, *T. arecibonense,* to *T. chipolana;* however, the smaller protoconch and more slender shape suggest that their true affiliation is with *T. dodonaia.* If this is the case *T. precursor* is the oldest known species of the *"laevigata"* line. Unfortunately the type material, which was poor to begin with, seems to be lost, and one must await discovery of better material before this conjecture can be proved or disproved.

TURBINELLA ARECIBOENSE Hubbard

Turbinella chipolana variety *areciboense* HUBBARD, 1921, N. Y. Acad. Sci., Sci. Surv. Porto Rico & Virgin Islands, v. 3, pt. 2, p. 154, pl. 23, fig. 8.

Diagnosis: "A single specimen in which the lower half of the body whorl is missing. Protoconch like that of variety *precursor,* but without median construction [*sic*] of the tip, and with the third whorl almost entirely concealed by the overlapping of the first post-nuclear whorl, giving the appearance of a two-whorl protoconch. The tip is slightly larger (diameter 3 mm) than that of *precursor,* and slightly more swollen when compared with the succeeding whorls. The whorl following the tip is nearly flat, whereas in *precursor* it is noticeably convex. The first post-nuclear whorl has ribs, spirals, and sub-sutural band, or shoulder, as in *precursor* and represents the *precursor* stage. On the next and following whorls, however, the ribs become nodose, and on later whorls there are more spirals than in *precursor,* with occasionally a fine intercalated spiral. The longitudinal growth lines are similar to those of *precursor,* but show a tendency to alternate in strength. The sub-sutural band, or shoulder, is prominent in the first two post-nuclear whorls and marked by a single spiral; on the third whorl it is inconspicuous, and marked by two spirals, as in the later whorls of *precursor,* while on the fourth and fifth (or final) whorls it has disappeared altogether. This fact is interesting in showing the tendency to lose a primitive character which has apparently been completely lost in the Chipolan shell. Height of fragment 20 mm, maximum diameter 11 mm." (Hubbard, 1921)

Holotype: Not found.

Horizon: Quebradillas Limestone, lower Miocene. Lares Dist., Puerto Rico.

Discussion: The type material of this species is not only a juvenile but is also incomplete. Presumably it is the descendant of the middle Oligocene species *T. precursor,* and therefore antecedent to *T. dodonaia,* but until better material is available there is little that can be done with this species. In the same paper Hubbard reported finding "a few fragments" of a species which he referred to *"Xancus validus,"* stating that these fragments showed the sculpture of that species. It is possible that *T. arecibonense* is a synonym of *T. valida,* for the early whorls of the two forms are similar; however, the nature of the nucleus seems to suggest that *T. arecibonense* is more closely allied with the *"laevigata"* line.

TURBINELLA DODONAIA (Gardner)

Plate I, figures 2a, 2b, 2c

Xancus wilsoni (Conrad). MAURY, 1902, Bulls. Amer. Paleont., v. 3, no. 15, p. 64 (374). *Not* of Conrad.

? Xancus sp. indet. MAURY, 1925, Serv. Geol. Min. Brasil, Mon. 4, p. 154-155, pl. 7, figs. 6, 10.

Xancus dodonaius GARDNER, 1944, U.S.G.S. Prof. Paper 142-G, p. 440, pl. 49, fig. 2.

Xancus mauryae FERREIRA and CUNHA, 1957, Mus. Paraense Emílio Goeldi, Bol.; Geologia No. 4, p. 24, pl. 2, fig. 1.

Diagnosis: "Shell probably very large and heavy, the height of perfect individuals exceeding a foot. Outline rudely fusiform, the maximum diameter approximating the median horizontal. Whorls of conch probably 8 or 9 in number. Outline of the early volutions obscured by the axial costae, the medial whorls narrowly tabulated, flattened laterally or feebly rounded, rudely trapezoidal in outline; the later volutions developing an acute keel a little behind the median line, this shouldered portion becoming increasingly less oblique and in the older individuals, becoming tuberculate. Body flattened medially, smoothly constricted at the base. Protoconch broken away in all available material but probably large at the base. Axial sculpture, with the exception of the incrementals, restricted to the early whorls. Axials on earliest whorls of the conch narrow, rounded, persistent to the posterior suture, probably as many as 10 in number, rapidly becoming broader and evanescing on the closely appressed posterior third, reducing to 7 in number on the third and later volutions, becoming increasingly

broader and lower on each succeeding volution and altogether obsolete near the fifth. Spiral lirae initiated with the axials, sharp and sharply elevated, and from 4 to 6 in number upon the earliest whorls, with 2 or 3 additional lirae developed upon the appressed posterior portion; secondaries intercalated on the third or fourth volution, as in *chipolanus;* spiral sculpture diminishing with the axial but persisting as well defined lirae through another revolution; an obscure spiral shagreening but no well defined liration usually visable on the adult whorls. Base of body, pillar, and fasciole in many individuals finely and rather obscurely threaded. Sutures impressed upon the earlier volutions, feebly channeled upon the later. Aperture obliquely pyriform in outline. Labrum broadly arcuated, not lirate within. Parietal wall heavily glazed, the callus spread in a broad arc from the posterior commissure to the anterior canal. Columella triplicate, the posterior fold placed directly at the base of the body, the outer two approximately equal and parallel to it and almost horizontal near their termination. Anterior canal rather broad, very feebly recurved. Anterior fasciole strongly arched in the adults, corrugated by the incrementals, obliquely truncate or broadly emarginate at its extremity. Umbilicus normally imperforate.

"Dimensions of holotype: Height, 90 millimeters; length of aperture, 55 millimeters; maximum diameter, 34.0 millimeters." (Gardner, 1944)

Holotype: USNM 371439.

Horizon: Oak Grove Sand and Chipola Formation, uppermost lower Miocene. Florida.

Figured specimens: Fig. 2a, PRI 26909; height 210 mm, diameter 80 mm; locality TU 549. Fig. 2b, PRI 26910; height 17 mm, diameter 9 mm; locality TU 458. Fig. 2c, PRI 26911; height 47 mm, diameter 17 mm; locality TU 459. Other occurrences: TU locality nos. 70, 91, 453, 457, 546, 547, 548.

Discussion: The type specimen of *T. dodonaia* although of "mature" aspect is by no means an adult shell, for one specimen from the Chipola River, here figured, measures 210 mm and Gardner reported a specimen which if complete would have measured over 300 mm in length. It seems to be characteristic of the genus *Turbinella* that the animal never reaches a point where it stops growing completely. The shell attains a mature aspect at a fairly early stage and the animal simply continues to grow larger until death overtakes it. Certainly immature or adolescent specimens of any species of *Turbinella* are more common, and one should be wary of declaring any small specimen an "adult."

This species is widespread in the Chipola Formation, but it is never common. Collections usually consist of juveniles and only rarely is a large individual found. This form is clearly ancestral to *T. regina* and the Recent *T. laevigata.* There are a number of intermediate forms in Venezuela and the Caribbean which are also exceedingly like *T. dodonaia* and will be discussed in sequence. Maury (1925) figured two specimens from the Pirabas Limestone of Brazil, correlated with the Chipola Formation, that are very much like *T. dodonaia,* and it is probable they represent this species. More recently Ferreira and Cunha (1957) described *Xancus mauryae* from the Pirabas Limestone which they compared with Maury's specimens and which is most certainly conspecific with *T. dodonaia.*

T. dodonaia occurs with another superficially similar species, *T. chipolana* Dall. The juvenile shell of *T. chipolana* may be distinguished readily from that of *T. dodonaia,* the more common species. *T. dodonaia* is smaller, the nucleus being approximately 2 mm in diameter and proportionally less in length. The nucleus of *T. chipolana* is about 4 mm in diameter and much larger in proportion to the neanic shell than is the delicate *T. dodonaia.* Adult specimens of these two species may be distinguished by the relative slenderness of *T. dodonaia,* and by the smoother shell of that species. *T. dodonaia* loses the neanic nodes and spiral ribs simultaneously on the fourth to fifth post-nuclear whorl and the adult shell is almost completely smooth. Even on the pillar only a faint trace of spiral ornamentation remains. The neanic whorls of *T. dodonaia* retain their axial nodes for a much longer duration than those of *T. chipolana.* The first five post-nuclear whorls of *T. dodonaia* retain the juvenile ornamentation and only subsequently does the shell become smooth. This characteristic is very similar in *T. regina* and the young shells of both species are strikingly alike. In *T. regina* the spiral ribbing is retained for a longer time than in *T. dodonaia.* However, in the upper Miocene forms of *T. regina* the spiral ribbing dies out in an earlier stage than the Pliocene forms, suggesting an evolutionary sequence.

TURBINELLA PRAELAEVIGATA, E. H. Vokes, nom. nov.

Turbinellus ovoidea Kiener. MOORE, 1850, Geol. Soc. London, Quart. Jour., v. 6, p. 40; MOORE, 1853, *ibid.*, v. 9, p. 130. *Not* of Kiener.

Turbinellus ovoideus Kiener. GUPPY, 1866, Geol. Soc. London, Quart. Jour., v. 22, p. 575; GUPPY, 1874, Geol. Mag. (decade 2) v. 1, p. 438 (in part); GUPPY, 1876, Geol. Soc. London, Quart. Jour., v. 32, p. 523. *Not* of Kiener.

Turbinella ovoidea Kiener. GABB, 1873, Amer. Phil. Soc., Trans., (N.S.) v. 15, p. 218. *Not* of Kiener.

Xancus proaevoideus [*sic*] MAURY, 1917, Bulls. Amer. Paleont., v. 5, no. 29, p. 83 (247), pl. 14 (40), fig. 18. Corrected to *praeovoideus* in errata. Not *Turbinella praeovoidea* Vredenburg, 1916.

Xancus praeovoideus Maury. PILSBRY, 1922, Acad. Nat. Sci., Phila., Proc., v. 73, p. 343.

Turbinella praeovoidea (Maury). VREDENBURG, 1923, Geol. Surv. India, Records, v. 55, pt. 2, p. 125. Not *T. praeovoidea* Vredenburg, 1916.

Not *Xancus praevoideus* [*sic*] Maury. MAURY, 1925, Bulls. Amer. Paleont., v. 10, no. 42, p. 207 (359), pl. 38 (49), fig. 1 (= *T. riosecana* Hodson).

Xancus praeovoideus Maury. MAURY, 1925, Serv. Geol. Min. Brasil, Mon. 4, p. 623, pl. 7, fig. 12.

Xancus praeovoideus Maury. H. K. HODSON, 1931, Bulls. Amer. Paleont., v. 16, no. 59, p. 40; H. K. HODSON, 1931, *ibid.*, v. 16, no. 60, p. 13 (107).

Xancus praeovoideus Maury. RUTSCH, 1942, Verh. Naturf. Gesell., Basel, v. 54, p. 162.

Xancus praeovoideus Maury. FERREIRA and CUNHA, 1957, Mus. Paraense Emílio Goeldi, Bol.; Geologia No. 4, p. 27.

Diagnosis: "Our recent shells of *X. ovoidea* collected by the Hartt expedition at Bahia, Brazil, show the spire is spirally striate, *not costate.* In the fossils the spire is *strongly tuberculately costate* for about five whorls, and the three columellar plications are decidedly heavier. Length 178, width 71 mm." (Maury, 1917)

Holotype: Cornell 36829.

Horizon: Cercado Formation, lower Miocene; Gurabo Formation, middle Miocene. Dominican Republic.

Discussion: Xancus praeovoideus was so named by Maury because of its resemblance to the Recent species *T. ovoidea* Kiener (=*T. laevigata*), living off the coast of Brazil. However, almost simultaneously with Maury's work, Vredenburg (1916) gave the same name to a species from the lower Miocene (Burdigalian) Gáj Beds of India, also because of its resemblance to *T. ovoidea.* At the time Vredenburg was of the opinion that the upper Miocene Indian form was conspecific with the Recent Brazilian species, however later (1923, p. 121) he decided that the two were not synonymous, and named the Indian species *T. mekranica.* He then stated, "The mutation that links *T. mekranica* to the lower Miocene *T. affinis* can no longer be known under the misleading name of *praeovoidea* which I now propose to alter to *praemekranica.* As the shell has not been figured, taxonomists may perhaps forgive me this change of nomenclature." He then suggested that because the Santo Domingan fossil was obviously the true ancestor of *T. ovoidea,* "Miss Maury's designation is so excellently suited to the fossil under consideration that we cannot do better than adopt it." (p. 125). Unfortunately the modern rules of nomenclature do not permit such a solution, and Maury's name must be considered as preoccupied by that of Vredenburg. However, as "the Lord giveth and the Lord taketh away," so the Law of Priority has given us another name to replace that of Maury. The familiar name *T. ovoidea* has been found to be a junior synonym of *T. laevigata* Anton; therefore Maury's *T. praeovoidea* is herein transmuted to *T. praelaevigata* and once again stability is established.

This species is one of the more common Santo Domingan fossils. Pilsbry (1922, p. 343) stated that Gabb had collected this shell "in considerable quantity." Maury (1917, p. 84) also stated that "we collected a number of specimens." The shell reaches a length of 200 mm and is consequently a conspicuous element in the fauna at any locality where it occurs. The species was reported from Santo Domingo by all of the early writers, such as Gabb and Guppy, as *"T. ovoidea,"* but as Maury pointed out, the shells differ noticeably. The Recent species also is usually smaller. The largest size reported (Abbott, 1950, p. 207) is 120 mm.

Maury (1917, p. 84) reported finding this species at both Bluff 1 and Bluff 3, Cercado de Mao. Bluff 1 she referred to an "upper" formation, correlated with the Gatun Formation of Panama, and Bluff 3, she referred to a "lower" formation, correlated with the Chipola Formation of Florida (1917, table after p. 459). She subsequently (1919) named these the Gurabo (upper) and the Cercado (lower) Formations, one middle Miocene and the other lower Miocene.

T. praelaevigata is much like *T. dodonaia*

but may be distinguished by a pronounced presutural band or constriction. Moreover, the suture of *T. praelaevigata* is strongly appressed and the spiral ornamentation is much more conspicuous. This species is also closely related to *T. regina,* the upper Miocene-Pliocene member of the line, but may be distinguished by the slightly more inflated form of *T. praelaevigata* as well as by the presutural band.

TURBINELLA FALCONENSIS (H. K. Hodson)

Xancus falconensis H. K. HODSON, 1931, Bulls. Amer. Paleont., v. 16, no. 59, p. 40, pl. 22, figs. 1, 3.

Xancus falconensis Hodson. H. K. HODSON, 1931, Bulls. Amer. Paleont., v. 16, no. 60, p. 13 (107).

Diagnosis: "The shell is of medium size, slender, flat-whorled. The youngest whorls are unknown. The last 3½ neanic whorls are strongly noded longitudinally below a narrow, flat band, which is just in front of the posterior suture; there are 5 or 6 nodes on each whorl; each neanic whorl bears about 5 primary spiral threads, between which secondary spirals rapidly appear and increase in strength as the whorls grow larger. The sculpture of the neanic stage dies out rather abruptly leaving the early adult whorls smooth except for a few, fine, spiral threads; the adult whorls are long, flat-sided, and bear only a trace of the shoulder produced by the posterior sinus. The later adult whorls have practically no spiral threads. The sutures are usually channeled. The posterior sinus is deep and narrow; below this, the lip is flat-sided to its anterior constriction. The mouth measures almost half of the length of the shell in the adult.

"This species is more slender and flatter-whorled than *X. praeovoideus* Maury; on our species the nodes on the neanic whorls and the spiral threads disappear earlier." (Hodson, 1931)

Dimensions of holotype: height 153 mm, diameter 64 mm.

Holotype: PRI 24111.

Horizon: ? Socorro Formation, middle Miocene. Dist. of Falcón, Venezuela.

Discussion: There is a series of three species from the middle Miocene, the upper Miocene, and the Pliocene of Venezuela and Trinidad which are all exceedingly alike. They differ solely in having an increasing degree of inflation of the body whorl. *T. riosecana,* the Pliocene form, is the most inflated; *T. falconensis,* the middle Miocene form, is the least inflated. The line is clearly an almost direct descendant of *T. dodonaia* from the lower Miocene of Florida.

Hodson originally gave the locality of *T. falconensis* as "Cantura, Cocodito area, Paraguaná Peninsula, Dist. of Falcón, Falcón, Venezuela." This was subsequently corrected to "Cantaure, Cocodite area" by Brann and Kent (1960, p. 980). Dusenbury *(in litt.)* places the species in beds approximately equivalent to the Socorro Formation.

TURBINELLA TRINITATIS (Maury)

Xancus trinitatis MAURY, 1925, Bulls. Amer. Paleont., v. 10, no. 42, p. 208 (360), pl. 39 (50), fig. 1.

Xancus trinitatis Maury. H. E. VOKES, 1938, Amer. Mus. Novitates, no. 988, p. 4.

Xancus trinitatis Maury. RUTSCH, 1942, Verh. Naturf. Gesell., Basel, v. 54, p. 162, pl. 9, figs. 2, 4.

Diagnosis: "Shell exceedingly large and heavy, differing in contour from *praeovoideus,* the shape being more fusiform, the body proportionately longer and less wide and all the volutions less convex. The very early whorls are lacking, but below the last striated volution the first whorls are slightly but clearly carinate below the suture. All the shells are incomplete, but the largest is 255 mm long and when entire would measure 300 x 100 mm." (Maury, 1925)

Holotype: PRI 1117.

Horizon: Springvale Beds, upper Miocene. Trinidad.

Discussion: T. trinitatis is the middle member of the sequence discussed under *T. falconensis* and is only slightly less inflated than the Pliocene *T. riosecana.* In all of these species we are hampered by a lack of specimens with which to establish the range of variation. Studies of *T. regina* (see discussion following) suggest that the length/width ratio is fairly constant and that these three forms are probably good stratigraphic subspecies if nothing more. *T. regina* is closely related to this line but is more slender than any of the southern species.

TURBINELLA RIOSECANA (H. K. Hodson)

Turbinellus ovoideus Kiener. GUPPY, 1866, Geol. Soc. London, Quart. Jour., v. 22, p. 576; GUPPY, 1874, Geol. Mag. (decade 2) v. 1, p. 438 (in part). *Not* of Kiener.

Turbinelus [*sic*] *ovoideus* Kiener. GUPPY, 1910, Agri. Soc. Trinidad and Tobago, Paper no. 440, p. 6 (*ex* Harris reprint: Bulls. Amer. Paleont., 1921, v. 8, no. 35, p. 149 (297).) *Not* of Kiener.

Xancus praevoideus [*sic*] Maury. MAURY,

1925, Bulls. Amer. Paleont., v. 10, no. 42, p. 207 (359), pl. 38 (49), fig. 1. *Not* of Maury, 1917.

Xancus praeovoideus riosecanus H. K. HODSON, 1931, Bulls. Amer. Paleont., v. 16, no. 60, p. 12 (106), pl. 11 (35), fig. 1; pl. 12 (36), fig. 1.

Xancus praeovoideus Maury. H. E. VOKES, 1938, Amer. Mus. Novitates, no. 988, p. 4. *Not* of Maury, 1917.

Xancus trinitatis riosecanus H. K. Hodson. RUTSCH, 1942, Vehr. Naturf. Gesell., Basel, v. 54, p. 161, pl. 9, figs. 1, 3.

Diagnosis: "This is a large, fat species. The last whorl of the neanic stage is about the youngest one preserved on the present specimens; it carries 7 longitudinal nodes and about 6 primary spiral threads. The transition from the neanic to the adult stage is rather gradual, leaving the first adult whorls with faint primary spirals and in some instances with a poorly developed keel at the edge of the presutural band. The larger whorls are practically smooth, and a large shell has a proportionately greater diameter than a young shell. The columella bears only 3 folds." (Hodson, 1931)

Dimensions of holotype: height 172 mm, diameter 93 mm (not 101 mm, as stated by Hodson).

Holotype: PRI 24148.

Horizon: Springvale Beds, upper Miocene, Trinidad. Rio Seco Formation, Pliocene, Falcón, Venezuela.

Discussion: The locality given by Hodson for *T. riosecana* is approximately 20 km northeast of Urumaco, Falcón, Venezuela. According to Dusenbury *(in litt.)* the species occurs in the Rio Seco Formation of Pliocene age. *T. riosecana* is the third member of the sequence just discussed. The inflation of the shell increases successively from oldest to youngest species, with *T. riosecana* being the most inflated of the three. If this tendency toward increasing "plumpness" represents an "orthogenetic" trend then this line is probably directly ancestral to the Recent *T. laevigata,* the most inflated form of of the sequence.

Maury (1925) reported *Xancus praeovideus {sic}* from the Springvale beds of Trinidad. However the specimen which she figured is much more inflated than *T. praeovoidea* (=*T. praelaevigata,* nom. nov.) and does not seem to be nearly as close to the Santo Domingan species as does the second species that she described at the same time, *Xancus trinitatis.* Rutsch (1942) figured a similar specimen under the name *Xancus trinitatis riosecanus,* recognizing the Trinidad *"praeovoideus"* to be the same as the Venezuelan *X. praeovoideus riosecanus* Hodson. Because the name *T. praeovoidea* (Maury) is preoccupied by that of Vredenburg he placed the subspecies in *T. trinitatis* rather than the Santo Domingan *T. praeovoidea* to which it originally had been referred by Hodson.

TURBINELLA COLINENSIS (H. K. Hodson)

Xancus colinensis H. K. HODSON, 1931, Bulls. Amer. Paleont., v. 16, no. 59, p. 40, pl. 21, fig. 4.

Diagnosis: "This species is small, unless the specimens found as yet are all young, and easily recognized. The shell is slender, noded throughout its length and ornamented with fine spiral lines. The youngest whorls are unknown; the neanic whorls carry 5 nodes (sometimes 6), and about 7 spiral threads. As the shell grows, the spiral threads become more numerous and the longitudinal nodes gradually less prominent, although there is no marked difference or marked boundary between the neanic and adult whorls. The presutural band is flat or only slightly excavated, and the whorls are flat-sided except for the nodes." (Hodson, 1931)

Dimensions of holotype: height 73 mm, diameter 27.7 mm.

Holotype: PRI 24110.

Horizon: La Vela Formation, upper Miocene. Dist. of Colina, Falcón, Venezuela.

Discussion: Once again as in the other Hodson species, the horizon is a matter of guesswork; however, in this case the task is simplified by the fact that the type locality of the species is the same as the type locality of the La Vela Formation of upper Miocene age (Liddle, 1942, p. 496).

This species is undoubtedly described from immature individuals, for the type specimen is very much like the young of *T. regina* of similar size. There are certain observable differences, however, and they are not believed to be identical. The nodes on the neanic whorls of *T. colinensis* are relatively stronger and persist longer than do those of *T. regina.* Although this species occurs in the same stratigraphic position as *T. trinitatus,* it is apparently not just the juvenile form of this species, as might be suspected from first glance. *T. colinensis* may be distinquished by the retention of the early neanic nodes to a later stage of development.

TURBINELLA REGINA Heilprin

Plate III, figures 3a, 3b

Turbinella regina HEILPRIN, 1887, Wagner Free Inst. Sci., Trans., v. 1, p. 74, pl. 3, fig. 5.
Turbinella regina Heilprin. DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 98, pl. 3, fig. 4.
Turbinella regina Heilprin. HUBBARD, 1921, N. Y. Acad. Sci., Sci. Surv. Porto Rico & Virgin Islands, v. 3, pt. 2, p. 154.
Turbinella regina Heilprin. PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 343.
Turbinella regina Heilprin, VREDENBURG, 1923, Geol. Surv. India, Records, v. 55, pt. 2, p. 126.
Xancus wilsoni (Conrad). TUCKER and WILSON, 1933, Bulls. Amer. Paleont., v. 18, no. 66, p. 10 (72), pl. 1 (10), fig. 10. *Not* cf Conrad.
Xancus reginus (Heilprin). GARDNER, 1944, U.S.G.S. Prof. Paper 142-G, p. 439.
Xancus regina (Heilprin). OLSSON and HARBISON, 1953, Acad. Nat. Sci. Phila., Mon. 8, p. 195, pl. 24, fig. 6; pl. 37, fig. 9.
Xancus regina (Heilprin). DUBAR, 1958, Florida Geol. Surv., Bull. 40, p. 190, pl. 10, fig. 9.

Diagnosis: "Shell ovate-oblong, sub-fusiform; spire elevated, gradually tapering, and consisting of from eight to ten volutions; whorls nearly flat, or slightly convex, somewhat angulated above, and only nodulose in the region of the apex; surface covered with revolving raised lines, about five on each whorl below the upper angulation, above which they are less pronounced and more closely placed.

"Body-whorl convex, considerably longer than one-half the length of the shell, and ornamented by numerous raised lines, similar to those found on the other whorls. Toward the base these lines become more crowded, somewhat flexuous and coarse, appearing in the form of paired rugations; suture impressed; aperture elliptical, produced into a straight, but deflected, canal of considerable length.

"Columellar surface covered with a thick deposit of callus, which leaves partially uncovered a long and narrow umbilicus; columellar plaits three, the median one of which is the strongest.

"Length of longest specimen—imperfect below and above, and lacking probably an inch and a half—eleven inches; width across the centre, four inches.

"Caloosahatchie, in the banks below Fort Thompson." (Heilprin, 1887)

Holotype: WFIS 907.

Horizon: Unnamed upper Miocene formation; Caloosahatchee Formation, Pliocene. Florida.

Figured specimens: Fig. 3a, PRI 26912; height 120 mm, diameter 39 mm; locality TU 541. Fig. 3b, PRI 26913; height 40 mm, diameter 14 mm; locality TU 519. Other occurrences: TU locality nos. 79, 200, 202, 203, 283, 520, 523, 529, 532, 535, 539B, 540, 579, 583.

Discussion: This species is widespread in the late Neogene of southern Florida. It first appears in the uppermost Miocene where it is exceedingly common, particularly at one locality near Brighton, on the north side of Lake Okeechobee (TU locality 520). It is possible here to collect the shell by the hundreds, were one so disposed. The species also is not rare in most of the Pliocene Caloosahatchee localities, although nowhere as common as at Brighton. However, at the close of the Pliocene, *T. regina* disappeared from the Florida area. If *T. laevigata* is descended from the Venezuelan sequence as mentioned above, then the *T. regina* line leaves no descendants.

With the large number of specimens available the writer was able to make a study of the range of variation present in this species, with the hope that it might shed some light on other species of *Turbinella.* Fifty adult specimens from various localities in southern Florida were measured for length (approximated to what it should be if the specimen were complete) and diameter. From these measurements the following data were derived.

Average length of 50 specimens: 132 mm.
Average width of 50 specimens: 42 mm.
Length-width ratio of hypothetical "average" shell—3.1/1
Ratio for largest shell measured (length 310 mm)—3.1/1
Ratio for smallest shell measured (length 60 mm)—3.2/1

The range of figures calculated for the length-width ratios of 50 specimens is from 2.6 to 3.6 with 42 of the group falling between 2.8 and 3.3. The largest number fell in the 3.1 to 3.3 range with 33 being in that range.

It was also possible to measure the average diameter of the nuclear shell of both *T. regina* and *T. scolymoides* which often occurs with it. For *T. regina,* 25 specimens measured an average of 3.3 mm in diameter, ranging between 3.0 and 4.0 mm. For *T. scolymoides,* 30 specimens measured an average of 5.7 mm, with the range being 4.5 to 7.0 mm. Thus, it is immediately possible to distinguish the juvenile shells of these two

species solely on the basis of the nuclear diameter.

TURBINELLA LAEVIGATA Anton

Turbinella laevigata ANTON, 1839, Verzeichniss der Conchylien, Halle, p. 71.
Turbinella ovoidea KIENER, 1841, Coquilles Vivantes, v. 6, p. 7, pl. 17, fig. 1.
Turbinella ovoidea Kiener. REEVE, 1847, Conchologia Iconica, v. 4, *Turbinella*, pl. 4, fig. 23.
Turbinella ovoidea Kiener. HEILPRIN, 1887, Wagner Free Inst. Sci., Trans., v. 1, p. 74.
Turbinella ovoidea Kiener. DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 96.
Xancus ovoidea (Kiener). MAURY, 1917, Bulls. Amer. Paleont., v. 5, no. 29, p. 84 (248); MAURY, 1925, *ibid.*, v. 10, no. 42, p. 207 (359); MAURY, 1925, Serv. Geol. Min. Brasil, Mon. 4, p. 152-153.
Turbinella ovoidea Kiener. PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 343 (also as *Xancus ovoideus*).
Turbinella ovoidea Kiener. VREDENBURG, 1923, Geol. Surv. India, Records, v. 55, pt. 2, p. 120 *et seq.*
Xancus laevigatus (Anton). WINCKWORTH, 1939, Malac. Soc. London, Proc., v. 23, p. 347.
Xancus laevigatus (Anton). M. SMITH, 1940, Worldwide Seashells, p. 64, fig. 861.
Xancus laevigatus (Anton). ABBOTT, 1950, Johnsonia, v. 2, no. 28, p. 207, pl. 91, figs. 1, 2.
Xancus laevigatus (Anton). FERREIRA and CUNHA, 1957, Mus. Paraense Emílio Goeldi, Bol.; Geologia No. 4, p. 26.

Diagnosis: "Adult shell varying from 100 to 120 mm in length (4 to 5 inches). Solid and heavy, somewhat turnip-shaped. Whorls 7 to 8, globose, smooth. Color of shell dull white, but often hidden by the moderately thick, brown periostracum. Spire pointed but not high, slightly to moderately concave, with the whorls becoming increasingly more rounded. Suture fairly even, deeply indented. Aperture relatively small, elongate, narrowing posteriorly into a narrow channel and produced anteriorly into a relatively short siphonal canal. Parietal wall, in adults, developed into a small, glazed shield which, at the spire end, possesses a low, rounded, thick callus. Length of last whorl (aperture and siphonal canal) equal to or slightly more than ⅔ that of the entire shell. Outer lip heavy with a fairly sharp edge. Columella possesses on its center three well-developed plicae, the upper two being the largest. They protrude laterally and slightly downward from the columellar wall. Opposite these, and on the inside of the body whorl, there is a raised, spiral, irregular ridge in most specimens. Axial sculpture confined to the earlier whorls and consists of about 6 low, rounded, tubercules. Spiral sculpture consists of about 10 raised, even threads on the top third of each whorl and on the outside of the siphonal canal. Nuclear whorls unknown. Periostracum fairly thick, persistent, light to dark brown. Operculum corneous, heavy, unguiculate, dark brown, 2½ times as long as wide, narrow at each end, and with a very large muscle scar. Animal unknown." (Abbott, 1950)

Holotype: Lost.

Type Locality: Bahia, Brazil (selected by Abbott, 1950, p. 208).

Discussion: Although *T. laevigata* now apparently is restricted to one small area off the northeastern coast of Brazil, it is the only living representative of a group which once flourished from Florida to Venezuela.

T. laevigata has for years been known under a different name, that of *T. ovoidea*

PLATE II

Figures Page

1. *Turbinella chipolana* Dall 58
   a. USNM 111914 (Holotype); height 44 mm, diameter 18 mm (X 1½)
      Locality: USGS 2212. Chipola Formation.
   b. USNM 498892 ("cotype"); height 120 mm, diameter 55.5 mm (X 1)
      Locality: USGS 2212. Chipola Formation.
   c. PRI 26914; height 23 mm, diameter 9.5 mm (X 2)
      Locality: TU 546. Chipola Formation.

2. *Turbinella dalli* E. H. Vokes, n. sp. 59
   a, b. PRI 26918 (Holotype); height 85 mm, diameter 41 mm (X 1)
      Locality: TU 554. Chipola Formation.
   c. PRI 26919 (Paratype); height 22 mm, diameter 11 mm (X 2)
      Locality: TU 547. Chipola Formation.

PLATE II

Kiener. However, Winckworth in 1939 (p. 347) made the statement, "Unfortunately it has an earlier name, *Turbinella laevigata* Anton 1839." Although Winckworth did not document his statement the change in nomenclature has been accepted by subsequent writers and therefore can no longer be dismissed as a *nomen oblitum.* Anton did not refer to any published figure, nor did he give a locality. His description, although it may very well be of *T. ovoidea,* could equally apply to the Indian species. Anton's types are no longer extant so that the actual species to which he referred cannot be determined.

THE *"ANGULATA"* LINEAGE

TURBINELLA CHIPOLANA Dall

Plate II, figures 1a, 1b, 1c

Turbinella chipolana DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 97, pl. 10, fig. 7.

Turbinella chipolana Dall. MAURY, 1902, Bulls. Amer. Paleont., v. 3, no. 15, p. 60 (370).

Turbinella chipolana Dall. HUBBARD, 1921, N. Y. Acad. Sci., Sci. Surv. Porto Rico & Virgin Islands, v. 3, pt. 2, p. 153.

Turbinella chipolana Dall. VREDENBURG, 1923, Geol. Surv. India, Records, v. 55, pt. 2, p. 126.

Xancus chipolanus (Dall). GARDNER, 1944, U.S.G.S. Prof. Paper 142-G, p. 439, pl. 49, fig. 1, (after Dall).

Diagnosis: "This form would at first sight be taken for a variety of *T. wilsoni* with a little shorter spire and more rounded whorls than that species, but a study of a good series shows the following distinctive characters:

"The last whorl is rounded and not with flattened sides and the keel at the shoulder is obsolete; there is no presutural constriction or band; the whorls, except in the earliest on two [*sic*], are not appressed, but distinct or even partially channelled; the space of 20.0 mm from the base of the larval shell forward includes three and a half instead of seven whorls; instead of seven or more ribbed whorls there are but two or three; instead of uniform strong spiral threads as in *T. wilsoni,* the spirals on the early whorls alternate coarse and fine; the whorls are gracefully rounded and not flattened; the diameter of the spire at the anterior end of the larval shell is 4.0 mm, instead of 1.3 mm, the spirals are finer and continue more distinctly over the whorls in the adult; the adult shell has six whorls beside the nucleus, *T. wilsoni* has eleven or more in the same length." (Dall, 1890)

Dimensions of holotype: height 44 mm, diameter 18 mm.

Holotype: USNM 111914.

Horizon: Chipola Formation, uppermost lower Miocene. Florida.

Figured specimens: Fig. 1a, USNM 111914 (holotype); height 44 mm, diameter 18 mm; locality USGS 2212 (= TU 546). Fig. 1b, USNM 498892 ("cotype"); height 120 mm, diameter 55.5 mm; locality USGS 2212. Fig. 1c, PRI 26914; height 23 mm, diameter 9.5 mm; locality TU 546. Other occurrences: TU locality nos. 70, 453, 457, 547.

Discussion: There are three species of *Turbinella* in the Chipola Formation of northwestern Florida. The first described was *T. chipolana,* and because Dall figured only a juvenile specimen, more than a little confusion has resulted. Although the unfigured "cotype" of *T. chipolana* is 120 mm in height and appears to be an adult shell (see Pl. II, fig. 1b), two imperfect specimens have been found (TU loc. 453, 457) which indicate an ultimate height of at least 180 mm.

The affiliations of *T. chipolana* seem to lie with the *"angulata"* line, for it has the very large nucleus of that group. The neanic whorls lose their nodes at an early stage, between the second and third whorl, but the spiral ribbing continues much longer giving the shell a distinctive appearance. Not until almost the seventh post-nuclear whorl is the spiral ornamentation lost, and even then it persists on the pillar. The shoulder becomes obscurely noded in the adult shell and the outer lip flares up at the suture to form a thickened anal notch. The inner lip bears a heavy free-standing callus. The resemblance of *T. chipolana* to *T. dodonaia* has been discussed under that species and it was observed that the juvenile shells of the two species are readily separable. It is less easy, however, to distinguish the juvenile shells of *T. dalli,* n. sp., from those of *T. chipolana,* for the nuclei of both are approximately 4 mm in diameter. However, the young shell of *T. dalli* is much more strongly noded than *T. chipolana* and is more abruptly constricted into the pillar in the manner of the young of *T. scolymoides.* The adult shell of *T. dalli* has a much lower spire than *T. chipolana* and a relatively more inflated body whorl.

TURBINELLA DALLI E. H. Vokes, n. sp.
Plate II, figures 2a, 2b, 2c

Turbinella polygonata Heilprin. DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 97 (in part).

Xancus polygonatus Heilprin. DALL, 1915, U. S. Natl. Mus. Bull. 90, p. 63 (in part).

Xancus sp. GARDNER, 1944, U.S.G.S. Prof. Paper 142-G, p. 440.

Diagnosis: Shell moderately large and heavy, body whorl inflated. Seven to eight post-nuclear whorls in the adult, plus three nuclear whorls. The nucleus consists of smooth, equi-diameter whorls which form a cylindrical protoconch, approximately 4 mm in diameter. The neanic whorls are strongly sculptured with about eight nodes. On the post-neanic whorls these nodes degenerate into tubercles at the shoulder, with about 12 of these ill-defined protuberances on the body whorl. Spiral ornamentation on the neanic whorls consists of approximately nine raised threads, which gradually die out, until the later whorls are very nearly smooth except on the pillar, where the sculpture consists of alternating strong and weak cords, perhaps a dozen of each. The pillar is broad, almost straight, with a slight anterior fasciole. Parietal wall lightly glazed with a callus wash, the columella bearing three plications of equal strength.

Dimensions of holotype: height 85 mm (lacking about 7 mm of nucleus and early neanic whorls); diameter 41 mm.

Holotype: PRI 26918; paratype: PRI 26919.

Type locality: TU 554, East bank of Chipola River, at power line crossing (SW ¼ Sec. 17, T1N, R9W), Calhoun County, Florida.

Horizon: Chipola Formation, uppermost lower Miocene. Florida.

Figured specimens: Fig. 2a, 2b, PRI 26918 (holotype); height 85 mm, diameter 41 mm; locality TU 554. Fig. 2c, PRI 26919 (paratype); height 22 mm, diameter 11 mm; locality TU 547.

Discussion: T. dalli is rare in the Chipola Formation, the few specimens found have been assigned to *T. polygonata.* Gardner discussed this species, stating: "There is another species at Alum Bluff, too imperfect to name but represented, possibly, by very young shells and by decorticated fragments of adults that must have attained a height of at least 200 millimeters. The fragments referred by Dall to the Tampa species, *Turbinella polygonata* Heilprin, are doubtless referable to this undescribed form." (1944, p. 440). Specimens from Alum Bluff are poorly preserved as the outgrop usually is below water. However, one good specimen of this species has been collected on the Chipola River. This specimen is not an adult but is sufficiently "mature" so that its selection as type is justified. The maximum size this species attains is not known, but Gardner suggested that the species reaches 200 mm (see above quote).

The juvenile shell of *T. dalli* may be distinguished from the similar shell of *T. chipolana,* with which it occurs, by the stronger nodes on the neanic whorls of *T. dalli,* and the more inflated appearance of the shell. The adult shell is distinguishable from both *T. chipolana* and *T. dodonaia* by its very much lower spire. In addition the neanic whorls are strongly noded to a later stage than is *T. chipolana.* These nodes gradually pass into tubercles at the shoulder of the adult whorl and are never completely lost. This new species is probably ancestral to the Pliocene form *T. scolymoides* as the juvenile shells are very similar.

Although referred to *T. polygonata* by Dall, the shells of *T. dalli* differ from that species not only in the early development but have a more sloping shoulder, a more inflated body whorl, and a much lower spire.

TURBINELLA BRASILIANA (Maury)

Xancus brasilianus MAURY, 1925, Ser. Geol. Min. Brasil, Mon. 4, p. 154-155, pl. 7, fig. 3.

Xancus brasilianus Maury, WOODRING, 1928, Carnegie Inst. Washington, Publ. 385, p. 252.

Xancus brasilianus Maury. FERREIRA and CUNHA, 1957, Mus. Paraense Emílio Goeldi, Bol.; Geologia No. 2, p. 35.

Diagnosis: "Shell with the early whorls very finely striated with threads alternating in thickness, and corrugated with rounded, irregularly undulating, longitudinal ribs. Later whorls not excavated posteriorly, but evenly rounded. Last whorl convex, not angulated as in the preceding species [*T. grata*]. Columella with three distinct folds, which appear on the mold as strong, deep transverse grooves. Length of shell 70 mm, width 24 mm. The specimen is probably a young shell." (Maury, 1925)

Holotype: DGM 570.

Horizon: Pirabas Limestone, uppermost lower Miocene. Pará, Brazil.

Discussion: This species is based on an immature specimen of a species of the *"angulata"* line. It is similar to the young of both *T. textilis* and *T. scolymoides,* but is sufficiently different from each to be con-

sidered as a distinct species. The Pirabas Limestone was correlated with the Chipola Formation by Maury (1925, p. 139); however, *T. brasiliana* is dissimilar to *T. chipolana* and *T. dalli,* n. sp., the *"angulata"* representatives in those beds, so the exact affiliations are uncertain.

TURBINELLA TEXTILIS (Guppy)

Fasciolaria textilis GUPPY, 1873, Proc. Sci. Assoc. Trinidad, v. 2, p. 80 (*ex* Harris reprint: Bulls. Amer. Paleont., 1921, v. 8, no. 35, p. 64 (212).); GUPPY, 1874, Geol. Mag. (decade 2) v. 1, p. 410, pl. 16, fig. 5; p. 438.
Turbinella textilis (Guppy). DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 99; DALL, 1903, *ibid.*, pt. 6, p. 1583.
Xancus textilis jamaicensis PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 307, 343, pl. 25, figs. 5, 6.
Turbinella textilis (Guppy). VREDENBURG, 1923, Geol. Surv. India, Records, v. 55, pt. 2, p. 126.
Xancus textilis (Guppy). WOODRING, 1928, Carnegie Inst. Washington, Pub. 385, p. 250, pl. 15, fig. 3 (Holotype).
Xancus textilis jamaicensis "Pilsbry and Johnson." FERREIRA and CUNHA, 1957, Mus. Paraense Emílio Goeldi, Bol.; Geologia No. 2, p. 35.

Diagnosis: "Elongate, fusiform, closely cancellated by numerous spiral ridges from 1 to 2 mm distant between which are (especially anteriorly) one, two, or three finer threadlike ribs; and by numerous closer and smaller longitudinal lines. Whorls 6, the first two of which are smooth, the apex deciduous and usually wanting, the last more than two-thirds of the shell, rather ventricose above the middle, produced and rather attenuated anteriorly; bearing on the upper half 5-7 elongate rounded tubercular prominences. Columella margin with three strong tooth-like plaits. — Interior of peristome smooth. Length nearly 70 mm breadth 30." (Guppy, 1873)

Holotype: USNM 115482.

Horizon: Bowden Formation, middle Miocene. Jamaica.

Discussion: Originally assigned to the genus *Fasciolaria* by Guppy, this species was based on an immature specimen. The adult form later was named *Xancus textilis jamaicensis* by Pilsbry (1922). Pilsbry gave no reason for assigning the subspecific designation, and Woodring subsequently placed the two forms in synonymy. This species apparently is rare and Woodring (1928, p. 251) stated, "Not more than three specimens are in any collection." He also added that none of the specimens are mature except the holotype of *T. jamaicensis,* which shows that "on the later whorls of adult shells the axial and spiral sculpture is somewhat suppressed, and it also shows that the later whorls have an axially wrinkled concave area adjoining the suture." According to Woodring, "the most striking feature of this species is the very large nucleus," which suggests a close relationship with the Florida species *T. scolymoides* also characterized by an exceedingly large nucleus. *T. scolymoides* differs from *T. textilis* in lacking the pronounced sutural concavity of that species.

TURBINELLA MAGDALENENSIS (Weisbord)

Xancus magdalenensis WEISBORD, 1929, Bulls. Amer. Paleont., v. 14, no. 54, p. 46 (278), pl. 7 (42), fig. 1.

Diagnosis: "Shell ponderous, solid and heavy; spire with 9 or 10 whorls when complete. Earlier whorls with about 6 wide rounded costae at about the middle. These costae later develop into [five] large protruding rather pointed knobs. The whorls are sculptured with fairly strong revolving lirae and intercalary finer threads. On the later whorls, transverse growth lines become numerous and give a reticulate pattern to them. Sutures narrow, well incised. Body whorl nearly smooth above, but ornamented below with alternating stronger and finer revolving lines, crossed by fine transverse growth striae. There are three strong columellar plaits, the anterior one slightly sulcate. Below this there is another weak fold. Umbilicus narrow and deep. Anterior canal long and narrow.

"Dimensions: Alt. (when whole) 190 mm; Approximate width 93 mm." (Weisbord, 1929)

Holotype: PRI 22956.

Horizon: Tuberá Group, middle Miocene. Dept. of Atlantico, Colombia.

Discussion: T. magdalenensis is strikingly similar to the Recent *T. angulata.* It differs primarily in having only five axial nodes on each whorl in contrast to the six nodes characteristic of *T. angulata.* In addition the nodes are developed at an earlier age, so that the overall aspect of the shell of *T. magdalenensis* is more nodose. The suture of *T. magdalenensis* is distinctly incised, while that of *T. angulata* is rather markedly appressed.

This species occurs in the Tuberá Group which is correlated with the Gatun Formation of Panama. *T. magdalenensis* is closely akin to another middle Miocene species, *T. scopula* Olsson, described from the Gatun

Formation of Costa Rica. The latter is an extremely coronate form which bears seven, high, rounded axial nodes.

TURBINELLA SCOPULA (Olsson)

Xancus scopulus OLSSON, 1922, Bulls. Amer. Paleont., v. 9, no. 39, p. 111 (283), pl. 11 (14), fig. 1.

Xancus scopulus Olsson. WOODRING, 1928, Carnegie Inst. Washington, Publ. 385, p. 252.

Xancus scopulus Olsson. WEISBORD, 1929, Bulls. Amer. Paleont., v. 14, no. 54, p. 47 (279).

Diagnosis: "Shell large, solid and heavy; spire nearly as long as the aperture; spire-whorls 6 plus (the tip broken), strongly coronate above and with large, wide, persistant ribs; the earlier spire-whorls are simply shouldered or angled about the middle, but the area about the upper sutures rapidly deepens and on the later whorls is a deep, excavated sutural zone, above which project the ends of the ribs; there is a strong sutural cord and a rather wide, ribbon-like band just above, forming at first a strongly appressed suture; the last whorl has about 7 large, wide ribs, the areas between appearing as troughs or depressions; the sutural excavated zone carries several irregular spiral threads which are crossed by large growth-lines so that the resulting sculpture is more or less cancellate, more particularly on the earlier whorls; the growth-lines cross the sutural cord and upon the ribbon above, become much crowded and strongly bent forwards; the young shell was sculptured over the whole shell with strong spirals, but with maturity, the spirals become obsolete and the shell is smooth and polished; columella with 3, strong plicae as in the recent *scolymus;* a long anterior canal, with a narrow, deep umbilicus behind the spreading inner lip.

"Height 265, diameter 136, aperture 158, last whorl 195 mm." (Olsson, 1922)

Holotype: PRI 21071.

Horizon: Gatun Formation, middle Miocene. Costa Rica.

Discussion: T. scopula represents an extreme development of the *"angulata"* stock in which the axial nodes are very high and projecting. The shoulder is wide and deeply excavated with the tops of the nodes level with the suture. *T. magdalenensis* from the middle Miocene of Colombia is much like this species and may represent only a local variant. Both are very close to the Recent *T. angulata,* closer in fact than the Pliocene species, *T. scolymoides,* which is presumed to be immediately ancestral to *T. angulata.*

TURBINELLA SCOLYMOIDES Dall

Plate III, figures 1a, 1b

Turbinella scolymoides DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 98, pl. 3, figs. 2, 5; DALL, 1892, *ibid.,* pt. 2, p. 229.

Turbinella scolymoides Dall. PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 343.

Turbinella scolymoides Dall. VREDENBURG, 1923, Geol. Surv. India, Records, v. 55, pt. 2, p. 127.

Xancus scolymoides (Dall). DUBAR, 1958, Florida Geol. Surv., Bull. 40, p. 190.

Diagnosis: "Shell much resembling the recent *T. scolymus* L., especially when young, but having a more elongated and acute spire and canal, with two more whorls to the same diameter in the young shell; it is more globose, smooth and less ribbed on the body-whorl and with a proportionally shorter canal in the adult. Whorls ten or eleven without the nucleus, from which the protoconch has in all the specimens been lost during the life of the animal.

"The larval shell without the protoconch appears to have had not to exceed one short whorl with incremental striae, but it is, in the absence of a complete specimen, unsafe to form a conclusive opinion on the point. The minute sculpture of the young is exactly like that of *T. scolymus,* but in the adult the fine sculpture and ribbing are obsolete and the body-whorl is inflated and nearly smooth. The pillar is straight, short, with a deep umbilical foramen, the whole shell is thin and light, considering its size. The suture is distinct and lies on a thin band of callus, in the last whorl, which extends a little behind the suture. The adult figured is 231 x 140 mm, but when perfect was about 260 mm in length." (Dall, 1890)

Holotype: USNM 111924.

Horizon: Caloosahatchee Formation, Pliocene; unnamed post-Caloosahatchee formation, Pleistocene. Florida.

Figured specimens: Fig. 1a, PRI 26915; height 108 mm, diameter 45 mm; locality TU 202. Fig. 1b, PRI 26916; height 32 mm, diameter 14 mm; locality TU 580. Other occurrences: TU locality nos. 79, 201, 519, 527, 529, 532, 536, 539B, 541, 579, 583, 584.

Discussion: While generally occurring in the same beds as *T. regina* Heilprin, *T. scolymoides* is the less common species. It is not certain that *T. scolymoides* ranges into the uppermost Miocene, for the boundary between these beds and the Pliocene Caloosahatchee Formation is almost impossible to ascertain. There are a number of localities that are believed to be Miocene in which only *T. regina* occurs (*e.g.,* TU localities 283, 520, 535), however there are also other localities which also may be Miocene in

which both species are found. More stratigraphic work must be done before the absolute range of *T. scolymoides* is established.

It is equally difficult to determine the upper limit, for it is possible that the *scolymoides* form still lives today. Abbott (1950, pl. 90, fig. 3) figured a Recent specimen of *T. angulata* which is exceedingly close to *T. scolymoides* and he said (p. 204): "The spiral threads on the whorls are prominent in some shells [of *T. angulata*]." The writer has collected Recent specimens off the coast of Campeche, Mexico, which seem identical with *T. scolymoides.* This form occurs with the true *T. angulata* and probably is, as Abbott treated it, only a variant of *T. angulata;* however, it may be a different species, the descendant of the Pliocene *T. scolymoides. T. scolymoides* certainly survived to the Pleistocene (TU localities 201, 580) in southern Florida and there is no reason to believe that it is now extinct. The typical smooth *T. angulata* resembles more closely the middle Miocene species, *T. magdalenensis* and *T. scopula,* than it does the Pliocene *T. scolymoides.* It gives cause to wonder whether the ancestry of *T. angulata* is not more directly linked to these South and Central American species than to the Florida one. *T. angulata* and *T. scolymoides* occur together at one Florida Pliocene locality (TU 519) and it may be that this marks an invasion by the new species from a more southern point of origin rather than the appearance of a new "mutation."

The embryonic shell of *T. scolymoides* is strikingly large and a juvenile specimen may be distinguished from a comparable shell of *T. regina* at a glance, as discussed under that species. Although the type specimen is a large shell, most specimens collected are smaller. A length of 200 mm is rare, the usual size being about 100 mm. However, one specimen in the collection of the Paleontological Research Institution measures almost 400 mm. Because of the preponderance of smaller specimens it has been said to be distinguished from *T. regina* by its smaller size. This is not entirely accurate, but is a good generalization. A far greater number of specimens of *T. regina* attain a larger size.

TURBINELLA ANGULATA (Solander *in* Lightfoot)

Plate III, figures 2a, 2b

Voluta angulata SOLANDER *in* LIGHTFOOT, 1786, Portland Catalogue, p. 76.
Murex scolymus GMELIN, 1791, Systema Naturae, ed. 13, v. 1, pt. 6, p. 3553.
Turbinella scolymus (Gmelin). LAMARCK, 1816, Tableau Encyclop. et Méth., pl. 431b, figs. 2a, 2b.
Turbinella scolyma (Gmelin). REEVE, 1847,

PLATE III

Figures Page

1. *Turbinella scolymoides* Dall 61
   a. PRI 26915; height 108 mm, diameter 45 mm (X 1)
      Locality: TU 202. Caloosahatchee Formation.
   b. PRI 26916; height 32 mm, diameter 14 mm (X 2)
      Locality: TU 580. Unnamed post-Caloosahatchee Formation.

2. *Turbinella angulata* (Solander *in* Lightfoot) 62
   a. PRI 26917; height 107.5 mm, diameter 46.5 mm (X 1)
      Locality: TU 519. Caloosahatchee Formation.
   b. PRI 26917a; height 32 mm, diameter 15 mm (X 2)
      Locality: TU 519. Caloosahatchee Formation.

3. *Turbinella regina* Heilprin 55
   a. PRI 26912; height 120 mm, diameter 39 mm (X 1)
      Locality: TU 541. Unnamed upper Miocene formation.
   b. PRI 26913; height 40 mm, diameter 14 mm (X 2)
      Locality: TU 519. Caloosahatchee Formation

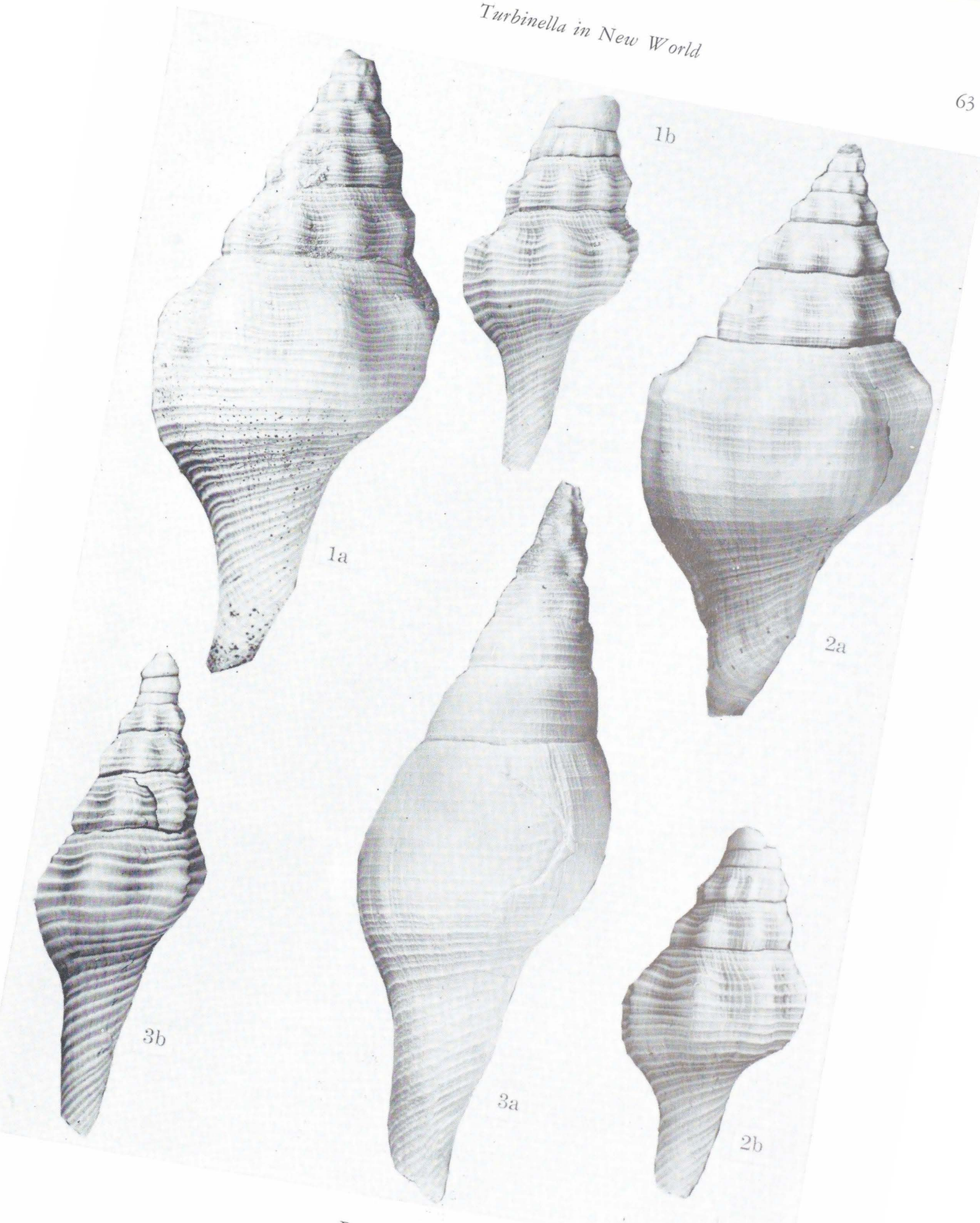


PLATE III

Conchologia Iconica, v. 4, *Turbinella*, pl. 1, fig. 4.

Turbinella scolymus (Gmelin). HEILPRIN, 1887, Wagner Free Inst. Sci., Trans., v. 1, p. 74.

Turbinella scolymus (Gmelin). DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 96.

Xancus scolymus (Gmelin). PILSBRY and JOHNSON, 1917, Acad. Nat. Sci. Phila., Proc., v. 69, p. 167.

Xancus scolymus (Gmelin). MAURY, 1917, Bulls. Amer. Paleont., v. 5, no. 29, p. 83 (247); MAURY, 1925, Serv. Geol. Min. Brasil, Mon. 4, p. 152-153.

Xancus scolymus (Gmelin). OLSSON, 1922, Bulls. Amer. Paleont., v. 9, no. 39, p. 111 (283).

Turbinella scolymus (Gmelin). VREDENBURG, 1923, Geol. Surv. India, Records, v. 55, pt. 2, p. 127.

Xancus scolymus (Gmelin). WOODRING, 1928, Carnegie Inst. Washington, Publ. 385, p. 251.

Xancus scolymus (Gmelin). WEISBORD, 1929, Bulls. Amer. Paleont., v. 14, no. 54, p. 47 (279).

Xancus angulatus (Solander). M. SMITH, 1940, Worldwide Seashells, p. 64, fig. 859.

Xancus angulatus (Solander). ABBOTT, 1950, Johnsonia, v. 2, no. 28, p. 204, pl. 90, figs. 1-3.

Xancus angulatus (Solander). ABBOTT, 1955, American Seashells, p. 244.

Diagnosis: "Adult shell varying from 180 to 360 mm in length (7 to 14 inches). Solid, heavy, and fusiform in shape. Whorls 8 to 11, angulate at the shoulder and with prominent blunt tubercles at the top of the whorl. Color of shell cream-white, but often hidden by the thick, light-brown periostracum. Spire pointed, flat-sided, and of an angle of 50 to 60 degrees. Suture prominent, wavy, well-indented. Aperture large, elongate, with a porcelaneous finish and colored either a yellowish-white, pinkish-cream or a deep, brownish-orange. Parietal wall in adults developed into a thick, oval shield which has a glossy finish and is often more richly colored than the aperture. The shield continues anteriorly into the long, open siphonal canal. The length of the last whorl (aperture and siphonal canal) is generally ⅔ of the length of the entire shell. Outer lip strong, sharp, and often slightly crenulated at the edge on the lower third. Columella bears 3 strong, widely-spaced, rounded plicae or plaits which run back into the shell. They are situated opposite the widest part of the aperture and appear to be almost on a plane vertical to the axis of the shell. There is a thickened, spiral, indistinct, and sometimes absent, ridge on the center of the body whorl inside the aperture. This often accompanies a spiral, light color-streak on the outside of the shell. Umbilicus irregularly formed, deep, slit-like. Axial sculpture consists of 6 to 8 prominent, blunt tubercles on the top of each whorl. Spiral sculpture consists of numerous, small, raised threads which are coarsely beaded by the interruption of the fine axial threads. These spiral threads are usually absent on the center of the body whorl. Nucleus large, bulbous and rather smooth. Periostracum thick, persistent, light-brown in color. Operculum horny, hard, unguiculate, dark-brown, 2½ times long as wide, narrow at each end, and with a very large muscle scar. Animal unknown." (Abbott, 1950)

Holotype: Lost. "Type figure": Martini, 1780, Conchyl.-Cab. (1), v. 4, fig. 1325 (selected by Abbott, 1950, p. 205).

Type locality: "Island of Providence" (Lightfoot, 1786, p. 16); Nassau, New Providence Island, Bahamas (Abbott, *ibid.*, p. 206).

Figured specimens: Fig. 2a, PRI 26917; height 107.5 mm, diameter 46.5 mm; locality TU 519. Fig. 2b, PRI 26917a; height 32 mm, diameter 15 mm; locality TU 519.

Discussion: This common Caribbean species appears in most of the literature as *Turbinella scolymus* (Gmelin). However *Voluta angulata* of the Portland Catalogue (1786) was based on the same figure as Gmelin's *Murex scolymus* and the older name has begun to become recognized. The Portland Catalogue was published anonymously, however, Dance (1962) proved the author to be Dr. John Lightfoot.

Turbinella angulata is a shallow water species, reported from intertidal flats by Abbott (1950, p. 202), and dredged from 14 to 20 fathoms (Springer and Bullis, 1956). It ranges from the Bahamas to Colombia. Large specimens may attain a length of almost 400 mm, although the average size is about 200 mm.

V. LOCALITY DATA

70. Chipola Fm., Ten Mile Creek, at bridge of Florida Highway 73 (NW¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.
79. Caloosahatchee Fm., Ortona Locks, Caloosahatchee River, Glades Co., Florida.
91. Oak Grove Sand, type locality, west bank of Yellow River, about 100 yards below bridge at Oak Grove, Okaloosa Co., Florida.
200. Unnamed Miocene formation, marl pits south of Acline, Charlotte Co., Florida.
201. Unnamed post-Caloosahatchee formation, spoil banks, two miles south of Belle Glade, Palm Beach Co., Florida.
202. Caloosahatchee Fm., south bank of Caloosahatchee River, about two miles west of La Belle, Hendry Co., Florida.
203. Caloosahatchee Fm., north bank of Caloosahatchee River, about two miles east of Fort Denaud, Hendry Co., Florida.

283. Unnamed Miocene formation, 1.3 miles south of Murdock on Florida Highway 771, Charlotte Co., Florida.
334. Byram Marl, east side of U. S. Highway 61, about 1½ miles north of Vicksburg Natl. Military Cemetery, Vicksburg, Mississippi.
453. Chipola Fm., Alum Bluff, Apalachicola River (SE¼ Sec. 24, T1N, R8W), Liberty Co., Florida.
457. Chipola Fm., west bank of Chipola River (SW¼ Sec. 17, T1N, R9W), Calhoun Co., Florida. (Same as USGS 2213, "One mile below Bailey's Ferry.")
458. Chipola Fm., east bank of Chipola River, above Farley Creek, (Center Sec. 20, T1N, R9W), Calhoun Co., Florida.
459. Chipola Fm., east bank of Chipola River (NW¼ Sec. 29, T1N, R9W), Calhoun County, Florida.
519. Caloosahatchee Fm., Harney Pond Canal spoil banks, northwest side of Lake Okeechobee, Glades Co., Florida.
520. Unnamed Miocene formation, spoil banks, canal ⅓ mile east of Brighton, Highlands Co., Florida.
523. Caloosahatchee Fm., Harney Pond Canal spoil banks, six miles north of Florida Highway 78, Brighton Indian Reservation, Glades Co., Florida.
527. Caloosahatchee Fm., Pumping station 127, north shore Lake Okeechobee, Glades Co., Florida.
529. Caloosahatchee Fm., north bank of Caloosahatchee River, about three miles west of La Belle, Hendry Co., Florida.
532. ? Caloosahatchee Fm., spoil banks, canal (Center Sec. 24, T40S, R22E) southeast of Murdock, Charlotte Co., Florida.
535. Unnamed Miocene formation, Indian Prairie Canal spoil banks, at crossing of Florida Highway 78, Glades Co., Florida.
536. Caloosahatchee Fm., south bank of Caloosahatchee River, about one mile upstream from La Belle, Hendry Co., Florida.
539B. Caloosahatchee Fm., Shell Creek (Dall's locality), lower beds. About eight miles east of Cleveland, Charlotte Co., Florida.
540. Caloosahatchee Fm., Miami Canal spoil banks, one to three miles south of pumping station at Palm Beach county line, Broward Co., Florida.
541. Caloosahatchee Fm., spoil banks, Miami Canal, two miles north of pumping station at Broward county line, Palm Beach Co., Florida.
546. Chipola Fm., Ten Mile Creek, about 1 mile west of Chipola River (NE¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.
547. Chipola Fm., west bank of Chipola River (SW¼ Sec. 29, T1N, R9W), Calhoun Co., Florida.
548. Chipola Fm., west bank of Chipola River (NW¼ Sec. 29, TIN, R9W), Calhoun Co., Florida.
549. Chipola Fm., east bank of Chipola River, about ½ mile below Four Mile Creek (NE¼ Sec. 32, T1N, R9W), Calhoun Co., Florida.
554. Chipola Fm., east bank of Chipola River, at power line crossing (SW¼ Sec. 17, T1N, R9W), Calhoun Co., Florida.
579. Caloosahatchee Fm., Miami Canal spoil banks, four miles north of pumping station at Broward County line, Palm Beach Co., Florida.
580. Unnamed post-Caloosahatchee formation, spoil banks, North New River Canal, one mile south of South Bay, Palm Beach Co., Florida.
583. Caloosahatchee Fm., Miami Canal spoil banks, seven miles north of pumping station at Broward County line, Palm Beach Co., Florida.
584. Unnamed post-Caloosahatchee formation, spoil banks, St. Lucie Canal, at Port Mayaca, Martin Co., Florida.
USGS 2212. Chipola Fm., Ten Mile Creek, one mile west of "Bailey's Ferry" on the Chipola River, Calhoun Co., Florida. (= TU 546)

VI. Literature Cited

Abbott, R. T., 1950, The genera *Xancus* and *Vasum* in the western Atlantic: Johnsonia, v. 2, no. 28, p. 201-219, pls. 89-95.

Blake, J. F., 1902, List of the types and figured specimens recognized by C. D. Sherborn, F.G.S., in the collection of the Geological Society of London: Geol. Soc. London, 100 p. + appendix xxxii p.

Brann, D. C. and L. S. Kent, 1960, Catalogue of the type and figured specimens in the Paleontological Research Institution: Bulls. Amer. Paleont., v. 40, no. 184, 996 p., 1 pl.

Dance, Peter, 1962, The authorship of the Portland Catalogue (1786): Jour. Soc. Biblio. Nat. Hist., v. 4 (1) p. 30-34.

Gardner, Julia, 1944, The molluscan fauna of the Alum Bluff Group of Florida, Pt. 7: Stenoglossa (in part): U.S.G.S. Prof. Paper 142-G, p. 437-491, pls. 49-51.

Hodson, Floyd, and H. K. Hodson, 1931, Some Venezuelan mollusks, Pt. 1: Bulls. Amer. Paleont., v. 16, no. 59, p. 1-94, pls. 1-24; Pt. 2: *ibid*, v. 16, no. 60, p. 95-132, pls. 25-36.

Hornell, James, 1916, The Indian varieties and races of the genus *Turbinella:* Indian Museum, Mem., v. 6, no. 2, p. 109-122, pls. 10-12.

Liddle, R. A., 1946, The geology of Venezuela and Trinidad, Second edition: Paleont. Research Inst., Ithaca, N. Y., 890 p., 90 pls., 27 figs., map.

[Lightfoot, John], 1786, A catalogue of the Portland Museum: Privately printed, London, 194 p.

Mansfield, W. C., 1937, Mollusks of the Tampa and Suwannee Limestones of Florida: Florida Geol. Surv., Bull. 15, 334 p., pls. A-D, 1-21, figs. 1-2, tables 1-2.

Maury, C. J., 1917, Santo Domingo type sections and fossils, Pt. 1: Mollusca: Bulls. Amer. Paleont., v. 5, no. 29, p. 165-

415, pls. 29-65, map; Pt. 2: Stratigraphy: *ibid.*, v. 5, no. 30, p. 416-478, correlation chart.

MAURY, C. J., 1919, A proposal of two new Miocene formational names: Science, (N.S.) v. 50, no. 1304, p. 591.

MAURY, C. J., 1925, Fosseis Terciarios do Brasil: Serv. Geol. Min. Brasil., Mon. 4, 665 p., 24 pls.

MOORE, E. J., 1962, Conrad's Cenozoic fossil marine mollusk type specimens at the Academy of Natural Sciences of Philadelphia: Acad. Nat. Sci. Phila., Proc., v. 114, no. 2, 23-120, pls. 1-2.

OLSSON, A. A., 1930, Contributions to the paleontology of northern Peru, part 3: Eocene mollusca: Bulls. Amer. Paleont., v. 17, no. 62, p. 1-96, pls. 1-12.

PILSBRY, H. A., 1922, Revision of W. M. Gabb's Tertiary Mollusca of Santo Domingo: Acad. Nat. Sci. Phila., Proc., v. 73, p. 305-435, pls. 16-47.

RUTSCH, R. F., 1942, Die Mollusken der Springvale-Schichten (Obermiocaen) von Trinidad (British - West - Indien): Verhand. Naturforsch. Gesell., Basel, v. 54, p. 96-182, pls. 3-9, 2 text-figures.

SPRINGER, STEWART and H. R. BULLIS, JR., 1956, Collections by the *Oregon* in the Gulf of Mexico: U. S. Fish and Wildlife Serv., Spec. Sci. Rept., — Fisheries No. 196, 134 p.

STAINFORTH, R. M., 1955, Ages of Tertiary formations in northwest Peru: Amer. Assoc. Pet. Geol., Bull., v. 39, no. 10, p. 2068-2077.

VREDENBURG, E. W., 1916, Note on the geological history of *Turbinella* in India: Indian Museum, Mem., v. 6, no. 2, p. 123-125.

VREDENBURG, E. W., 1923, On the phylogeny of some Turbinellidae: Geol. Surv. India, Records, v. 55, p. 2, p. 119-132, pl. 19.

WINCKWORTH, RONALD, 1939, On the species of *Xancus* or *Turbinella:* Malac. Soc. London, Proc., v. 23, no. 6, p. 345-347.

WOODRING, W. P., 1928, Miocene mollusks from Bowden, Jamaica, Pt. 2: Gastropods and discussion of results: Carnegie Inst. Washington, Publ. 385, 564 p., 40 pls.

VII. APPENDIX I

Nomenclatorial note on the name *Turbinella* Lamarck

The name *Turbinella* Lamarck, 1799, was for many years considered the proper taxon for the genus typified by *Voluta pyrum* Linnaeus. However, there is an older name, *Xancus* Röding, 1798, based on the same species. This older name appears in the *Museum Boltenianum,* an account of the arrangement of the "cabinet" of shells of J. F. Bolten, of Hamburg. This system was published posthumously by his family with the assistance of a friend, Peter Friedrich Röding, who supplied references to the Gmelin edition of the *Systema Naturae* of Linnaeus and also to figures in the various iconographies, especially the *Conchylien-Cabinet* of Martini and Chemnitz. This publication, although exceedingly well done for its time, was relatively obscure until the beginning of this century. It was not, however, completely unknown to conchologists, for Mörch and H. & A. Adams cited "Bolten" names, but the influence of the Lamarck followers was such that, in general, the work was ignored. As nomenclature became increasingly sophisticated, a need for rules of priority became necessary. With the recognition that the taxa in the *Museum Boltenianum* were indeed the first binomial names applied to the species cited, the importance of this work could no longer be ignored by systematists. Therefore in 1906 a facsimile reprint was published by Sherborn and Sykes, and, reluctantly, the names of both genera and species cited therein began to replace the better known later ones. Dall was a particular advocate of the Röding names, in 1906 having given a review of the generic names of "Bolten" and assigned type species to the genera not already provided with same. In 1915 he further provided an Index to the "multitude of names contained in this small volume" in order to provide systematic workers in Mollusca "with some easy and feasible method of detecting them."

In the ensuing years there was much verbal sharpshooting by foes of the Röding names. In the case of *Xancus-Turbinella,* for example, Vredenburg (1923, p. 119) expressed a typical sentiment of the time, stating: "Commonsense refuses to submit to such an absurdity as *Xancus* Bolten. I cannot accept any of the Bolten nomenclature, the adoption of which would reflect discredit on the genius of Lamarck." Pilsbry, one of the staunchest anti-Boltenists proclaimed: "The replacement of the name *Turbinella* by *Xancus* is one of the outrages against scientific nomenclature consequent upon the adoption of Bolten's *Museum* as a source of generic and specific names." (1922, p. 342).

Many zoologists simply refused to accept the names, declaring that the work was only a "sales catalogue" and as such was not a "publication" under the International Rules of Zoological Nomenclature. The question

of the status of the *Museum Boltenianum* was finally placed before the International Commission on Zoological Nomenclature and in Opinion 96 (1926, p. 16-18) that body observed that the work "bears all the earmarks of a carefully prepared manuscript intended to be printed as a permanent record with only incidental reference to sale," and ruled that it was "nomenclatorially available under the International Rules."

The opponents of the *Museum Boltenianum* may have been down, but they were not out. One in particular, Joshua L. Baily, Jr., ultimately applied to the Commission to use its Plenary Powers to reject the name *Xancus* and reestablish *Turbinella.* Why Baily should have been concerned in the least with this special taxonomic controversy is somewhat of a mystery to this writer, as Baily lists himself as a specialist in the field of fresh-water Mollusca of the western United States (Blackwelder, 1961). His petition appeared in the Bulletin of Zoological Nomenclature (1956) and comments upon its worth were solicited by the Commission. In reply the Commission received comments (see Opinion 489, 1957) approving the action from four persons: a specialist in fish, a botanist, a specialist in land snails, and finally one from a marine conchologist. In addition there was one letter of support from the Royal Anthropological Institute of Great Britain and Ireland stating that the name *Turbinella* was preferred by that group. Objections were received from seven persons: among them R. Tucker Abbott, Myra Keen, and Harold A. Rehder, probably the three leading marine malacologists in the United States. One letter of opposition from A. N. Dusenbury, a paleontologist in Venezuela, was received too late for consideration. These letters of opposition carefully documented the usage of *Xancus* and *Turbinella* in the recent literature. Abbott stated that, "Of twelve popular identification books on mollusks published in the last fifteen years, eleven use *Xancus,* one used *Turbinella.* The scientific literature is almost unanimous in its use of *Xancus.* . . . A perusal of the Zoological Record shows that the vast majority of workers in the last fifteen years have been using *Xancus.*" Keen adds: "The name *Xancus* has almost without exception been adopted in scientific literature and by museums since 1927." Dusenbury had the most cogent point to make, however, saying that had the proposal been made in 1926 when the *Museum Boltenianum* was declared available there would have been no objections, but "in the thirty years which have elapsed since 1926, *Xancus* [Röding] and the family XANCIDAE are names which have become deeply rooted in paleontological and conchological literature. . . . Dr. Baily's proposal would penalize those authors who have followed the *Règles* and favor those who have neglected them."

In spite of the strong support given to the continuation of the usage of the name *Xancus,* the Commission voted 18 for suppression, and six against (Opinion 489, 1957). Presumably the non-zoological support from the anthropologists was a contributing factor in their decision, but the resulting confusion has not excluded the field of anthropology. Recently the writer (1963) published a paper on *Turbinella* in an anthropological journal, and was soon rebuked by a leading anthropologist for "using an obsolete name."

Whatever our personal preferences may be in this matter, we have little choice but to follow the decision of the Commission. However, Keen expressed the opinion of many when she warned, in her letter of protest over *Turbinella,* "I feel that granting this petition by the Commission would only add to the growing feeling among many systematists that the supposedly firm ground of priority is being made into a quagmire and that the number of exceptions to the *Règles* waxes too great to be worth trying to remember."

Literature Cited

Baily, J. L., Jr., 1956, Proposed use of the Plenary Powers to preserve the generic name "Turbinella" Lamarck, 1799, as the name for the Sacred Chank Shell of India: Bull. Zool. Nomencl., v. 11, pt. 11, p. 330-332.

Blackwelder, R. E. and R. M., 1961, Directory of Zoological Taxonomists of the World: Soc. Syst. Zool., Carbondale, Illinois, 404 p.

Dall, W. H., 1906, Early history of the generic name *Fusus* [includes list of Bolten genera with type designations]: Jour. Conch., v. 11, p. 289-297.

Dall, W. H., 1915, An index to the Museum Boltenianum: Smithson. Inst. Publ. 2360, 64 p.

Pilsbury, H. A., 1922, Revision of W. M. Gabb's Tertiary Mollusca of Santo Domingo: Acad. Nat. Sci. Phila., Proc., v. 73, p. 305-435, pls. 16-47.

SHERBORN, C. D. and E. R. SYKES, 1906, Museum Boltenianum [facsimile reprint]: London, 199 p.

VOKES, E. H., 1963, A possible Hindu influence at Teotihuacán: American Antiquity, v. 29, p. 94-95, Figs. 1-2.

VREDENBURG, E. W., 1923, On the phylogeny of some Turbinellidae: Geol. Surv. India, Records, v. 55, pt. 2, p. 119-132, pl. 19.

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE, 1926, Opinions rendered by the International Commission on Zoological Nomenclature, Opinions 91 to 97: Smithson. Misc. Coll., v. 73, no. 4, p. 1-30 [Reprinted in facsimile by the International Commission, 1958, as "Opinions and declarations by the International Commission on Zoological Nomenclature, v. 1, sect. B, Opinions 1-133"].

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE, 1957, Opinion 489: Validation under the Plenary Powers of the generic name *Turbinella* Lamarck, 1799 (Class Gastropoda), as the name for the Sacred Chank Shell of India: Opinions and declarations rendered by the International Commission on Zoological Nomenclature, v. 17, pt. 11, p. 155-178.

April 30, 1964

ERRATA

VOLUME 1 (1962-1963)

NO. 1—page i, Editorial Committee. For H. V. Anderson, read H. V. Andersen.

page 66 from the plate descriptions was inadvertently omitted by the printer. A replacement leaf is available on request.

NO. 3—page 100, col. 1, line 33. The locality should read NE¼, not NW¼.

page 109, col. 1, lines 28-30. The quotation should read "the Florida specimens are often of a deep rose-pink."

page 112, locality 456. The locality should read NE¼, not NW¼.

page 112, locality 546. The locality should read about 1 mile west, not 1½ miles west; and (= USGS 2212), not (? same as USGS 2212).

page 113, locality 554. The locality should read SW¼ Sec. 17, not NW¼ Sec. 20.

NO. 4—plate 2, opposite page 130. The proper scale is: one mile = 3 inches.

page 154, col. 2, lines 36 and 38; also page 155, col. 1, line 4. For *Torvomurex,* read *Torvamurex.*

page 157, col. 2, line 25. For *consulae,* read *consuelae.*