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# THE GENUS *VASUM* (MOLLUSCA: GASTROPODA) IN THE NEW WORLD

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## CONTENTS



## ILLUSTRATIONS



## I. ABSTRACT

The genus *Vasum* originated in the New World with the late Eocene species *V. humerosum* Vaughan. The history of the genus is fairly well documented in the New World but the fossil record is poorly known in the Old World; no species have been reported from mid-Miocene time until the Recent. There are 13 Recent species of *Vasum* presently known, worldwide, and 23 fossil species. All of the New World species, both fossil (19) and Recent (6) are treated systematically, including three species herein described from the Miocene of Florida. These are: *V. jacksonense,* n. sp., from the Choctawhatchee Formation; *V. olssoni,* n. sp., from the Pinecrest Beds; and *V. chipolense,* n. sp., from the Chipola Formation.

## II. INTRODUCTION

The generic name *Vasum* was first proposed in 1798 by Röding in the *Museum Boltenianum* (p. 56). Although there was neither diagnosis nor type species given, the species included by Röding are: *V. urna* [=*V. muricatum* (Born)], *V. capitellum* (Linn.), *V. turbinellus* (Linn.), *V. cerami-*

*cum* (Linn.), and two species now referred to the genus *Drupa, V. hippocastana* and *V. casteneum.* The work of Röding was ignored in the early 19th Century, until 1853, when H. and A. Adams took notice of the names proposed therein and erected a family VASIDAE, including in it the genera *Vasum* "Bolten" and *Mazza* Klein. (This latter name is a synonym of *Xancus* Röding, 1798, and *Turbinella* Lamarck, 1799. As Klein is a pre-Linnean author, the first available name is *Xancus* Röding. Unfortunately, the International Commission on Zoological Nomenclature ruled, in Opinion 489, 1957, that *Turbinella* Lamarck, 1799, is the correct name to be used for the group.) There is, however, a previous family, TURBINELLIDAE, proposed in 1840 by Swainson. This family comprises the same two genera although Swainson used the name *Scolymus* rather than *Vasum* for that group. At the same time he proposed two subfamilies, TURBINELLINAE and SCOLYMINAE, and it is from Swainson's work that the family name TURBINELLIDAE and the subfamily TURBINELLINAE date. According to the International Code of Zoological Nomenclature (Art. 36) the subfamily VASINAE would date from the Adams' 1853 usage.

The species selected by the Adams' as the type of *Vasum* was *V. cornigerum* "Linn." (=Lamarck). Although this species is a synonym of *V. turbinellus,* the name *"cornigerum"* was not used by Röding and, therefore, is not available for selection as type. Several subsequent authors have accidentally, or otherwise, designated type species for this genus, but most of the designations have proved to be invalid. The first unimpeachable, though inadvertent, designation seems to be that of Winckworth (1945, p. 145) who stated: *"Vasum,* 56. Type, designated by Cossmann 1901 for *Vasum* (Bolten) Link, *V. turbinellus* R.= *Voluta turbinellus* L. 1767=*Murex turbinellus* L. 1758. *Turbinella cornigera,* Lamarck, 1822, is the same." Abbott (1950. p. 209) gave a detailed discussion of the problems of a type designation and concluded by redesignating *"V. turbinellus* Röding 1798= *Murex turbinellus* Linne 1758."

The genus *Vasum* is a small group including approximately a dozen living species. The fossil record is predominantly New World and there is a striking lack of information on the Old World forms. There are a few Miocene species described from Europe, but there is a complete hiatus between the middle Miocene and the Recent, and yet the genus must have been living somewhere in the Old World during this interval, for half of the Recent species are found in the Indo-Pacific region. With this complete dearth of information, little can be said concerning the Old World history of the group. In contrast, the New World history is fairly well documented. The oldest known *Vasum* is found in the New World, *V. humerosum* from the upper Eocene beds of Louisiana. This original form gave rise to three complexes in the New World, one of which continued through time almost unchanged and is represented in the Recent fauna by *V. capitellum* (Linn.). There are secondary branchings off this line which gave rise to the other Recent Atlantic species *Vasum globulum* (Lamarck) and *V. (Siphovasum) latiriforme* Rehder and Abbott. The second group is first seen in the lower Miocene Tampa Limestone with a species tentatively referred to *V. haitense* (Sowerby) although better material may prove it to be different. This complex is represented in the Recent fauna by the widespread species *V. muricatum* in the Caribbean and by *V. caestus* (Broderip) in the eastern Pacific. A third line diverged probably in the early Miocene to give rise to two branches, one represented by the Recent species *V. cassiforme* (Kiener), and the other by a series of exceedingly spinose forms placed in the subgenus *Hystrivasum.* This latter line lasted from the upper Miocene through the Pliocene but died out at the end of the Pliocene. For a diagramatic phylogenetic arrangement of all of the known species of *Vasum* see Table 1.

In the Old World the oldest known species is *V. subpugillare* (d'Orbigny), 1852, from the Oligocene (Tongrian) of Gaas, France. *V. subpugillare* is a large form not unlike the Recent *V. ceramicum* of the Indo-Pacific region. The Aquitanian species *V. aquitanicum* Peyrot, 1928, would seem to link this early form with the Recent Indo-Pacific species: *V. turbinellus* (Linn.), 1758; *V. armatum* (Broderip), 1833; *V. rhinoceros* (Gmelin), 1791; *V. tubiferum*

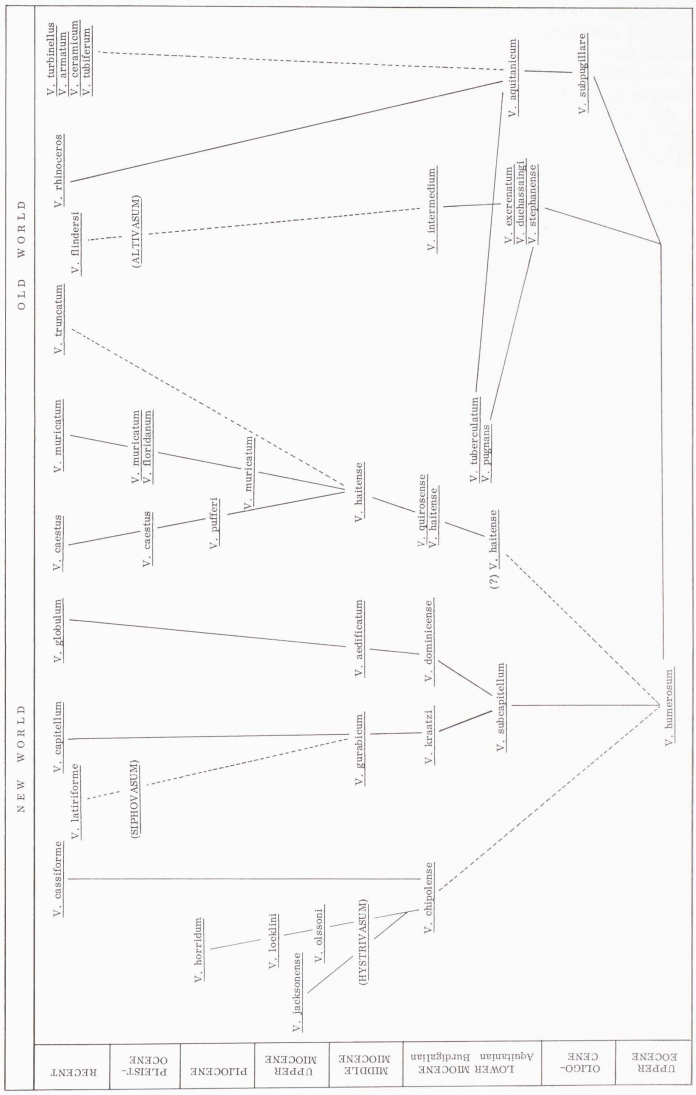


Table 1. Phylogenetic arrangement of the species of VASUM.

(Anton), 1839; and *V. ceramicum* (Linn.), 1758. For a systematic treatment, with references, of the Recent Old World species of *Vasum* the reader should see Abbott (1959). In addition to these above mentioned two fossil species there is a second group comprising four lower Miocene species from France and Italy, all much alike and all similar to the ancestral *V. humerosum.* This group includes *V. duchassaingi* (Michelotti), 1861; *V. excrenatum* Sacco, 1904; *V. stephanense* Peyrot, 1928; and *V. intermedium* (Grateloup), 1840.

In general, the living species of *Vasum* are shallow water dwellers or reef dwellers. They are reported to be carnivorous, feeding on clams and worms, (Abbott, 1959, p. 15). In life the shells are covered by a periostracum which may be heavy and matted as in *V. muricatum, V. caestus, V. truncatum,* and *V. cassiforme,* or thin and translucent as in *V. turbinellus* and all of the other Recent species, both Old and New World. This difference in the nature of the periostracum would suggest that the Old World species are most closely related to the central *V. humerosum - V. capitellum* complex in the New World, a relationship that is discussed further under *V. humerosum.*

## III. Acknowledgments

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## IV. Systematic Descriptions

Phylum Mollusca

Class Gastropoda

Subclass Prosobranchia
(or Streptoneura)

Order Neogastropoda (or Stenoglossa)

Suborder Rachiglossa

Superfamily Volutacea

Family Turbinellidae

Subfamily Vasinae

Genus Vasum Röding, 1798

Subgenus Vasum *sensu stricto*

*Vasum* Röding, 1798, Museum Boltenianum, p. 56.
Type species: *Murex turbinellus* Linn., by subsequent designation, Winckworth, 1945, Proc. Malac. Soc. London, v. 26, p. 145.

*Volutella* Perry, 1810, Arcana, pl. 2 (sign. B 1), fig. 1.
Type species: *Volutella divergens* Perry, by monotypy. [*Volutella divergens* Perry = *Vasum muricatum* (Born)]

*Cynodonta* Schumacher, 1817, Essai nouveau système des habitations vers testacés, p. 73.
Type species: *Voluta ceramica* Linn., by original designation and monotypy.

*Cynodona* Schumacher, 1817, Essai nouveau système des habitations vers testacés, p. 241. [Error.]

*Scolymus* Swainson, 1835, Elements of modern conchology, p. 21.
Type species: *Turbinella cornigera* Lamarck, by subsequent designation, Abbott, 1950, Johnsonia, v. 2, no. 28, p. 208. [*Turbinella cornigera* Lamarck = *Vasum turbinellus* (Linn.)]

*Globivasum* Abbott, 1950, Johnsonia, v. 2, no. 28, p. 215.
Type species: *Turbinella nuttingi* Henderson, by original designation. [*Turbinella nuttingi* Henderson = *Vasum globulum* (Lamarck)]

### Vasum humerosum Vaughan

Plate 1, fig. 1

*Vasum humerosum* Vaughan, 1896, U. S. G. S. Bull. 142, p. 34, 50, pl. 2, figs. 7, 8.

*Vasum humerosum* Vaughan. Harris and Palmer, 1947, Bulls. Amer. Paleontology, v. 30, no. 117, Sect. 2, p. 390, pl. 51, figs. 10, 11.

*Vasum humerosum* Vaughan. Palmer and Brann, 1966, Bulls. Amer. Paleontology, v. 48, no. 218, p. 1012.

*Diagnosis:* "Whorls shouldered, about six, each having eight sharp, short, thick, pointed humeral spines; surface marked by distinct coarse elevated revolving lines; there are several between the shoulder and

suture, one on the shoulder and five below it. About two-thirds the distance from the shoulder to the anterior extremity there is a spiral row of spines; one spine for each humeral spine. Anterior to these spines there is a prominent subspinous revolving elevation. Shell umbilicated. On the columella there are three revolving folds, the uppermost the most prominent." (Vaughan, 1896).

Dimensions of holotype: height 50 mm, diameter 28 mm.

Holotype: USNM 147037.

Type locality: Montgomery Landing, Red River, Grant Parish, Louisiana.

Horizon: Moody's Branch Marl, Louisiana; upper Eocene.

*Figured specimen:* USNM 645136 (topotype); height 39 mm, diameter 26 mm; locality TU 99.

*Discussion: V. humerosum* is the oldest known species referable to *Vasum* in the world. It is not rare at the type locality but it is not known from anywhere else. Harris and Palmer (1947, p. 391) do not list other occurrences, and it has not been collected by the Tulane Geology Department except at Montgomery Landing. There is very little difference between this upper Eocene species and the lower Miocene species *V. subcapitellum* Heilprin. If it were not for the great geologic separation, they would probably be placed in synonymy but in view of this separation it seems best not to do so. There is a conspicuous change in molluscan fauna between the end of the Eocene and the beginning of the Miocene, a change which suggested the division of the Cenozoic into the Paleogene and the Neogene. The Oligocene is a time of transition with many of the modern groups first appearing and although there are certain genera which bridge the gap between Paleogene and Neogene there are few species which do so. The central line of the genus *Vasum* has continued almost unchanged from the upper Eocene ancestor to the Recent *V. capitellum* but other branches off the main line have developed many diverse forms. Nevertheless, these diverse forms, however different they may appear in the adult stage, all have juvenile shells which are markedly like *V. humerosum.* It is the ultra-conservative central *Vasum* line which succeeded in bridging the older-newer Tertiary transition.

A persistant trait, first seen in this species, is the appearance of about a dozen paired spiral lines or denticulations on the interior of the outer lip. This same trait is seen in the other species most directly descended from *V. humerosum* such as *V. subcapitellum, V. gurabicum,* and the Recent species: *V. capitellum, V. latiriforme,* and *V. globulum.* Due to the imperfect preservation of the other species of the New World line, including *V. dominicense, V. aedificatum,* and *V. kraatzi,* it is not certain that they possessed these denticulations but it seems reasonable to assume that they did. The same type of markings is known to appear in the European Tertiary species *V. stephanense* and *V. intermedium,* and to a lesser degree in *V. subpugillare* and all of the Recent Indo-Pacific species. It is, by contrast, not seen in any of the species of the offshoot lines in the New World which arose from *V. chipolense* and *V. haitense* respectively (see Table 1). From this observation it is assumed that the central New World *V. humerosum* complex is more closely related to the European Tertiary and Indo-Pacific Recent species than either of the secondary New World groups.

Another species, *Vasum wilmingtonense,* was described from the upper Eocene Castle Hayne Formation of North Carolina by Brown and Pilsbry (1912, p. 153). Their specimen, only an internal mold of a large volutid gastropod, is not to be referred to the genus *Vasum.* It is probably a large *Fusimitra* for it shows the four flattened "T-shaped" columellar plications characteristic of that group.

### VASUM SUBCAPITELLUM Heilprin

Plate 1, figs. 2-4

*Vasum subcapitellum* HEILPRIN, 1887, Wagner Free Inst. Sci., Trans., v. 1, p. 109, pl. 15, fig. 44.

*Turbinella (Vasum) subcapitellum* Heilprin. DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 99, pl. 4, fig. 12.

*Vasum subcapitellum* Heilprin. COSSMANN, 1901, Essais Paléoconch. Comp., v. 4, p. 66.

*Vasum subcapitellum* Heilprin. DALL, 1903, Wagner Free Inst. Sci., Trans., v. 3, pt. 6, p. 1566, 1571.

*Vasum subcapitellum* Heilprin. DALL, 1915, U.S. Nat. Mus. Bull. 90, p. 63, pl. 7, fig. 2 (after Dall, 1890, pl. 4, fig. 12).

*Vasum subcapitellum* Heilprin. PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 344 (in synonymy of *V. aedificatum*).

*Vasum subcapitellum* Heilprin. MAURY, 1925, Serv. Geol. Min. Brasil, Mon. 4, p. 156-157.

*Vasum subcapitellum* Heilprin. MANSFIELD,

1937, Florida Geol. Surv., Bull. 15, p. 15, 113.

*Vasum subcapitellum* Heilprin. Ferreira and Cunha, 1957, Mus. Paraense Emilio Goeldi, Bol., (N. S.) Geologia no. 2, p. 40.

*Vasum subcapitellum* Heilprin. Glibert, 1960, Mem. Inst. Roy. Sci. Nat. Belgique, (ser. 2) fasc. 61, p. 45.

*Diagnosis:* "Shell elevated, pagodaeform; whorls of the spire about seven in number, coronated and strongly costated, the concentric lines (two or three) below the shoulder prominent, those on the rugose shoulder less distinct; the coronary spines prominent, sharp, and directed outwardly; body-whorl with a single row of sharp basal spines, about six in number, below which are two not very prominent lines, and above, some seven sharply-defined concentric ridges, separated by interstitial finer lines; shoulder of whorls elevated; outer lip strongly lined internally; inner lip well expanded, but leaving a broadly-open umbilicus; columellar plaits three, transverse, the upper the largest; surface of shell covered with rugose lines of growth.

"Length, 1.4 inch; width, .7 inch." (Heilprin, 1887)

Holotype: Wagner Free Inst. Sci. no. 843.

Type locality: Ballast Point, Tampa Bay, Florida.

Horizon: Tampa Limestone, Florida; lower Miocene.

*Figured specimens:* Fig. 2, USNM 165072; height 41 mm, diameter 27.5 mm; locality, Ballast Point. Fig. 3, USNM 111927; height 26 mm, diameter 16.4 mm (specimen figured by Dall, 1890); locality, Ballast Point. Fig. 4, USNM 165072a; height 30 mm, diameter 18.5 mm; locality, Ballast Point.

*Discussion:* Schuchert, *et al.*, (1905, p. 688) stated that the "holotype" of *V. subcapitellum* is in the collection of the U. S. National Museum, number 111927. The shell bearing this number is the specimen figured by Dall in 1890 (pl. 4, fig. 12) and also in 1915 (pl. 7, fig. 2), but it is not the type. The type specimen is in the collection of the Wagner Free Institute of Science in Philadelphia as Mansfield (1937, p. 113) stated. In 1915 Dall cited USNM number 165072 (p. 63) suggesting that this is the number of his figured specimen. But his figure is only a copy of the illustration given in 1890 of the above-mentioned shell number 111927 as is verified by his measurement of 27 mm for the height of the figured specimen (1915, p. 161). The specimen bearing the number 165072 (here figured, for the first time, pl. 1, fig. 2) is a much larger shell. It is a pity that none of the U. S. National Museum specimens is the type for all are considerably better than the designated type in Philadelphia.

### Vasum quirosense F. Hodson

Plate 3, fig. 5

*Vasum quirosense* F. Hodson, 1931, Bulls. Amer. Paleontology, v. 16, no. 59, p. 41, pl. 23, figs. 2, 3, 5.

*Diagnosis:* "The shell is small, wide for its height, and delicately sculptured. The tip of the protoconch is broken; only one whorl of the protoconch remains; there are about 6 subsequent whorls; the apex is acute and contrasts with the broad shoulder formed by the body whorl. The spire whorls bear about 7 tubercles each, and close-set, spiral threads on the exposed portion. The body whorl almost overlaps the shoulder of the preceding whorl, and the suture is very tortuous. Near the top of the body whorl is a wide shoulder and a spiral ridge bearing tubercles; the inferior tubercular ridge is almost continuous with the posterior spiral fold on the columella; between the shoulder and inferior tubercular ridges, there are 4 or 5 strong spiral threads with weaker spirals between them; spiral threads of various strengths cover the remaining portion of the body whorl; the spiral sculpture is crossed nearly at right angles by close-set growth lines, which are less pronounced than the spirals. The columella bear 4 plaits: the 2 posterior are strong, the 2 anterior are weaker and have the appearance of being a low, wide anterior plait divided into 2 parts by a shallow groove. The outer lip bears about 5 elongate lirae of different lengths, the middle 3 being the longest." (Hodson, 1931)

Dimensions of holotype: height 28 mm, diameter 27 mm.

Holotype: PRI 24115.

Type locality: Hodson's locality No. 6. Oil seep at El Mene de Saladillo, 1.5 km southwest of Quiroz, Dist. of Miranda, Zulia, Venezuela.

Horizon: La Rosa Formation, Venezuela; (?) lower Miocene, probably middle Miocene.

*Figured specimen:* PRI 24115 (holotype).

*Discussion:* Although Hodson gave no stratigraphic assignment for this or any other fossil, Dusenbury (1956, p. 290) made the statement that: "Hodson's locality No. 6... is the most prolific fossil locality in the Quiroz Formation." The Quiroz he considered to be synonymous with the La Rosa. The age of the La Rosa was given as Aquitanian by Dusenbury (*ibid.*, p. 297) but in a more recent paper, Jung (1965, p. 410) suggested a younger age for the Quiroz beds on the basis of a high percentage of fossil

species found to be in common between Hodson's Quiroz locality and the middle Miocene beds of the Central Paraguaná Peninsula of Venezuela. Whether this means that the Quiroz beds are not to be correlated with the La Rosa Formation, or that the entire La Rosa is of middle Miocene age was not established by Jung. The observation of Jung tends to corroborate the earlier publication of Williston and Nichols (1928) who, in disagreement with Liddle's (1927) correlation of the Quiroz beds, made the statement: "The paleontologic evidence throughout Liddle's book indicates that the Quiroz... [beds] are more closely related to the lower Socorro series than to the Aqua Clara Formation." (1928, p. 449). The Socorro Formation is now thought to be middle Miocene and the Aqua Clara to be Aquitanian, or lower Miocene, in age.

The type specimen of this minute form strongly suggests a dwarfed example of the widespread Miocene species *V. haitense* (Sowerby). However, the other fossils described from this locality by Hodson bear no evidence of being dwarfed, and it is presumed to be a normal fauna. For the present time *V. quirosense* will be accepted as a valid species until more material is known. Jung *(ibid.)* did not cite any species of *Vasum* from the Paraguaná region.

### VASUM KRAATZI Ferreira and Cunha

*Vasum kraatzi* FERREIRA and CUNHA, 1957, Mus. Paraense Emilio Goeldi, Bol., (N. S.) Geologia no. 2, p. 37, pl. 3, figs. 9, 10.

*Diagnosis:* Shell elevated, pagodiform; whorls of the incomplete spire slightly broken, but it is possible to count four represented. The surface presents transverse growth lines, very fine and narrow, this characteristic being identical to *Vasum haitense* (Sowerby).

The coronate spines are prominent, sharp pointed, and somewhat recurved upward. There are basal spines, but this part is imperfect so that we cannot make a clear distinction. The body of the basal whorl presents wide ribs or ribbed elevations, which go from the spinose projection, diminishing gradually until they disappear in the basal or siphonal curve. These ribs are separated by distinct folds, which start at the turns of the penultimate whorl and parallel the ribs to the base. Just under the major spines, on the back of each of the ribs, there are nodules which are not very prominent. On all the whorls are spinose projections, more or less salient and pointed which gradually diminish in size in the direction of the apex. Circling each elevated whorl, the latter whorls envelop the former successively and gradually to the apical extremity. The surface of the primary whorl is ornamented by strong rugose lines, which circle the whorl equidistantly over its entire length; between these lines running symetrically is another more tenuous and delicate line. Six major lines, and a number of smaller ones are present in this concentric sequence. The coronate spines are sulcate at the ends as in *Vasum haitense* (Sowerby). (Ferreira and Cunha, 1957, *translated*)

Dimensions of holotype: height 45 mm, diameter, including spines, 40 mm.

Holotype: Mus. Paraense Emilio Goeldi no. 365-I.

Type locality: Ilha Forteleza, baía de Pirabas, Pará, Brazil.

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

*Discussion:* Although Ferreira and Cunha compared their species with *V. haitense* (Sowerby), it more closely resembles *V. subcapitellum* from the somewhat older Tampa Limestone. The principal difference is the presence in *V. kraatzi* of axial folds which correspond to each of the shoulder spines. It is probable that the Brazilian species represents the link between *V. subcapitellum* and the middle Miocene species, *V. gurabicum* Maury.

Maury (1925, p. 156-157) cited another species of *Vasum* from the Pirabas Limestone, a form which seems to be *V. haitense* (Sowerby). Ferreira and Cunha (1957) stated that they could add nothing to Maury's original determination due to lack of material, but it is at least definite that there are two species of *Vasum* present in the Pirabas, a formation which Maury (1925, p. 44-45) correlated with the Chipola Formation in northwestern Florida. There is some question as to the exact age of the Chipola (see Vokes, 1965), but for the time, we will continue to use the presently accepted age of uppermost lower Miocene (Burdigalian) for the Pirabas Limestone and for the Chipola.

### VASUM DOMINICENSE Gabb

Plate 1, fig. 8

*Vasum dominicensis* GABB, 1873, Amer. Phil. Soc., Trans., (N. S.) v. 15, p. 218.

*Vasum dominicense* Gabb. MAURY, 1917, Bulls. Amer. Paleontology, v. 5, no. 29, p. 84 (248).

*Vasum dominicense* Gabb. PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 344, pl. 27, figs. 4, 5 (fig. 5, lectotype).

*Vasum dominicense* Gabb. FERREIRA and CUNHA, 1957, Mus. Paraense Emilio Goeldi, Bol., (N.S.) Geologia no. 2, p. 39.

*Diagnosis:* "Shell small, very robust; spire about as long as the mouth in old shells, not so long in the younger stages, whorls 10, concave above, angulated; body whorl convex in the middle, concave in advance and broadly umbilicated; surfaces marked by about 7 larger slightly oblique longitudinal ribs, more or less tuberculate on the angle and crossed by numerous revolving ribs, the whole rendered more or less squamose by lines of growth; there is a larger revolving rib or row of tubercles in advance. Aperture elongate-oval; inner lip covered with a heavy plate, with four transverse folds. Length 2.5 inches, width 1.5 inch." (Gabb, 1873)

Dimensions of lectotype: height 60 mm, diameter 37.5 mm.

Lectotype (designated by Pilsbry, 1922, p. 344); ANSP 2623.

Type locality: Dominican Republic.

Horizon: ? Baitoa Formation, Dominican Republic; lower Miocene.

*Figured specimen:* ANSP 2623 (lectotype).

*Discussion:* Although Gabb described this species as having four folds on the columella, both of the specimens in the type lot in the Gabb Collection at the Academy of Natural Sciences of Philadelphia have only three. It is possible that Gabb was including what is now known as *V. aedificatum* (Guppy) in the description of his species, for there are specimens of this species in his collection which bear no identification made by Gabb. Presumably he considered them the same as one of his species or he would have given them a name. On the other hand, Pilsbry, in the introduction to his revision of the Gabb material, stated that "Gabb's descriptions give evidence of haste," (1922, p. 307) and perhaps this is the explanation for the error. The two shells figured by Pilsbry still bear the label written in Gabb's own hand identifying them as *"Vasum dominicensis* Gabb." Pilsbry selected as lectotype the larger of the two which more nearly matched Gabb's cited measurements, and he further explained: "Dimensions of the shells were often omitted, and when given are almost invariably inexact, as though estimated rather than actually measured." (p. 307).

There are six *Vasums* known from the Miocene of Santo Domingo. With the exception of the two species reported by Maury (1917), nothing is known of the stratigraphic assignment of any of them. Pilsbry noted that in the Gabb Collection "with two or three exceptions, none of the labels bore any indications of locality or horizon further than 'Santo Domingo'" (*ibid.*, p. 307). Woodring (1928, p. 51) also discussed this problem and stated: "Gabb did not believe in leaving records of localities, but it is clear that he and Colonel Heneken, who collected the material Sowerby and Guppy described, collected from the Baitoa Formation. In all probability many of Gabb's species not found by later collectors are from these beds, and he may have found a better locality than the type locality on Rio Yaque del Norte at Baitoa, for large numbers of the characteristic Baitoa species are in the Gabb collection." Maury earlier also suggested that Gabb had probably collected in older beds than did the 1916 expedition, "in the eastern part of the Yaqui valley where the Revolution prevented our securing sections and collections." (1917, p. 41 (547)). It is a sad commentary that although 50 years have elapsed since Miss Maury and her companions attempted to collect in the Dominican Republic, it is still just as politically unfeasible to visit this treasure house of Miocene fossils, and the stratigraphic occurrence of many species is no better known today than it was in Gabb's time.

### VASUM TUBERCULATUM Gabb

Plate 2, fig. 4

*Vasum tuberculatum* GABB, 1873, Amer. Phil. Soc., Trans., (N.S.) v. 15, p. 218.

*Vasum tuberculatum* Gabb. GUPPY, 1876, Geol. Soc. London, Quart. Jour., v. 32, p. 523.

*Vasum tuberculatum* Gabb. DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 100.

*Vasum tuberculatum* Gabb. COSSMANN, 1901, Essais Paléoconch. Comp., v. 4, p. 66.

*Vasum tuberculatum* Gabb. PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 344, pl. 27, figs. 2, 3 (lectotype).

*Vasum tuberculatum* Gabb. FERREIRA and CUNHA, 1957, Mus. Paraense Emilio Goeldi, Bol., (N.S.) Geologia no. 2, p. 39.

*Diagnosis:* "Shell large, ponderous, broad; spire elevated, half as long as the mouth, whorls about eight or nine; broadly angulated, concave and sloping above, bearing a few very large tubercles on the angle; body whorl tapering rapidly below the angle and strongly ridged in advance. Surface covered with a few revolving lines. Aperture broad behind, narrowed in advance and expanded at the termination of the an-

terior ridge. Inner lip with four or five large folds. Length 4 inches, width 3 inches." (Gabb, 1873)

Dimensions of lectotype: height 111 mm, diameter 86 mm.

Lectotype (designated by Pilsbry, 1922, p. 344): ANSP 2624.

Type locality: Dominican Republic.

Horizon: ? Baitoa Formation, Dominican Republic; lower Miocene.

*Figured specimen:* ANSP 2624 (lectotype).

*Discussion:* This large species of *Vasum* is unlike any other New World form but is so close to *V. aquitanicum* Peyrot from the Aquitanian of France, (1928, p. 29) that it may well be conspecific with it. Both of these Miocene forms bear a strong resemblance to the Recent *V. rhinoceros* (Gmelin), a species presently confined to the east-central coast of Africa. Nothing is known of the stratigraphic occurrence of *V. tuberculatum* but its close relationship with *V. aquitanicum* suggests that it is from the lower Miocene Baitoa Formation. This would bear out the suggestion that Gabb had collected in beds older than the middle Miocene. The Baitoa is considered to be Burdigalian in age (Woodring, 1928, p. 39), or somewhat younger than the beds in which the European species occurs, but the present state of our knowledge concerning the exact correlation between the Caribbean section and the European type sections is such that the Baitoa might well be Aquitanian. The writer suspects that the Gurabo, rather than the Baitoa or the Cercado, may correlate with the Chipola Formation in Florida, and that both may be Helvetian in age; this would then make the Cercado Burdigalian and the Baitoa Aquitanian. These conjectures are based on meager evidence and are only tentatively put forth at this time.

Guppy (1876, p. 523) without benefit of having seen figures of Gabb's specimens suggested that the *V. tuberculatum* of Gabb was *V. haitense* (Sowerby). On the basis of Gabb's description alone this is not an unreasonable surmise, but examination of specimens show that *V. tuberculatum* is immediately distinguished by its much higher spire and by six strong bifid nodes at the shoulder. There is a slight tendency toward this bifid condition in large specimens of *V. haitense* such as the one figured by Guppy (1876, pl. 29, fig. 3 and text figure 1 here). It may also be seen in the larger specimen figured here (pl. 3, fig. 4), but it does not approach the degree developed in *V. tuberculatum.*

A lectotype for this species was selected by Pilsbry (1922, p. 344) from the Gabb Collection, and the form was figured for the first time. The shell figured here is the same specimen.

### VASUM PUGNANS Pilsbry and Johnson

Plate 2, fig. 3

*Vasum pugnans* PILSBRY and JOHNSON, 1917, Acad. Nat. Sci. Phila., Proc., v. 69, p. 167.

*Vasum pugnans* Pilsbry and Johnson. PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 344, pl. 27, fig. 1.

*Vasum pugnans* Pilsbry and Johnson. FERREIRA and CUNHA, 1957, Mus. Paraense Emilio Goeldi, Bol., (N.S.) Geologia no. 2, p. 39.

*Diagnosis:* "The shell is biconic; spire elevated, the whorls having rounded peripheral nodes, about 8 on a whorl, and spiral threads, about 12 with a few minor ones, on the penult whorl. On the last whorl there are short, thick axial folds extending a short distance downward from the shoulder, and an inferior row of blunt tubercles. From the shoulder down there are low, well-spaced spiral cords, with about 3 smaller spirals in their intervals." (Pilsbry and Johnson, 1917)

Dimensions of holotype: height 80 mm, diameter 50 mm.

Holotype: ANSP 2626.

Type locality: Dominican Republic.

Horizon: ? Baitoa Formation, Dominican Republic; lower Miocene.

*Figured specimen:* ANSP 2626 (holotype).

*Discussion: V. pugnans* is based on a single, poorly preserved specimen from the Gabb Collection at the Academy of Natural Sciences of Philadelphia. As with the other species of Gabb, nothing is known of the stratigraphic position of *V. pugnans,* but it resembles the European species *V. stephanense* Peyrot described from the Aquitanian of France (1928, p. 32). *V. pugnans* is larger than the French species, but the nature of the greatly appressed suture and the type of ornamentation are strikingly similar. This similarity and, as discussed previously, the probability of Gabb's collections being made in the Baitoa Formation suggest placement here.

VASUM CHIPOLENSE E. H. Vokes, n. sp.

Plate 2, figs. 1, 2

*Diagnosis:* Shell with ten whorls in the adult including the protoconch. Early whorls with eight sharply pointed spines at the shoulder, gradually increasing to ten on the penultimate whorl and becoming almost obsolete on the body whorl. Spire high, approximately 1/3 of shell height. Suture undulating, appressed, immediately anterior in position to shoulder spines of preceding whorl. At the base of the siphonal canal a second row of sharp spines, seven in number in the adult shell. Axial ornamentation consisting only of poorly developed growth lines, seen principally on the siphonal canal. Spiral ornamentation of six relatively strong ribs on the body whorl, alternating with weaker ribs, and between these very faint tertiary threads. On the siphonal canal, anterior to the single row of spines, two or three strong ribs and an equal number of smaller intercalary threads. Aperture marked by a prominent flaring of the posterior channel and a second smaller notch corresponding to the row of spines at the base of the anterior canal. Outer lip smooth with forward edge crenulated as a reflection of the spiral ribs; inner lip with a strong callus wash on the parietal wall. Columella bearing four plications which diminish in size from posterior to anterior so that the last is almost obsolete.

Dimensions of holotype: height 88 mm, diameter 53 mm.

Holotype: USNM 645137.

Type locality: TU 547, west side of Chipola River, (SW ¼ Sec. 29, T1N, R9W), Calhoun County, Florida. (Approximately 2½ miles below "Bailey's Ferry.")

Horizon: Chipola Formation, Florida; (?) uppermost lower Miocene.

*Figured specimens:* Fig. 1, USNM 645137 (holotype). Fig. 2, USNM 645212 (paratype); height 47 mm, diameter 30 mm; locality TU 547.

*Discussion: V. chipolense* is unlike any Miocene form but it bears a marked resemblance to the Recent species, *V. cassiforme*, living today only off the coast of Brazil. The type locality of this new species, TU 547, is a coral reef and a number of unique forms have been collected at this spot. Unfortunately, little is known of the ecology of the Recent *V. cassiforme* which might shed light on the paleoecology of this fossil coral reef.

There is a sequence of three species of *Vasum* in the upper Miocene and Pliocene of southern Florida which has been said by authors to have no known antecedents. These three species are: *V. olssoni* E. H. Vokes, n. sp., *V. locklini* Olsson and Harbison, and *V. horridum* Heilprin. There is just enough resemblance between *V. chipolense* and *V. olssoni*, the oldest member of the sequence, to suggest that here may lie the ancestor of the group. *V. olssoni* is a much heavier, more strongly ornamented shell, but it does have a tendency toward the flaring aperture seen in *V. chipolense* and the general shape of the shells is comparable. Although *V. chipolense* and *V. cassiforme* seem to form a direct line, the other three species are a distinct side branch and apparently lead to an evolutionary "dead-end," for there is no Recent equivalent of the Pliocene *V. horridum*. These three species, together with a fourth species, *V. jacksonense* E. H. Vokes, n. sp., are placed in a separate subgenus *Hystrivasum* erected by Olsson and Petit (1964, p. 547). Neither the ancestral species nor the Recent *V. cassiforme* is placed in this subgenus because both lack the secondary row of shoulder spines which serves to distinguish the group.

VASUM HAITENSE (Sowerby)

Plate 3, figs. 1-4; Plate 4, fig. 3

Text figure 1

*Turbinellus haitensis* G. B. SOWERBY (I), 1850, Geol. Soc. London, Quart. Jour., v. 6, p. 50.

*Turbinellus haitensis* Sowerby. GUPPY, 1866, Geol. Soc. London, Quart. Jour., v. 22, p. 575; GUPPY, 1867, Sci. Soc. Trinidad, Proc., p. 157 (*ex* Harris reprint: Bulls. Amer. Paleontology, 1921, v. 8, no. 35, p. 36 (184).); GUPPY, 1874, Geol. Mag., v. 11, p. 438; GUPPY, 1876, Geol. Soc. London, Quart. Jour., v. 32, p. 523, pl. 29, fig. 3 (lectotype).

*Vasum haitensis* (Sowerby). GABB, 1873, Amer. Phil. Soc., Trans., (N.S.) v. 15, p. 218.

*Vasum muricatum* (Born). GABB, 1881, Acad. Nat. Sci. Phila., Jour., (Ser. 2) v. 8, no. 4, p. 354 (in part, *not* of Born).

*Turbinella (Vasum) haitense* Sowerby. DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 100.

*Turbinella (Vasum) haitense* var. *engonatum* DALL, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 100.

*Turbinellus haitensis* Sowerby. COSSMANN, 1901, Essais Paléoconch. Comp., v. 4, p. 66.

*Vasum haitense* var. *engonatum* Dall. DALL, 1903, Wagner Free Inst. Sci., Trans., v. 3, pt. 6, p. 1569.

*Vasum engonatum* Dall. DALL, 1903, Wagner Free Inst. Sci., Trans., v. 3, pt. 6, p. 1576.

[?] *Vasum engonatum* Dall. DALL, 1915, U.S. Nat. Mus. Bull. 90, p. 63, pl. 11, figs. 2, 3.

*Vasum haitense* (Sowerby). MAURY, 1917, Bulls. Amer. Paleontology, v. 5, no. 29, p. 84(248), pl. 13(39), fig. 6; MAURY, 1917, *ibid.*, no. 30, p. 18 (434), 19(435), 22(438).

*Vasum haitense* (Sowerby). PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 344.

*Vasum* cf. *haitense* (Sowerby). MAURY, 1925, Serv. Min. Geol. Brasil, Mon. 4, p. 156-157, pl. 9, fig. 18.

*Vasum engonatum* Dall. MAURY, 1925, Serv. Min. Geol. Brasil, Mon. 4, p. 158-159.

*Vasum haitense* (Sowerby). MAURY, 1925, Serv. Min. Geol. Brasil, Mon. 4, p. 158-159, pl. 9, fig. 16.

*Vasum haitensis* (Sowerby). HANNA, 1926, Calif. Acad. Sci., Proc., (Ser. 4) v. 14, p. 459.

*Vasum engonatum* Dall. HANNA, 1926, Calif. Acad. Sci., Proc., (Ser. 4) v. 14, p. 460.

[?] *Vasum egonatum* [*sic*] Dall?. MANSFIELD, 1937, Florida Geol. Surv., Bull. 15, p. 53.

[?] *Vasum engonatum* Dall. MANSFIELD, 1937, Florida Geol. Surv., Bull. 15, p. 113.

*Vasum* aff. *V. engonatum* Dall. GARDNER, 1944, U.S.G.S. Prof. Paper 142-G, p. 441.

[?] ?*Vasum engonatum* Dall. COOKE, 1945, Florida Geol. Surv., Bull. 29, p. 94 (after Mansfield, 1937, p. 53).

*Vasum haitense* (Sowerby). FERREIRA and CUNHA, 1957, Mus. Paraense Emilio Goeldi, Bol., (N.S.) Geologia no. 2, p. 38.

*Vasum engonatum* Dall. FERREIRA and CUNHA, 1957, Mus. Paraense Emilio Goeldi, Bol., (N.S.) Geologia no. 2, p. 40.

*Vasum* cf. *haitense* (Sowerby). FERREIRA, 1964, Mus. Paraense Emilio Goeldi, Bol., (N.S.) Geologia no. 10, p. 3.

*Vasum haitensis* (Sowerby). EMERSON, 1964, Amer. Mus. Novitates, no. 2202, p. 7.

*Vasum egonatum* [*sic*] Dall. EMERSON, 1964, Amer. Mus. Novitates, no. 2202, p. 7.

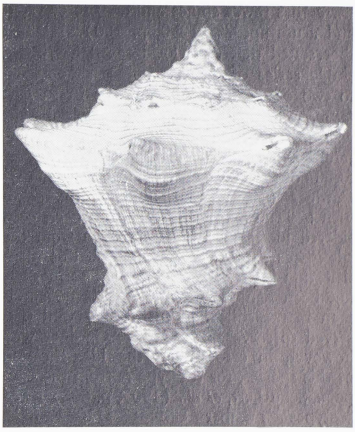
*Diagnosis:* "Testa subtrigona, turbinata, transversim striata, tuberculata, spira subdepressa, subacuminata; anfratibus senis, postice anguliferis, ad angulum tuberculiferis, lateribus declivibus; antice seriebus duabus tuberculcrum, quarum postica multo major; labio columellari quadriplicato; canali extus subtuberculato.

"The flatness of the spire at once distinguishes this from *T. pugillaris,* Lam." (Sowerby, 1850).

Dimensions of lectotype: height 78 mm, diameter 74 mm.

Lectotype (here designated): British Museum (Nat. Hist.) no. GG 20270 (formerly London Geol. Soc. 12845).

Type locality: Rio Yaque, Dominican Republic.



Text figure 1. *Vasum haitense* (Sowerby) (reduced, height 78 mm). Lectotype: British Museum (Nat. Hist.) GG 20270. Photograph courtesy British Museum (Nat. Hist.).

Horizon: ? Suwannee Limestone, Florida; upper Oligocene. ? Tampa Limestone, Florida; lower Miocene. Pirabas Limestone, Pará, Brazil; Chipola Formation, Florida; (?) uppermost lower Miocene. Gurabo Formation, Dominican Republic; middle Miocene.

*Figured specimens:* Fig. 1, USNM 645138; height 62.5 mm, diameter, including spines, 58 mm; locality TU 457. Fig. 2, USNM 645139; height 51 mm, diameter 52.5 mm; locality 458. Fig. 3 (pl. 3), USNM 645140; height 18.6 mm, diameter 13 mm; locality TU 458. Fig. 4, ANSP 2627, height 81 mm, diameter 72.5 mm; locality unknown, Gabb Collection, Dominican Republic. Fig. 3 (pl. 4), USNM 165070; height 109 mm, diameter 94 mm; locality, Ballast Point, Tampa Bay, Florida. Other occurrences: TU locality nos. 546, 547, 548, 554.

*Discussion: V. haitense* is the most common and widespread species of *Vasum* in the Miocene beds of the western Atlantic region. It has been reported from the Dominican Republic by Sowerby (1850), Gabb (1873), Guppy (1876), and Maury (1917) among others. As *V. engonatum* it has been reported from the Tampa Limestone and the Chipola Formation of Florida. Dall separated the Florida form from the typical Dominican species because *V. hai-*

*tense* "has fewer spines and a more elevated and acute apex." (1890, p. 100). He further stated that the Florida shell has but a single series of anterior spines as opposed to two or even three such rows in *V. hatense*. Examination of better material than was available to Dall reveals that these differences are not consistent. The type material of Dall's species is so poor that Gardner (1944, p. 442) made the statement: "The Chipola species has been considered identical with the species from the silex beds at Tampa, and though this identification is probably in error the former has not been named because there is no specimen in the collection sufficiently well preserved to serve as the type." Gardner was, however, in error about the identification of this species, for the type *is* from the Chipola. Schuchert, *et al.,* (1905, p. 688) listed "cotypes" number USNM 111932 from "near Bailey's Ferry" (USGS 2213 = TU 457). If the Tampa and the Chipola forms are not the same, then it is the Tampa species which needs a new name. Unfortunately, the only known example of the Tampa form is so poorly preserved that it does not seem wise to select it as type of a new species. Until better material is discovered it is better not to separate the Tampa and Chipola species. The only known example of the Tampa form is the one figured by Dall (1915, pl. 11, figs. 2, 3) and here refigured (pl. 4, fig. 3). It is this specimen which was taken to be the type of *V. engonatum* by both Gardner (1944, p. 442) and Mansfield, who stated (1937, p. 114): "When this specimen is compared with the best but poorly preserved specimens from the Chipola Formation certain differences are observed. The Chipola form has a lower spire with a more appressed suture and stronger spirals below the basal spines than the Tampa species. The two forms are closely related and may represent mutations of the same species." Mansfield (1937, p. 53) also reported the possibility of this species occurring in the upper Oligocene Suwannee Limestone of Hernando County, Florida.

*V. haitense* is a highly variable species. The degree of this variability is well illustrated by two of the specimens figured here. Plate 3, figures 1 and 2 are shells from the same geologic horizon, the lower Chipola, separated geographically by less than one mile. Both shells are approximately the same size. On the basis of these two specimens alone anyone would say that here are two species, but a series of 30 specimens clearly shows that they are the same. The "heavy" form appears to be somewhat dwarfed and more nearly resembles what would ordinarily be a larger shell. The "spinose" form is the more typical juvenile and bears a stronger resemblance to the ancestral *V. humerosum* Vaughan (a fact which should delight advocates of "Haeckel's Law"). The maximum size for the Chipola specimens is usually 70 to 90 mm in height. Dall's unfigured type is 95 mm and is the largest specimen seen. The Dominican specimens sometimes attain a larger size for one specimen in the Gabb Collection is over 100 mm.

Maury (1925, pl. 9, fig. 18) figured a *Vasum* cf. *haitense* from the Pirabas Limestone of Pará, Brazil. The material she had was fragmentary, but she observed that the form "is certainly a near relative of the Dominican." (p. 159). Her illustration, said to be "drawn from a cast of a fragmentary external imprint of the shell" (p. 629), is almost identical with specimens from the Chipola, and, as the Pirabas is correlated with the Chipola by Maury (1925, p. 44-45), there seems little doubt that the Brazilian species is the same as the Florida and Dominican one.

In the Heneken Collection of Santo Domingan fossils, originally the property of the Geological Society of London and now housed in the British Museum (Nat. Hist.), there is no holotype of *Turbinellus haitensis* Sowerby. The specimen figured subsequently by Guppy is present and is here selected as lectotype. It is probable that this was Sowerby's type specimen, but, as neither Sowerby nor Guppy provided labels, this is not certain. The specimen was identified by Sherborn and catalogued by Blake (1902, p. 70) as R 12845. When the Geological Society Collection was transferred to the British Museum (Nat. Hist.) it was given the number GG 20270. It is this specimen which is here shown in Text figure 1.

VASUM AEDIFICATUM (Guppy)

Plate 1, fig. 5

Text figure 2.

*Turbinellus aedificatus* GUPPY, 1876, Geol. Soc. London, Quart. Jour., v. 32, p. 523, pl. 28, fig. 5.

*Turbinellus aedificatus* Guppy. DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 99.

*Vasum edificatum* [*sic*] (Guppy). PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 344.

*Vasum aedificatum* (Guppy). MANSFIELD, 1937, Florida Geol. Surv., Bull. 15, p. 15, 113.

*Vasum edificatum* [*sic*] (Guppy). FERREIRA and CUNHA, 1957, Mus. Paraense Emilio Goeldi, Bol., (N.S.) Geologia no. 2, p. 40.

*Diagnosis:* "Shell solid, rimate, very shortly fusiform, spire high, composed of seven or eight whorls adorned with strong longitudinal ribs each terminating on the angle in a subtubular spine, and with numerous close spiral ridges, which are crossed by fine squamose lines of growth. Aperture narrow; inner lip covered with a thick callus bearing about four plaits." (Guppy, 1876)

Dimensions of holotype: height 62.5 mm, diameter, 33 mm.

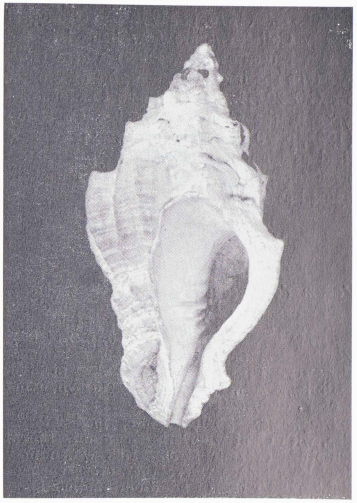
Holotype: British Museum (Nat. Hist.) no. GG 20255 (formerly Geol. Soc. London R 12839, *not* R 18239 as given by Blake, 1902, p. 70).

Type locality: Rio Yaque, Dominican Republic.

Horizon: Gurabo Formation, Dominican Republic; middle Miocene (*fide* Mansfield, 1937, p. 15, 113.)

*Figured specimen:* ANSP 2625; height 51 mm, diameter 29.5 mm; locality unknown, Gabb Collection, Dominican Republic.

*Discussion:* In the Gabb Collection from Santo Domingo there are four specimens which were labeled "*Vasum aedificatus* Guppy," this identification presumably made subsequently by Heilprin as the species was not named at the time of Gabb's work. Pilsbry (1922, p. 307) noted that the collection bore labels on cards written by Prof. Heilprin. Two of these four specimens are not *V. aedificatum* but *V. gurabicum* Maury. Undoubtedly it was these specimens which caused Pilsbry questioningly to include *V. gurabicum* in the synonymy of *V. aedificatum* and to note: "The neanic stage is rather profusely spinose." (1922, p. 344). *V. gurabicum* is here figured (pl. 1, figs. 6 and 7) for comparison with *V. aedificatum* of almost the same size. Although the two forms are similar, there is little reason to confound them. *V. aedificatum* is a more massive shell with almost no spiral ornamentation, but *V. gurabicum* has strong spiral ribs which may or may not bear sharp spines. Maury did not report *V. aedificatum* from the localities where her party collected but Mansfield (1937, p. 15) stated that *V. aedificatum* occurs in the Gurabo Formation. As Mansfield had access to the U. S. Geological Survey collections made in Santo Domingo, it is presumed that this assignment is correct.



Text figure 2. *Vasum aedificatum* (Guppy) (slightly enlarged, height 62.5 mm). Holotype: British Museum (Nat. Hist.) GG 20255. Photograph courtesy British Museum (Nat. Hist.).

Guppy's species was based on material in the collection of the Geological Society of London, collected in Santo Domingo by J. S. Heneken about 1850. In 1876 Guppy wrote: "In August last Professor Gabb did me the kindness to send me a copy of his publications relating to the geology and paleontology of Haiti.* I deemed the opportunity a favorable one for reexamining the Haitian fossil mollusca, which had been untouched

* The island of Haiti, as it was known at the time, included the Republic of Santo Domingo. Today the island is called Hispaniola, and Haiti is the name of a republic occupying the western one-third of it. This can lead to confusion with titles such as Guppy's *On the Miocene Fossils of Haiti* which actually refers to the fossils from Santo Domingo.

since 1853." (1876, p. 517). The Geological Society Collections are now housed in the British Museum (Nat. Hist.) where Guppy's type specimen has been given the number GG 20255. In the Blake Catalogue of types in the Geological Society Collection (1902, p. 70) this specimen was incorrectly cited as number R 18239, a typographical error for R 12839. This specimen is here figured as Text figure 2.

VASUM GURABICUM Maury

Plate 1, figs. 6, 7

*Vasum dominicense* Gabb, var. *gurabicum* MAURY, 1917, Bulls. Amer. Paleontology, v. 5, no. 29, p. 84(248), pl. 13(39), fig. 7; MAURY, 1917, *ibid.*, no. 30, p. 21(437).

*Vasum dominicense* Gabb, var. *gurabicum* Maury. PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 344 (in synonymy of *V. aedificatum*).

*Diagnosis:* Shell biconic, moderate in size, with eight whorls in the adult. Spiral sculpture of four strong ribs which may bear long spines where they cross each of eight axial ribs. In addition, another spinose rib at the base of the short, somewhat recurved siphonal canal. Secondary spiral ornamentation of a network of fine spiral threads crossed by axial growth lines giving rise to a fimbriate surface texture. Suture wavy, appressed, occurring just anterior to the second row of spines on the previous whorl. Aperture elongate, approximately the same length as the height of the spire. Columella bearing three strong plaits and a free standing inductura on the parietal wall. Outer labium markedly lirate with about a dozen paired lirae.

Dimensions of incomplete holotype: height 37 mm, diameter 24 mm.

Holotype: Paleontological Laboratory, Cornell University, no. 36803.

Type locality: Rio Gurabo at Los Quemados, Dominican Republic.

Horizon: Gurabo Formation, Dominican Republic; middle Miocene.

*Figured specimens:* Fig. 6, ANSP 31242; height 44 mm, diameter, including spines, 27 mm; locality unknown, Gabb Collection, Dominican Republic. Fig. 7, ANSP 31243; height 43.5 mm, diameter 24.5 mm; locality unknown, Gabb Collection, Dominican Republic.

*Discussion:* Maury compared her specimens with *V. dominicense* Gabb and separated the variety *gurabicum* on the basis of the presence of three columellar plaits instead of four. Apparently the species with which she actually was comparing her form was *V. aedificatum* (Guppy) which does in fact have four plications, whereas *V. dominicense* has but three. *V. gurabicum* is compared with *V. aedificatum* in the discussion of the latter species.

The specimens figured here are from the Gabb Collection and are in a much better state of preservation than Maury's type. The development of the spines on the portion of the body whorl between the shoulder and the anterior canal is variable in this species. Figure 6 presents the maximum development, the type specimen somewhat less. Figure 7 has only nodes at the point where the axial ribs are crossed by the spiral ribs. The single row of spines at the base of the canal seems to be constant.

Although several Miocene species, such as *V. subcapitellum*, have been put forth as the "ancestor" of the Recent *V. capitellum*, which is presently confined to the Lesser Antilles and northern South America, *V. gurabicum* is by far the best candidate for the position. The principal difference seems to be the strengthening, in the Recent species, of a fine intercalary rib between the two posterior primary spiral ribs. These are the two ribs which are not covered by the succeeding whorls and thus appear on each whorl of the spire. *V. gurabicum*, therefore, has only two primary ribs on the early whorls, and *V. capitellum* has three, two of which are more prominent.

VASUM PUFFERI Emerson

*Vasum caestum* (Broderip). HANNA, 1926, Calif. Acad. Sci., Proc., (Ser. 4) v. 14, p. 459 (*not* of Broderip).

*Vasum (Vasum) pufferi* EMERSON, 1964, Amer. Mus. Novitates, no. 2202, p. 11, figs. 7, 8.

*Diagnosis:* "The adult shell ranges from 63 to 95 mm, is solid, and heavy. The whorls are estimated to number eight to nine (spires are lacking), are slightly concave on the sides, and are shouldered with spines that are somewhat intermediate in development between the blunt tubercles formed in *V. caestus* and the more delicate, pointed spines of *V. muricatum* . . . In the paratype, there is a ridge below the row of prominent blunt spines near the base of the body whorl. The axial sculpture consists of weakly developed threads, but growth lines are prominent on the body whorl of the holotype. The columellar plaits, according to Hanna (1926, p. 495), number four or five; in the paratype . . . there are four plaits, arranged in the manner typical for *V. caestus*, i.e., two large plaits and one small plait above the basal plait, which is actually a columellar fold. The umbilicus is moderately developed." (Emerson, 1964)

Dimensions of holotype: height 95 mm, diameter approximately 90 mm.

Holotype: University of California, Berkeley; Museum of Paleontology No. 15089.

Type locality: Carrizo Mountain, Imperial County, California.

Horizon: Imperial Formation, California; Pliocene.

*Discussion:* Emerson recently described the first fossil species of *Vasum*, except for Pleistocene specimens of the Recent *V. caestus* (Broderip), to be known from the West Coast of America. He made the statement that this new species "is apparently more closely related to *Vasum muricatum* than to *V. caestus*" and suggested that the West Coast *V. caestus* is not simply the Pacific analogue of *V. muricatum* as has been considered by most authors. However, to this writer's eye, *V. pufferi*, the new species, is like neither *V. caestus* nor *V. muricatum* but is more like the Miocene *V. haitense*. Both *V. muricatum* and *V. caestus* are marked by heavy spiral ribs between the shoulder spines and the base of the siphonal canal. In *V. pufferi* these ribs are lacking and the body whorl is smooth except for very fine ribs such as those seen in *V. haitense*.

The primary resemblance between *V. pufferi* and the Recent *V. caestus* is in the arrangement of the columellar plications. Both have a tendency toward the development of only four of these plaits with a weaker fifth one added sometimes. This is the ancestral condition, for *V. haitense* usually has four plications with the occasional addition of a fifth. The Recent *V. muricatum* has completely lost this variability and always has five, but the West Coast species seems to have retained the older trait. Thus we would seem to have a good case of parallel evolution in two lines which, although separated since the late Miocene, have developed similar forms quite different from their common ancestor. Both have strong spiral ribs and heavy axial folds, although in *V. muricatum* the latter are seen only in gerontic individuals.

### Vasum muricatum (Born)

*Voluta muricata* Born, 1778, Index Rerum Nat. Musei Caesarei Vindobonensis, pt. 1, p. 222; Born, 1780, Testacea Musei Caesarei Vindobonensis, p. 233.

*Vasum urna* Röding, 1798, Museum Boltenianum, p. 56.

*Volutella divergens* Perry, 1810, Arcana, pl. 2 (sign. B 1), fig. 1; Perry, 1811, Conchology, pl. 26, fig. 3.

[?] *Turbinella umbilicaris* Lamarck, 1816, Tableau Encyclopédique et Méthodique, v. 3, pl. 431 B*, figs. 1a, b, c. (Pathologie?)

Not *Turbinella muricata* (Born). Lamarck, 1816, Tableau Encyclopédique et Méthodique, v. 3, pl. 431 B*, fig. 4. Corrected to *T. capitellum* in text, 1832, p. 1087.

*Turbinella capitellum* (Linnaeus). Lamarck, 1816, Tableau Encyclopédique et Méthodique, v. 3, pl. 431 B*, fig. 3. Corrected to *T. pugillaris* in text, 1832, p. 1085.

*Turbinella pugillaris* Lamarck, 1822, Anim. s. Vertèbres, v. 7, p. 104.

*Turbinella pugillaris* Lamarck. Kiener, 1841, Coquilles Vivantes, v. 6, p. 17, pl. 8.

Not *Turbinella muricata* (Born). Grateloup, [1847], Conchyliologie fossile du Bassin de l'Adour, v. 1, Univalves, Atlas, pl. 22 (Turbinelles, pl. 1), fig. 1 (=*T. intermedia* Grateloup; also *T. submuricata* d'Orbigny).

Not *Turbinella pugillaris* (Lamarck). Grateloup, [1847], Conchyliologie fossile du Bassin de l'Adour, v. 1, Univalves, Atlas, pl. 22 (Turbinelles, pl. 1), fig. 3 (=*T. subpugillaris* d'Orbigny).

*Turbinella muricata* (Born). Reeve, 1847, Conchologia Iconica, v. 4, *Turbinella*, pl. 7, figs. 35a, b.

*Vasum muricatum* (Born). Gabb, 1881, Acad. Nat. Sci. Phila., Jour., (Ser. 2) v. 8, no. 4, p. 350.

Not *Vasum muricatum* (Born). Smith, 1919, Calif. Acad. Sci., Proc., (Ser. 4) v. 9, p. 135 (=*V. caestus* Broderip).

*Vasum (Vasum) muricatum* (Born). Abbott, 1950, Johnsonia, v. 2, no. 28, p. 210, pl. 72, figs. 1, 2.

*Vasum muricatum* (Born). Warmke, 1958, Nautilus, v. 72, p. 29, pl. 4, figs. 1 (shell), 3 (radula), 5 (operculum).

*Vasum muricatum* (Born). Shuster and Bode, 1961, Nautilus, v. 75, p. 1.

*Vasum (Vasum) muricatum* (Born). Emerson, 1964, Amer. Mus. Novitates, no. 2202, p. 7, figs. 3, 5.

*Diagnosis:* "Testa plicata, spinisque muricata, columella quinque plicata, perforata.

"Mart. Konch. Kab. III. 99, t. 949. 950. f.

"Testa ponderosa, transversim sulcata, sulcis acutis alternatim aequalibus. Spira conica, nodosa. Anfractus, vertrisque basis spinosa; spinis conicus, fornicatis, obtusis. Apertura oblonga. Labrum exterius denticulatum, subtus plicatum. Columella laevis, rugis transversis tribus majoribus, duabus alternis minoribus. Basis perforata; color albus, aperturae roseus." (Born, 1778).

Dimensions of holotype: height 41 mm, diameter 32 mm.

Holotype: Naturhistorisches Museum, Vienna, no.: 4934/31.

Type locality: Kingston, Jamaica (designated by Abbott, 1950, p. 211).

Horizon: Cubagua Formation, Venezuela; upper Miocene or Pliocene. "Pliocene Clay Beds," Costa Rica; late Pliocene or Pleistocene. Recent, Caribbean Sea. Intertidal to three fathoms (ANMH Collection).

*Discussion:* As with many long known species *V. muricatum* has an excess of available names. *Vasum urna* Röding was based on the same Martini reference as Born's *Voluta muricata. Turbinella pugillaris* Lamarck likewise was referred to the same figures together with two other references which also represent this shell. However, Lamarck's own figure of *T. pugillaris* (1816, pl. 431 bis*, fig. 3) shows a shell with a somewhat higher spire as is discussed further under *V. floridanum.* In 1816 Lamarck also figured another form he called *Turbinella umbilicaris.* This species has never been mentioned by any subsequent author, including Lamarck himself in 1822. The illustration suggests perhaps a pathologic specimen of *V. muricatum.* Perry, in 1810 and 1811, figured a shell to which he gave the name *Volutella divergens.* From his figures it is assumed that the shell intended to be represented is *V. muricatum* although the locality cited is "the coast of Amboyna." Mathews and Iredale (1912, p. 9), in an analysis of Perry's *Arcana,* stated: "this species is perhaps *V. muricatum.*" Abbott (1950, p. 208) designated *Volutella divergens* as the type of the genus *Volutella,* adding that *V. divergens*=*V. rhinoceros* (Gmelin). He subsequently (1959, p. 15) corrected this designation to read "Type by monotypy: *V. divergens* Perry, 1810,= *muricatum* Born 1778."

Dodge (1955, p. 146) made the statement that: "The 'Index" of Born, which bears the date 1778 on the title page was not actually published until 1780. The 'Testacea' bears the date 1780 and was published in that year. The latter is a folio volume limited to Mollusca and is not a second edition of the 'Index,' which included other matter. The two works were prepared simultaneously, as they quote each other." Rutsch (1956, p. 78) refuted this statement and cited evidence that the *Index* was in truth published in 1778 as the title page shows. He also suggested that many of Born's type specimens are in the Naturhistorisches Museum at Vienna. Correspondence with Dr. Oliver M. Paget, of that institution, revealed that the type of *Voluta muricata* Born is still to be found in their collections with the accession number 4934/31.

The distribution of this widespread Caribbean species has been shown in a map by Warmke and Abbott (1961, p. 325). According to this map, the range is from Puerto Rico westward through Central America and south to Colombia. However, the eastward boundary should be extended, for the species has been reported from the Virgin Islands (Abbott, 1950, p. 212) and Antigua (Shuster and Bode, 1961, p. 1). The westward limit in the Gulf of Mexico should also be extended into the Bay of Campeche, for the writer has taken one specimen as far west as Isla Aguada, Campeche, with other specimens from intermediate localities. The northernmost extension of the range is the southern tip of Florida, but the species has not been reported from the Bahamas (Abbott, 1950, p. 211). The range of *V. capitellum* is complementary, extending eastward from Puerto Rico through the Lesser Antilles to Colombia on the northern coast of South America. The two species overlap in the vicinity of Cartagena, Colombia, and at the eastern end of the Greater Antilles.

There is a rare species, *V. truncatum* (G. B. Sowerby, III), 1892, living only off the southern tip of Africa which seems to be most closely related to *V. muricatum.* Abbott (1959, p. 23) described it as being "65 to 72 mm (about 2 to 3 inches) in length, solid whitish, subtriangular and nodulated. Spire flattish, except for the two raised, smooth, papillate nuclear whorls." The periostracum is "rather thick, deciduous, matted, and light brown in color" much like that of *V. muricatum.* It has, however, only four columellar plications, a condition more like the ancestral *V. haitense.* Nothing is known of the history of this offshoot of the New World line.

*V. muricatum* lives in shallow water, usually less than 6 feet, although Perry and Schwengel (1955, p. 171) reported it from as deep as six fathoms off Florida. It prefers a sandy bottom and is almost always found in association with turtle grass.

*V. muricatum* first appears in the Cubagua Formation of Venezuela. It has not

been reported in the literature but there are specimens in the collections of the Museum of Paleontology at the University of California, Berkeley. The exact age of the Cubagua beds is not certain but they are thought to be late Miocene and/or early Pliocene (Rivero, 1956, p. 180).

This species has been reported from the Pliocene Clay Beds at Moin Hill, Costa Rica by Gabb (1881, p. 350). According to Emerson (1964, p. 8) the beds at Moin Hill are to be correlated with the unnamed post-Caloosahatchee formation of southern Florida. This latter formation is the "Unit A" of Olsson and Petit (1964, p. 521) and is thought to be either late Pliocene or early Pleistocene in age. In the Florida beds the species *V. floridanum* is found rather than *V. muricatum* suggesting that the living form evolved in the more southerly reaches of the Caribbean.

VASUM FLORIDANUM McGinty

Plate 6, fig. 5

*Vasum floridanum* McGINTY, 1940, Nautilus, v. 53, p. 82, pl. 10, fig. 1.
*Vasum floridanum* McGinty. ABBOTT, 1950, Johnsonia, v. 2, no. 28, p. 212.
*Vasum (Vasum) floridanum* McGinty. EMERSON, 1964, Amer. Mus. Novitates, no. 2202, p. 8, fig. 6 (holotype).
*Vasum floridanum* McGinty. OLSSON and PETIT, 1964, Bulls. Amer. Paleontology, v. 47, no. 217, p. 522.

*Diagnosis:* "Shell large, spire somewhat elevated, whorls about 7 (nucleus lost), prominently spined; a single row of large spines, not sharp, nine in number on the last whorl; surface sculpture of irregular mostly small spiral ridges, most conspicuous are two flat V-shaped ridges below the crown and two rounded ridges with a smaller between just above the basal spines, two rows of basal spines, about 6 in number with a smaller ridge below not spined each about equidistant; columellar plaits 4, upper largest; surface of shell covered with fine rugose lines of growth. Height 108 mm. (without nucleus), width 81 mm." (McGinty, 1940)

Holotype: McGinty Collection.

Type locality: Ortona Locks, Caloosahatchee River, Florida (upper beds).

Horizon: Unnamed post-Caloosahatchee formation, Florida; late Pliocene or Pleistocene.

*Figured specimen:* USNM 646079; height 121 mm, diameter 116 mm; locality TU 79a. Other occurrences: TU locality no. 759.

*Discussion: V. floridanum* is the northern analogue of *V. muricatum* (Born) the most common and widespread species of *Vasum* in the western Atlantic. The two forms are distinguished on the basis of the four, rather than five, columellar plications of *V. floridanum* and the position of the suture which in *V. muricatum* tends to reach almost to the level of the shoulder spines of the previous whorl, whereas in *V. floridanum* it is somewhat below giving the shell a more steplike elevated spire.

There are specimens of *V. muricatum* which have the suture in the same position as that of *V. floridanum,* although this is a rare condition. Reeve (1847, pl. 7, fig. 35b) and Kiener (1841, pl. 8) both figured shells more like *V. floridanum* than the typical lower spired *V. muricatum.* Lamarck 1822, p. 104) gave the name *Turbinella pugillaris* to the shell which he figured in the *Tableau Encyclopédique et Méthodique* as *"Turbinella capitellum"* (1816, pl. 431 bis*, fig. 3) and it is this shell which Kiener refigured. Kiener's figure does show five columellar plications so there is no question that the shell is *V. muricatum.*

Although there are only four obvious columellar plications in *V. floridanum* there is a much weaker fifth one sometimes developed. Whether this represents an ancestral or a degenerate condition cannot be established at this time. Unfortunately *V. floridanum* is a rare species known from only a few specimens all found near the type locality on the Caloosahatchee River.

VASUM CAESTUS (Broderip)

[?] *Volutella sulcata* PERRY, 1811, Conchology, pl. 26, fig. 2.
*Turbinella ardeola* VALENCIENNES, 1832, Coq. Amer. Équinoxiale (*in* Humboldt and Bonpland, Voyage rég. équinoxiales Nouv. Cont., pt. 2, Recueil obs. zool. et anat. comp. v. 2), p. 283, 284.
*Turbinella caestus* BRODERIP, 1833, Zool. Soc. London, Proc., pt. 1, p. 8.
*Turbinella caestus* Broderip. REEVE, 1847, Conchologia Iconica, v. 4, *Turbinella*, pl. 6, figs. 34a, b.
*Vasum cestus* [*sic*] (Broderip). DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 100.
*Vasum caestus* (Broderip). DALL, 1918, Nautilus, v. 32, p. 23.
*Vasum muricatum* (Born). SMITH, 1919, Calif. Acad. Sci., Proc., (Ser. 4) v. 9, p. 135 (*not* of Born).
Not *Vasum caestum* (Broderip). HANNA, 1926, Calif. Acad. Sci., Proc., (Ser. 4) v. 14, p. 459 (=*V. pufferi* Emerson).
*Vasum caestus* (Broderip). JORDAN, 1936,

Cont. Dept. Geol. Stanford Univ., v. 1, no. 4, p. 115.

*Vasum caestus* (Broderip). PALMER and HERTLEIN, 1936, So. Calif. Acad. Sci., Bull., v. 35, p. 69.

*Vasum caestus* (Broderip). RIVERA, 1953, Min. Conch. Club So. Calif., no. 129, p. 12.

*Vasum caestus* (Broderip). DURHAM, 1950, Geol. Soc. Amer., Mem. 43, p. 104, pl. 35, fig. 11.

*Vasum coestus* [*sic*] "Reeve." ABBOTT, 1950, Johnsonia, v. 2, no. 28, p. 211.

*Vasum caestus* (Broderip). HERTLEIN, 1957, So. Calif. Acad. Sci., Bull., v. 56, p. 64.

*Vasum caestus* (Broderip). EMERSON *in* SQUIRES, 1959, Amer. Mus. Nat. Hist., Bull., v. 118, p. 389.

*Vasum caestus* (Broderip). KEEN, 1964, Seashells of Tropical West America, p. 432, fig. 664.

*Vasum (Vasum) caestus* (Broderip). EMERSON, 1964, Amer. Mus. Novitates, no. 2202, p. 5, figs. 2, 4.

*Diagnosis:* "Turb. testa subrhomboidea, crassissima, ponderosissima, alba, anfractu basali longitudinaliter subplicato, angulato et transversim sulcato, angula tuberculis conico acutis, maximis, armato, sulcis maximis; cingulis basalibus tuberculatis, penultimo maximo; columella quadriplicata; labro sinuato; epidermide crassa, longitudinaliter striata; umbilico magno: Long. 3⅞, lat. 3⅛ poll. [One pollex=one inch]" (Broderip, 1833)

Type locality: Bay of Caracas, Ecuador.

Horizon: Santa Rosalía Formation, Baja California; Colotepec Formation, Oaxaca, Mexico; Tablozos Formation, Ecuador and Peru; Pleistocene. Recent, Gulf of California to Peru. Intertidal to 11 fathoms (AMNH Collection).

*Discussion:* This species, the only Recent *Vasum* from the West Coast of America, had a comparable range in the Pleistocene as evidenced by the numerous reports from various authors cited in the synonymy above. It was reported from Baja California by Dall (1918), Jordan (1936), Durham (1950), Emerson *in* Squires (1959), Hertlein (1957), and Emerson (1964). Although the formation was not named by any of the authors, it is presumed to occur in the Santa Rosalía Formation, named in 1948 by Wilson (p. 1769) for "a thin layer of fossiliferous marine sandstone and conglomerate" of Pleistocene age in the vicinity of Santa Rosalía, Baja California, Mexico. The species was also reported from the Colotepec Formation of Oaxaca, Mexico, by Palmer and Hertlein (1936), and from the Tablozos Formation of Ecuador and Peru by Rivera (1953) and Smith (1919).

Emerson (1964, p. 5) recently discussed this species and concluded that the older name *Vasum ardeolum* (Valenciennes), 1832, should be dismissed as a *nomen oblitum.* In addition to this "forgotten name" there is another name which may apply to this species, *Volutella sulcata* Perry, 1811. Most of Perry's illustrations leave much to be desired, but this one does show distinctly only four columellar plications and has the appearance of a beachworn specimen of *V. caestus.* Perry gave no locality but said the shell was "thick, white, streaked transversely with a bright brown color." On the same plate, Perry gave figures of five other species of *Volutella* which may be identified as *Vasum cornigerum* (fig. 1); *V. muricatum* (fig. 3); *V. capitellum* (fig. 4); *V. ceramicum* (fig. 5); and *V. turbinellus* (fig. 6). Simple process of elimination tends to confirm the identification of figure 2 as *V. caestus.* Like the Valenciennes name, this one also should be considered a *nomen oblitum.*

Considering the conservative nature of the genus *Vasum* as a whole the differences between *V. caestus* and *V. muricatum* are impressive. The most important difference is in the heavy spiral ribs on the body whorl. In *V. muricatum* there are six, but in *V. caestus* there are only four. The ribs in *V. caestus* are, in addition, much heavier than in *V. muricatum.* The periostracum in *V. caestus* is darker brown in color and much thicker than in *V. muricatum.* Another difference, not always constant, is the number of columellar plications. In *V. muricatum* there are always five; three stronger with two weaker ones between. In *V. caestus* there are usually only four, but sometimes a weaker fifth one is intercalated between the posterior two in the fashion of *V. muricatum.* The juvenile of *V. caestus* bears a remarkable resemblance to the ancestral *V. humerosum* as can be seen from the figure given by Emerson (1964, fig. 4). If ontogeny has anything to do with phylogeny then it would appear that *V. caestus* is even more closely related to the ancestral line than is *V. muricatum.*

VASUM CASSIFORME (Kiener)

*Turbinella cassiformis* "Valenciennes" KIENER, 1841, Coquilles Vivantes, v. 6, p. 20, pl. 9, fig. 1.

*Turbinella cassidiformis* Kiener. DESHAYES,

1843, Anim. s. Vertèbres, ed. 2, v. 9, p. 395. (Error, not emendation.)

*Turbinella cassidiformis* Kiener. Reeve, 1847, Conchologia Iconica, v. 4, *Turbinella*, pl. 6, fig. 32.

*Vasum (Vasum) cassiforme* Kiener. Abbott, 1950, Johnsonia, v. 2, no. 28, p. 212, pl. 93, figs. 1, 2.

*Diagnosis:* "T. testa ovata-turbinata, ventricosa, transversim sulcis squamosis cincta, albo-grisea, epidermide fusco-brunea; spira brevi, conica; anfractibus supra planis, carinatis, tuberculis elongatis spinoformibus muricatis; labro dextro plicato; superne subdilatato; columella crassa, triplicata." (Kiener, 1841)

Dimensions of holotype: "3 pouces" [=3 inches]. (Kiener, 1841, p. 21).

Type locality: "l'ocean Atlantique austral, sur les côtes de Bahia." (Kiener, 1841, p. 21).

Horizon: Recent only, coast of Brazil. Five to ten fathoms (ANMH Collection).

*Discussion:* This rare species, apparently confined to the coast of Bahia, Brazil, is an almost direct descendent of *V. chipolense* from the Miocene Chipola Formation of northwestern Florida. Although placed in synonymy of *V. rhinoceros* by Tryon (1882, p. 71), there is only a generic resemblance between the two species. *V. rhinoceros* is a massive shell bearing usually five large bifid nodes at the shoulder. The area between the shoulder nodes and the spines encircling the siphonal canal is almost completely smooth, whereas in *V. cassiforme* the most prominent characteristic is the series of about a dozen squamose spiral ribs. The flaring outer lip which gives rise to the apparent similarity seems to represent parallel evolution in two lines separated since the early Miocene at least. *V. rhinoceros* presumably is descended from the European species *V. aquitanicum.*

VASUM GLOBULUM (Lamarck)

*Bucinella tuberculata* Perry, 1811, Conchology, pl. 27, fig. 7.

*Turbinella globulus* Lamarck, 1816, Tableau Encyclopédique et Méthodique, v. 3, p. 431 B*, fig. 2.

*Turbinella globulus* Lamarck. Lamarck, 1822, Anim. s. Vertèbres, v. 7, p. 107.

*Turbinella globulus* Lamarck. Kiener, 1841, Coquilles Vivantes, v. 6, p. 16, pl. 10, fig. 2.

*Turbinella globulus* Lamarck. Reeve, 1847, Conchologia Iconica, v. 4, *Turbinella*, pl. 2, fig. 11.

*Turbinella nuttingi* Henderson *in* Nutting, 1919, Univ. Iowa. Stud. Nat. Hist., v. 8, no. 3 [(Ser. 1) no. 28], p. 201, pl. 40, fig. 1.

*Vasum (Globivasum) globulum globulum* (Lamarck). Abbott, 1950, Johnsonia, v. 2, no. 28, p. 216.

*Vasum (Globivasum) globulum nuttingi* (Henderson). Abbott, 1950, Johnsonia, v. 2, no. 28, p. 217, pl. 95, figs. 1, 2.

*Vasum globulus nuttingi* (Henderson). Shuster and Bode, 1961, Nautilus, v. 75, no. 1, p. 1, figs. a-d.

*Diagnosis:* "T. testa ventricoso-globosa, umbilicata, crassa, transversim striata et sulcata, alba; plicis longitudinalibus crassis; sulcis crenato-scabris; spira brevi; apertura rosea; columella triplicata." (Lamarck, 1822).

Dimensions of holotype: "19 lignes" [=22.75 mm]. (Lamarck, 1822, p. 107).

Horizon: Recent only, West Africa and Lesser Antilles.

*Discussion:* Abbott (1950, p. 216) separated *V. nuttingi* (Henderson) from the typical *V. globulum* on the basis of the color of the aperture, *V. globulum* "having a bright, rosy-pink aperture instead of a brownish-orange to dark chocolate-brown one." But there are specimens from Antigua, B.W.I., the type locality of *V. nuttingi,* in the Tulane collections which have a pink aperture. Since the shell is in no other way different, a subspecific designation does not seem warranted. Apparently Henderson felt the Antigua species was the same as Lamarck's West African one for the specimens which he sent to the USNM bear the label "*globulus* Lamarck" (Abbott, 1950, p. 218). Henderson did not compare his shell with *V. globulum* in the original description but stated only that it was "a very pretty *Turbinella* of an apparently undescribed species." One would assume that when he discovered the existence of *V. globulum* he realized that his "new species" was the same.

Abbott (1950, p. 215) erected a new subgenus, *Globivasum,* for this species, designating *V. globulum nuttingi* the type. This form represents only the extreme in reduction of spines first seen in the Miocene species, *V. aedificatum,* and would not seem to be necessary.

The ecology of *V. globulum nuttingi* was discussed in detail by Shuster and Bode (1961), and they stated that the normal habitat is the intertidal zone. They also figured an atypical "elongate specimen" (fig. c, p. 5) which shows a marked resemblance to the Miocene *V. aedificatum* mentioned above, offering confirmation of the relationship.

Perry (1810) figured a shell that he named *Bucinella tuberculata* which is almost certainly this species. However, he cited as locality "Amboyna," a locality not in the range of the species as known today. In the interest of stability and in view of the discrepancy in locality it seems advisable to consider Perry's *Bucinella tuberculata* as a *nomen oblitum,* or "forgotten name."

VASUM CAPITELLUM (Linnaeus)

*Murex capitellum* LINNAEUS, 1758, Systema Naturae, ed. 10, p. 750.
*Voluta capitellum* (Linnaeus). LINNAEUS, 1767, Systema Naturae, ed. 12, p. 1195.
*Vasum capitellum* (Linnaeus). RÖDING, 1798, Museum Boltenianum, p. 56.
*Volutella rubescens* PERRY, 1811, Conchology, pl. 26, fig. 4.
*Turbinella muricata* (Born). LAMARCK, 1816, Tableau Encyclopédique et Méthodique, v. 3, pl. 431 B*, figs. 4a, 4b (*not* of Born). Corrected to *T. capitellum* in text, 1832, p. 1087.
Not *Turbinella capitellum* (Linnaeus). LAMARCK, 1816, Tableau Encyclopédique et Méthodique, v. 3, pl. 431 B*, fig. 3. Corrected to *T. pugillaris* in text, 1832, p. 1085.
*Turbinella mitis* LAMARCK, 1822, Anim. s. Vertèbres, v. 7, p. 106.
*Turbinella bilamillata* RISSO, 1826, Nat. Hist. Europe Merid., v. 4, p. 212.
*Turbinella capitellum* "Lamarck." KIENER, 1841, Coquilles Vivantes, v. 6, p. 14, pl. 12, fig. 1.
*Turbinella capitellum* var. *mitis* Lamarck. KIENER, 1841, Coquilles Vivantes, v. 6, p. 14, 16, pl. 12, fig. 2.
*Turbinella capitellum* (Linnaeus). REEVE, 1847, Conchologia Iconica, v. 4, *Turbinella,* pl. 5, fig. 30.
*Vasum (Altivasum) capitellum* (Linnaeus). ABBOTT, 1950, Johnsonia, v. 2, no. 28, p. 214, pl. 94, figs. 1, 2.
*Vasum capitellum* (Linnaeus). WARMKE, 1958, Nautilus, v. 72, p. 29, pl. 4, figs. 2 (shell), 4 (radula), 6 (operculum).

*Diagnosis:* "M. testa ecaudata obovata rugosa nodosa, columella plicata. Argenv. conch. t. 18, f. K." (Linnaeus, 1758)
Holotype: Linnaean Collection, Linnaean Society of London (*fide* Hanley, 1855, p. 234).
Type locality: St. Lucia, Lesser Antilles (designated by Abbott, 1950, p. 215).
Horizon: Recent only, Lesser Antilles to Colombia, S. America.

*Discussion:* As with *V. muricatum, V. capitellum* also bears a number of superfluous names. *Volutella rubescens* Perry, said to be from "Guiana," is unmistakably the same. *Turbinella mitis* Lamarck is merely a less spinose shell and was reduced to a variety of *V. capitellum* by Kiener (1841, p. 16). The only difference in the two forms recognized by Kiener is that the spiniform tubercules are reduced to nodes, usually as a result of wear. His figure of Lamarck's shell verifies this conclusion. A study of the type specimens in the Paris Museum by Fischer-Piette and Beigbeder (1944) did not uncover the Lamarck type specimens, but it did disclose that the type of *Turbinella bilamillata* Risso, 1826, is also only a worn specimen of *V. capitellum.*

*V. capitellum* is descended from the Miocene species *V. gurabicum,* and, as with that species, is highly variable in the degree of spinosity. Abbott (1950, p. 215) suggested: "The great variation in spinosity, which may in some cases be reduced to a simple nodulation, may be due to environmental conditions, although at present there are insufficient data to support this conjecture." Abbott placed *V. capitellum* in the subgenus *Altivasum* which is based on the Australian species *Altivasum flindersi* Verco, 1914. The latter is a large (5 to 6 inches), exceedingly spinose form with a much higher spire. Although *V. capitellum* is a spinose form compared to other New World species, it is only slightly more spinose than the type of *Vasum* (s.s.) and the other Indo-Pacific species. Considering their phylogenetic history, it seems unwarranted to place *V. capitellum* and *V. flindersi* in the same group.

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Subgenus SIPHOVASUM Rehder and Abbott, 1951

*Siphovasum* REHDER and ABBOTT, 1951, Soc. Malac. "Carlos de la Torre," Revista, v. 8, no. 2, p. 61.
Type species: *Vasum (Siphovasum) latiriforme* Rehder and Abbott, by original designation.

VASUM (SIPHOVASUM) LATIRIFORME Rehder and Abbott

*Vasum (Siphovasum) latiriforme* REHDER and ABBOTT, 1951, Soc. Malac. "Carlos de la Torre," Revista, v. 8, no. 2, p. 61, pl. 9, figs. 5, 6.
*Siphovasum latifrons* [*sic*] Rehder and Abbott. SPRINGER and BULLIS, 1956, U. S. Dept. Interior, Special Sci. Rept. Fisheries no. 196, p. 30.

*Diagnosis:* "55 to 60 mm in length, solid, fusiform, weakly umbilicate, angle of spire about 50°, length of spire about 6/10 that of the entire shell. Whorls 8, moderately convex and somewhat shouldered. Nuclear

whorl 1, rather large or slightly bulbous, smoothish and white. Suture wavy, small but rather well-indented, axial sculpture of 6 strong, low ribs which are obscured by the strong spiral cords. Numerous growth lines are miscroscopic threads except near the top of the whorl where they become minute fimbriations consisting of fine axial, anteriorly leaning lamellae. Spiral sculpture of numerous, rather strong, wavy cords of varying sizes. The upper whorls show only 2 or 3 strong cords, the uppermost bearing short or long, scale-like, anteriorly hollowed spines in the regions of the axial ribs. In the last and penultimate whorl this largest, peripheral cord is not spinose. Above it, there is a rather smooth band, bearing 2 or 3 very small spiral cords. Below there are about 14 to 16 slightly smaller cords, often interspaced with a much smaller one. 2 or 3 cords on the siphonal cords bear rather prominent, small anteriorly hollowed scales. Siphonal canal sealed over, its anterior opening obliquely truncate. Umbilicus weakly funnel-shaped, with a very small, deep hole in the center. Aperture oblong, with squarish corners. Peristome entire with the parietal wall elevated. Outer lip minutely curled back, glossy, slightly crenulate. Columella with 3 rather strong plicae which slant anteriorly very little and which are situated about half way up the aperture. Inside of outer wall of aperture with about 6 weak spiral lirae. Color of 2 specimens yellowish white, the third a beautiful even peach to shell pink, except for both sides of the parietal ridge and the interior of the aperture. Periostracum thin, translucent yellow on the immature specimen, scrubbed off in the two adult specimens. Operculum horny, thick, unguiculate, curved, narrow at the anterior (lower) end, rounded at the other, with a muscle scar of about ½ to ⅔ the area of the inner side. Animal unknown." (Rehder and Abbott, 1951)

Dimensions of holotype: height 51 mm (tip broken), diameter 23 mm.

Holotype: USNM 597517.

Type locality: Approximately 60 miles N. W. of Cape Catoche, Territory of Quintana Roo, Mexico.

Horizon: Recent only, Gulf of Mexico.

*Discussion:* The type and only species of this subgenus of *Vasum* is apparently an offshoot of the *Vasum capitellum* line. *Vasum latiriforme* is distinguished by having a much higher spire than *V. capitellum* and a larger nucleus. It is this latter trait together with the closed canal which serves to separate *Siphovasum* as a distinct subgenus. The large nucleus suggests an affinity with the genus *Tudicula* Adams, 1864, a form closely related to *Vasum,* but the general shell morphology suggests placement nearer to typical *Vasum* (s.s.). *V. latiriforme* is little known, but it does not seem to be exceedingly rare. Springer and Bullis (1956, p. 30) reported it from three localities in the Gulf of Mexico, two of these near the type locality off the Yucatán Peninsula and the third off Brownsville, Texas. The type lot was dredged in 18 to 20 fathoms and the other reports are 20, 29, and 124 fathoms respectively.

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Subgenus HYSTRIVASUM Olsson and Petit, 1964

*Hystrivasum* OLSSON and PETIT, 1964, Bulls. Amer. Paleontology, v. 47, no. 217, p. 547. Type species: *Vasum horridum* Heilprin, by original designation.

VASUM (HYSTRIVASUM) JACKSONENSE E. H. Vokes, n. sp.

Plate 4, figs. 1, 2a, 2b

*Diagnosis:* Shell biconic, with probably nine whorls in the adult. Nucleus and early whorls unknown. Axial ornamentation on the median whorls consisting of nodes which become spines in the later growth stages. Spiral ornamentation of several rows of moderately strong cords; seven in number on the body whorl. In addition, in immature specimens, one row of about ten spines at the shoulder and another row of smaller spines just anterior to the suture. The siphonal canal also bearing three to four rows of spines, decreasing in strength from posterior to anterior. Adult specimens less spinose and almost smooth, the spiral cords and spines much diminished. Columella with four plications, the posterior two much stronger than the anterior. Heavy callus over parietal wall partially covering large siphonal fasciole.

Dimensions of immature holotype: height 53.5 mm, diameter 37 mm.

Dimensions of incomplete adult paratype: height 88.5 mm, diameter 55 mm.

Holotype: USNM 645145; paratype: USNM 645146.

Type locality: TU 60, borrow pits at Jackson Bluff, Ochlockonee River, (NW ¼ Sec. 21, T1S, R4W), Leon County, Florida.

Horizon: Choctawhatchee Formation, Florida; upper Miocene.

*Figured specimens:* Fig. 1, USNM 645146 (paratype). Fig. 2, USNM 645145 (holotype).

*Discussion:* This new species of *Vasum,* although not rare at the type locality, is invariably found in a poor state of preservation. There are six specimens in the Tulane collections and the one selected as the type is the best preserved of these. There are other specimens in other collections seen by

the author but none is better. Usually the outer layer of shell spalls off and only columellas are found. Mansfield (1930, p. 62) stated: "A fragment of a shell consisting of the lower columella, collected by Mr. Herman Gunter from Harveys Creek . . . may belong to this genus."

This new species is most nearly allied to the southern Florida species of the *V. olssoni-V. horridum* lineage. The juveniles bear a strong resemblance to the juveniles of *V. horridum,* but the adults seem more akin to *V. olssoni. V. jacksonense* differs from the southern forms in having much reduced spiral ornamentation, resembling in this respect what is assumed to be the ancestral species of both lines, *V. chipolense. V. jacksonense* shares with the *V. olssoni-V. horridum* group the unique trait of a secondary row of spines just anterior to the suture, a character which gives the exceptionally spinose appearance to the members of this group. This trait is not seen in the ancestral *V. chipolense* so presumably *V. jacksonense* and *V. olssoni* diverged from a common intermediate species not yet known. It is this secondary row of spines which serves to distinguish the subgenus *Hystrivasum* to which this new species, as well as the three southern species, is to be referred.

### Vasum (Hystrivasum) olssoni

E. H. Vokes, n. sp.

Plate 5, figs. 1a, 1b; Plate 6, figs. 3, 4

*Diagnosis:* Shell massive with approximately eight post-nuclear whorls in the adult. Nucleus of 1½ smooth, polished whorls, ornamentation beginning gradually with about nine axial nodes on each of the first six whorls. On the median whorls axial ornamentation reduced to small growth lines which, crossing the spiral cords, give rise to a scabrous appearance. Spiral ornamentation consisting of a series of strong cords, about 12 in number; three slightly stronger and bearing open spinelets in young individuals. The most posterior of these three semispinose cords immediately adjacent to the suture, the second at the shoulder, and the third at the base of the siphonal canal. In addition, two weaker ribs between the two posterior cords. Occasionally smaller intercalary riblets between the spiral cords but not invariably. Aperture elongate; outer lip crenulated by the spiral cords, with flaring notches corresponding to the three primary cords. The posterior notch forming a large channel. Inner lip with a heavy callus formed over the parietal wall and a strong siphonal fasciole. Columella bearing four plications diminishing in size from posterior to anterior, the first very wide and the last almost obsolete.

Dimensions of holotype: height 107 mm, diameter 68 mm.

Holotype: USNM 645141.

Type locality: TU 729, west side of Kissimmee River, ½ mile south of U. S. Corps of Engineers Structure 65-D, (S½ Sec. 33, T36S, R33E), Highlands County, Florida.

Horizon: Pinecrest Beds, Florida; upper Miocene.

*Figured specimens:* Figs. 1 and 3, USNM 645141 (holotype). Fig. 4, USNM 645142 (paratype); height 40 mm, diameter 22 mm; locality TU 729. Other occurrences: TU localities 535, 581, 728, 730, 737, 769.

*Discussion: V. olssoni* is the oldest member of a distinct evolutionary sequence seen in the upper Miocene and Pliocene of southern Florida. There are several trends that can be observed in this line which includes, together with *V. olssoni,* the uppermost Miocene species *V. locklini* Olsson and Harbison, and the Pliocene *V. horridum* Heilprin. The first of these trends is the number of shoulder spines which decreases with more recent time. The number of spines (if they can be said to be counted) in *V. olssoni* is on the order of 25 to 30; in *V. locklini* it averages from 13 to 18 (although it may vary from 11 to 20); in *V. horridum* it averages 10 to 13 (varying from 9 to 16). At the same time the length of the spines is increasing so that, whereas *V. olssoni* has only scabrous open spinelets, *V. horridum* bears a crown of long shoulder spines and a second row of spines circling the anterior canal. A third trend seen is the decrease in the number of intermediate spiral cords between the more-or-less spinose cord at the shoulder and the one circling the anterior canal. In *V. olssoni* there are usually six, in *V. locklini* five and in *V. horridum* only four. However, the anteriormost of these intermediate cords is variable in strength so that at times it is as strong as the others, but may be much weaker so the exact number is variable by one cord.

Although *V. olssoni* and *V. locklini* both occur in the upper Miocene Pinecrest Beds they are not contemporaneous; *V. olssoni* is in the older part of the formation and *V. locklini* is in what Olsson (*in* Olsson and Petit, 1964, p. 517) termed "the Brighton facies," apparently the youngest beds of the Pinecrest. At the type locality of *V. olssoni*

(TU 729) specimens of *V. locklini* are found at the southernmost exposure of the "outcrop" (actually dredge piles) suggesting a transition at this point.

To the northwest of Lake Okeechobee the Neogene beds are well developed in a time offlap sequence. Deposits in the vicinity of Fort Basinger are the oldest and carry a fauna equivalent to that of the type Pinecrest at Forty-Mile Bend. To the south of Fort Basinger one passes through the "Brighton facies" into the Pliocene Caloosahatchee Formation just at the edge of the lake near the Harney Pond Canal. South and southwest of Lake Okeechobee the reverse situation is seen with the Miocene reappearing at the surface (although it is present in the subsurface farther north) at about the Broward-Palm Beach County line and continuing to the Tamiami Trail. Much of this area is overlain by Olsson's "Unit A," a late Pliocene or Pleistocene formation and to the east of Lake Okeechobee this is almost all that is seen at the surface.

The ancestry of the *V. olssoni-V. horridum* line is uncertain but it is probable that the Chipola species *V. chipolense* is the ancestor of the group. The relationship of the two forms is discussed further under the latter species. Certainly the line left no known descendants. All of the Recent species of *Vasum* have an ancestry traceable to some other line and none bears any resemblance to the *V. olssoni* group.

### Vasum (Hystrivasum) locklini

Olsson and Harbison

Plate 5, fig. 2; Plate 6, fig. 1

*Vasum locklini* Olsson and Harbison, 1953, Acad. Nat. Sci. Phila., Mon. 8, p. 194, pl. 40, fig. 1.

*Vasum (Hystrivasum) locklini* Olsson and Harbison. Olsson and Petit, 1964, Bulls. Amer. Paleontology, v. 47, no. 217, p. 547.

*Diagnosis:* "Shell biconic, solid, white, sculptured with strong, spiniferous or scabrous spiral cords in the adult stage. Whorls 10 or more, forming a medium-height spire, the earliest whorls of which have a more elevated form and a simpler sculpture of spirals and *Fusus*-like ribs. Sutures indistinct, wholly or partly covered by the sutural cord. On the last whorl, the shoulder is strongly angled and bears a crown-like ring of crowded, reflexed, fluted spines or tubercles, generally 18 in number. Another similar but lower ring of tubercles adjoins the sutures. In the middle zone of the body-whorl between the shoulder and above the plicated columella, there are 5 smaller cords, the upper one the strongest and somewhat spiniferous, the others merely scabrous; these cords are separated by quite wide, flattened and nearly smooth intervals. Anterior canal has three or four strongly spiniferous cords. Base not constricted, the inner lip with a shelf of callus. Columella has 4 horizontal to slightly oblique folds. Tip of anterior canal narrowly umbilicate or perforate." (Olsson and Harbison, 1953)

Dimensions of holotype: height 80 mm, diameter 57 mm.

Holotype: ANSP 19313.

Type locality: Acline, Florida (=TU 200).

Horizon: Pinecrest Beds, Florida; upper Miocene.

*Figured specimen:* USNM 645143; height 123 mm, diameter 87 mm, locality TU 520. Other occurrences: TU localities 200, 283, 523, 532, 540, 728, 729, 740, 741, 742, 752, 753, 756, 769, 770.

*Discussion:* Although the type of this species was originally cited as from Shell Creek, Florida (=TU 539B), there was an error in the locality data in the Locklin Collection and the specimen came from Acline, Florida (=TU 200), according to Druid Wilson *(in litt.)* who has worked with the collection for many years. The beds at Acline correspond to the so-called "Brighton facies" north of Lake Okeechobee and probably represent the uppermost beds of the Pinecrest. *V. locklini* is intermediate in form between *V. olssoni,* n. sp., and *V. horridum.* The spines at the shoulder are more pronounced than in *V. olssoni* and more numerous than in *V. horridum;* thus, this intermediate species is in reality much more "horrid," or spiny, than true *V. horridum.*

### Vasum (Hystrivasum) horridum

Heilprin

Plate 5, fig. 3; Plate 6, fig. 2

*Vasum horridum* Heilprin, 1887, Wagner Free Inst. Sci., Trans., v. 1, p. 75, pl. 4, figs. 6, 6a; p. 132, pl. 16a, fig. 72.

*Turbinella (Vasum) horridum* Heilprin. Dall, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 99.

*Vasum horridum* Heilprin. Cossmann, 1901, Essais Paléoconch. Comp., v. 4, p. 66. (Reference to Heilprin, 1887, pl. XV, fig. 44 in error, = *V. subcapitellum.*)

*Vasum horridum* Heilprin. Dall, 1903, Wagner Free Inst. Sci., Trans., v. 3, pt. 6, p. 1607.

*Vasum horridum* Heilprin. Maury, 1925, Serv. Geol. Min. Brasil, Mon. 4, p. 156-157.

*Vasum horridum* Heilprin. COOKE and MOSSOM, 1929, Florida Geol. Surv., Ann. Rep. 20, pl. 19, fig. 4.
*Vasum horridum* Heilprin. MANSFIELD, 1939, Florida Geol. Surv., Bull. 18, p. 19.
*Vasum horridum* Heilprin. COOKE, 1945, Florida Geol. Surv., Bull. 29, fig. 28-4 (after Cooke and Mossom, 1929).
*Vasum horridum* Heilprin. OLSSON and HARBISON, 1953, Acad. Nat. Sci. Phila., Mon. 8, p. 195, pl. 40, figs. 2, 2a.
*Vasum horridum* Heilprin. DUBAR, 1958, Florida Geol. Surv., Bull. 40, p. 190, pl. 10, fig. 15.
*Vasum horridum* Heilprin. GLIBERT, 1960, Inst. Roy. Sci. Nat. Belg., Mem., (Ser. 2) fasc. 61, p. 45.
*Vasum (Hystrivasum) horridum* Heilprin. OLSSON and PETIT, 1964, Bulls. Amer. Paleontology, v. 47, no. 217, p. 547.

*Diagnosis:* "Shell ovate, thick, ventricose, with the greatest width at about the middle; spire elevated, about one-fourth the length of the shell, and consisting of ? nodulose volutions [*sic*].

"Body-whorl strongly angulated on the shoulder—the angulation being at an angle of about 45 degrees to the outer wall—and probably prominently coronated with foliaceous or lamellar tubercles; surface, as well as that of the rest of the shell, profoundly grooved, with about eight sharply elevated revolving ridges below the shoulder angulation, the sixth and seventh from the top most prominent, and separated from each other by a space equal to two of the other interspaces; sutural line somewhat impressed, and bordered inferiorly by a lamellar ridge; aperture produced posteriorly [anteriorly] into a short canal, somewhat more than one-half the length of the shell.

"Columellar surface covered with a thick deposit of callus, which leaves partially exposed a broad umbilicus; columellar plaits three, of which only the upper two are prominent, the basal one being rudimentary.

"Length of imperfect specimen, lacking probably a full half-inch, about five and a half inches; width, three and a half inches." (Heilprin, 1887)

Holotype: Wagner Free Inst. Sci. no. 908.

Type locality: Caloosahatchee River, below Fort Thompson, Florida.

Horizon: Caloosahatchee Formation, Florida; Pliocene.

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PLATE 1

Figures — Page

1. *Vasum humerosum* Vaughan (X 1½) — 4
USNM 645136; height 39 mm, diameter 26 mm.
Locality: TU 99. Moody's Branch Marl.

2. *Vasum subcapitellum* Heilprin (X 1½) — 5
USNM 165072; height 41 mm, diameter 27.5 mm.
Locality: Ballast Point, Tampa Bay, Florida. Tampa Limestone.

3. *Vasum subcapitellum* Heilprin (X 1½) — 5
USNM 111927; height 26 mm, diameter 16.4 mm.
Locality: Ballast Point, Tampa Bay, Florida. Tampa Limestone.

4. *Vasum subcapitellum* Heilprin (X 1½) — 5
USNM 165072a; height 30 mm, diameter 18.5 mm.
Locality: Ballast Point, Tampa Bay, Florida. Tampa Limestone.

5. *Vasum aedificatum* (Guppy) (X 1½) — 12
ANSP 2625; height 51 mm, diameter 29.5 mm.
Locality: Dominican Republic. Gurabo Formation.

6. *Vasum gurabicum* Maury (X 1½) — 14
ANSP 31242; height 44 mm, diameter, including spines, 27 mm.
Locality: Dominican Republic. Gurabo Formation.

7. *Vasum gurabicum* Maury (X 1½) — 14
ANSP 31243; height 43.5 mm, diameter 24.5 mm.
Locality: Dominican Republic. Gurabo Formation.

8. *Vasum dominicense* Gabb (X 1) — 7
ANSP 2623 (lectotype); height 60 mm, diameter 37.5 mm.
Locality: Dominican Republic. ? Baitoa Formation.


PLATE 1

*Figured specimen:* USNM 645144; height 106 mm, diameter, including spines, 82 mm; locality: TU 519. Other occurrences: TU localities 79b, 202, 203, 283, 527, 529, 539b, 541, 579, 583, 726, 745, 755, 767, 770.

*Discussion: V. horridum* is characterized by a crown of long spines extending almost horizontally from the shoulder. The species is widespread in the Caloosahatchee Formation and is evidently restricted to that formation. In 1964 Olsson and Petit designated *V. horridum* the type of a new subgenus, *Hystrivasum,* for the species in which "the angled shoulder is armed with a crown of fluted spines." (p. 547). However, *Vasum turbinellus,* the type of the genus, although smaller, is certainly just as "spiny" in proportion to its size as *V. horridum.* The one character which is unique to the group designated as *Hystrivasum* is the possession of a secondary row of spines just anterior to the suture. This row of spines is not seen in any other species of *Vasum* except the four Florida species: *V. jacksonense, V. olssoni, V. locklini,* and *V. horridum.* It is this characteristic which is the diagnostic feature of the subgenus.

### V. Locality Data

60. Choctawhatchee Fm., borrow pits at Jackson Bluff, Ochlockonee River, (NW ¼ Sec. 21, T1S, R4W), Leon Co., Florida.
79b. Coloosahatchee Fm., Ortona Locks, Caloosahatchee River, (Sec. 27, T42S, R30E), Glades Co., Florida.
79a. Unnamed post-Caloosahatchee formation, same as TU 79b, but stratigraphically higher.
99. Moody's Branch Marl, Montgomery Landing (also known as Creola Bluff), Red River, (Sec. 20, T8N, R5W), Grant Parish, Louisiana.
200. Pinecrest Beds, borrow pits about one mile southwest of Acline, (Sec. 29, T41S, R23E), Charlotte Co., Florida.
202. Caloosahatchee Fm., south bank of Caloosahatchee River, about two miles west of LaBelle, (SE ¼ Sec. 12, T43S, R28E), Hendry Co., Florida.
203. Caloosahatchee Fm., north bank of Calcosahatchee River, about two miles east of Fort Denaud, (SW ¼ Sec. 11, T43S, R28E), Hendry Co., Florida.
283. Pinecrest Beds, spoil banks on cross canal 1.3 miles southwest of Port Charlotte Railroad Station (formerly Murdock), on Florida Highway 771, (Sec. 12, T40S, R21E), Charlotte Co., Florida.
457. Chipola Fm., west bank of Chipola River, about ½ mile below Ten Mile Creek, (SW ¼ 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.
519. Caloosahatchee Fm., Harney Pond Canal spoil banks, at Florida Highway 78, northwest side of Lake Okeechobee, (NW ¼ Sec. 18, T40S, R33E), Glades Co., Florida.
520. Pinecrest Beds, spoil banks, canal 0.9 miles east of Brighton on Florida Highway 70, (Sec. 25, T37S, R32E), Highlands Co., Florida. (Incorrectly given in previous papers as "⅓ mile east of Brighton.")
523. Pinecrest Beds, Harney Pond Canal spoil banks, six miles northwest of Florida Highway 78, Brighton Indian Reservation, (NW ¼ Sec. 22, T39S, R32E), Glades Co., Florida.
527. Caloosahatchee Fm., north shore Lake Okeechobee, Pumping Station no. 127, (NE ¼ Sec. 35, T39S, R33E), Glades Co., Florida.

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### Plate 2

Figures Page

1. *Vasum chipolense* E. H. Vokes, n. sp. (X 1) ..... 10
   USNM 645137 (holotype); height 88 mm, diameter 53 mm.
   Locality: TU 547. Chipola Formation.

2. *Vasum chipolense* E. H. Vokes, n. sp. (X 1) ..... 10
   USNM 645212 (paratype); height 47 mm, diameter 30 mm.
   Locality: TU 547. Chipola Formation.

3. *Vasum pugnans* Pilsbry and Johnson (X 1) ..... 9
   ANSP 2626 (holotype); height 80 mm, diameter 50 mm.
   Locality: Dominican Republic. ? Baitoa Formation.

4. *Vasum tuberculatum* Gabb (X 1) ..... 8
   ANSP 2624 (lectotype); height 111 mm, diameter 86 mm.
   Locality: Dominican Republic. ? Baitoa Formation.

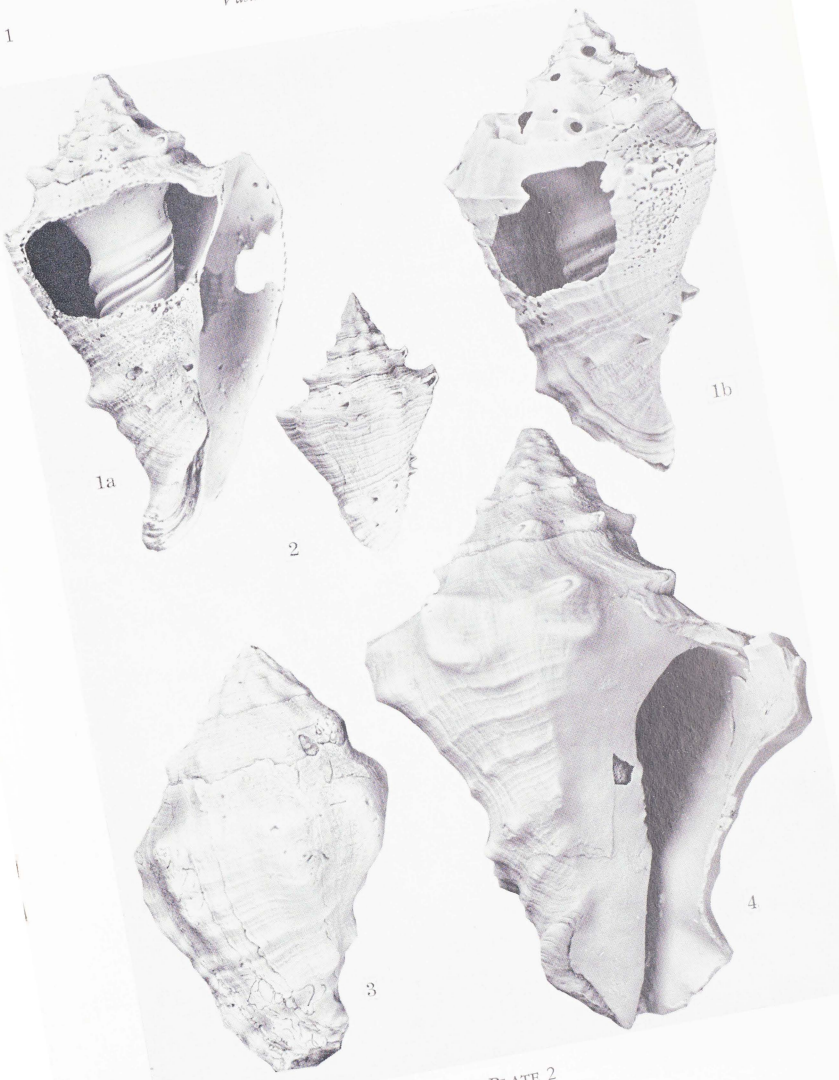


PLATE 2

529. Caloosahatchee Fm., north bank of Caloosahatchee River, about two miles west of LaBelle, (SE ¼ Sec. 12, T43S, R28E), Hendry Co., Florida.
532. Pinecrest Beds, spoil banks on cross canal 1¾ miles south of Florida Highway 771, 1.3 miles southwest of Port Charlotte Railroad Station (formerly Murdock), (SE ¼ Sec. 24, T40S, R21E), Charlotte Co., Florida.
535. Pinecrest Beds, Indian Prarie Canal spoil banks, at Florida Highway 78, north shore Lake Okeechobee, (Sec. 24, T39S, R33E), Glades Co., Florida.
539b. Caloosahatchee Fm., lower beds Shell Creek, about eight miles east of Cleveland, (Sec. 30, T40S, R25E), Charlotte Co., Florida.
540. Pinecrest Beds, Miami Canal spoil banks, one to three miles south of pumping station at Palm Beach county line, Broward Co., Florida.
541. Caloosahatchee Fm., Miami Canal spoil banks, two miles north of pumping station at Broward county line, Palm Beach Co., Florida.
546. Chipola Fm., Ten Mile Creek, about 1¼ miles west of Chipola River (NE ¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.
547. Chipola Fm., west bank of Chipola River (SW ¼ Sec. 29, T1N, R9W), Calhoun Co., Florida.
548. Chipola Fm., west bank of Chipola River (NW ¼ Sec. 29, T1N, R9W), Calhoun Co., Florida.
554. Chipola Fm., east bank of Chipola River, at power line crossing (SW ¼ 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.
581. Pinecrest Beds, pits on south side of U. S. Highway 41, at Dade-Collier county line, Collier Co., Florida.
583. Caloosahatchee Fm., Miami Canal spoil banks, seven miles north of pumping station at Broward county line, Palm Beach Co., Florida.
726. Caloosahatchee Fm., Hendry County rockpit, ½ mile north of Florida Highway 80, three miles west of La Belle, (SE ¼ Sec. 14, T43S, R28E), Hendry Co., Florida.
728. Pinecrest Beds, spoil banks on west side of Kissimmee Canal and east side of Kissimmee River, just across from U. S. Corps of Engineers Structure 65-D, (Sec. 33, T36S, R33E), Okeechobee Co., Florida.
729. Pinecrest Beds, spoil banks on west side of Kissimmee Canal and east side of Kissimmee River, approximately ½ mile south of U. S. Corps of Engineers Structure 65-D, (S ½ Sec. 33, T36S, R33E), Highlands Co., Florida.
730. Pinecrest Beds, embankment of Seaboard Airline Railroad, just west of Kissimmee River, (NW ¼ Sec. 20, T36S, R33E), Highlands Co., Florida.
736. Pinecrest Beds, spoil banks on east side of Kissimmee River and south side of Florida Highway 70, (Sec. 19, T37S, R34E, and Sec. 25, T37S, R33E), Okeechobee Co., Florida.
737. Pinecrest Beds, levee fill, L-28, 2.8 miles west of gate at U. S. Corps of Engineers Structure S-12-A, at "Forty-Mile

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PLATE 3

Figures Page

1. *Vasum haitense* (Sowerby) (X 1) ..... 10
   USNM 645138; height 62.5 mm, diameter, including spines, 58 mm.
   Locality: TU 457. Chipola Formation.

2. *Vasum haitense* (Sowerby) (X 1) ..... 10
   USNM 645139; height 51 mm, diameter 52.5 mm.
   Locality: TU 458. Chipola Formation.

3. *Vasum haitense* (Sowerby) (X 2) ..... 10
   USNM 645140; height 18.6 mm, diameter 13 mm.
   Locality: TU 458. Chipola Formation.

4. *Vasum haitense* (Sowerby) (X 1) ..... 10
   ANSP 2627; height 81 mm, diameter 72.5 mm.
   Locality: Dominican Republic. ? Gurabo Formation.

5. *Vasum quirosense* F. Hodson (X 2) ..... 6
   PRI 24115 (holotype); height 28 mm, diameter 27 mm.
   Locality: El Mene de Saladillo, 1.5 km southwest of Quiroz, Dist. of Miranda, Zulia, Venezuela. La Rosa Formation.

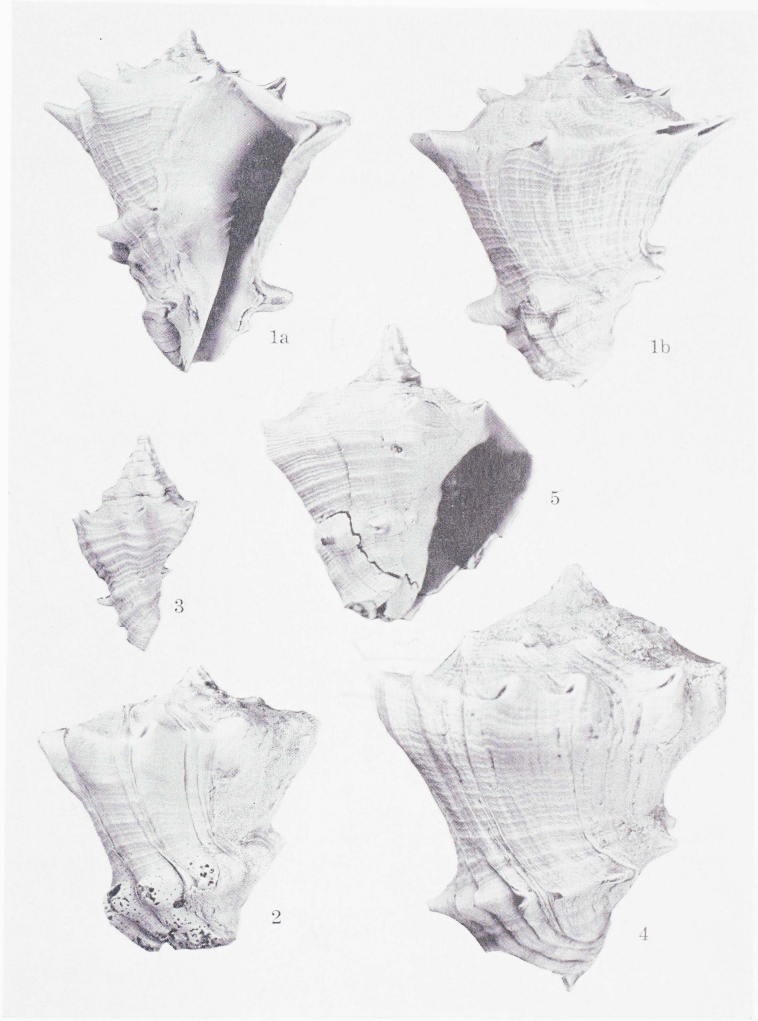


PLATE 3

Bend," U. S. Highway 41, Dade Co., Florida.

740. Pinecrest Beds, levee fill, L-28, 3.6 miles west and 2.6 miles south of pumping station on Miami Canal at Broward-Palm Beach county line, Broward Co., Florida.

741. Pinecrest Beds, levee fill, L-28, 3.6 miles west and 3.6 miles south of pumping station on Miami Canal at Broward-Palm Beach county line, Broward Co., Florida.

742. Pinecrest Beds, levee fill, L-28, 3.6 miles west and 5.6 miles south of pumping station on Miami Canal at Broward-Palm Beach county line, Broward Co., Florida.

745. Caloosahatchee Fm., Miami Canal spoil banks, 10.8 miles north of pumping station at Broward county line, Palm Beach Co., Florida.

752. Pinecrest Beds, spoil banks on south side of Canal 41-C ("Slough Ditch") at crossing of country road, 4.3 miles east of Brighton and 1.4 miles south of Florida Highway 70, (SE ¼ Sec. 33, T37S, R33E), Highlands Co., Florida.

753. Pinecrest Beds, spoil banks on south side of Canal 41-C, 1.5 miles east of TU locality 752, or 5.8 miles east of Brighton, (SE ¼ Sec. 35, T37S, R33E), Highlands Co., Florida.

755. Caloosahatchee Fm., Miami Canal spoil banks, 17.4 miles north of pumping station at Broward county line, Palm Beach Co., Florida.

756. Pinecrest Beds, spoil banks west side of Elkcan Waterway, Port Charlotte Development, 2.3 miles southeast of Port Charlotte Railroad Station (formerly Murdock) and 1.7 miles east of U. S. Highway 41, (Sec. 10, T40S, R22E), Charlotte Co., Florida.

759. Unnamed post-Caloosahatchee formation, north side of Caloosahatchee River, two miles west of Ortona Locks, (NE ¼ Sec. 29, T42S, R30E), Glades Co., Florida.

767. Caloosahatchee Fm., north side of Caloosahatchee River, five miles west of Ortona Locks, (NW ¼ Sec. 36, T42S, R29E), Glades Co., Florida.

769. Pinecrest Beds, spoil banks east side of Kissimmee River, 1½ to two miles south of U. S. Corps of Engineers Structure 65-D, (NE ¼ Sec. 35, T36S, R33E), Okeechobee Co., Florida.

770. Pinecrest Beds and Caloosahatchee Fm. mixed, spoil banks west side of Kissimmee River, 1½ to 3½ miles north of Florida Highway 70, (Secs. 10, 14, 15, and 28, T37S, R33E), Highlands Co., Florida.

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## Plate 4

Figures Page

1. *Vasum jacksonense* E. H. Vokes, n. sp. (X 1) ..... 21
   USNM 645146 (paratype); height 88.5 mm, diameter 55 mm.
   Locality: TU 60. Choctawhatchee Formation.

2. *Vasum jacksonense* E. H. Vokes, n. sp. (X 1) ..... 21
   USNM 645145 (holotype); height 53.5 mm, diameter 37 mm.
   Locality: TU 60. Choctawhatchee Formation.

3. ? *Vasum haitense* (Sowerby) (X 1) ..... 10
   USNM 165070; height 109 mm, diameter 94 mm.
   Locality: Ballast Point, Tampa Bay, Florida. Tampa Limestone.

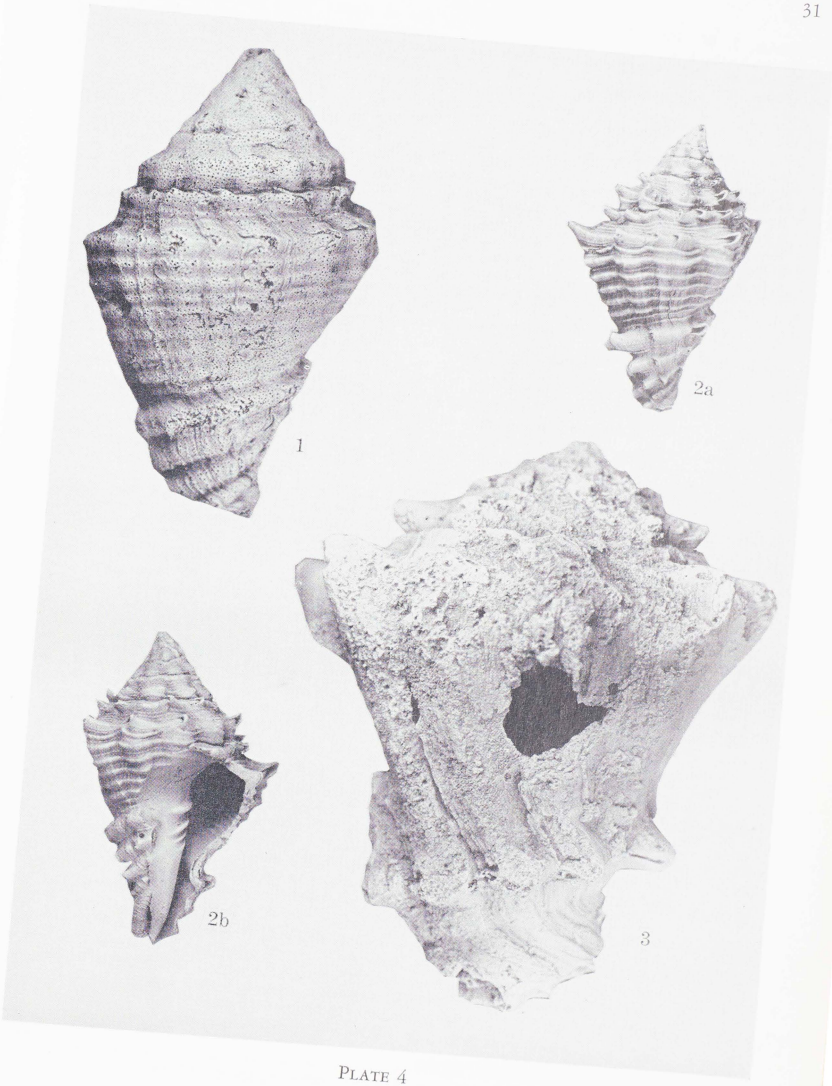


PLATE 4

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## PLATE 5

Figures Page

1. *Vasum olssoni* E. H. Vokes, n. sp. (X 0.8) ..... 22
   USNM 645141 (holotype); height 107 mm, diameter 68 mm.
   Locality: TU 729. Pinecrest Beds.

2. *Vasum locklini* Olsson and Harbison (X 0.8) ..... 23
   USNM 645143; height 123 mm, diameter 87 mm.
   Locality: TU 520. Pinecrest Beds.

3. *Vasum horridum* Heilprin (X 0.8) ..... 23
   USNM 645144; height 106 mm, diameter, including spines, 82 mm.
   Locality: TU 519. Caloosahatchee Formation.

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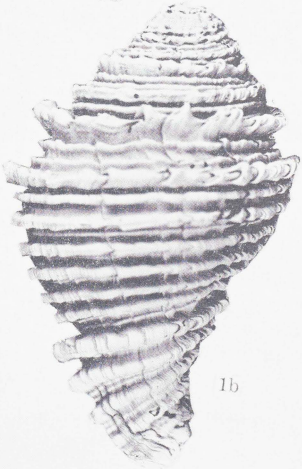

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PLATE 5

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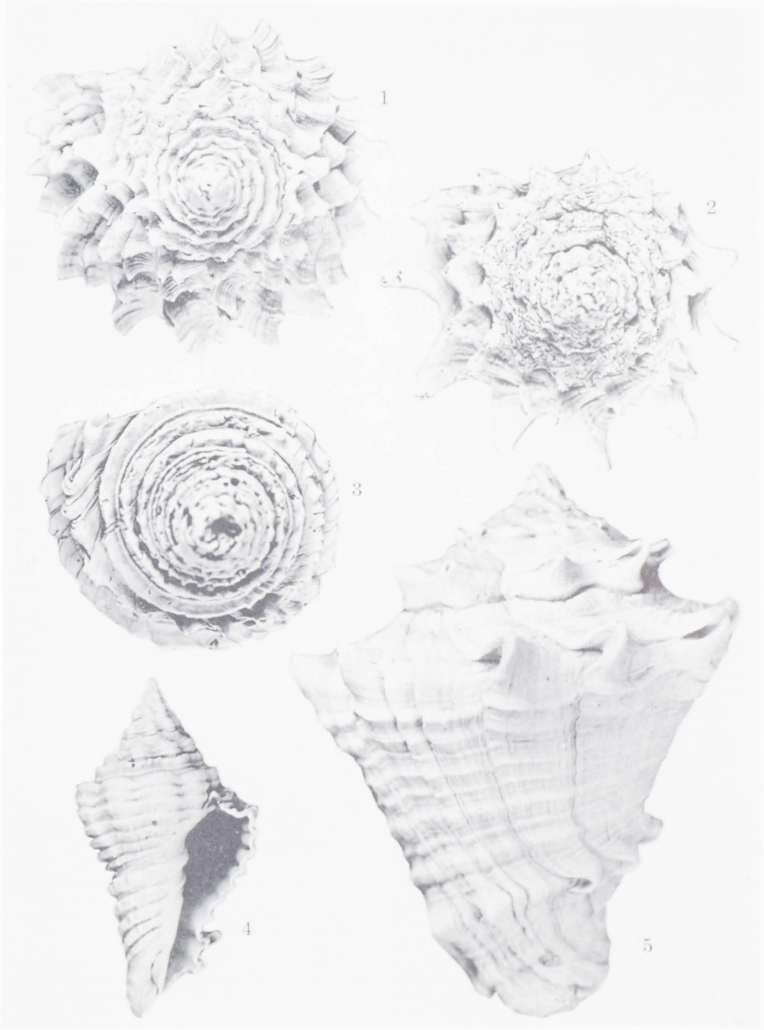
## PLATE 6

Figures

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# A NEW SPECIES OF *CHICOREUS* (MOLLUSCA: GASTROPODA) FROM THE MIOCENE OF SOUTHERN FLORIDA

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CHICOREUS (CHICOREUS) SHIRLEYAE

E. H. Vokes, n. sp.

Text figure 1

*Diagnosis:* The shell is fusiform, having ten whorls in the adult. Nucleus consists of two smooth whorls terminating abruptly in a small varix. Ornamentation of the early whorls is cancellate, formed by about ten axial nodes crossed by four spiral ridges. On about the third post-nuclear whorl varices begin to be formed by the increase in size of every third axial node, giving rise to three varices per whorl. The other nodes persist as intervarical swellings for about five post-nuclear whorls but gradually die out until the adult is more-or-less completely unnoded between the varices. The spiral sculpture, at first a series of four single ridges, soon develops a multitude of smaller threads covering the surface of the ridges and also the interspaces. With each successive whorl more threads are added until the entire surface of the shell is covered; however, the original four ridges are still present and form the large ramous spines at the varices. On the body whorl there are six such ridges with an additional three on the extended siphonal canal. Between each of the major spirals a slightly smaller, narrow ridge is developed in the later stages. The suture is deeply incised in the adult shell. Where the spiral ridges cross the axial varices large open spines are formed, each spiral thread opening into a digitation on the spine. The smaller intermediate ridges are not produced into spines but form small notches in the apertural lip. The outer lip is formed in advance of the varix and the open spines are closed over so that the edge is continuous, but crenulated with twelve small notches representing each of the spines and the intermediate ridges. When the next growth segment is added this labium remains as a distinct line in front of the varix. The most posterior spine is greatly reflexed, and cemented to the former whorl, forming a deep anal notch. The inner lip is smooth, standing free at the anterior end of the columella. The siphonal canal is long and recurved, partially covered over by a lamellar extension from the columellar wall. Each previous canal remains as a spur off the canal.

Dimensions of holotype: height 88 mm, diameter 39 mm.

Holotype: USNM 645147.

Type locality: TU 729, west side of Kissimmee Canal, east side of Kissimmee River, approximately ½ mile south of U. S. Corps of Engineers Structure 65-D, (S ½ Sec. 33, T36S, R33E), Okeechobee County, Florida. Paratype material from TU localities 728 and 730.

Horizon: Pinecrest Beds, Florida; upper Miocene.