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CENOZOIC MURICIDAE OF THE WESTERN ATLANTIC REGION

PART VI—*ASPELLA AND DERMOMUREX*

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I. ABSTRACT

The two muricine genus-groups *Aspella* Mörch and *Dermomurex* Monterosato share certain unusual shell-characters that suggest they had a common ancestor, but it has not been recognized. The two groups begin almost simultaneously in geologic time: *Dermomurex* is slightly older, occurring first in the early Oligocene of Mississippi then in the late Oligocene of western France, the latter together in time, although not in space, with the first *Aspella* in the late Oligocene of southern France. There are numerous species of both genera found in many parts of the world throughout ensuing time. In the Recent

fauna *Aspella* occurs in both the eastern and western Pacific Ocean, in the Indian Ocean, and in the western Atlantic. There are no living eastern Atlantic or Mediterranean forms known. *Dermomurex* is well represented in the New World by eight species, either eastern Pacific or western Atlantic. There are but three Indo-Pacific species, plus the type of the genus found in the Mediterranean. Five of the Recent species are placed in *Dermomurex* s.s., two each in the subgenera *Takia* Kuroda, *Trialatella* Berry, and *Gracilimurex* Thiele, and one in *Viator* Vokes.

In this paper the western Atlantic species are treated systematically, but there is only one member of *Aspella* as yet described, *A. senex* Dall, a Pliocene to Recent form often confounded with the Indo-Pacific *A. anceps* (Lamarck). Because of the undue amount of confusion over the Recent species of *Aspella* s.s., several of the Indo-Pacific species are illustrated for comparison with the western Atlantic *A. senex.*

There are eleven western Atlantic species assigned to *Dermomurex,* ranging in age from early Oligocene to Recent. Of these, three each are placed in the subgenera *Dermomurex* s.s., *Trialatella,* and *Viator,* and one each in *Gracilimurex* and *Takia.* Of that number five are new species described herein: *Dermomurex (Dermomurex) matercula, D. (Trialatella) farleyensis,* and *D. (? Viator) curviductus,* all from the late lower Miocene Chipola Formation of northwestern Florida; *D. (Takia) cookei,* from the early Oligocene of Mississippi; and *D. (Trialatella) antecessor,* from the Pleistocene of Florida and Costa Rica.

II. INTRODUCTION

The systematic position and relationships of the groups treated in this paper have been subject to a great deal of shifting about over the years. *Aspella* was originally named in the Ranellidae (= Bursidae) because of its two-varixed form; *Dermomurex* was placed in the Muricinae because of its three or six-varixed form. Later, the chalky outer layer that is so characteristic of both seemed to indicate placement in the Trophoninae (Cossmann, 1903, p. 55).

The writer once made the statement (Vokes, 1964, p. 29): "The genus *Aspella* seems to be intermediate between the Muricinae and the Tritonaliinae [Ocenebrinae] with the operculum of the first and a radula which is closer to the second." The basis of this statement was Troschel's illustration of the radula of *"Murex alveatus,"* which at that time was the only radular drawing available believed referrable to the group. The identity of *"Murex alveatus"* was somewhat uncertain but it was thought to be an *Aspella.* Further work has shown *M. alveatus* to be an older name for *M. intermedius* C. B. Adams, from the Caribbean, and both it and *M. erosus* are now considered to belong to the genus *Favartia,* subgenus *Caribiella,* of the subfamily Muricopsinae (Radwin and D'Attilio, 1971, p. 64). Radular drawings subsequently provided the writer by Messrs. Radwin and D'Attilio show an unequivocal muricine radular type for all of the species of *Aspella* and *Dermomurex* thus far investigated.

Keen (1971, p. 296) erected a subfamily Aspellinae to include not only *Aspella* and its kin, but also *Eupleura, Calotrophon, Attiliosa, Favartia,* and *Phyllocoma.* As the writer has discussed previously (Vokes, 1971a, p. 7, footnote), the need for this subfamily has not been adequately demonstrated.

The most recent suggestion for subfamilial placement was that of Radwin and D'Attilio (1971, p. 59), who, because of the chalky outer layer, concluded that the Typhinae might also include *Aspella* and *Dermomurex.* There is a certain logic in placing the aspelloids in the Typhinae, inasmuch as both groups do possess the chalky layer. This coating has been the subject of a paper by D'Attilio and Radwin (1971) and these authors proposed the name INTRITACALX for the layer. As they point out, the intritacalx is perhaps best developed in *Aspella, Dermomurex,* and certain typhine genera, but it occurs almost at random among the Mollusca, being found in at least four families of Gastropoda and three families of Bivalvia. So the presence of an intritacalx is hardly justification in itself for familial placement. The shells of the Typhinae also

possess buttressed sutures, which may be homologous to those in *Aspella* and *Dermomurex,* or they may be an analogous development in response to certain ecologic or morphologic conditions. Both groups have a "normal" muricine radula and on radular bases alone there would be no justification in separating either group from the Muricinae. The principal distinguishing character of the Typhinae always has been considered to be the anal tubes that are essentially confined to this group and there seems no value in disturbing this otherwise simple arrangement.

Therefore, it seems the best solution to include members of *Aspella* and *Dermomurex* in the subfamily Muricinae. The radula and the operculum are both completely compatible with this placement, and the shells, except for the heavy intritacalx, are not significantly different.

The close affinities of *Aspella* and *Dermomurex* were recognized first by Dall (1889, p. 206), who made *Aspella* a subgenus of *Trophon,* and *Dermomurex* (under the name *Poweria)* a synonym of *Aspella.* More recently workers have favored treating *Dermomurex* as a subgenus of *Aspella,* the writer having followed this scheme until the present paper. However, work on the geologic history of the two groups has convincingly demonstrated that, although the two groups do share certain marked resemblances, they have been separate and distinct for such a long time that the more accurate picture is to treat them as parallel genera*. Undoubtedly they had a common ancestor in the lower Tertiary but nothing is known of it.

In the early Oligocene beds of Mississippi we find the first aspelloid species, here referred to *Dermomurex (Takia) cookei,* n.sp. In the late Oligocene (Stampian) of western France (at Pierrefiette, near Nancy) there is a second species, which is very close to *D. cookei,* named *"Murex" cotteavi* Meunier, 1880. Simultaneously in the Stampian beds of southern France (at Gaas, near Dax), we find the first species of *Aspella* s.s. From this initial

Text figure 1. *Aspella senex* Dall. Dry Tortugas, Florida. X35.

appearance the two lines have been completely distinct.

In the early ontologic development of *Aspella* s.s. the shell has six varices but as the animal grows larger four of these are lost and appear only as buttress-like structures across the suture, connecting the lower whorl with that above it. In some species two of the four may continue in a weakened state but the shell develops a characteristic bilaterally-flattened shape (see pl. 1, figs. 12 and 13). In *Dermomurex* the species also start with six varices per whorl, and the Oligocene species continue through their entire development with six. However, two lines branch off the ancestral stock in the lower Miocene and in both of these there is eventually the loss of every other varix, with the consequent development of an adult shell having three varices and three inter-varical buttresses per whorl (see pl. 2, figs. 4 and 5).

In *Dermomurex* and in *Aspella* the protoconch is large, usually of one and one-half bulbous whorls. On the first post-nuclear whorl there are six small crescentic varices that overlap onto the protoconch (see text fig. 1). This is exactly

*The genus *Aspella* thereby becomes a genus without subgenera. But it will continue to be cited as "*Aspella* s.s." in this paper to prevent possible confusion.

the same type of early development that occurs in the *Poirieria-Pterynotus* line and it is, therefore, assumed that the members of the two groups were derived from a *Poirieria*-like ancestor. The modern representatives of *Poirieria* and its subgenera still exhibit a thin layer of intritacalx further corroborating this assumption. The Oligocene members of *Dermomurex* s.s. are not too dissimilar from the contemporaneous members of *Panamurex,* which is a side-branch of the *Poirieria* line, and the confusion we shall see between members of *Panamurex* and *D. (Viator)* can be more easily understood if this relationship is assumed to exist. The species of *Panamurex* in the early Miocene Chipola Formation have a fairly heavy intritacalx, although it is usually to be seen only on juvenile shells, suggesting that it is more fragile than the normal aspelloid intritacalx.

The history of the Muricinae has been discussed at length in another paper (see Vokes, 1971b). Briefly summarized: we find in the Paleocene beds of North America members of *Paziella, Poirieria,* and *Pterynotus* all occurring together. The three lines continue through time into the Recent fauna with essentially no change, but along the way certain side branches have appeared. Prior to the beginning of the Oligocene epoch the *Panamurex* and *Dermomurex* lines must have diverged independently as there are marked differences between the two early species *Poirieria (Panamurex) macneili* Vokes and *Dermomurex (Takia) cookei,* n.sp., which occur in the Oligocene beds of Mississippi. Morphologically the later members of *Panamurex,* especially *P. clarksvillensis* (Mansfield), have a strong resemblance to the members of *Viator,* a subsequent development from *Dermomurex,* but as both are derivative forms it is probably due to convergence.

Compared to other groups within the Muricinae, the aspelloids are small in number. There has never been any great period of abundance either in numbers of species or of individuals, so far as the fossil record reveals. The greatest number of species, not surprisingly, is in the Recent fauna, with five described species of *Aspella* (G. E. Radwin has a paper in press adding several to this total) and twelve species of *Dermomurex* (five in *Dermomurex* s.s., two each in *Takia, Gracilimurex,* and *Trialatella,* and one in *Viator).* In a sense it seems unnecessary to distribute such a few species, a total of 10 in *Aspella* and 32 in *Dermomurex,* into so many subgeneric units, but the geologic history of the group seems to warrant it.

Each line has been separate since the early Miocene and the small number of known species may well be a reflection of the lack of preservation of fossil aspelloids. In the Recent fauna most of the species occur in shallow water, frequently under or among stones. The preference for a littoral environment is not conducive to preservation, as can be readily ascertained from the lack of neritids as fossils in contrast to the great numbers to be found on any rocky shore. At Barra de Navidad, Jalisco, Mexico (TU R-166) the writer collected almost 100 specimens of *Aspella pyramidalis* within the period of one extremely low tide, so it is obviously not a "rare" species. But the total number of fossil examples of *Aspella* s.s. in the entire world probably all would fit comfortably in a small teacup. Most fossil species are represented by one or two specimens; *A. senex,* the most abundant, is represented in the Tulane Collections by a total of eight specimens, augmented by the loan of another 20 specimens from various friends. Attempts to borrow Recent examples from museum sources met with notable lack of success.

The *Dermomurex* group is little better, although most collections have a few Recent specimens. The single most abundant fossil species is *D. engonatus* (Dall) but in general most species are again represented by just a very few specimens.

The relationships between the various lineages of the two genera *Aspella* and *Dermomurex* are illustrated diagramatically in tables 1 and 2.

ASPELLA: The species at present referred to the genus *Aspella* s.s. were for the most part originally named as *Ranella* because of the most conspicuous morphologic feature of the genus, the paired row of varices aligned on either side of the spire. The first species named was *Ranella anceps* Lamarck, 1822, and it was this name that was given as the type of the genus by Mörch, 1877. However, the identity of Lamarck's species has been subject

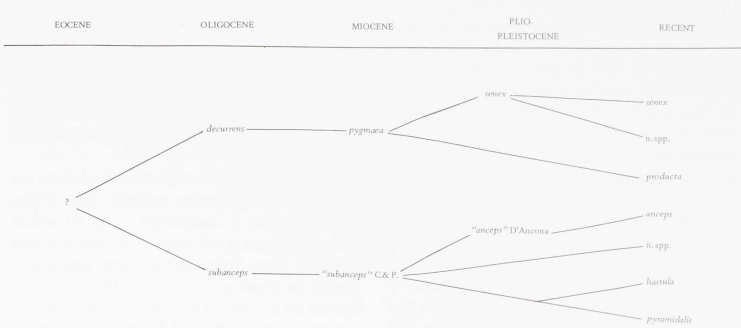

TABLE 1. Inferred relationship of the species of ASPELLA.

to much confusion because of the lack of either a locality or any reference to a figured specimen. The second species of *Aspella* that was described was *Ranella pyramidalis* Broderip, 1833, and this form with its East Pacific locality was considered by many to be the same as Lamarck's *R. anceps.* The description given by Lamarck, however, has the words *"nitida, alba"* (shiny, white), indicating that the specimen he had before him was not the same as *A. pyramidalis,* for the latter is not white at the same time that it is shiny. When the intritacalx is present on *A. pyramidalis* it may be a dirty dull chalky-white, although it usually is a yellowish color and usually has fine brown lines (see pl. 1, fig. 10). When worn and the intritacalx is no longer present, the shell is shiny but then the underlying color, which is mostly brown or rarely a dingy cream, is revealed (see pl. 1, fig. 11). Kiener (1842, p. 37) was the first to place the two species in synonymy, and as a result gave "les côtes du Pérou et celles de Panama" as the type locality for *"Ranella" anceps.* This was echoed by Reeve (1844, *Ranella,* pl. 8, expl.) who figured another specimen of *A. anceps,* but placed *A. pyramidalis* in synonymy, noting that "the longitudinal line which Mr. Broderip describes as traversing the whole length of the shell, both on the upper and under sides, is somewhat imaginary. It is suggested, no doubt, by the natural elevation of the sutural plates [buttresses], and has no analogy with the varices." Such is not the case for the "longitudinal line" is very real, as can be seen in pl. 1, figs. 5b, 6b, and 13b, and it is the vestige of a former varix (see pl. 1, fig. 12).

As a direct result of this confusion between *A. anceps* and *A. pyramidalis,* there is one unnecessary name for *A. anceps, "Ranella" acuticostata* Turton, 1932, which that author states "is a common S. African shell, and has usually been identified as *Ranella* (or *Aspella*) *anceps* Lamarck, but Bartsch says definitely it does not agree with the *anceps* from the west coast of America, which is the type locality." (1932, p. 109, pl. 14, fig. 789). Comparison of the South African shell (see pl. 1, fig. 5) and Kiener's illustration of Lamarck's species is completely convincing, to this writer at least, that the South African specimen is indeed the true *Aspella anceps.*

Aspella s.s. has a long geologic history, first appearing in the Oligocene beds of Dax, France. Here we see two similar although distinct species, one of which was originally called *"Ranella anceps"* by Grateloup (1847, pl. 24, figs. 28, 30). As the species is probably not true *anceps* it was renamed *Ranella subanceps* d'Orbigny, 1852. The second Oligocene species of *Aspella* s.s. was named as *"Fusus" decurrens* by Grateloup (*ibid,* pl. 24, figs. 43, 44). In the Burdigalian beds of France there is another species that was cited by Cossmann and Peyrot (1923, p. 234, pl. 12,

figs. 24, 25) as *"Eupleura" subanceps,* but it does not seem to be the same as the shell figured by Grateloup. The Burdigalian species resembles *A. hastula* (Reeve, 1844), being covered with small granules. This same form is also figured by Hörnes (1856, pl. 21, fig. 6) as *"Ranella anceps"* from the Tortonian beds of Steinabrunn, Austria. At the same time another species appeared that is almost certainly ancestral to the *A. producta* line, *"Ranella" pygmaea* Bellardi, 1873, from the middle Miocene of Italy (*Ranella emmae* Boettger, 1901, from the middle Miocene of Rumania, is the same). This species has a much wider shell than the true *A. anceps* and closely resembles the Caribbean *A. senex*. The *"R. anceps"* figured by Hoernes and Auinger (1885, p. 190, pl. 24, fig. 3) said also to be from Steinabrunn, is probably *A. pygmaea.* The *"Aspella anceps"* figured by Friedberg (1912, p. 183, pl. 11, fig. 16) from the Miocene of Poland is not any species of *Aspella* s.s. but is a specimen of *Dermomurex (Takia) distinctus* (Cristofori and Jan, 1832). In the Pliocene beds of Italy another undescribed form occurs. The specimen figured by D'Ancona (1873, pl. 10, fig. 5) as *"Ranella" anceps,* from Orciano Pisano (south of Pisa), is not the same as either the species of Hörnes or of Doderlein (the latter being *A. pygmaea,* well figured by Montanaro, 1935, pl. 7, fig. 6), although D'Ancona places both of these references in his synonymy. Neither, however, is it *A. anceps,* the shell being somewhat broader, with a marked angle at the shoulder in contrast to the "streamlined" appearance of the Recent species. So far as is known the line is now extinct in the eastern Atlantic and Mediterranean area.

In the New World the species *A. senex* Dall first appears in the Pliocene Pinecrest beds of Florida. There are no other western Atlantic *Aspella* s.s. known until the Recent, where we still find *A. senex* (frequently cited as *A. anceps*), along with three as-yet undescribed species. On the west coast of tropical America we see *A. pyramidalis* (Broderip) (pl. 1, figs. 10–13), and another undescribed species (that figured by Keen, 1958, fig. 376, as *A. pyramidalis*), which is the "cognate"* of *A. senex* (pl. 1, fig. 9). These new species are all to be described by George Radwin and are mentioned here for the sake of completeness. The only other New World species of *Aspella* is *A. hastula* (pl. 1, fig. 8), endemic to the Galapagos Islands. All of these forms are here figured for comparative purposes.

In the Indo-Pacific region we find there are two morphologic types present. One is the typical slender *A. anceps* (pl. 1, fig. 6), which as noted above is the same as *A. acuticostata* (Turton) from South Africa, and which also occurs in Australia at least. The specimen figured by Ponder (1972, pl. 23, fig. 7) is that species, as is confirmed by other specimens from New South Wales in the collection of the writer. Other localities are not certain. The second species, which seems to be the more common one, has been named *Ranella producta* Pease, 1861, and *Bursa lamellosa* Dunker, 1863. Although *"B." lamellosa* was figured by Dunker in the *Novitates Conchologicae* (1866, pt. 6, pl. 18, fig. 6) and refigured by Tryon (1881, Ranelliane, pl. 24, fig. 67), the type of *A. producta* was not figured until 1965 by Kay (1965, pl. 6, fig. 17, 18). From these illustrations it can be seen that *A. producta* is the correct name for the larger, more inflated form that is widespread throughout the Pacific Ocean. It has been taken at Hawaii (type locality of *A. producta*), Japan (type locality of *A. lamellosa*), Australia (Ponder, 1972, pl. 23, fig. 8), and Reunion Islands (Coll. MCZ) to the writer's certain knowledge. The East Pacific species, mentioned above as the "cognate" of *A. senex,* is a member of the *A. producta* line, but it is not, as stated by Ponder (*ibid.,* p. 229), the same species.

Thus we find there are two distinct lines of *Aspella* s.s., which go back to the Oligocene ancestors. One of these we might term the *"anceps"* group, which begins with the species *"Ranella" subanceps* d'Orbigny and today includes *A. anceps* from the Indo-Pacific region, *A. pyramidalis* from the East Pacific,

*For a discussion of the merits of the word "cognate" *vs.* the more commonly used "analog" see Radwin, 1969, Trans. San Diego Soc. Nat. Hist., v. 15, no. 14, p. 233.

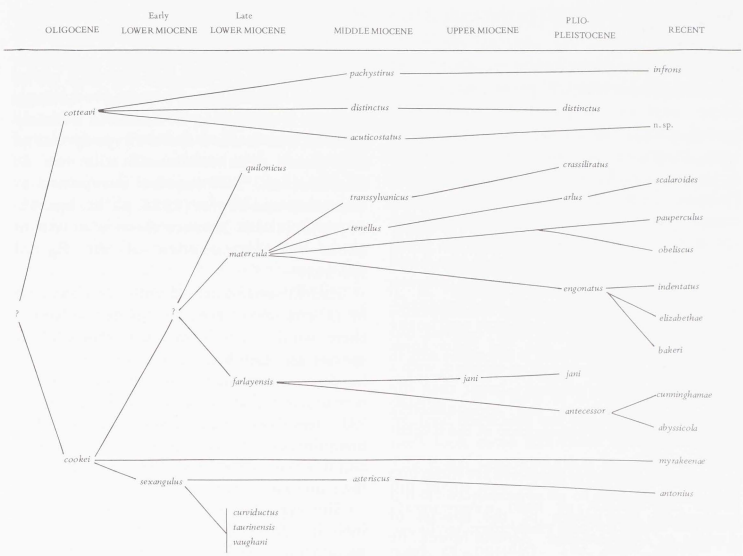

TABLE 2. Inferred relationship of the species and subgenera of DERMOMUREX.

and *A. hastula* from the Galápagos Islands. The second group, that of *A. producta,* begins with *"Fusus" decurrens* Grateloup, includes *"R." pygmaea* Bellardi, and today consists of *A. producta* from the Indo-Pacific area, *A. senex* from the Caribbean, and *A.* "species" from the East Pacific.

DERMOMUREX: Although all of the species assigned to this genus are clearly akin, there are some marked morphological distinctions among the various lines, and these have given rise to confusion in the nomenclature of the group. The species almost all originally were named as *"Murex,"* due to the presence of the three or six varices that characterize the group. The earliest name is *Poweria* Monterosato, 1884; however, this proved to be preoccupied by a genus of fishes, and so was re-named in 1890 by Monterosato as *Dermomurex.* The type-species was originally designated by Monterosato as *"Murex" scalarinus* Bivona-Bernardi, from the Mediterranean.

There have been several names proposed for this Recent Mediterranean species, in part due to its variability, but also due to the coincidence of several people working on the Mediterranean fauna at almost the same time. Thus we find in a short interval three names: *"Murex" scalaroides* Blainville, 1829; *"M." scalarinus* Bivona-Bernardi, 1832; and *"M." leucoderma* Scacchi, 1836. During the same period we have *"M." distinctus* Cristofori and Jan, 1832, which although named for a Pliocene fossil, has been synonymized by many authors with the Recent species. In addition, there are emendations of *M. scalaroides* that further add to the complexity of the synonymy. These are *"scalarioides,"* which seems to have originated with Reeve (1845) and *"scalariformis,"* an emendation by Locard. This same author had previously suggested in a footnote (1886, p. 165) "melius: *scalaformis,*" but apparently decided this was not "optimus" and so in 1892 (p. 101) employed the name *"M." scalariformis.*

As is typical of all Dermomurexes the type-species begins life with six varices. It ultimately changes to only three varices, but most individuals seen still possess six, five, or four varices, depending upon the growth-state. These six-varixed juveniles have been identified by authors as *"Murex" distinctus* (*e.g.,* Reeve, 1845, pl. 32, fig. 161; Philippi, 1836, pl. 11, fig. 32). For a comparison of the Recent species, its Pliocene ancestor *"Murex" arlus* de Gregorio, 1885, and the true *D. distinctus,* see pl. 5, figs. 5 and 8; and pl. 4, fig. 7. The differences between the Recent *D. scalaroides* and the Pliocene *D. arlus* are minimal, and the two may well be the same biologic species, but the older form seems to be consistently more inflated, with a body whorl that is relatively larger than the spire in contrast to the approximately equal-proportioned appearance of the Recent form.

A second name was proposed for the group by Cossmann, who to all appearances did not understand the nature of the species of *Aspella* or *Dermomurex. Aspella* Mörch, he stated (1903, p. 54), has six lamellar varices and hence he included *Poweria* (apparently unaware of *Dermomurex*) in synonymy with *Aspella* s.s., placing the genus in the subfamily Trophoninae. He noted that the genus differs from *Trophon* by its tropical rather than boreal distribution, and by having *only* six varices. His diagnosis was said to be based upon the species *"Trophon" engonatus* Dall, which is a *Dermomurex.* It would seem that his concept of the genus *Aspella* also came from Dall (1889), whose treatment of the aspelloids is discussed further in the Systematic portion of this paper.

In the same work, Cossmann (*ibid.,* p. 47) proposed a new subgenus of *Hadriania,* which he named *Hexachorda.* The name itself gives a clue to what Cossmann seemed to think was the distinguishing feature of this group, and he makes much of the varices being cord-like rather than lamellar or foliaceous. He named as type the French Miocene species *"Murex" tenellus* Mayer, 1869, which is another example of *Dermomurex.* However, it is probable that he was misled by Mayer's original illustration, which is a juvenile specimen of *"M." tenellus,* for the shell that Cossmann illustrates as *Hadriana (Hexachorda) tenella* (*ibid.,* pl. 2, fig. 14) is not *"M." tenellus* but is probably an example of *D. distinctus* (Cristofori and Jan). As he included the species *"Murex" cotteavi* Meunier in this group, *D. distinctus* is clearly what he had in mind for the type-species of the genus. The misidentification of *D. distinctus* as *"M." tenellus* is repeated in Cossmann and Peyrot (1923, pl. 12, figs. 48, 49) and in this instance there is no doubt about the identification of the figured specimen.

Had Cossmann named either *D. distinctus* or *D. cotteavi* as type for his new subgenus there would have been justification. These species are members of a subgroup that do have a morphologic distinctness, and it clearly is this group that he had in mind. By naming *"M." tenellus* as type, however, he created an unequivocal synonym of *Dermomurex* s.s., and it remained for Kuroda (1953) to propose the name *Takia* for the group.

The type lot of Mayer's *Murex tenellus* includes four specimens. In the original description (1869, p. 82) Mayer stated, "je n'en ai que trois examplaires," with the measurements of the type cited as "Long. 17, lat. 7 mill." The original label is still in the box and it can be seen that this label has been altered to read "4 ex." One of the specimens (figured here on pl. 2, fig. 1) measures 15.7 mm in height and is the one figured by Mayer. It is here designated as lectotype. However, there is a larger specimen that was added later (here figured on pl. 2, fig. 2). Mayer's original illustration was an apertural view only and the specimen appears to have six varices, but this can be seen to be a false impression by examining the dorsal view given here. The larger specimen removes any doubt as to the generic affinities of the species. It is a typical three-varixed *Dermomurex.*

In the New World a species similar to *D. tenellus* first appears in the late lower Miocene Chipola Formation of Florida. This new species *D. matercula,* is probably a direct ancestor to *D. pauperculus* (C. B. Adams), living in the western Atlantic, and also to two of the species of *Dermomurex* from the west coast of tropical America. Here the genus is flourishing and there are five species: *D.*

indentatus (Carpenter), *D. obeliscus* (A. Adams), *D. myrakeenae* (Emerson and D'Attilio), *D. cunninghamae* (Berry), and *D. bakeri* (Hertlein and Strong). The first three species have been the subject of a paper by Emerson and D'Attilio (1970) and are well figured there. From their illustrations it can be seen that *D. indentatus* is the Pacific "cognate" of *D. engonatus* (Dall) and *D. obeliscus* is the "cognate" of *D. pauperculus*. *D. myrakeenae* seems most closely related to the ancestral Oligocene *D. cookei* and is here referred to *D. (Takia); D. cunninghamae* is the type-species of the subgenus *Trialatella* Berry, 1964; *D. bakeri* is the type-species of *Gracilimurex* Thiele, 1929.

For the most part the Recent species of *Dermomurex* s.s. are confined to the New World. However, in the geologic record the genus has a much greater distribution. As noted above, *D. tenellus* is found the Miocene of southern Europe; and another similar form *"Murex" transsylvanicus* Hoernes and Auinger, 1885, from Lapugy, Hungary, is its contemporary in central Europe. In the Pliocene of Italy *D. tenellus* is replaced by *D. arlus* (de Gregorio), the ancestor of *D. scalaroides;* and in Australia there is a Pliocene form, *"Murex" crassiliratus* Tate, 1888. An Indo-Pacific species, *"Tritonalia" quilonica* Dey, 1962, was described from beds in southern India that are stated to be lower or middle Miocene in age (Subramanyan, 1964, pp. 59, 62). If the age is correct (and there is no statement as to basis for this age determination) then the history of the Dermomurexes as here established is subject to some rearrangement because this Indian species more nearly resembles the Florida Pliocene *D. engonatus* (Dall) than any other form. For now it must remain an enigma.

In the Recent fauna of the Indo-Pacific there is but a single species referred, with some hesitation to *Dermomurex* s.s. This is an apparently undescribed species, which is a somewhat atypical example of the line in that the aperture is totally smooth with no trace of the denticulations on the outer lip occurring in every other member of the genus. Except for this unusual form, there is but one species of *Dermomurex* s.s. outside of the New World, the type of the genus, which is from the Mediterranean. Two other species are Indo-Pacific in distribution and are here assigned one to the subgenus *Takia* and the second to *Viator*.

GRACILIMUREX: In the Gulf of California, western Mexico, there is a strange form that has been named as the type-species of the subgenus *Gracilimurex* Thiele, 1929 (as *"Murex" bicolor* Thiele, *non M. bicolor* Risso, 1826, *nec* Valenciennes, 1832, *nec* Cantraine, 1835). Originally described without locality, it is, without doubt, the same species subsequently named *Aspella bakeri* Hertlein and Strong, 1951. The taxonomic placement of this subgenus is uncertain as it seems to be intermediate between *Dermomurex* and *Aspella* s.s. There is a tendency toward bilateral flattening but the early whorls of the shell look more like those of *Dermomurex*. The spiral ornamentation is greatly reduced but seems also to be more akin to that of *Dermomurex* than to *Aspella* s.s., which usually is completely smooth or else has spiral rows of pustules. The color pattern of *"Aspella" bakeri,* which is a brown and white banding (hence the older name—*bicolor*) is strongly reminiscent of the west Mexican *A. pyramidalis,* but this may be convergence as the radulae of the two species are markedly dissimilar.

In the western Atlantic there is a form much like *"Aspella" bakeri* lacking, however, the marked color bands. This is the Recent species *"Aspella" elizabethae* McGinty, 1940. In the Pleistocene beds of southern Florida we find specimens of what would appear to be a form intermediate between *Dermomurex engonatus* (Dall) and *"Aspella" elizabethae*. It has the tendency toward the loss of varices and consequent bilateral flattening of *A. elizabethae* but has the strong spiral ornamentation of *D. engonatus*. Whether it is in fact the ancestor of *A. elizabethae* is not at all certain and the fossil history of *"Aspella" bakeri* is totally unknown, so for the time we can make no statements concerning the relationship between these various species. It may well be that the two Recent species represent parallel evolution and are not closely related but, according to Radwin (*in*

litt.), the radulae of the two are extremely close, indicating that they are common descendants of some as-yet unknown ancestor.

The weight of the evidence suggests that the group is more closely allied with *Dermomurex* than with *Aspella* s.s., and so it is considered as a subgenus of *Dermomurex* herein.

TRIALATELLA: The fourth of the above-mentioned eastern Pacific species of *Dermomurex, D. cunninghamae,* was named as the type of a new genus *Trialatella* by Berry (1964) but the type species (holotype figured here, pl. 4, fig. 4) shows differences that are subgeneric at best. The group is characterized by having three greatly expanded wing-like varices in the adult stage. The line has its ancestry in another Chipola species, *D. farleyensis,* n. sp. Although not previously recognized in the western Atlantic the subgenus is still present, with a species that is very near the west Mexican *D. cunninghamae.* This form is thought to be the species named *"Murex" abyssicola* Crosse, but further collecting may show that two species occur in the Caribbean.

TAKIA: The earliest species of *Dermomurex, D. cookei,* n. sp., and *D. cotteavi* (Meunier), from the Oligocene of Mississippi and France, respectively, are both characterized by the retention of six varices through their entire growth-span. In addition, the varices are rounded and cord-like, being only indistinctly set off from the remainder of the shell. The line persists in the Old World with the species *"Murex" distinctus* Cristofori and Jan, 1832, which is widespread in the Miocene and Pliocene of the European area. It has been reported from the Miocene of Austria (Hörnes, 1856, pl. 25, fig. 7, as *Murex distinctus*), Poland (Friedberg, 1912, pl. 11, fig. 16, as *Aspella anceps*!), Italy (Montanaro, 1935, pl. 4, fig. 1, as *A. scalarioides* var. *distincta* from the Miocene, and D'Ancona, 1871, pl. 2, fig. 4, as *M. distinctus,* from the Pliocene), and France (Glibert, 1952, pl. 6, fig. 7, as *A. scalarioides*). The French Miocene species *"Murex" cancellarioides* Grateloup, 1833, (and its emendation *M. cancellariiformis* Mayer) is the same. In the Miocene of Java *"Murex" acuticostatus* Wanner and Hahn, 1935, *(non M. acuticostatus* Gümbel, an *Ocinebrina*) is extremely close to *D. distinctus* and may well be the same species. In the middle Miocene (Balcombian) of Australia there is another species, *"Murex" pachystirus* Tate, 1888, that is still very much like the Oligocene *D. cotteavi,* its presumed ancestor. Probably this is the species that gave rise to the Recent *D. infrons* Vokes (a new name proposed in 1974 for the preoccupied *"Murex" inermis* Sowerby), type of *Takia* Kuroda, 1953. Most of the examples of *D. infrons* have six varices in the adult (see pl. 5, fig. 1) and it looks rather like the Mio-Pliocene *D. distinctus* (figured here pl. 5, fig. 5). However, specimens have been collected that have lost every other varix on the last whorl, which suggests that here is another branch that is shifting, somewhat belatedly, from six to three varices.

In the New World the species *D. myrakeenae* (Emerson and D'Attilio) still retains six varices normally, although some specimens do show a tendency to lose one or more of the last ones (see pl. 5, fig. 7). Morphologically the shell is still much like the Oligocene *D. cookei,* and one can only assume that there is a long "missing link" connecting the two species. No other known forms in the fossil record of the New World are at all close to these two.

VIATOR: In the vicinity of northwestern Australia there is a second Indo-Pacific species, only recently described, *D. (Viator) antonius* Vokes (1974, p. 4). This elegant species is the sole descendant of a line that branched off the original *Dermomurex* stock early in the history of the group. In the early lower Miocene (Aquitanian) of the eastern United States there is a species described as *"Murex (Panamurex) gilletteorum"* by the writer. This name proved to be a synonym of *"Murex" sexangula* Dall, 1915, but under either name it is the first member of an unusual line of the aspelloids. This early Miocene form is assumed also to have given rise to a bizarre side group of species, two in the Chipola Formation of Florida and a third in the beds of the same age in Italy and France. But in the middle Miocene (Balcombian) of Australia there appears

another species, *"Murex" asteriscus* Tate, 1888, that can only be interpreted as a direct descendant of the early Miocene *D. sexangulus*. The mechanism of this migration is a complete enigma, but in light of present knowledge such migration is unavoidable. There are no other similar species until the appearance of the Recent *D. antonius*. Without the presence of this modern form the affinities of the fossil species would still be somewhat puzzling, as they have been to the writer previously. But the Recent species with its heavy coat of intritacalx (see pl. 6, fig. 4) immediately shows the placement within the aspelloids. Fossil specimens rarely have very much intritacalx preserved and it is mainly by analogy with the Recent descendants that we can determine how the fossils must have appeared in life. A comparison of pl. 6, figs. 3 and 5, suggests what the older forms of *Viator* must have looked like.

At first glance one might wonder at the necessity for the erection of a subgenus to accommodate these few species of *Dermomurex*. The subgeneric name *Takia* very nearly could be applied to them. However, when one examines the type-species (see pl. 5, fig. 1) it can be seen that in actuality *D. infrons* is more like the ancestral *D. cookei* and *D. cotteavi* than it is like the species here referred to as *Viator*. In *Viator* there is an elongation of the anterior canal and a comparable shortening of the spire. In the ancestral Oligocene species the distance from the posterior edge of the aperture to the apex is almost exactly one-half the total height of the shell. The same ratio is still present in *D. infrons*. However, in *D. antonius* it is about one-third, and in *D. asteriscus* it is between one-third and one-half (four-tenths). The spiral ornamentation is also much more pronounced in *Viator*, and the anterior canal is straight rather than curved.

III. ACKNOWLEDGMENTS

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IV. SYSTEMATIC DESCRIPTIONS

Phylum MOLLUSCA
Class GASTROPODA
Subclass PROSOBRANCHIA
Order NEOGASTROPODA
Suborder STENOGLOSSA
Superfamily MURICACEA
Family MURICIDAE
Subfamily MURICINAE
Genus ASPELLA Mörch, 1877

Aspella MÖRCH, 1877, Malak. Blatter, v. 24, p. 24. Type-species: *Ranella anceps* Lamarck, by monotypy.

ASPELLA SENEX Dall
Plate 1, figs. 1–4, 7

[?] *Aspella anceps* (Lamarck). DALL, 1889, Harvard Mus. Comp. Zool., Bull., v. 18, p. 207. [Based on previous authors' reports only].

Aspella hastula (Reeve). DALL, 1889, Harvard Mus. Comp. Zool., Bull., v. 18, p. 207 (*not* of Reeve).

Aspella senex DALL, 1903, Wagner Free Inst. Sci., Trans., v. 3, pt. 6, pl. 60, fig. 14 (not in text).

Aspella senex Dall. SCHUCHERT *et al.*, 1905, U. S. Natl. Mus., Bull. 53, pt. 1, p. 67.

Aspella hastula (Reeve). JOHNSON, 1934, Boston Soc. Nat. Hist., Proc., v. 40, no. 1, p. 116 (*not* of Reeve).

Aspella senex Dall. OLSSON and HARBISON, 1953, Acad. Nat. Sci. Phila., Mon. 8, p. 250, pl. 39, fig. 8.

Aspella anceps (Lamarck). WARMKE and ABBOTT, 1962. Caribbean Seashells, p. 108, pl. 19, fig. C (*not* of Lamarck).

Aspella senex Dall. S. E. HOERLE, 1970, Tulane Stud. Geol. Paleont., v. 8, no. 2, p. 64.

[?] *Aspella anceps* (Lamarck). RIOS, 1970, Coastal Brazilian Seashells, p. 83.

[Aspella] (Aspella) senax [sic] Dall. E. H. VOKES, 1971, Bulls. Amer. Paleontology, v. 61, no. 268, p. 97.

Aspella anceps (Lamarck). PORTER and WOLFE, 1971, Jour. de Conchyl., v. 109, p. 96, 104 (*not* of Lamarck).

Diagnosis: "Shell small, subfusiform, the spire 1½ to 2 times the length of the aperture, strongly compressed dorso-ventrally and sculptured with bowed, axial riblets. Aperture subelliptical, the forward part narrowed and produced into a medium-length, straight, anterior canal. Peristome nearly continuous, with a slightly raised rim, the outer lip thickened by the last varix, the inner side of the lip smooth or crenulate. Axials about 6, 2 each on the dorsal and ventral sides, the other 2 on the lateral sides being somewhat stronger and forming varices which mark the position of the aperture at earlier stages of growth. Surface between the axials is smooth or with an earthy texture, sometimes with faint spirals." (Olsson and Harbison, 1953)

Dimensions of holotype: height 9.5 mm, diameter 4.0 mm.

Holotype: USNM 163959.

Type locality: Shell Creek, Cleveland County, Florida (= TU 539).

Occurrence: Pinecrest beds, (?) early and middle Pliocene; Caloosahatchee Formation, late Pliocene; unnamed post-Caloosahatchee formation, Pleistocene; Florida. Recent, from Cape Fear, North Carolina, to Ft. Walton, Florida. West Indies and Yucatán Peninsula.*

Figured specimens: Fig. 1, USNM 739566; height 14.0 mm, diameter 8.0 mm; "Hourglass" Station L, about 85 miles off Ft. Myers, Florida, 27 fathoms. Fig. 2, USNM 647439; height 14.6 mm, diameter 6.4 mm; locality TU 759. Fig. 3, USNM 647440; height 12.3 mm, diameter 5.6 mm; locality TU 726. Fig. 4, USNM 647441; height 7.0 mm, diameter 3.5 mm; locality TU 726. Fig. 7, USNM 93510; height 9.7 mm, diameter 4.5 mm; *Blake* Station 2617, 25 miles off Cape Fear, North Carolina, 14 fathoms. Other occurrences: TU locality nos. 201, 202, 203, 529, 536, 727, 729, 767, 768, 803, 1000, R-99, R-263, R-283.

Discussion: As noted in the Introduction, the species *Aspella anceps* has been poorly understood because Lamarck cited neither locality nor figure. The species of *Aspella* s.s. that occurs not uncommonly in the western Atlantic has been identified as *A. anceps* by several authors, but the American shell is, in reality, the equivalent of the other Indo-Pacific species, *A. producta* (Pease).

The western Atlantic species first appears in the Pliocene Pinecrest beds of southern Florida. However, it is rare here, being represented in the Tulane Collections by a single specimen from TU 729 and another one from the latest Pinecrest beds at TU 1000 (in the collection of Mrs. Evelyn Bradley, of Bradenton, Florida). Heretofore the Pinecrest beds have been correlated with other formations that bear planktonic foraminifera

*The writer recently has learned that *Aspella senex* was taken live at Enmedio Reef, just off Veracruz, Mexico, in the western Gulf of Mexico, by J.W. Tunnell, Jr., Texas A.& M. University *(in litt.)*. This represents a considerable extension of range. Along with *Aspella senex* were several other muricine species usually associated with the Caribbean reef faunas, including *Dermomurex pauperculus*, another extension of range.

indicating an age of lower Pliocene (Zone N. 19) (see Akers, 1972) but more recent work on calcareous nannofossils found at locality TU 1000, Sarasota, Florida, gives an age of middle Pliocene (Zone N. 20) (Akers, 1974). Inasmuch as the lower and upper parts of the Pinecrest unit have certain molluscan differences it seems probable that the lower portion of the Pinecrest is, in fact, lower Pliocene and the upper part (that usually referred to as the "Brighton facies") is middle Pliocene. However, until more definite evidence is available detailed age assignments for various localities are conjectural.

In the later Pliocene beds of the Caloosahatchee Formation *A. senex* is somewhat less rare but it is never a common shell. It persists with approximately the same degree of rarity through the Pleistocene "Glades" fauna and is still living in the Gulf of Mexico and the Caribbean today. Modern depth records range from 14 to 30 fathoms. The apparent rarity of the species in the fossil fauna is probably due to its small size, as Warmke and Abbott (1962, p. 108) note that the Recent form is "fairly common in drift sand and shallow dredgings."

At first appearance the modern form does not look as though it is the same species as the fossil representatives. This is due to the peculiar nature of the intritacalx, which forms extensions of the varices in the living animal. In the fossil condition the intritacalx is usually lacking and the shell appears to be narrower, with less extended varices. Comparison of a worn Recent specimen with a fossil one, however, demonstrates the similarity. (Compare pl. 1, fig. 2, a fossil, and fig. 7, a worn Recent specimen).

The only person who has ever done any work at all on this group in the western Atlantic was Dall, who seemingly did not understand the strange nature of the aspelloids. His treatment of the *Dermomurex* line is even more confused than that of *Aspella* s.s., and his concept of *Aspella anceps* is unfathomable. In the *Blake* Report (1889, p. 207) he identified the western Atlantic species of *Aspella* s.s. as *Aspella hastula* Reeve, which he stated "has 3-5 varices to the whorl; *A. anceps* always six. The revolving lines are less elevated than is usual with *A. anceps*, and never nodulated, as is often the case with the latter." The specimen that he cited as *A. hastula* is USNM 93510 (here figured, pl. 1, fig. 7), and it is a worn example of *A. senex*, lacking the white intritacalx, which gives it a flesh color, not "chestnut-brown" as Dall stated, unless it has faded greatly over the last 80 years. His description of *A. anceps* sounds more like *Dermomurex* than *Aspella* s.s. but he discussed the species of *Dermomurex* in some detail, although he did not use the name, considering them as members of *Aspella* s.l. His treatment of this group will be covered under *D. (Dermomurex) pauperculus*.

Genus DERMOMUREX Monterosato, 1890

Poweria MONTEROSATO, 1884, Nomen. Conch. Medit., p. 113. (*Non Poweria* Bonaparte, 1840).

Type species: *Murex scalarinus* Bivona-Bernardi, by original designation [*Murex scalarinus* Bivona-Bernardi, 1832, = *Murex scalaroides* Blainville, 1829].

Dermomurex MONTEROSATO, 1890, Natural. Sicil., v. 9, p. 181. New name for *Poweria* Monterosato *non* Bonaparte.

Hexachorda COSSMANN, 1903, Essais Paléoconch. Comp., v. 5, p. 47.

Type species: *Murex tenellus* Mayer, by original designation.

Subgenus DERMOMUREX s.s.

DERMOMUREX (DERMOMUREX) MATERCULA* E. H. Vokes, n. sp.

Plate 2, fig. 3

Diagnosis: Protoconch of one and one-half large, bulbous whorls, with seven post-nuclear whorls in adult specimen. Axial ornamentation beginning on first post-nuclear whorl with six crescentic varices that overlap onto the protoconch. Each succeeding whorl with six strap-like varices, until about the fifth post-nuclear whorl where certain of these become greatly reduced so that they are little more than inter-varical nodes, their former existence being demonstrated mainly by the presence of a small

*The latin word *matercula*, "little mother," is a noun and does not agree in termination with the masculine *Dermomurex*.

buttress at the suture and a small flange at the anterior canal. Spiral ornamentation consisting of two to four weak cords on the early whorls and about eight on the body-whorl, almost invisible except where they cross the varices, with deep pits formed between the cords. Entire shell, except for the protoconch, covered with a heavy intritacalx, but larger specimens usually decorticated and this coating best seen on juveniles. Intritacalx almost smooth when fresh, but beneath the surface a system of fine tunnel-like structures may be seen at broken edges of the intritacalx; these appearing when slightly worn as fine spiral grooves covering the shell surface. Suture greatly appressed and situated toward the anterior end of the whorl, so giving a marked convexity to each whorl; body-whorl almost twice the height of the spire. Aperture elliptical, outer lip slightly crenulated at the spiral cords, with a small raised rim; very faint denticles may appear on the inside of the outer lip. Terminal varix rounded, with slight nodes where the spiral cords cross, a small flange developed on the anterior portion where the

PLATE 1

Figures Page

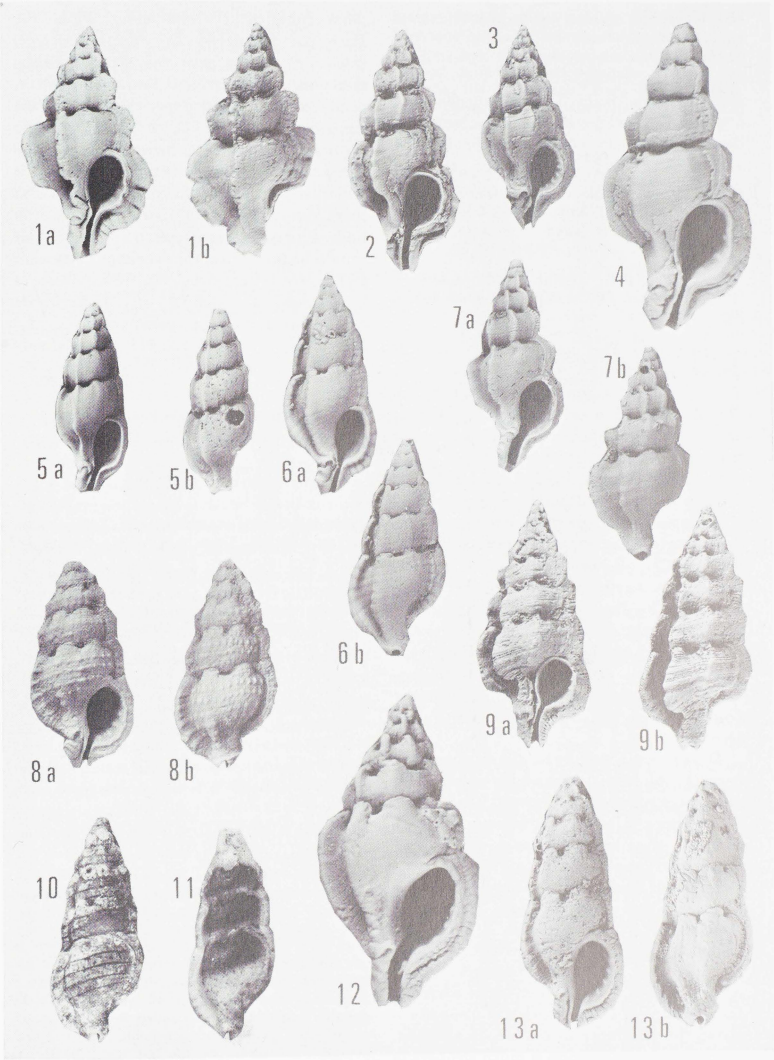

PLATE 1

varix curves into the basal constriction forming the anterior canal. Inner lip smooth, appressed posteriorly, standing free at anterior end, partially covering the relatively large umbilical fasciole. Anterior canal short, open by a slit, strongly recurved at the distal end toward the dorsum.

Dimensions of holotype: height 16.2 mm, diameter 8.5 mm.

Holotype: USNM 647442.

Type locality: TU 830, Ten Mile Creek, at power-line crossing about one mile west of Chipola River (SE¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.

Occurrence: Chipola Formation, late lower Miocene, Florida.

Figured specimen: USNM 647442 (holotype). Other occurrences: TU locality nos. 547, 548, 555, 825, 827, 998.

Discussion: This new species, which is almost certainly the direct ancestor of the Recent *D. (D.) pauperculus,* is rare in the Chipola Formation of northwestern Florida. The type lot contains, in addition to the holotype, only eight smaller paratypes. Three of these were taken at TU 548, on the Chipola River, all other localities listed above being represented by a single specimen. In contrast, the second species of *Dermomurex* described from the Chipola Formation is much less rare, although scarcely what would be called common. The distribution of the two forms is distinct, with *D. (Trialatella) farleyensis* almost totally confined to localities on Farley Creek. *D. (D.) matercula* is less restricted, with a small representation from each area: Chipola River, Ten Mile Creek, and Farley Creek.

D. matercula may be readily distinguished from *D. farleyensis,* as the body-whorl tends to be more rounded and the shell is inflated at the anterior end, rather than being constricted toward the siphonal canal; the spiral ornamentation of *D. matercula* is much more conspicuous than that of *D. farleyensis,* which is almost non-existent. From its modern descendant, *D. pauperculus,* it may be distinguished by the much less elongate shell; pl. 2, fig. 7, is a worn example of *D. pauperculus* of the same number of whorls as the holotype of *D. matercula* and comparison shows the difference in outline. In addition, the spiral ornamentation is much stronger in the younger species.

It seems probable that the French middle Miocene species *D. tenellus* (Mayer) is also a descendant of *D. matercula.* While the European Oligocene *D. (Takia) cotteavi* (Meunier) clearly gave rise to *D. (Takia) distinctus* (Cristofori and Jan), *D. tenellus* is so unlike either of these species and so like the American *D. matercula,* there can be little argument. As the writer has noted before, the fauna of the French Aquitaine Basin is remarkably similar to that of the Chipola, and there almost has to have been interchange in both directions (see Vokes, 1973, p. 97). It should be noted that the specimen Cossmann and Peyrot (1923, pl. 12, figs. 48-49) figure as a Burdigalian example of *"Hexachorda tenella"* is actually a specimen of *D. (T.) distinctus.*

DERMOMUREX (DERMOMUREX) ENGONATUS (Dall)

Plate 3, figs. 5, 6

Trophon (Aspella) engonatus DALL, 1892, Wagner Free Inst. Sci., Trans., v. 3, pt. 2, p. 243, pl. 13, fig. 6a.

Aspella engonata (Dall). DALL, 1903, Wagner Free Inst. Sci., Trans., v. 3, pt. 6, p. 1607.

[Aspella (Aspella)] engonatus (Dall). COSSMANN, 1903, Essais Paleoconch. Comp., v. 5, p. 55, text fig. 4.

Trophon (Aspella) engonatus Dall. SCHUCHERT, *et. al.,* 1905, U. S. Natl. Mus., Bull. 53, pt. 1, p. 670.

Aspella scalarioides (Blainville). MAURY, 1917, Bulls. Amer. Paleontology, v. 5, no. 29, p. 268 (104), pl. 43 (17), fig. 11 (*not* of Blainville).

Aspella (Aspella) engonata (Dall). OLSSON and HARBISON, 1953, Acad. Nat. Sci. Phila., Mon. 8, p. 251, pl. 39, fig. 5.

[Aspella] (Dermomurex) engonatus (Dall). E. H. VOKES, 1971, Bulls. Amer. Paleontology, v. 61, no. 268, p. 45.

Diagnosis: "Shell elevated, with prominent sculpture and eight whorls; nucleus small, smooth, of two and a quarter whorls; remaining whorls each with three principal and three minor varices, which are thin, sharp and spinose at the intersection of the spiral ribs, especially at the shoulder; whole surface covered with a thin limy coat, evenly and finely spirally striate, but this coating is usually partly worn off, being very perishable; other spiral sculpture of three (on the last whorl 6) sharp, narrow, elevated spiral riblets which overrun the varices, and (especially on the major varices) tend to form spines at the intersection; the spiral rib at the shoulder is especially prominent and tends to

turriculate the whorls; whorls full, rounded under the sculpture; aperture ovate; canal long, open, narrow, much recurved; outer lip with a few coarse lirae within the adult." (Dall, 1892)

Dimensions of lectotype: height 28 mm, diameter 12 mm.

Lectotype: USNM 113273.

Type locality: Shell Creek, Cleveland County, Florida (=TU 539).

Occurrence: Pinecrest beds, early and middle Pliocene; Caloosahatchee Formation, late Pliocene; unnamed post-Caloosahatchee formation, Pleistocene; Florida. Gurabo Formation, Dominican Republic; (?) Miocene. (?) Tuberá Group, Colombia; Pliocene.

Figured specimens: Fig. 5, USNM 647444; height 26.4 mm, diameter 11.0 mm; locality TU 797. Fig. 6, USNM 647445; height 18.2, diameter 8.8 mm; locality TU 768. Other occurrences: TU locality nos. 202, 203, 520, 529, 536, 539b, 579, 726, 729, 745, 767, 768, 769, 770, 797, 933, 974, 975, 978, 991, 1000, 1023.

Discussion: D. engonatus is the commonest fossil species of *Dermomurex,* being relatively widespread in the Pliocene beds of south Florida. It is equally well represented in both the Pinecrest beds and the Caloosahatchee Formation, but to the writer's knowledge there is only a single unequivocal specimen from the Pleistocene "Glades" fauna. The species is found at a number of localities where both the Caloosahatchee and the "Glades" occur together, but only TU locality 978, South Bay, Florida, is a pure "Glades" locality. At two other unmixed "Glades" localities (TU 759 and 803) a different form, which is intermediate between *D. engonatus* and the Recent *D. elizabethae,* occurs. This variant has a tendency toward the loss of the third major varix and shows a bilateral flattening that is more akin to *D. elizabethae,* although the spiral ornamentation is stronger, as in *D. engonatus* (see pl. 3, figs. 3, 4).

In addition to the Florida occurrences this species has been figured from the Gurabo Formation of Santo Domingo by Maury as *"Aspella scalarioides."* Maury noted (1917, p. 268) that "Dr. Dall very kindly examined our specimen and decided it was identical with the recent species living in the Antilles and the Mediterranean." Dall's Recent *"scalarioides"* included *D. pauperculus* of the Antilles and *D. scalaroides* of the Mediterranean; Maury's figured specimen is neither of these but is very clearly the same as *D. engonatus.* In the collections from the Museum of Paleontology, Berkeley, there is another specimen of *D. engonatus* from Punta Puá, near Cartagena, Dept. of Bolivár, Colombia. It was collected by T. J. Etherington, and was indicated as being from a "Miocene fauna in 2 foot band above the coral limestone," presumed to be in the Tuberá Group. At the same locality there are specimens of *Murex olssoni* Vokes, originally named from the Recent and from beds near Limon, Costa Rica, which were then thought to be upper Miocene in age, the "upper Gatun" of Olsson. These beds are now known to be the Moín Formation, of early Pleistocene age, correlating with the "Glades" fauna of south Florida, and *Murex olssoni* is believed to be confined to the Pliocene and later formations. Thus the Tuberá occurrence of *D. engonatus* is probably Pliocene. The age of the beds in Santo Domingo has always been considered to be middle Miocene; however, recent work on planktonic foraminifera is shifting many of the western Atlantic formations into a position stratigraphically higher than previously thought, and there is considerable evidence that the Santo Domingo beds may also be, at least in part, Pliocene in age.

In terms of chronology *D. pauperculus* should be the modern descendant of *D. engonatus,* but the two forms are sufficiently dissimilar as to cast doubt on this relationship. The Recent species lives among the rocks of the intertidal zone and this is almost the worst environment for fossil preservation. *D. engonatus* is the only fossil *Dermomurex* species that may be said to be "common" and this is probably because of its having lived in water of a slightly greater depth. Unfortunately nothing is known of the habitat of the Recent West Coast *D. indentatus* (Carpenter), which unquestionably is the modern descendant of *D. engonatus,* but presumably if it were intertidal it would not be so rare in collections. The writer suspects that there is a long unbroken line of very shallow water species extending from the Chipola *D. matercula* to the Recent *D. pauperculus,* which simply have not been taken as fossils, and the *D. engonatus-D. indentatus* line is a distinct side-branch.

The Recent *D. indentatus* is sufficiently close to *D. engonatus* that Olsson and Harbison said (1953, p. 251): "That *engonata* occurs Recent along the Pacific coast of Panama and Central America is established by specimens in the U. S. National Museum from Panama City, which are indistinguishable in every way from the Florida shells." The two forms are close but not quite that close, and they are distinguishable by the relatively higher spire and straight-sided body whorl of *D. engonatus*. *D. indentatus* is diamond-shaped, with the shell distinctly extended at the periphery, which is, however, somewhat above the midline of the shell. The periphery of *D. engonatus* is indistinct, but is located almost exactly on the midline, giving the shell a more elongated appearance.

There is another name that has been cited as a western Atlantic species of *Dermomurex* –*"Murex" alabastrum* A. Adam, 1864 *(M. adamsii* Kobelt is an unnecessary new name for *M. alabastrum* Adams *non M. alabaster* Reeve). If this species were in fact from the western Atlantic it would be the undeniable descendant of *D. engonatus*. Unfortunately no examples comparable to it have ever been taken in the waters of the western Atlantic and, although described as coming from Martinique, the species is almost certainly the West Mexican *D. indentatus*. The illustration shows a small rounded aperture exactly like that of *D. indentatus*. The type specimen of *"Murex" alabastrum,* although originally in the Brit. Mus. (Nat. Hist.), is apparently lost (K. Thomas, *in litt.*) and so no photographic comparison is possible at this time.

In his original description Dall cited the measurements of his species as "Alt. 28 mm" but the figured specimen is cited as "22 mm." Schuchert *et. al* (1905, p. 670) listed USNM 113273 as the number of the "cotypes;" therefore, the specimen measuring 28 mm in height is here designated as the lectotype and the 22 mm figured specimen is considered a paralectotype.

DERMOMUREX (DERMOMUREX) PAUPERCULUS (C. B. Adams)

Plate 2, figs. 4–7

Murex pauperculus C. B. ADAMS, 1850, Contributions to Conchology, no. 4, p. 60.
Triton cantrainei RECLUZ, 1853, Jour. de Conchyl., v. 4, p. 246, pl. 8, fig. 10.

PLATE 2

Figures — Page

1,2. *Dermomurex (Dermomurex) tenellus* (Mayer) (X 3) 128
Locality: Pont-Levoy, near Blois, France. Helvetian Stage, middle Miocene.
1. Basel H 16677 (lectotype); height 15.7 mm, diameter 7.2 mm.
2. Basel H 16678 (idiotype); height 20.8 mm, diameter 11.0 mm.

3. *Dermomurex (Dermomurex) matercula* E.H. Vokes, n. sp. (X 3) 133
USNM 647442 (holotype); height 16.2 mm, diameter 8.5 mm.
Locality: TU 830. Chipola Formation, Florida; late lower Miocene.

4–7. *Dermomurex (Dermomurex) pauperculus* (C.B. Adams) 138
4. (X 3) USNM 739573; height 11.4 mm, diameter 6.4 mm.
Locality: TU R–68, Cayos Arcos, Mexico. Recent.
5. (X 2) MCZ 125072; height 30.0 mm, diameter 14.8 mm.
6. (X 2) MCZ 125072a; height 24.2 mm, diameter 12.0 mm.
Locality for both: Causeway, Biscayne Bay, Miami, Florida. Recent.
7. (X 3) USNM 739570; height 20.3 mm, diameter 10.0 mm.
Locality: TU R-94, Duarte Cays, north of Porto Bello, Panamá. Recent.

PLATE 2

Murex alveatus Kiener. TRYON, 1880, Man. Conch., v. 2, p. 128, pl. 38, fig. 264 *(Triton cantrainei)* (in part only, *not* of Kiener).

Aspella scalarioides var. *paupercula* (C. B. Adams). DALL, 1889, Harvard Mus. Comp. Zool, Bull., v. 18, p. 208.

Aspella scalarioides var. *obeliscus* (A. Adams). DALL, 1889, Harvard Mus. Comp. Zool., Bull., v. 18, p. 208 (*not* of Adams).

Aspella scalaroides (Blainville). DALL and SIMPSON, 1902, U. S. Fish Comm. Bull., v. 20, p. 410 (*not* of Blainville).

[Aspella] pauperculus (C. B. Adams). CLENCH and TURNER, 1950, Harvard Occas. Papers Moll., v. 1, no. 15, p. 323, pl. 39, fig. 16 (lectotype).

Aspella scalaroides obeliscus (A. Adams). M. SMITH, 1953, Illus Cat. Recent Species Rock Shells, p. 18, pl. 14, fig. 3 (*not* of Adams).

Aspella scalaroides paupercula (C. B. Adams). M. SMITH, 1953, Illus. Cat. Recent Species Rock Shells, p. 18, pl. 14, fig. 2.

Aspella paupercula (C. B. Adams). ABBOTT, 1958, Acad. Nat. Sci. Phila., Mon. 11, p. 62, pl. 1, fig. m.

Aspella paupercula (C. B. Adams). NOWELL-USTICKE, 1959, Check List Marine Shells St. Croix, p. 63.

Aspella paupercula (C. B. Adams). WARMKE and ABBOTT, 1962, Caribbean Seashells, p. 108, pl. 19, fig. d.

Aspella varians NOWELL-USTICKE, 1969, Supplementary Listing New Shells, p. 12; 1971, *ibid.* (revised ed.) p. 12, placed in synonymy with *Aspella cantrainei* Recluz.

[Aspella] (Dermomurex) pauperculus (C. B. Adams). E. H. VOKES, 1971, Bulls. Amer. Paleontology, v. 61, no. 268, p. 79.

Aspella paupercula (C. B. Adams). MORRIS, 1973, Field Guide to Shells . . . Third Edition (W. J. Clench, Ed.), p. 194, pl. 52, fig. 16.

Diagnosis: "Shell elongated, obliquely subfusiform: whitish, within the aperture yellowish: with three not very stout varices on each whorl, and slender intermediary varicoid ridges; with a few distant spiral ridges, the intersections being nodulous: apex subacute: spire with the outlines a little convex: whorls six, quite convex, with a deep suture: aperture elliptical: canal short, rather wide and recurved." (Adams, 1850)

Dimensions of lectotype: height 15.9 mm, diameter 7.8 mm.

Lectotype: Harvard MCZ 156124 (designated by Clench and Turner, 1950, p. 382).

Type locality: Jamaica.

Occurrence: Moín Formation, early Pleistocene; Costa Rica. Recent, western Atlantic from Florida to Lesser Antilles, and east coast of Central America from Mexico to Panamá.*

Figured specimens: Fig. 4, USNM 739573; height 11.4 mm, diameter 6.8 mm; locality TU R-68. Fig. 5, MCZ 125072; height 30.0 mm, diameter 14.8 mm; Biscayne Bay, Miami, Florida, on rocks. Fig. 6, MCZ 125072a; height 24.2 mm, diameter 12.0 mm; locality same as fig. 5. Fig. 7, USNM 739570; height 20.3 mm, diameter 10.0 mm; locality TU R-94. Other occurrences: TU locality nos. 954, R-44, R-181, R-269.

Discussion: Although *D. pauperculus* is by far the most common *Dermomurex* in the western Atlantic, as can be seen from the synonymy given above, it has been a long time in being recognized for what it is. The initial confusion may have been caused by Sowerby, who in the *Thesaurus Conchyliorum* (1879, pl. 23, fig. 233), gave a locality of "Isl. St. Thomas" for *"Murex" obeliscus* A. Adams, a species that had been described without locality. Tryon, the following year (1880, p. 128), combined *"M." pauperculus, "M." obeliscus,* and *"Triton" cantrainei,* all under the name *"M." alveatus* Kiener, a species that has only a superficial resemblance to the species of *Dermomurex.* While *"Triton" cantrainei* is undoubtedly a synonym of *D. pauperculus,* the other species *"M." obeliscus* A. Adams is not but, as has been shown recently by Emerson and D'Attilio (1970, p. 91), is a similar species from the west coast of tropical America.

Dall (1889, p. 208) was confused by the growth stages of *Dermomurex* and gave the name *"paupercula"* to the small specimens and *"obeliscus"* to the larger, more elongated adults. He also included *D. elizabethae* in the same "species," employing the varietal name *lamellosa* Dunker for this form. However, all of his "varieties" were included in the Mediterranean type species of the genus, *D. scalaroides,* with Dall evidently using the latter in place of a subgeneric assignment. It is true that all of the species of *Dermomurex* are similar, but the resemblances are generic rather than specific.

As was noted under *D. engonatus,* fossil specimens of *Dermomurex* are usually very scarce. *D. pauperculus* has never been reported from the fossil record but there is a single juvenile specimen from TU 954, Puerto Limon, Costa Rica, in the early Pleistocene beds of the Moín Formation.

*See note, p. 132 under *Aspella senex.*

Subgenus GRACILIMUREX Thiele, 1929

Gracilimurex THIELE, 1929, Handbuch syst. Weichtierkunde, v. 1, p. 289.

Type-species: *Murex bicolor* Thiele, by original designation [*Murex bicolor* Thiele, 1929, *non Murex bicolor* Risso, 1826, *nec M. bicolor* Valenciennes, 1832, *nec M. bicolor* Cantraine, 1835, = *Aspella bakeri* Hertlein and Strong, 1951.]

DERMOMUREX (GRACILIMUREX) ELIZABETHAE (McGinty)

Plate 3, figs. 1, 2

Aspella scalarioides var. *lamellosa* Dunker. DALL, 1889, Harvard Mus. Comp. Zool., Bull., v. 18, p. 208 (*not* of Dunker).

Aspella elizabethae T. McGINTY, 1940, Nautilus, v. 53, no. 3, pl. 10, fig. 7 (Jan., 1940); *ibid.* v. 54, no. 2, p. 63 (Oct., 1940).

[?] *Aspella scalarioides lamellosa* Dunker. M. SMITH, 1953, Illus Cat. Recent Species Rock Shells, p. 18, pl. 14, fig. 5 (*not* of Dunker).

Aspella elizabethae McGinty. NOWELL-USTICKE, 1959, Check List Marine Shells St. Croix, p. 63.

[Aspella] (Dermomurex) elizabethae McGinty. E. H. VOKES, 1971, Bulls. Amer. Paleontology, v. 61, no. 268, p. 44.

Diagnosis: "Shell elongated, obliquely subfusiform, chalkish white, with five or six varices on each whorl; several narrow grooves on the spire and low spiral cords between varices, about six on the body whorl. Nucleus smooth, opaque, apex acute, convex, suture deeply impressed, aperture elliptical, lip expanded and indented, operculum yellow and corneus, canal short, narrow and recurved." (McGinty, 1940)

Dimensions of holotype: height 12.5 mm, diameter 5.8 mm.

Holotype: ANSP 176449.

Type locality: Middle Sambo Shoals, near Key West, Florida.

Occurrence: Recent, south and west Florida; Bahamas to Virgin Islands.

Figured specimens: Fig. 1, ANSP 176449 (holotype). Fig. 2, MCZ 244935; height 14.6 mm, diameter 6.8 mm; Sand Key, 7 miles SW of Key West, Florida.

Discussion: The specimen in the USNM collection originally referred by Dall (1889, p. 208) to "*Aspella scalarioides* var. *lamellosa*" (USNM 545338) represents the species named much later as *Aspella elizabethae* McGinty. The failure to recognize this form as distinct is partly responsible for Dall's misunderstanding of the western Atlantic aspelloids, and he noted that in the species he cited as "*Aspella scalarioides*" (really *D. pauperculus* Adams) "a tendency is often exhibited in two of the normal six varices to grow bigger than the others, besides which the intermediate part of the whorl actually becomes somewhat flattened. A specimen of this sort, especially if the flattening is pronounced, as it sometimes is, looks much like a large white *Aspella hastula [i.e., A. senex]*, and one such was described by Dunker as *Ranella lamellosa.*" (*ibid.*, p. 209). As is noted in the Introduction, *A. lamellosa* (Dunker) is a synonym of *A. producta,* and does resemble *A. senex,* but the species subsequently named *A. elizabethae,* although it occasionally becomes flattened as to mimic an *Aspella* s.s., nevertheless seems to be more nearly allied with the members of *Dermomurex*.

DERMOMUREX (GRACILIMUREX) cf. ELIZABETHAE (McGinty)

Plate 3, figs. 3, 4

Figured specimens: Fig. 3, USNM 647443; height 18.5 mm, diameter 8.0 mm; TU 759. Fig. 4, USNM 739572; height 16.4 mm, diameter 7.8 mm; Pompano Beach, Florida (dredged fill).

Discussion: Along the Caloosahatchee River, west of Ortona Lock, there is a small area where a peculiar form of *Dermomurex* occurred. The form is figured here, on pl. 3, fig. 3, and it appears to be intermediate between *D. engonatus* and *D. elizabethae.* In this small area, represented only by two localities (TU 759 and 803) on opposite sides of the Caloosahatchee "Canal" no specimens of typical *D. engonatus* were found, only this aberrant form, some dozen or more being taken at the two localities. At these same localities there were a number of other strange occurrences, especially the hitherto very rare *Murex anniae* Smith, previously known from two examples, which was found by the hundreds. These localities were created when the U. S. Corps of Engineers deepened the previous channel in the river and piled the

spoil on both sides. The two prior specimens of *M. anniae* had come from near here at Ortona Lock and it is presumed that they were just fortuitous examples of the species that had wandered a bit far from its usual "home."

All along the Caloosahatchee "Canal" there is an undulating surface contact between the early Pleistocene beds that carry the "Glades" fauna, and the underlying late Pliocene Caloosahatchee Formation. Although the dredgings were made to a uniform depth along the bottom, at various spots one could find (while the dredging was in progress) spoil that ranged in age from the "Glades" (or younger in places) to the middle Pliocene Tamiami Formation. Thus at Ortona Lock we find there was a mixture of "Glades" and Caloosahatchee, indicating that the entire "Glades" section had been penetrated. But at the localities two miles west, there was no mixture and the entire section was in the "Glades" unit. This locality has been discussed by McGinty (1970, p. 54), who concluded that the fauna was indicative of a rocky situation. Certainly the replacement of *D. engonatus* by this intermediate form was not indicative of time as one typical *D. engonatus* has been taken at TU 978, a locality of "Glades" fauna only, but of a different ecology.

It seems a reasonable speculation that this occurrence of an intermediate form between *D. engonatus* and *D. elizabethae* is the point of transition between the two species and the two subgenera *Dermomurex* s.s. and *Gracilimurex*. In most places we have a distinct time break between strata, and the evolving species appear to be delimited by stratigraphic breaks. In south Florida we have an almost continuous record and intermediate forms should be the rule rather than the exception. This theory is complicated slightly, however, by the discovery of the intermediate form still living (or at least until very recently) off Pompano Beach, Florida. In 1970 offshore material was pumped in to "replenish" the beach at Pompano and in this material were found specimens of the "intermediate form" (see pl. 3, fig. 4.) Therefore, the validity of this form as an intermediary between *D. engonatus* and

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PLATE 3

(All figures magnified X 3)

Figures — Page

1,2. *Dermomurex (Gracilimurex) elizabethae* (McGinty) 141

1. ANSP 176449 (holotype); height 12.5 mm, diameter 5.8 mm.
Locality: Middle Sambo Shoals, Florida. Recent.

2. MCZ 244935; height 14.6 mm, diameter 6.8 mm.
Locality: Sand Key, Florida. Recent.

3,4. *Dermomurex (Gracilimurex)* cf. *elizabethae* (McGinty) 141

3. USNM 647443; height 18.5 mm, diameter 8.0 mm.
Locality: TU 759. Unnamed post-Caloosahatchee formation, Florida; early Pleistocene.

4. USNM 739572; height 16.4 mm, diameter 7.8 mm.
Locality: Pompano Beach, Florida. Recent.

5,6. *Dermomurex (Dermomurex) engonatus* (Dall) 136

5. USNM 647444; height 26.4 mm, diameter 11.0 mm.
Locality: TU 797. Pinecrest beds, early Pliocene.

6. USNM 647445; height 18.2 mm, diameter 8.8 mm.
Locality: TU 768. Caloosahatchee Formation, Florida; late Pliocene.

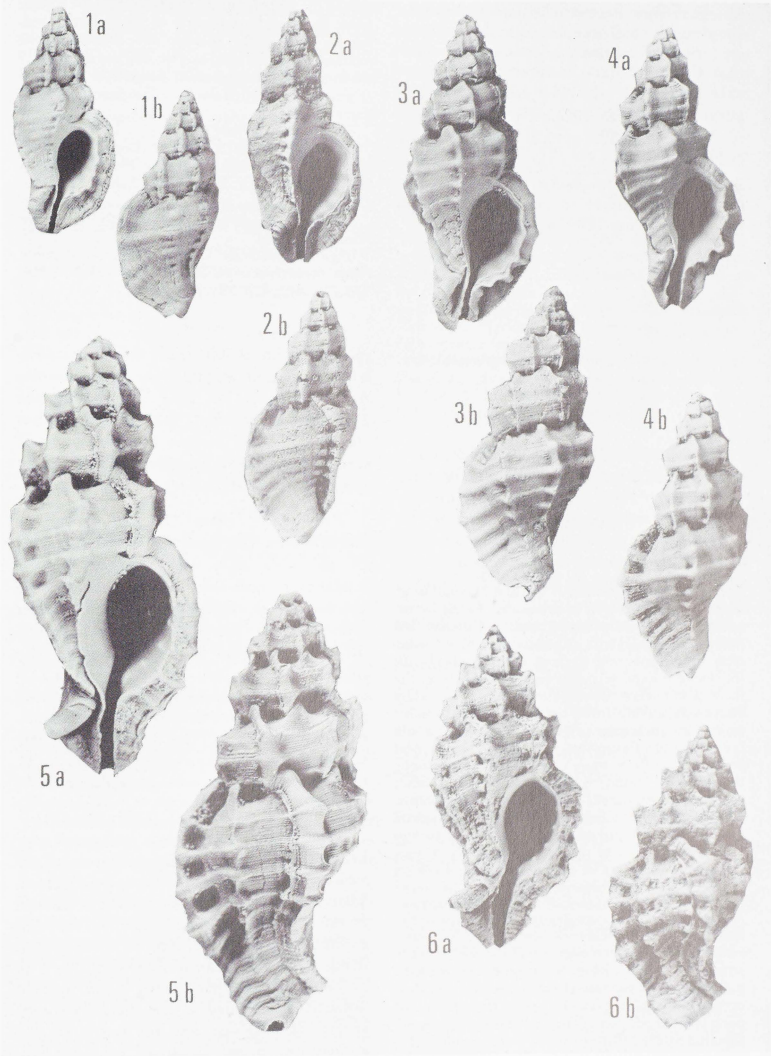

PLATE 3

D. elizabethae becomes less certain. But for the time we shall accept it as such until other evidence proves otherwise. It is not impossible that the transitional form may continue to exist along side the new form for a short period of time, to ultimately be completely replaced by it. The typical *D. engonatus* is essentially confined to the Pliocene beds in south Florida with but a single post-Caloosahatchee specimen known, that noted above from TU 978.

Subgenus TRIALATELLA Berry, 1964

Trialatella BERRY, 1964, Leaflets in Malac., v. 1, no. 24, p. 149.

Type-species: *Trialatella cunninghamae* Berry, by original designation.

DERMOMUREX (TRIALATELLA) FARLEYENSIS E. H. Vokes, n. sp.

Plate 4, fig. 1

Diagnosis: Protoconch of one and one-half large, bulbous whorls; seven post-nuclear whorls in the adult. Axial ornamentation beginning on the first post-nuclear whorl with six small varices that overlap onto the protoconch. Each succeeding whorl with six thickened and recurved varices, until about the sixth post-nuclear whorl where every other varix disappears, leaving only a buttress at the suture-line to indicate its former presence. Varices with a thin free-standing flange on the dorsal side, best developed on the anterior portion of the varix, along the siphonal canal. Spiral ornamentation faint, consisting of numerous fine threads on early whorls. On about the fourth post-nuclear whorl a slightly larger cord developed at the periphery, giving rise to a faint angulation in the varices where it crosses. Ultimately about six of these vague larger cords on the body-whorl, superimposed on the more numerous, finer spiral threads that cover the surface. A heavy intritacalx completely covering the entire shell; when fresh relatively smooth on the outer surface, but at broken edges small tunnel-like spiral structures visible within; when worn appearing to have fine spiral grooves of approximately the same order of magnitude as the spiral threads on the porcelaneous portion of the shell. Suture appressed, sinuated by the abutting varices, which are aligned in a slightly curving line up the spire. Aperture oval, with a narrow raised rim in advance of the terminal varix. On the inner side of the outer lip about five small denticles, on the anterior half of the lip only, that at the juncture of the siphonal canal the largest, Inner lip smooth, appressed at the posterior end, free-standing at the anterior end. Siphonal canal medium in length, open by a slit, slightly recurved at the distal end, forming a small umbilical chink.

Dimensions of holotype: height 14.5 mm, diameter 7.5 mm.

Holotype: USNM 647448.

Type locality: TU 999, Farley Creek, about 900 feet downstream from bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W), Calhoun County, Florida.

Occurrence: Chipola Formation, late lower Miocene; Florida.

Figured specimen: USNM 647448 (holotype). Other occurrences: TU locality nos. 458, 554,818, 819, 820, 825, 826, 951, 1049.

Discussion: D. (T.) farleyensis in the first species of a line that is clearly differentiated in later stages, culminating in the Recent species that was named as type of a new genus *Trialatella* Berry, 1964. The Recent form has greatly extended varices but this in itself seems insufficient reason for more than subgeneric separation (see pl. 4, fig. 4).

From the other Chipola species of *Dermomurex,* this form may be distinguished by its more alate varices, which have a tendency toward a shoulder angulation. The aperture of *D. farleyensis* is much smaller proportionally than that of *D. matercula* and the siphonal canal is more extended. The spiral ornamentation of *D. matercula* is coarser in nature, with *D. farleyensis* being almost smooth in overall appearance. Essentially the same criteria separate this new species from the French Miocene species *D. tenellus,* which is the same general form as *D. matercula.*

From its descendants, *D. farleyensis* may be separated by its less alate and less angulated varices, and by its shorter siphonal canal. There are four species that seem to be derived from *D. farleyensis.* One is *D. (T.) cunninghamae* (Berry), type of the subgenus, living on the west coast of Mexico, one is *D. (T.) abyssicola* (Crosse), living in the western Atlantic, the third is an Italian Pliocene species *D. (T.) jani,* and the last is *D. (T.) antecessor,* n. sp., discussed next. All four forms are so similar that one can only assume that the Italian species is in the direct line of descent from *D. farleyensis.*

The name of this new species is indicative of its distribution. Although there are a few specimens from the Chipola River, the majority of the individuals have been taken on Farley Creek. The fauna of Farley Creek is distinctive and it is undoubtedly an ecologic factor that controls the appearance of *D. farleyensis*. In numbers of specimens there are 24 from Farley Creek and only nine from the Chipola River, seven of these being from a single locality, TU 554. At this locality other species are found that otherwise commonly occur only on Farley Creek, as was recently noted by H.E. Vokes (1972, table 1) for *Arcopagia fausta*.

DERMOMUREX (TRIALATELLA) ANTECESSOR E. H. Vokes, n. sp.

Plate 4, figs. 5,6

Aspella (Dermomurex) cf. *jani* (Doderlein *in* Bellardi). S.E. HOERLE, 1970, Tulane Stud. Geol. Paleont., v. 8, no. 2, p. 64.

Diagnosis: Protoconch of one and one-half large bulbous whorls, six post-nuclear whorls in the adult. Ornamentation beginning on the first post-nuclear whorl with six small varices that overlap onto the protoconch, continuing with six varices per whorl up to about the fourth post-nuclear whorl when every other one disappears, leaving only a small buttressed node and an indistinct axial rib to mark the former position. Spiral ornamentation extremely faint, consisting of numerous fine lines underlain by about five larger ridges; the one at the shoulder making a faint angulation of the shell, best seen at the varices where a sharp flexture is developed. Where the other ridges cross the varices stronger raised bands are produced on both the ad- and abapertural sides; at the outer edge of the varices a thin free-standing flange extending the entire length of the varix, best developed toward the anterior canal. In life the entire exterior of the shell covered by an extremely thick intritacalx, greatly extending these varical flanges and giving the shell a wider aspect than when the intritacalx is removed. The bands on the varical surfaces also augumented by the intritacalx, especially on the apertural side, where deep pits are formed between the bands. The intritacalx, when unworn, with a massive earthy appearance , but when abraded displaying small spiral tunnels overlain by an axial fibrilar covering, giving a reticulate appearance to the entire surface. Aperture oval, outer lip crenulate; inside the outer lip five small denticles, corresponding to the spaces or pits between the varical bands of the spiral ornamentation. Inner lip smooth, appressed at the posterior end, slightly free-standing at the anterior end. Canal moderately long, open by a slit, somewhat recurved distally, with successive canals divaricating as spurs off the central axis.

Dimensions of holotype: height 17.0 mm, diameter 8.2 mm.

Holotype: USNM 647446.

Type locality: TU 954, hill cut immediately behind Standard Fruit Co. box factory, just west of cemetery at Pueblo Nuevo, about 2 km west of Puerto Limon, Costa Rica.

Occurrence: Unnamed post–Caloosahatchee formation, Florida; Moín Formation, Costa Rica; Pleistocene.

Figured specimen: Fig. 5, USNM 647447 (paratype); height 16.0 mm, diameter 8.1 mm; locality TU 201.Fig. 6, USNM 647446 (holotype). Other occurrences: TU locality no. 953.

Discussion: Although the subgenus *Trialatella* has not been recognized in the western Atlantic prior to this report, there are, in fact, three species from this region referable to the group. Recent representatives of the subgenus occur in waters of 15 to 30 fathoms. The beds at Moín are thought to be deposited in depths of about 30 fathoms, and the Florida occurrence is assumed, on the basis of other fauna, to have been about 25 fathoms in depth, so it is evident that *Trialatella* is an inhabitant of somewhat deeper water than the other species of *Dermomurex,* which for the most part are intertidal. The type-species has been taken only rarely on the west coast of Mexico and there is but a single Recent specimen of *Trialatella* known from the southern Caribbean, off Cape San Blas, Panamá, in 22 fathoms (see below). However, the group is fairly well represented in the Moín Formation, with 20 specimens from two localities, and another single specimen has been taken from the correlative beds of south Florida (TU 201).

This new species may be distinguished from the West Coast *D. (T.) cunninghamae* primarily by its more elongate shape, by its less depressed suture, and by the presence of a strong spiral cord at the shoulder, which gives rise to a marked angulation. The varices are much less expanded in the Pleistocene

specimens than in *D. cunninghamae*, even in examples of the latter that have the intritacalx removed, for this does have the effect of even more greatly extending the varices. *D. antecessor* also has heavier spiral ornamentation than does *D. cunninghamae*. Nevertheless, all of the species of *Trialatella* are very much alike, and differences are minimal. From the Chipola *D. farlayensis*, this new species differs in the relative proportions of aperture and canal length to total shell height. The anterior canal of the Pleistocene form is more attenuated than the older species. From the Recent *D. abyssicola* it differs in having weaker spiral ornamentation and also in its greater elongation.

In the Pliocene of northern Italy there is another species that appears extremely close to *D. antecessor*, but is distinguishable by the stronger spiral ribbing and larger aperture of the Italian species. This is the form originally cited only as *"Murex distinctus* var." by Cristofori and Jan, 1832, subsequently included in a list of nude names as *"M. jani"* by Doderlein, 1862, and only finally described in 1873 by Bellardi, who observed that it could be separated from the similar *"Murex scalarioides" (i.e., arlus)*, with which it occurs, by the very fine transverse striae, the

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PLATE 4

(All figures magnified X 3)

Figures Page

1. *Dermomurex (Trialatella) farleyensis* E.H. Vokes, n. sp. 144
   USNM 647448 (holotype); height 14.5 mm, diameter 7.5 mm.
   Locality: TU 999. Chipola Formation, Florida; late lower Miocene.

2,3. *Dermomurex (Trialatella) abyssicola* (Crosse) 148

   2. Holotype—after Crosse, 1865, pl. 1, figs. 4,5; height 11 mm, diameter 6 mm.
      Locality: Guadeloupe, Lesser Antilles, 250 fathoms. Recent.
   3. USNM 739571; height 9.0 mm, diameter 4.0 mm.
      Locality: TU R-98, Holandes Cay, off Cape San Blas, Panamá, 22 fathoms. Recent.

4. *Dermomurex (Trialatella) cunninghamae* (Berry) 130
   SUPTC 9502 (holotype); height 18.0 mm, diameter 9.2 mm.
   Locality: Puerto San Carlos, Sonora, Mexico, 15-35 fathoms. Recent.

5,6. *Dermomurex (Trialatella) antecessor* E.H. Vokes, n. sp. 145

   5. USNM 647447 (paratype); height 16.0 mm, diameter 8.1 mm.
      Locality: TU 201. Unnamed post-Caloosahatchee formation, Florida; early Pleistocene.
   6. USNM 647446 (holotype); height 17.0 mm, diameter 8.2 mm.
      Locality: TU 954. Moín Formation, Costa Rica; early Pleistocene.

7. *Dermomurex (Trialatella) arlus* (de Gregorio) 128
   Basel H 16679; height 20.0 mm, diameter 11.5 mm.
   Locality: Castell'Arquato, near Piacenza, Italy. Plaisancian Stage, Pliocene.

8. *Dermomurex (Trialatella) jani* (Bellardi) 146
   Basel H 16680; height 17.3 mm, diameter 8.4 mm.
   Locality: La Zinola, near Savona, Italy. Astian Stage, Pliocene.

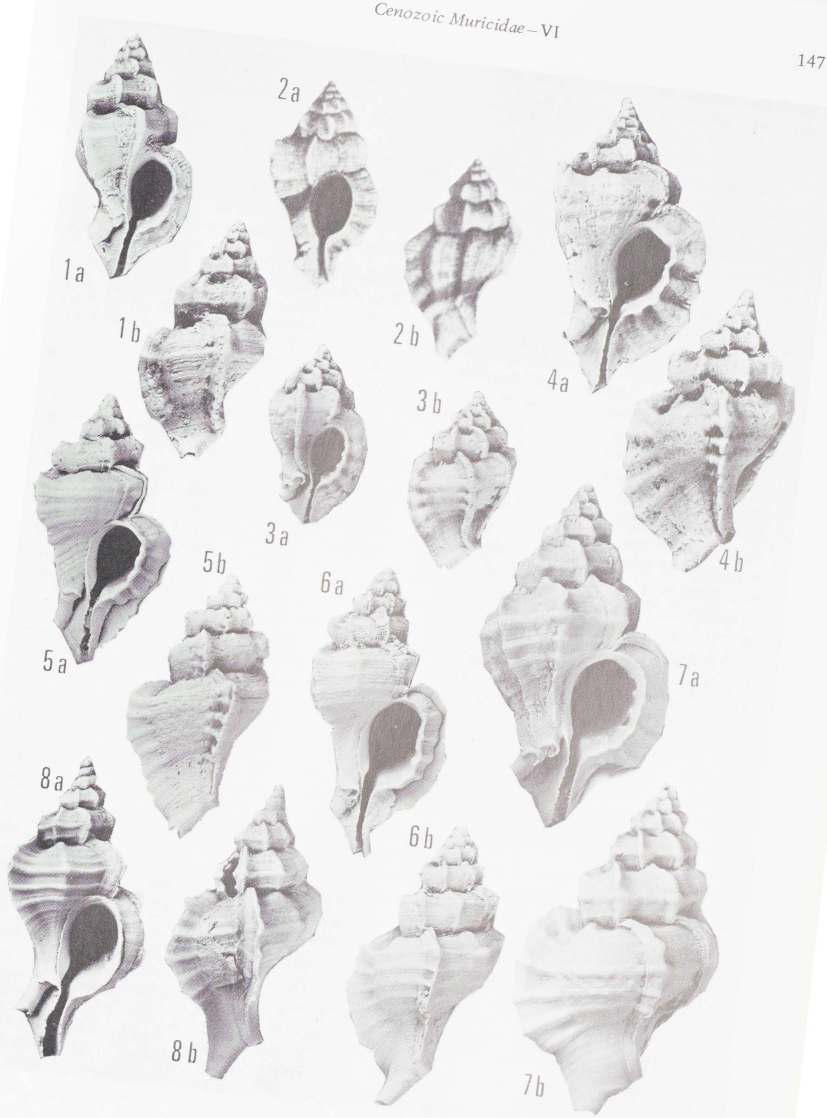

PLATE 4

small and inequal intervarical costae, and by the acute, laminar varices (1873, p. 73). It is also relativély smaller, as comparison of pl. 4, figs. 7 and 8 will demonstrate.

Considering that *D. jani* is completely unlike any other European species and so like the Chipola and Pleistocene western Atlantic forms, there seems little doubt but that somehow the Italian species is a decendant of the Floridian *D. farleyensis*. There is a parallel situation in the species *Murexiella absona* (Cristofori and Jan, 1832), which again is most closely related to the western Atlantic Pliocene-Recent *Murexiella macgintyi* (Smith), both having their immediate ancestor in the Chipola species *Murexiella shilohensis* (Heilprin). When or how the interchange occurred is not known, but sometime in the early or middle Miocene there was a connection between the Chipola sea and the Aquitaine Basin of southern France. The specimen figured from the Tortonian of Bulgaria by Kojumdgieva and Strachimirov (1960, pl. 40, fig. 7) as *"Aspella (Aspella) scalarioides"* is extremely close to *D. (T.) farleyensis* and may represent the transitional stage. In the Pliocene of the Maritime Alps there is a species of *Dermomurex,* named *"Murex" bisotensis* by Cossmann, 1903, which is probably a synonym of *D. jani.*

DERMOMUREX (TRIALATELLA) ABYSSICOLA (Crosse)

Plate 4, figs. 2,3

Murex abyssicola CROSSE, 1865, Jour. de Conchyl., v. 13, p. 30. pl. 1, figs. 4, 5.

Murex (Pterynotus) abyssicola Crosse. CLENCH and PÉREZ FARFANTE, 1945, Johnsonia, v.1, no. 17, p. 38, pl. 20, figs. 9,10.

[*Aspella*] *(Dermomurex) abyssicola* (Crosse). VOKES, 1971, Bulls. Amer. Paleontology, v. 61. no. 268, p. 12.

Diagnosis: "T. imperforata, trigona, oblonga, tenuiuscala, subtranslucida, peculiariter et tenuissime striato-decussata, coneo-fusca, plerumque plus minusve incrustate; anfr. 6 convexi, embryonales 1½ laeves, albidi, apice obtusiusculo, sequentes trifariam varicosi, varicibus latis, obliquis, foliaceo-nodosis, compressis, subacutis, antice marginatis, inter varices tuberculo prominulo, saepe longitudinaliter diviso ornati, ultimus spiram superans, zona parvula, pallide castanea transversim balteatus; apertura subovata, parva, intus livide fusca; columella subarcuata; margine dextro lato, foliaceo-nodoso, striato-decussato; canali subobliquo, longiusculo, recurvo." (Crosse, 1865)

Dimensions of holotype: height 11 mm, diameter 6 mm.

Holotype: Not found.

Type locality: Guadeloupe, Lesser Antilles.

Occurrence: Recent only, Caribbean Sea.

Figured specimens: Fig. 2, holotype (after Crosse). Fig. 3, USNM 739571; height 9.0 mm, diameter 4.0 mm; locality TU R-98.

Discussion: "Murex" abyssicola was based upon a single juvenile specimen and has not been recognized since its original description. However, the type came from rather deep water (250 fathoms) and this may explain why it has been overlooked for 100 years. Although Clench and Pérez Farfante (1945, p. 39) suggested that the holotype might be in the Caillet Collection at the École de Mines, Paris, correspondance with that institution reveals that the specimen is not there.

The original description leaves little doubt that the species is a *Dermomurex,* mentioning that the surface is ornamented by a "peculiar" and rather elegant system of fine transverse striae. In the Tulane Collections from off Cape San Blas, Panamá, there is one small specimen that seems to be referable to *D. abyssicola.* Certainly it is not a juvenile *D. pauperculus,* which differs in having a small spine-like angulation in each varix, at the shoulder, and also is proportionally more elongate. Comparison of pl. 2, fig. 4, and pl. 4, fig. 3, will show the difference in these two forms, as both specimens have the same number of whorls.

Although obviously very closely related to *D. (T.) cunninghamae,* the small shell from off Panamá is different in having much stronger spiral ornamentation. The presence of the heavy intritacalx masks this difference as it does the different outline of the varix, but specimens of *D. cunninghamae* with the intritacalx removed show an almost completely smooth shell, except on the varical flanges, where faint spiral ridges are

still visible. Likewise the shoulder angulation of *D. cunninghamae* without intritacalx is much more angulate, approximately a right angle turn into the suture, which is deeply impressed, whereas *D. abyssicola* has a gently rounded curve, with or without the intritacalx. There is some doubt as to whether the Panamanian specimen is actually the same as *D. abyssicola.* The great difference in depth is a discrepent factor, and the specimen also lacks the brown band said to circle the base of *D. abyssicola.* However, on the basis of one juvenile specimen, it seems best to treat the two forms as identical. Further collecting may alter this decision.

Subgenus TAKIA Kuroda, 1953

Takia KURODA, 1953, Venus, v. 17, no. 4, p. 190.

Type-species: *Murex inermis* Sowerby, 1841, by original designation *(non Murex inermis* Philippi, 1836, *nec M. inermis* Dujardin, 1837 [?=Philippi])=*Dermomurex (Takia) infrons* Vokes, 1974.

DERMOMUREX (TAKIA) COOKEI
Mac Neil MS, E. H. Vokes, n. sp.

Plate 5, figs. 2–4

Diagnosis: Shell large, with six post-nuclear whorls in adult; protoconch of two large bulbous whorls. Early ornamentation beginning gradually with six small varices that overlap onto the protoconch. Six rib-like varices on each whorl, forming a slightly abaperturally curved spiral line up the spire. Spiral ornamentation minimal, barely perceptible only by fourth or fifth post-nuclear whorl, consisting of faint cords, approximately eight in number on the adult body whorl, but five of these may be stronger. Whorls inflated, suture undulating, varices of each succeeding whorl abutted against the previous one. Aperture rounded; smooth, parietal lip, slightly raised; outer lip with about nine elongate denticles having little correlation with the external ornamentation. Siphonal canal medium in length, open, slightly recurved, becoming more so with increasing size; umbilicus small in juveniles, larger in adult. In life the shell covered by a heavy intritacalx, which seems to have been ornamented by fine spiral grooves, perhaps a dozen or more on the body whorl, but too poorly preserved on type material to be certain.

Dimensions of holotype: height 20.5 mm, diameter 11.0 mm.

Holotype: USNM 647449.

Type locality: USGS 15058, Chickasawhay River, about one mile southwest of Hiwanee, Wayne County, Mississippi (=TU 226).

Paratype A: USNM 498087; height 13.7 mm, diameter 7.8 mm; Chickasawhay River, 1 mile below Shubuta, Wayne County, Mississippi.

Paratype B: USNM 498209; height 11.6 mm, diameter 7.3 mm; Brown's Cave, Leaf River, Smith County, Mississippi.

Occurrence: Red Bluff Clay, lower Oligocene; Mint Springs Marl, middle Oligocene; Mississippi.

Figured specimens: Fig. 2, USNM 498087 (paratype A). Fig. 3, USNM 498209 (paratype B). Fig. 4, USNM 647449 (holotype). Other occurrences: TU locality no. 226.

Discussion: This oldest known *Dermomurex* was described in a manuscript on the fauna of the Vicksburg Group originally prepared by Stearns MacNeil of the U.S. Geological Survey. However, Dr. MacNeil's retirement has forced postponement of publication and so, due to the important position of this species in the history of the *Dermomurex* line in the New World, with Dr. MacNeil's permission it is included here. MacNeil proposed the name *cookei* in honor of C. Wythe Cooke, the noted Tertiary paleontologist, and the writer echoes his sentiment.

This new species from the Oligocene of Mississippi is exceedingly similar to *"Murex" cotteavi** Meunier, from the late Oligocene of France. No material is available of *"M." cotteavi* for comparative purposes, but to judge from the original illustration (Meunier, 1880, pl. 14, figs. 29, 30), and subsequent ones in Cossmann and Lambert (1884, pl. 6, fig. 2, as *"Murex (Trophon) tenellus* Mayer") and Cossmann (1903, pl. 2, fig. 13), the French species is more inflated and also smaller than the American one.

The early species of *Dermomurex* are all very similar and there is not a great deal of difference between the Oligocene *D. cotteavi* and *D. cookei* and the Mio-Pliocene *D.*

*Although named for G.H. Cotteau—(by coincidence also a student of echinoids as is Dr. Cooke), the original spelling of this species name was *"cotteavi,"* and is not to be emended, according to the Code of Zoological Nomenclature, Art. 32.

distinctus. The differences are more a matter of degree than of any striking morphologic change. *D. distinctus* has stronger ornamentation, both axial and spiral, than the earlier forms. In the Old World it is almost certain that *D. cotteavi* give rise to *D. distinctus*. In the New World there is a dual descent, with *D. cookei* presumably giving rise to the later species of *Dermomurex* as well as the species here assigned to *D. (Viator)*. The early Miocene *D.(V.) sexangulus* again is not too different from the Oligocene *D. cookei* and the differences seem to be more in degree of development than in any marked change. The canal in *Viator* becomes more elongate and straight, the spire is shortened, and the ornamentation is strengthened.

D. (T.) cookei is the only western Atlantic representative of the subgenus; but the line still survives in the eastern Pacific *D. (T.) myrakeenae* (Emerson and D'Attilio) (see pl. 5, fig. 7) and in the Indo-Pacific type-species of the subgenus *D. (T.) infrons* Vokes (=*Murex inermis* Sowerby *non* Philippi) (see pl. 5, fig. 1).

Subgenus VIATOR Vokes, 1974

Viator E.H. VOKES, 1974, Malac. Soc. Australia, Jour., v.3, no. 1, p. 4.

Type-species: *Dermomurex (Viator) antonius* Vokes, by original designation.

PLATE 5

(All figures magnified X 3)

Figures — Page

1. *Dermomurex (Takia) infrons* Vokes 130
   Holotype–after Sowerby, 1841, pl. 192, fig. 87; height 25.0 mm, diameter 11.9 mm.
   Locality: Japan. Recent.

2–4. *Dermomurex (Takia) cookei* E. H. Vokes, n. sp. 149
   2. USNM 498087 (paratype A); height 13.7 mm, diameter 7.8 mm.
      Locality: USGS 5263, Chickasawhay River, below Shubuta, Mississippi. Red Bluff Clay, early Oligocene.
   3. USNM 498209 (paratype B); height 11.6 mm, diameter 7.3 mm.
      Locality: USGS 7671, Leaf River, Smith Co., Mississippi. Mint Springs Marl, middle Oligocene.
   4. USNM 647449 (holotype); height 20.5 mm, diameter 11.0 mm.
      Locality: USGS 15058, Chickasawhay River, below Hiwannee, Mississippi (=TU 226). Red Bluff Clay, early Oligocene.

5,6. *Dermomurex (Takia) distinctus* (Cristofori and Jan) 128
   5. Basel H 16681; height 18.0 mm, diameter 10.0 mm.
      Locality: Castell'Arquato, near Piacenza, Italy. Plaisancian Stage, Pliocene.
   6. Basel H 16682; height 13.5 mm, diameter 7.7 mm.
      Locality: Basedasco, near Piacenza, Italy. Plaisancian Stage. Pliocene.

7. *Dermomurex (Takia) myrakeenae* (Emerson and D'Attilio) 130
   Wright Coll. M–309; height 16.3 mm, diameter 9.0 mm.
   Locality: West Mexico. Recent.

8. *Dermomurex (Dermomurex) scalaroides* (Blainville) 127
   USNM 87092; height 18.0 mm, diameter 8.8 mm.
   Locality: Sicily, Italy. Recent.

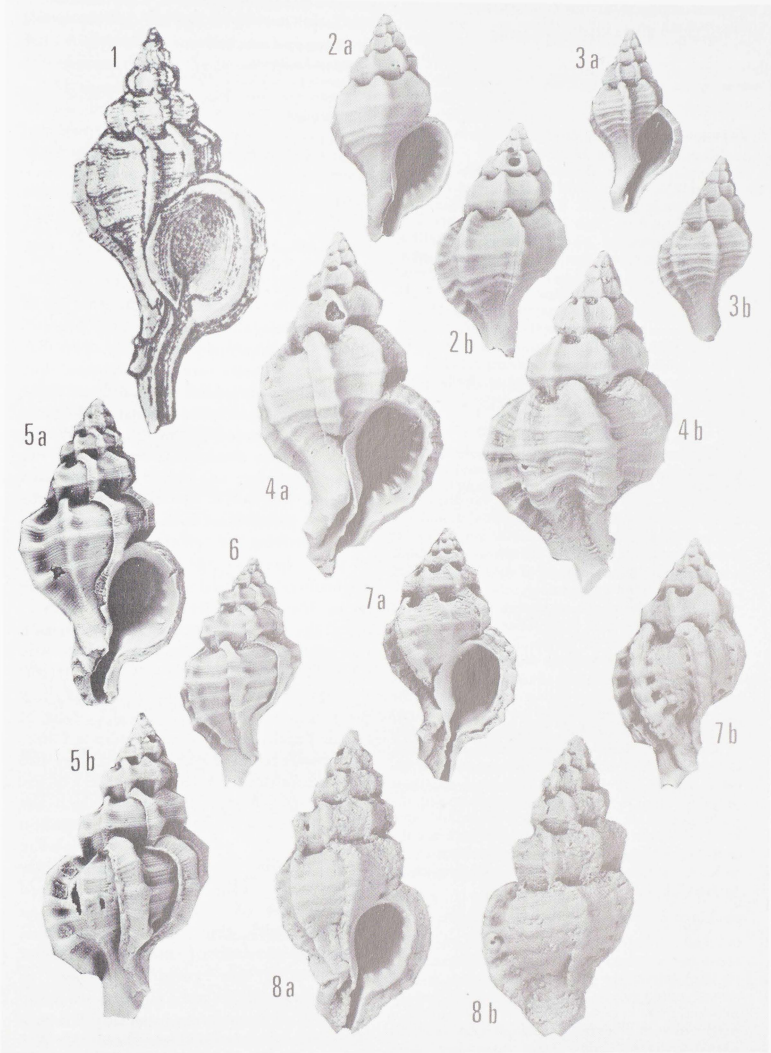

PLATE 5

DERMOMUREX (VIATOR) SEXANGULUS (Dall)

Plate 6, figs. 1,2

Murex sexangula DALL, 1915, U.S. Natl. Mus., Bull. 90, p. 74, pl. 13, fig. 11.
Eupleura sexangula (Dall). MANSFIELD, 1937, Florida Geol. Surv., Bull. 15, p. 132.
"Murex" sexangula Dall. WOODRING, 1959, U.S. Geol. Surv. Prof. Paper 306–B, p. 219.
Murex (Panamurex) gilletteorum E. H. VOKES, 1963, Tulane Stud. Geol., v. 1, no. 4, p. 160, pl. 2, figs. 1a, 1b.
[Poirieria (Panamurex)] gilletteorum (Vokes). E. H. VOKES, 1964, Malacologia, v. 2, no. 1, p. 18.
[Aspella] (Takia) sexangula (Dall). E.H. VOKES, 1971, Bulls. Amer. Paleontology, v. 61, no. 268, p. 97 (with *gilletteorum* in synonymy, p. 54).
Dermomurex (Viator) sexangulus (Dall). E.H. VOKES, 1974, Malac. Soc. Australia, Jour., v.3, no. 1, p. 7, pl 1, fig. 4.

Diagnosis: "Shell small, stout, rather short, with about 6 whorls of which the nuclear one and a half are smooth and rounded, the subsequent whorls subtabulate, with 6 well-developed varices; suture deep, distinct; whorls rather abruptly shouldered but not keeled; varices continuous and somewhat retractive, the line ascending the spire making about a quarter turn; spiral sculpture of about five rounded ridges, one behind the shoulder, subequally spaced, the two near the periphery closest, which are most prominent on the back of the varices and obsolete in the spaces between the varices; besides these there are numerous spiral grooves with wider, flattened interspaces which cover the whole surface and end in minor crenulations on the recurved edges of the varices; axial sculpture only of incremental lines and the varices, which are thick, recurved, longitudinally striate in front, finely crenulate at the recurved edge, with about five projections corresponding to the ends of the spiral ridges, of which the most prominent is at the shoulder; aperture rounded, the outer lip with six or eight feeble lirations internally; inner lip smooth, continous, partly free from the body whorl, canal rather wide, open, with a strong siphonal fasciole; a very narrow umbilical chink present."(Dall,1915)

"Shell large for the group, and heavy. Nucleus unknown, seven post-nuclear whorls in the adult. Axial ornamentation consists of six to seven stout rib-like varices; the spiral ornamentation of four strong, raised ridges, which ride over the varices. Between these conspicuous spiral ridges the shell is patterned with irregular microscopic spiral lirae and axial growth lines giving a semi-reticulate appearance. Aperture ovate, labium heavy, standing free in the anterior portion, somewhat appressed posteriorly. Outer lip denticulate, with about ten more or less well-defined teeth. Canal moderate in length, slightly recurved, and open." (Vokes, 1963)

Dimensions of holotype: height 21.4 mm, diameter 14.0 mm.

Holotype: USNM 165086.

Type locality: Ballast Point, Tampa Bay, Hillsborough County, Florida.

Occurrence: Tampa Limestone, Florida; "Silverdale beds," North Carolina; early lower Miocene.

Figured specimens: Fig. 1, USNM 165086 (holotype). Fig. 2, USNM 644377 (holotype–*Murex gilletteorum* Vokes); height 43.5 mm, diameter 26 mm; locality TU 562. Other occurences: TU locality no. 866.

Discussion: Comparison of the holotype of *D. (V.) sexangulus* with that of *"Murex" gilletteorum* does not immediately show that the two species are synonymous but comparison with smaller unfigured paratypes of *"M." gilletteorum,* approximately the same size as the holotype of *D. sexangulus,* indicates quite clearly that the two are the same. The writer was misled by Mansfield's reference of Dall's species to the genus *Eupleura* and did not consider *D. sexangulus* when describing *"M." gilletteorum.*

The species *"M." gilletteorum* was originally referred to the subgenus *Panamurex* (type: *Murex gatunensis* Brown and Pilsbry) but at the time it was noted the specimens in the type lot do not have the characteristic labial denticulations of *Panamurex.* It was thought perhaps better material might show these. Subsequently Mr. Richard E. Petit, of Myrtle Beach, South Carolina, collected three more well-preserved specimens and they also fail to show these denticulations. Work on the identity of *"Murex" vaughani,* which the writer observed to have an ornamentation similar to *"M." gilletteorum,* although she attributed the similarity to convergence (1963b, p. 152), led to the belated identification of *"M." gilletteorum* as an aspelloid, with the recognition of small remnant patches of intritacalx further corroborating this assignment. There is, nevertheless, still a marked resemblance to the members of *Panamurex,* especially *Poirieria (Panamurex) clarksvillensis* and *P. (P.) laccapoia,* as originally stated, but it is now thought that the resemblance is due to parallelism, for *Poirieria* is almost certainly

ancestral to both *Panamurex* and to *Dermomurex*. The species of *Panamurex* also have an intritacalx, but it is much thinner and less obvious than in the *Dermomurex* species.

Although there are two other species of *Viator* in the New World, in the slightly younger Chipola Formation, they represent a distinct side branch off the main line and the only other species of *Viator* occur in the Miocene and Recent faunas of Australia. As there are no other species known anywhere else in the world, it seems to be the inescapable conclusion that somehow the line made its way from the eastern United States to southern and then northwestern Australia without leaving a trace. The Australian middle Miocene (Balcombian) *D. (V.) asteriscus* (Tate) clearly shows the transition from the relative short-canaled *D. sexangulus* to the very long-canaled Recent *D. antonius* Vokes (compare plate 6, figs. 2, 3, and 5).

DERMOMUREX (VIATOR) VAUGHANI (Maury)

Plate 7, figs. 1,4

Murex vaughani MAURY, 1910, Bulls. Amer. Paleontology, v. 4, no. 21, p. 143, pl. 23, fig. 6.

Murex (Murex) vaughani Maury. GARDNER, 1947, U.S. Geol. Surv. Prof. Paper 142—H, p. 519.

Murex vaughani Maury. BRANN and KENT, 1960, Bulls. Amer. Paleontology, v. 40, no. 184, p. 573.

Murex (Murex?) vaughani Maury. E.H. VOKES, 1963, Tulane Stud. Geol., v. 1, no. 3, p. 102, pl. 1, figs. 2a. 2b.

Murex (Bolinus) vaughani Maury. E. H. VOKES, 1963, Tulane Stud. Geol., v. 1, no. 4, p. 151, pl. 1, figs. 1a. 1b.

[Murex] (Bolinus) vaughani Maury. E. H. VOKES, 1971, Bulls. Amer. Paleontology, v. 61, no. 268, p. 114.

Diagnosis: "Shell small, pyriform, compact, resembling in shape young specimens of *M. messorious* Sowerby of the Pliocene and recent faunas. Whorls about six, the nuclear nearly smooth, the three later whorls bearing each seven varices. On the body whorl the varices are prominent, rounded, somewhat broader than the interspaces. The varices of the shell form nearly continous, sinuous lines from near the apex to the base of the canal. Spiral sculpture of raised lines of which groups of two or three are much stronger and stand out prominently from among alternating feebler spirals. Outer lip with about ten strong internal lirae; aperture oval; canal not quite half the length of the shell." (Maury, 1910)

Dimensions of holotype: height 22.5 mm, diameter 14.0 mm.

Holotype: PRI 3461.

Type locality: "Baileys Ferry, Florida." TU 554, east bank of Chipola River, at power line crossing (SW¼ Sec. 17, T1N, R9W), Calhoun County, Florida (here designated).

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 1, USNM 647450; height 35.5 mm, diameter 23.3 mm; locality TU 825. Fig. 4, USNM 647451; height 15.6 mm, diameter 9.5 mm; locality TU 830. Other occurrences: TU locality nos. 458, 459, 546, 547, 548, 554, 818, 821, 823, 950, 951, 999, 1049, 1050.

Discussion: Although formerly placed in *Murex (Bolinus)* on the basis of generalized shell morphology, especially like that of *M. (B.) cornutus* Linné, work on the paleontology of *Bolinus* led to the realization that this was a result of convergence. The oldest species of *Bolinus*—those that would be contemporaneous with *D.(V.) vaughani*, such as *M.(B.) partschi* Hörnes—bear very little resemblance to the Chipola species, and it is not until the Pliocene that the similar appearing *M. (B.) torularius* Lamarck is developed. (The middle Miocene species that is often cited as *"M. torularius"* is a much higher spired shell, and is better denominated *M. gapus* de Gregorio, 1885.)

The presence of the large flaring inductura on the parietal wall of *D. vaughani*, so much like that in the Recent species of *Bolinus*, cannot be explained at this time. No other species of *Viator* has such a structure. The identical type of inductura appears independently in the modern species of *Phyllonotus* and *Bolinus* (it does not appear in the earlier species of either group). Thus, it does not indicate especially close relationships. It seems reasonable to conclude that this is a morphologic feature that has arisen independently in response to some functional need. A similar type of inductura may be seen in *Murex chrysostoma* Sowerby, generally accepted as a member of *Murex s.s.*

Dermomurex vaughani is now placed with the aspelloids, on the basis of the previously unrecognized intritacalx, but the placement within the subgenus *Viator* is a compromise.

Although this form may be placed in this group with no difficulty, there are two other species that obviously are closely related to *D. vaughani* but have curved siphonal canals more in the manner of *Takia.* Inasmuch as the low spire and the heavy spiral ornamentation seem more akin to *Viator,* all three of these somewhat atypical species are included here. The alternatives are to create yet another subgenus for these abberrant forms or to "stretch" the subgeneric concept; the writer prefers the latter. Certainly these three species represent a distinct side branch off the main *Viator* lineage. They apparently are an evolutionary "dead-end" as there are no other known species that seem to be related to the group.

Since the original discussion of *D. vaughani* in the earlier parts of this series (Vokes,1963a, p. 102, 1963b, p. 151), a number of other examples have been discovered in the Chipola Formation. However, in spite of the lenghty occurrence list cited above, it is never common and most of the localities are represented by only a single specimen or fragments. The original type locality was cited by Maury as "Baileys Ferry, Florida." As has been discussed before (Vokes, 1968, p. 102) there is no Chipola at that place, therefore a better type locality must be designated. Maury (1910, pp. 143–144) named three muricid species all from this same vague site. The locality TU 554 was previously designated by the writer as the type locality for *Hexaplex veatchi* (Maury), and as both *D. vaughani* (Maury) and *Pteropurpura virginiae* (Maury)–the other species in question–all are at TU 554, this probably was her original locality. It is also possible that collections were made all along the Chipola outcropping at the river's edge, and several TU localities actually may be involved. Certainly the species described by Maury from the same "locality" but in a different paper, as *"Pyrazisinus" harrisi*(see Hoerle, 1972, p. 21) occurs only at TU 459, and almost had to have been collected there.

PLATE 6

Figures Page

1,2. *Dermomurex (Viator) sexangulus* (Dall) 152

1. (X 3) USNM 165086 (holotype); height 21.4 mm, diameter 14.0 mm.
Locality: Ballast Point, Tampa Bay, Florida. Tampa Limestone, early lower Miocene.

2. (X 1½) USNM 644377 (holotype-*Murex gilletteorum* Vokes); height 43.5 mm, diameter 26.0 mm.
Locality: TU 562. Silverdale beds, North Carolina; early lower Miocene.

3. *Dermomurex (Viator) asteriscus* (Tate) (X 3) 153

USNM 157237 (topotype); height 24.4 mm, diameter 15.0 mm.
Locality: Muddy Creek, west of Hamilton, Victoria, Australia. Muddy Creek Formation, middle Miocene (Balcombian).

4,5. *Dermomurex (Viator) antonius* Vokes 153

4. (X 20) WAM. 2834–67 (paratype); height 15.7 mm, diameter 8.8 mm.
Locality: Legendre Island, Dampier Arch., Western Australia, 23 fathoms. Recent. (Detail of intritacalx).

5. (5a–X 6; 5b–X 3) WAM. 3646-67 (holotype); height 25.7 mm, diameter 13.5 mm.
Locality: Sholl Island, Dampier Arch., Western Australia, Recent. (Fig. 5a–section of shell with intritacalx removed to show underlying ornamentation.)

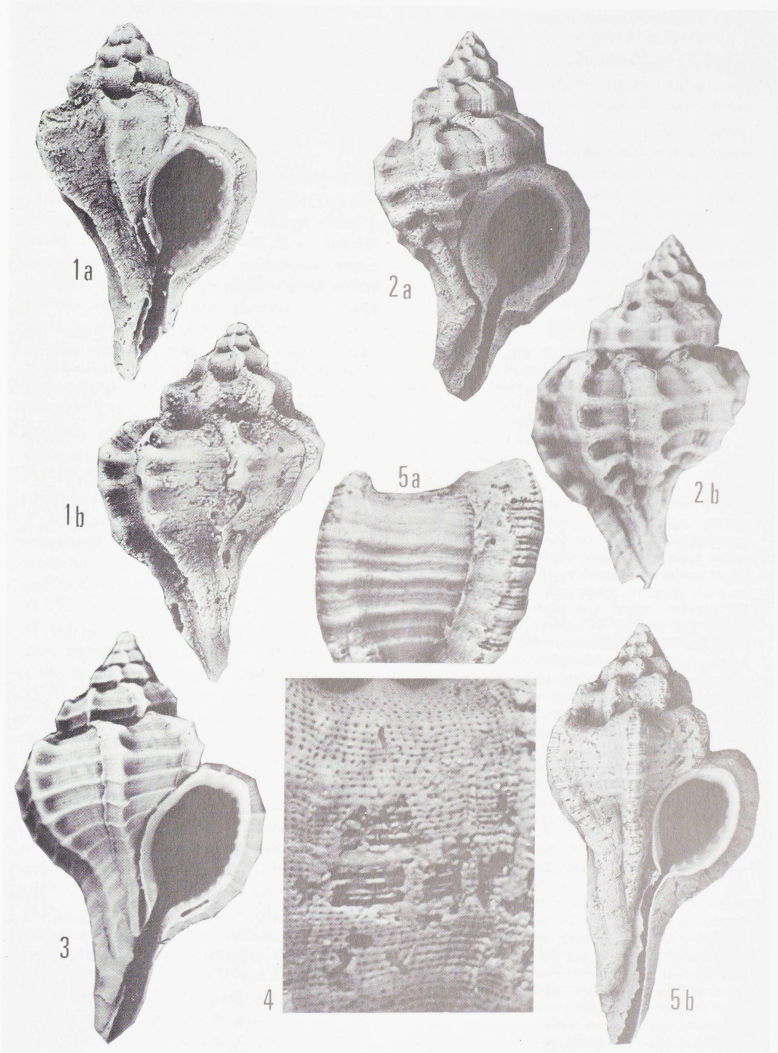

PLATE 6

In 1963 the writer stated (Vokes, 1963b, p. 152) that a fragment, consisting of a siphonal canal, indicated a total height of over 60 mm for this species. However, with much more material now available it seems more probable that this fragment should be assigned to *Murexiella calhounensis* Vokes, and not to *D. vaughani,* for the largest known specimen of the latter is an individual of 45 mm.

DERMOMUREX (? VIATOR)

CURVIDUCTUS E. H. Vokes, n. sp.

Plate 7, figs. 2,3

Diagnosis: Shell large for the group; protoconch of two and one-half bulbous whorls; adult with seven post-nuclear whorls. Teleoconch ornamentation begins as faint crescentic varices, visible only at the sutures; becoming broad swollen ridges by third post-nuclear whorl, seven in number on each whorl of teleoconch. Each varix abutting the previous whorl and placed abaxially to its counterpart forming a curved pattern down the spire. Spiral ornamentation of flattened cords, each bearing paired spiral threads upon its surface; six major cords on body whorl and two additional on siphonal canal. Cords obsolete in the intervarical areas, only noticeable where they cross the varices; here forming deep pits between each pair of cords as well as both before and behind the varices, creating the most conspicuous feature of the shell. Shell surface covered with poorly-defined spiral threads between the major spirals, approximately six between each pair. Spire low in proportion, about one-third total shell height. Suture impressed, sinuated by the varical abutments; whorls greatly inflated and sharply constricted into the narrow siphonal canal, which is twisted dorsally at the distal end, the succession of varices producing a long, curved, narrowly open tube. Aperture almost circular; inner side of outer lip with about 12 lirae, apparently not correlated with the external spiral sculpture; inner lip smooth, with a thin, free-standing inductura. In life shell covered with a thick intritacalx but none sufficiently well preserved to determine exact nature.

Dimensions of holotype: height 51.8 mm, diameter 34.5 mm.

Holotype: USNM 647452.

Type locality: TU 830, Ten Mile Creek, at power line crossing about one mile west of Chipola River (SE ¼ Sec. 12, T1N, R10W). Calhoun County, Florida.

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 2, USNM 647452 (holotype). Fig. 3, USNM 647453 (paratype); height 10.7 mm, diameter 7.5 mm; locality TU 830.

Discussion: Occurring with *D.vaughani,* but so far from a single locality (TU 830), is a new species that is obviously closely related to *D. vaughani* but differs in being larger, smoother, and in having a curved rather than straight siphonal canal. This new species is actually much more like a third species from the Burdigalian beds of Italy and France, *"Murex" taurinensis* Michelotti, 1841. Michelotti's original illustration(1841, pl. 4, figs. 8, 9) shows a gerontic specimen extremely close to the Florida species; however, the illustration given by Bellardi (1873, pl. 6, fig. 10) and the photograph given by Cossmann and Peyrot (1923, pl. 13, figs. 26, 27)*, as well as a young example in the Zurich Collection (here figured, pl. 7, fig. 5), shows that in the younger specimens of *D. taurinensis* the shoulder is more sharply angulated and the body-whorl less inflated. An unfigured paratype of *D. curviductus* that is the same size as the *D. taurinensis* still has the inflated appearance of the larger holotype, so that size is not a factor. The very young examples of *D. curviductus,* such as the paratype here figured (pl. 7, fig. 3), do show a more angulate outline much like the Italian species.

The specimen figured by Cossmann and Peyrot is from Peloua, near Saucats, France, which is the same locality where *Bursa pelouatensis* (Crossmann and Peyrot) occurs. The latter has been reported from the Chipola by the writer (Vokes, 1973, p. 97). The fauna at Peloua is,therefore, of special interest and it seems undeniable that there was some means of communication between the two areas. Many of the species in the two faunas have absolutely no correlation,

*In passing it should be noted that the specimen figured by Glibert (1952, pl. 5, fig. 2) as *"Murex taurinensis"* is not that species but an example of *"Murex" rudis* Borson, a *Hexaplex.*

for there are many Mediterranean elements found at Peloua that never occur in the southern United States, but the two species *D. curviductus* and *D. taurinensis* are too closely alike and too totally distinctive for there not to have been some interchange of faunas. It is inconceivable that the two species represent parallelism.

V. LOCALITY DATA

The following are Tulane University fossil locality numbers:

201. Unnamed post-Caloosahatchee formation, spoil banks at pit just south of Belle Glade, (at Belle Glade Camp), Palm Beach Co., Florida.
202. Caloosahatchee Fm., south bank of Caloosahatchee River, about two miles west of La Belle (SE ¼ Sec. 12, T43S, R28E), Hendry Co., Florida.
203. Caloosahatchee Fm., north bank of Caloosahatchee River, about two miles east of Fort Denaud (SW ¼ Sec. 11, T43S, R28E), Hendry Co., Florida.
226. Red Bluff Clay, Chickasawhay River at Hiwannee, 3½ miles south of Shubuta (Sec. 28, T10N, R7W, St. Stephens Base and Meridian), Wayne Co., Mississippi. (Given in previous papers as the type locality of the Red Bluff Clay, but subsequent work has proved that locality to the about two miles north of 226)
458. Chipola Fm., east bank of Chipola River, above Farley Creek (SW ¼ Sec. 20, T1N, R9W), Calhoun Co., Florida.
459. Chipola Fm., east bank of Chipola River, steep bank about 1500 feet above mouth of Taylor Lake Branch (NW ¼ Sec. 29, T1N, R9W), Calhoun Co., Florida.
520. Pinecrest Beds, spoil banks, canal 0.9 mile east of Brighton on Florida Highway 70 (Sec. 25, T37S, R32E), Highlands Co., Florida.
529. Caloosahatchee Fm, north bank of Caloosahatchee River, about two miles west of La Belle (SE ¼ Sec. 12, T43S, R28E), Hendry Co., Florida.
536. Caloosahatchee Fm., south bank of Caloosahatchee River about one mile east of La Belle (Sec. 3 & 4, T43S, R29E), Hendry Co., Florida. (Designated as type locality of the Caloosahatchee Formation by Olsson *in* Olsson and Petit, 1964, p. 519.)
539b. Caloosahatchee Fm., Shell Creek (lower beds), about eight miles east of Cleveland (Sec. 30, T40S, R25E), Charlotte Co., Florida.
546. Chipola Fm., Ten Mile Creek, about 1 3/4 miles west of Chipola River (NE ¼ Sec. 12, T1N, R10W), Calhoun Co., Florida (=USGS 2212, "one mile west of Bailey's Ferry.")
547. Chipola Fm., west bank of Chipola River, about 2000 feet above Four Mile Creek (SW ¼ Sec. 29, T1N, R9W), Calhoun Co., Florida.
548. Chipola Fm., west bank of Chipola River, at bend about 1800 feet south of mouth of Farley Creek (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.
555. Chipola Fm., east bank of Chipola River, about 1000 feet above Four Mile Creek (SW ¼ Sec. 29, T1N, R9W), Calhoun Co., Florida.
562. "Silverdale Beds," Onslow County marl pit, on south side of Webb Creek, near Silverdale, Onslow Co., North Carolina. (Note: in 1967 this locality was no longer collectable, pit is filled with water.)
579. Caloosahatchee Fm., Miami Canal spoil banks, four 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.
727. Unnamed post-Caloosahatchee formation, borrow pits 2.2 miles east of U.S. Highway 27, 15 miles south of South Bay, Palm Beach 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), Okeechobee Co., Florida.
745. Caloosahatchee Fm., Miami Canal spoil banks, 10.8 miles north of pumping station at Broward county line, Palm Beach Co., Florida.
759. Unnamed post-Caloosahatchee formation, spoil banks north side of Caloosahatchee River, two miles west of Ortona Lock (NE ¼ Sec. 29, T42S, R30E), Glades Co., Florida.
767. Caloosahatchee Fm. and unnamed post-Caloosahatchee formation mixed, spoil banks north side of Caloosahatchee River, five miles west of Ortona Lock (NW ¼ Sec. 36, T42S, R29E), Glades Co., Florida.
768. Caloosahatchee Fm. and unnamed post-Caloosahatchee formation mixed, spoil banks north side of Caloosahatchee River, 5½ miles west of Ortona Lock (NW ¼ Sec. 35, 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., 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.
797. Pinecrest Beds, material exposed during construction of "Alligator Alley," 13.3 miles

east of Florida Highway 29 (T49S, R32E), Collier Co., Florida.

803. Unnamed post-Caloosahatchee formation, spoil banks south side of Caloosahatchee River, two miles west of Ortona Lock (NE ¼ Sec. 29, T42S, R30E), Glades Co., Florida.

818. Chipola Fm., Farley Creek, 0.1 mile west of bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W), Calhoun Co., Florida.

819. Chipola Fm., Farley Creek, 0.2 mile west of bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W), Calhoun Co., Florida.

820. Chipola Fm., Farley Creek (lower beds), at bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W), Calhoun Co., Florida.

821. Chipola Fm., Farley Creek, 0.1 mile east of bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W), Calhoun Co., Florida.

823. Chipola Fm., Farley Creek, south bank about 2000 feet east of bridge of Florida Highway 275 (SE ¼ Sec. 21, T1N, R9W), Calhoun Co., Florida.

825. Chipola Fm., Farley Creek, at abandoned mill about ¼ mile west of bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W), Calhoun Co., Florida.

826. Chipola Fm., Farley Creek, about 0.1 mile west of abandoned mill, which is ¼ mile west of bridge of Florida Highway 275 (on section line between Sec. 20 & 21, T1N, R9W), Calhoun Co., Florida.

827. Chipola Fm., Farley Creek, about ½ mile west of bridge of Florida Highway 275 (SE ¼ Sec. 20, T1N, R9W), Calhoun Co., Florida.

830. Chipola Fm., Ten Mile Creek, at power line crossing about one mile west of Chipola River (SE ¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.

866. "Silverdale Beds", marl pit on north side of Webb Creek and east side of unnumbered county highway, Silverdale, Onslow Co., North Carolina.

933. Pinecrest Beds, material exposed during construction of "Alligator Alley," 21.5 miles east of Florida Highway 29, Collier Co., Florida.

950. Chipola Fm., west bank of Chipola River, about 200 feet above Farley Creek (SW ¼ Sec. 20, T1N, R9W), Calhoun Co., Florida.

951. Chipola Fm., Ten Mile Creek, about 1¼ miles west of Chipola River (SE ¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.

953. Moín Fm., type locality, Moín Hill, railroad cut and adjacent ditches on road to Sandoval, 4.5 km west of Puerto Limon, Costa Rica.

954. Moín Fm., hill cut immediately behind Standard Fruit Co., box factory, just west of cemetery at Pueblo Nuevo, about 2 km west of Puerto Limon, Costa Rica.

974. Caloosahatchee Fm. and unnamed post-Caloosahatchee formation mixed, north side Caloosahatchee Canal, 2½ to 3½ miles west of center of former Lake Hicpochee (now drained) (unmapped area, T42S, R32E), Glades Co., Florida.

975. Caloosahatchee Fm., spoil banks north side Caloosahatchee River, 0 to ½ mile west of center of former Lake Hicpochee (now drained) (unmapped area, T42S, R32E), Glades Co., Florida.

978. Unnamed post-Caloosahatchee formation, spoil banks at pit on south side of waterworks,

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PLATE 7

Figures Page

1,4. *Dermomurex (Viator) vaughani* (Maury) 153

1. (X 1½) USNM 647450; height 35.5 mm, diameter 22.7 mm.
Locality: TU 825. Chipola Formation, Florida; late lower Miocene.

4. (X 4) USNM 647451; height 15.6 mm, diameter 9.5 mm.
Locality: TU 830. Chipola Formation, Florida; late lower Miocene.

2,3. *Dermomurex (?Viator) curviductus* E.H. Vokes, n. sp. 156

2. (X 1¼) USNM 647452 (holotype); height 51.8 mm, diameter 34.5 mm.
Locality: TU 830. Chipola Formation, Florida; late lower Miocene.

3. (X 5) USNM 647453 (paratype): height 10.7 mm, diameter 7.5 mm.
Locality: TU 830. Chipola Formation, Florida; late lower Miocene.

5. *Dermomurex (? Viator) taurinensis* (Michelotti) (X 2) 156

Basel H 16683 (topotype); height 23.0 mm (incomplete); diameter 21.7 mm.
Locality: Rio della Batteria, Torino, Italy. Burdigalian Stage, lower Miocene.

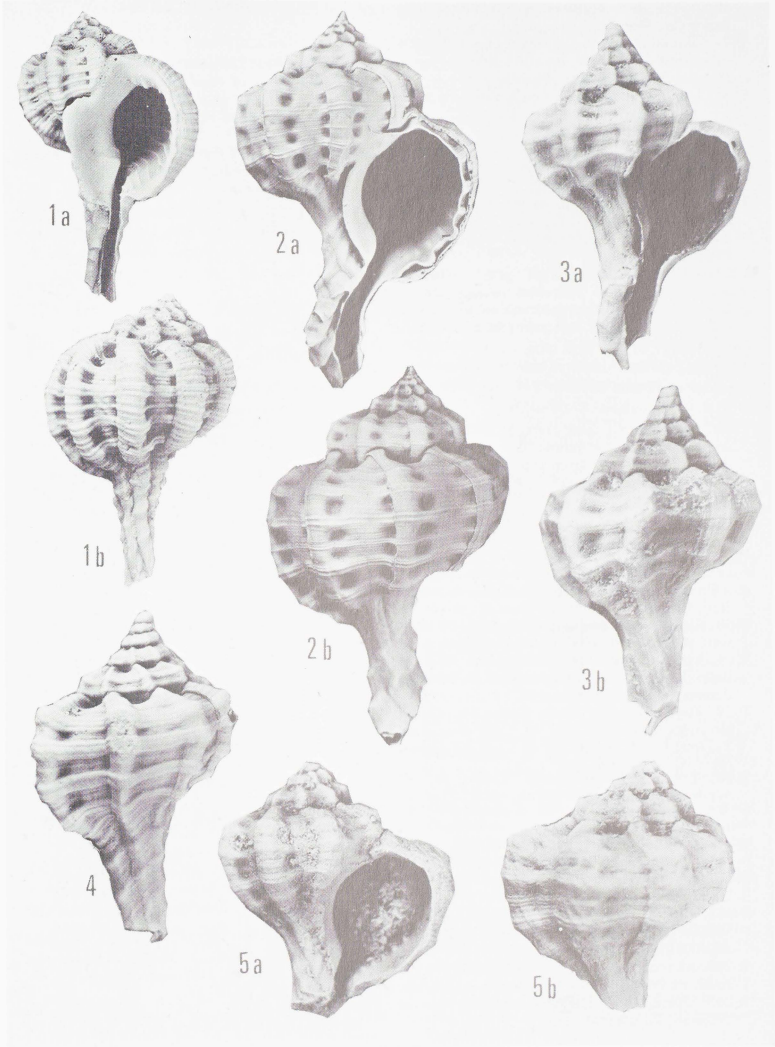

PLATE 7

about 1½ miles northeast of South Bay, Palm Beach Co., Florida.

991. Caloosahatchee Fm., Cochran Rock Pit, 2½ miles west of La Belle, on north side of Florida Highway 80, Hendry Co., Florida.

998. Chipola Fm., Ten Mile Creek, about 1¼ miles west of Chipola River (SE ¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.

999. Chipola Fm., Farley Creek, about 900 feet west of bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W), Calhoun Co., Florida.

1000. Pinecrest Beds, borrow pit at east end of 17th street, (T36S, R19E), about 8 miles east of U.S. Highway 30 at Sarasota, Sarasota Co., Florida.

1023. Caloosahatchee Fm. and unnamed post-Caloosahatchee formation mixed, pits on U.S. Highway 441, at intersection of Florida Highway 717, about one mile east of Pahokee, Palm Beach Co., Florida.

1049. Chipola Fm., Farley Creek, 1.0 mile east of bridge of Florida Highway 275 (NE ¼ Sec. 21, T1N, R9W), Calhoun Co., Florida.

1050. Chipola Fm., west bank of Chipola River immediately below power line crossing, and directly across river from loc. 554 (SW ¼ Sec. 17, T1N, R9W), Calhoun Co., Florida.

The following are Tulane University Recent locality numbers:

R-44. Isla Mujeres, open ocean side, Quintana Roo, Mexico.

R-68. Cayos Arcas, reef approximately 100 miles west of Campeche (city), Campeche, Mexico.

R-94. Durate Cays, North Island, north of Porto Bello, Panamá; Lat. 9 degrees 35.8' N, Long. 79 degrees 41' W, shore collection.

R-98. Dredged *Anton Bruun* Cruise 10, NW of Holandes Cay and ENE of Cape San Blas, Panamá; Lat. 9 degrees 37' N, Long. 78 degrees 50.3' W, 22 fathoms.

R-99. Dredged *Anton Bruun* Cruise 10, off northeastern Yucatán Peninsula, Mexico; Lat. 21 degrees 41' N, Long. 86 degrees 34' W, 17 fathoms.

R-166. Barra de Navidad, Jalisco, Mexico; rocky point across inlet from main sand bar.

R-181. Piña, beach on Caribbean coast due west of Gatun, Panamá.

R-263. Gulf of Mexico, about 10 miles off Fort Walton Beach, Florida, 14 fathoms. (Taken by SCUBA diver on coral patches.)

R-269. Akumal, on Caribbean coast about 100 km south of Puerto Juarez, Quintana Roo, Mexico.

R-283. Yukalpeten, sand beach 2.5 km west of Progreso, Yucatán, Mexico.

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POST SCRIPT

While the above paper was in press, the "unnamed post-Caloosahatchee formation" was finally named. DuBar, in a summary of south Florida Neogene stratigraphy (1974, p. 221), states: "The name Bermont Formation is informally proposed here for the uppermost fossiliferous marine sands exposed along Shell Creek in the Bermont quadrangle, Charlotte County. The formation was referred to as Unit F by DuBar (1962c) who, along with all earlier workers, considered it as a member of the Caloosahatchee Formation. According to Olsson and Petit (1964, p. 521) the unit was first delimited as a separate, post-Caloosahatchee formation by Druid Wilson about 1960. Because Wilson had not named the formation Olsson referred to it as Unit A."

By noting that the name is proposed "informally" DuBar automatically has created a name that really should not be used. The *Code of Stratigraphic Nomenclature* (1972) states that to name a formal rock-stratigraphic unit one must include a "statement of intention to designate a formal unit" (Code, Art. 13). Thus, rather than cutting the Gordian knot, with which we have struggled for so long, he has only added to the complications. However, since the name will undoubtedly pass into the literature in the same way as "Jackson Bluff Formation," "Pinecrest Beds," and the vast majority of the stratigraphic names presently being used in Florida, we might as well become accustomed to it. Even an informal name is better than none.

The type locality of the "Bermont Formation" is the same as TU locality 539 (see above) and is now under the waters of an artificial lake created by a small dam. This may be, in part, what influenced DuBar not to make a formal type locality of it. Although DuBar is of the opinion that the unit is medial Pleistocene in age, the writer and many other paleontologists believe it to be early Pleistocene, correlating with the Moín Formation of Costa Rica, which has been well dated by planktonic foraminifers.

DUBAR, J.R., 1974, Summary of the Neogene Stratigraphy of southern Florida *in* Post-Miocene Stratigraphy central and southern Atlantic Coastal Plain, R.J. OAKS, JR. and J.R. DUBAR, editors, Utah State University Press, p. 206-231, figs. 1-5, tables 1-7.