

## Some Cretaceous-Eocene Foraminiferal Mutations From the U.S. Gulf Coastal Plain

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By definition a mutation is an abruptly appearing abnormal biologic specimen (sport) with the potential and chance of eventually establishing itself through many reproductive generations. Mutation involves change in an organic species; and changes in species constitute new varieties, or new species, and eventually a new genus. Such organic development is evolution. Accordingly, mutation is recognized generally as a basic element in organic development or evolution.

The more complex and highly organized the form of life, the more opportunities there are for mutable reflections. On the other hand, the simplest forms of life are limited in potential change.

Mutations in Foraminifera are reflected only in their skeletons (tests). Foraminiferal abnormalities are not apparent in the single nucleus, nor in the surrounding protoplasm that actually secretes the freak skeleton.

In a sea teeming with representatives of a given calcareous foraminiferal species, for instance, most of the skeletons of this form are very similar in such specific features as shape, size, chambers, sutures, ornamentation, aperture and wall. Some exhibit sufficient minor variation in one or more features to justify varietal differentiation. It is conceivable that relatively few mutations will be secreted in an environment with favorable (or balanced) food, temperature, pressure, salinity, sedimentation, population, etc. The fact that many foraminiferal skeletal freaks are discovered, however, suggests that some unusual stimulus or unbalanced impetus, either inherent and within or accidental and without, stimulates the protoplasm to secrete differential skeletal material, resulting in mutation.

Mutations of three foraminiferal species are demonstrated herein, and the taxonomic problem of proper assignment of these abnormalities (sports) is discussed.

### *Bolivina midwayensis* Cushman, 1936

Pl. 1, Figs. 2, 3, 4?

*Bolivina midwayensis* Cushman, 1936, Cushman. Lab. Foram. Res., Spec. Publ. 6: 50, Pl. 7, Figs. 11a-b.

Additional Synonymy in: Harris and Jobe, 1951. Microfauna of basal Midway outcrops near Hope, Arkansas. Transcript Press, Norman, Oklahoma, p. 42.

Test slender, elongate, subapiculate, somewhat compressed, though thickest along the median axis, periphery subacute, though not carinate; seven to nine elongate chambers on one side alternating with similar chambers on opposite side of axis, proloculus simple, and developing directly into biserial stage; sutures distinct, slightly thickened along axis, slanting peripherally at angle of 50 to 60 degrees; wall calcareous, imperceptibly perforate, smooth, and polished; aperture a comma-shaped slit extending from base of distal chamber well into its apertural face.

Holotype from Midway (Paleocene) of the U. S. Gulf Coast.

Stratigraphic range: The species has been observed in Midway Paleocene samples from six states in the U. S. Gulf Coastal Plain, where it occurs as a fairly common index microfossil.

Specimens figured herein from Midway outcrop, 6.4 miles north of Hope, Arkansas.

Remarks: Specimen (Fig. 2) is typical of the species, consisting of seven or eight alternating chambers per side, and sutures slightly limbate along median axis.

The specimen (Fig. 3) is a mutation of the species in which several chambers of one side have become peripherally apiculate and slightly projecting beyond the margin (particularly noticeable in the three final chambers of one side). Otherwise, the specimen resembles the normal of the species except for slight peripheral lobulation of chambers. So distinctly apiculate and decidedly projecting is the final chamber of specimen (Fig. 3) that one is justified in foreseeing subsequent chambers even more apiculate (both sides) and more loosely connected by deeper and wider sutures. It is altogether probable, however, that in the addition of even one more chamber, the specimen would become uniserial, and no longer be considered a *Bolivina* d'Orbigny, 1839, but a *Loxostomum* Ehrenberg, 1854. Justifiable differentiation between the two genera, other than biserial versus uniserial growth, involves the common-shaped apertural slit in the face of the final chamber of *Bolivina*, versus the rounded, terminal aperture of *Loxostomum*.

The specimen (Fig. 4) involves an interesting mutation of *Bolivina midwayensis*, in which the specimen has attained the uniserial arrangement of *Loxostomum*, before adding a final pair of apiculate bolivine chambers. The full adult count of seven or eight chambers to the side (as depicted in Figs. 2 and 3) was obtained before the final mutable chambers were added. A logical explanation for the mutation of these final chambers in this instance would involve senility of the individual; for it is indeed proved that the species is an established adult in seven or eight chambers per side. So why the senile protoplasmic urge to secrete an additional chamber or so? At least this specimen made history and "got his picture in the paper"! Nevertheless, so obviously has this specimen become a so-called freak of nature in departing from normal *Bolivina midwayensis* (Fig. 2), that it is recognized *per se*, a freak *B. midwayensis*.

*Dorothia bulletta* (Carsey) Plummer, 1931

Pl. 1, Figs. 1?, 5.

*Gaudryina bulletta* Carsey, 1926. Univ. Texas, Bull. 2612: 28, Pl. 4, Fig. 4.

*Dorothia bulletta* Plummer, 1931. Univ. Texas, Bull. 3101: 132, pl. 8, figs. 13-17.

Additional synonymy in: Cushman, 1946. U. S. Geol. Survey, Prof. Pap. 206: 46.

Test subcylindrical, elongate, with distal end rounded (not truncated and flattened, as in *Marssonella* Cushman, 1933); earliest basal whorl with three or four chambers, later triserial, and in the adult becoming biserial, with sides slightly expanding as chambers are added; chambers distinct, in some specimens slightly lobulate distally; sutures distinct and slightly depressed; wall finely arenaceous, appearing smooth; aperture a low arch at base of apertural face of distal chamber. Maximum length approximates 1.00 mm.

**Stratigraphic range:** The species is known from six or more states of the U. S. Gulf and Atlantic Coastal Plains, in strata of Navarro (top-most Gulf) and Taylor ages. Cushman recorded it also from Navarro strata of Georges Bank in the Atlantic Ocean.

Specimens figured herein from Annona (Taylor) chalk outcrop, 2.5 miles north of Saratoga, Arkansas.

**Remarks:** Specimen (Fig. 5) is typical of the species: a subcylindrical, smoothly cemented, elongate form resembling a rifle bullet of 22-calibre (hence the specific name, *bulletta*). The specimen normally developed from an expanding, trochoid base of several chambers in a whorl, to an adult biserial stage. So long as the species added subsequent chambers in biserial arrangement, it would represent the genus *Dorothia* Plummer, 1931. With obvious increase in length, however, the form would then become either a variety of *D. bulletta* (if occurring in the same stratigraphic horizon), or a subspecies of *D. bulletta* (if occurring in a stratigraphic horizon other than that of the type).

The specimen (Fig. 1) is a mutation of *D. bulletta*, in which the biserial dorothine stage of Fig. 5 has become uniserial in the two final chambers. Furthermore, the dorothine aperture of Fig. 5 (at base of final chamber) has become a centralized, terminal pore. This uniserial specimen of Fig. 1 has indeed fulfilled all the taxonomic requirements for the establishment of a new foraminiferal genus; i. e., a change in shape, as well as a change in aperture. Unfortunately, this single specimen, warped and collapsed in final chambers, is the only specimen thus far discovered and reported. With the discovery, description, and illustration of a few additional specimens, then the form will be established as a new species of the genus *Goëssella* Cushman, 1933.

Such development from biserial to uniserial, as demonstrated respectively by *Dorothia* (Fig. 5) to the potentially new goësellid form of Fig. 1, is no surprise nor exception to the rule of foraminiferal skeletal evolution. Indeed, the law of foraminiferal skeletal development involves changing from: 1) A complex multilocular coiled or triserial base, becoming 2) Biserial, which in turn becomes 3) Uniserial, which in final end-member status becomes 4) Unilocular. Such foraminiferal skeletal development from the complex base to the unilocular end-member is depicted in phylogenetic family trees in the various text-books regarding Foraminifera. So, in respect to this potentially new goësellid form of Fig. 1, there is a taxonomic cubby-hole in the scheme of foraminiferal classification awaiting its appearance long before it is discovered to claim its rightful inheritance.

#### *Clavulinoides midwayensis* Cushman, 1936

Pl. 1, Fig. 6.

*Clavulina angularis* Plummer, 1927 (not d'Orbigny). Univ. Texas, Bull. 2644: 70, Pl. 3, Figs. 4, 5.

*Clavulinoides midwayensis* Cushman, 1936. Contr. Cushman Lab. Foram. Res., Spec. Publ. 6: 21, Pl. 3, Figs. 9, 15.

Additional synonymy in: Harris and Jobe, 1951. Microfauna of basal Midway outcrops near Hope, Arkansas. Transcript Press, Norman, Oklahoma, p. 10.

Test elongate, triangular, having developed from a triangular, triserial base, to a triangular uniserial stage whose final adult chambers become subspherical and nodose, periphery is subcarinate in triangular stage,

lobulate in final several chambers; chambers numerous, those of early triserial stage, indistinct, those of intermediate uniserial triangular stage fairly distinct, while the few final, rounded chambers are well defined by wide, deep sutures; aperture is a subcircular hole in the slightly produced terminal end of the final chamber; wall rather finely arenaceous. Length to 1.5 mm.

Stratigraphic range: The species occurs in abundance in basal Paleocene strata throughout the U. S. Gulf Coastal Plains.

Specimen illustrated herein from Midway (Paleocene) outcrop, 6.4 miles north of Hope, Arkansas.

The specimen (Fig. 6) is typical of the basal three-fourths of the species (the two or three rounded terminal chambers have been destroyed). The base is triangular and triserial; succeeded by a triangular uniserial stage.

The specimens (Figs. 7 and 8) occurring as contemporary forms of *C. midwayensis* (Fig. 6), apparently represent developments of the established species, becoming quadrate, rather than triangular, in the intermediate stage. Since many such quadrate specimens were discovered from this Paleocene section, then justification obtains for the erection of a new species of the genus *Clavulinoides* Cushman, 1936.

#### *Clavulinoides subquadrata* n. sp.

Pl. 1, Figures 7, 8.

Test elongate, subquadrate, consisting of a triserial, triangular base, becoming uniserial in intermediate and adult stages; intermediate uniserial stage is subquadrate in section, the lateral face that more or less develops astride a basal angular edge is not as wide as the other three lateral faces, adult uniserial stage develops rounded, nodose chambers separated by deep sutures, peripheral edges are subcarinate and elevated beyond the concave lateral faces; four or five quadrate chambers in intermediate stage, and two to four nodose chambers in terminal stage; aperture a central, subtriangular opening within a slightly produced, terminal neck; wall rather finely arenaceous and smoothly cemented.

The holotype (Fig. 8) and broken paratype (Fig. 7) from Midway (Paleocene) outcrop, 6.4 miles north of Hope, Arkansas.

Stratigraphic range: A form rarely occurring in the Paleocene.

Remarks: This species resembles *C. aspera* (Cushman) Cushman var. *whitei* (Cushman and Jarvis) Cushman, from the Upper Cretaceous of Trinidad, in its intermediate quadrate uniserial stage. The new species differs in its smaller size, smoother finish, sharper peripheries, more deeply concave sides, and more produced apertural end. Furthermore, one side of the quadrate section of the new form is not as wide as the others, while sides of the Cretaceous form are essentially equal in width.

The new species apparently developed as a mutation of *C. midwayensis*, with which it occurs. Figs. 6 and 7 illustrate similar triangular, triserial bases of the two different species. In *C. midwayensis* (Fig. 6) the triangular growth continued through the intermediate uniserial stage; while in *C. subquadrata* n. sp. (Figs. 7 and 8) a mutable, additional corner was developed for the intermediate quadrate uniserial stage. In final stages of both species the more or less standard rounded, nodose chambers obtained.

## CONCLUSIONS

The specimen (Fig. 2) illustrates an established Paleocene species of *Bolivina midwayensis*.

The mutation (Fig. 3) failed in its bid for establishment of a new, peripherally acuminate variety of biserial *B. midwayensis* in its asymmetrical development. Were several specimens discovered displaying sides symmetrically acuminate or fistulose, and particularly were a few more chambers to have increased its length, then a new variety of *Bolivina midwayensis* would be warranted.

The mutation (Fig. 4) displayed potentials of becoming not only a valid new species, but a different genus (*Loxostomum*), when the uniserial chamber was added beyond the biserial bolivine stage. When the final pair of bolivine biserial chambers capped the loxostomum stage, however, it became simply a "sport" or freak *B. midwayensis*, having violated the law of foraminiferal growth in its development from the simple to the more complex (the rule being: complex to simple). Not only must additional such freaks of *B. midwayensis* (as Fig. 4) be discovered to justify changing the concept of foraminiferal development, but such uniserial-to-biserial forms in other foraminiferal families must be discovered to corroborate the unusual reversal in development of this instance.

The specimen (Fig. 1) has observed the law of foraminiferal growth demonstrated in many other families of Foraminifera in developing from the complex base, to the intermediate biserial, to the adult uniserial (with attendant change to terminal aperture). The simple expedient of discovering several additional such specimens will fulfill taxonomic requirements for establishment of this form as a new goësellid species.

Figure 6 illustrates an established Paleocene triserial to uniserial, triangular *Clavulinoides midwayensis*.

Figures 7 and 8 illustrate a form, apparently descended from *C. midwayensis*, but justified as a new species, because several specimens have been discovered displaying simply a slight difference in shape of chambers; hence the new species *C. subquadrata*.

## LEGEND, PLATE I

Figs. 1?, 5 <i>Dorothia bulletta</i> (Carsey), Plummer .....	X50
Figs. 2-4? <i>Bolivina midwayensis</i> Cushman .....	X65
Fig. 6 <i>Clavulinoides midwayensis</i> Cushman .....	X50
Figs. 7, 8 <i>Clavulinoides subquadrata</i> n. sp. ....	X50

