

The genera with the ending —opsis must be masculine.

Microcometes paludosa Cienkowski

This genus can only belong to the masculine gender.

These comparisons could be continued indefinitely, and show the uncertainty in determining the gender of the various genera and even the impossibility of determining definitely the gender of artificially formed names, even on the basis of the Latin language. Furthermore, the use of trivial names is made additionally difficult through the two possibilities of using them in the form of adjectives or as substantives (for example: *Verneuilina favus* Bartenstein, but not *Verneuilina fava* Bartenstein; similarly *pilus*, *pilus*; *pugnus*, *pugnus*, etc.).

In order to finally abolish such difficulties for the foraminiferal nomenclature (and indeed for all zoological nomenclature) and to make a single correction of all generic and trivial names, which would be easily and freely usable for all later work, let me again quote the proposals of Richter (1942, p. 355):

1. Adjectival trivial names must appear in the feminine gender without regard to the gender of the generic name (as an unspoken complement to the word species).

2. The substantive-appositional trivial name must, in so far as it has the endings —us (—er), —a, —um, be used as a Latin adjective: these names must therefore appear, as are the adjectival trivial names, only in the feminine gender (following proposal 1).

In order to arrive at a binding international agreement, a discussion of these proposals as related to the field of micropaleontology would be very desirable. I am indebted to Professor Rudolf Richter for his assistance on this problem.

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EDITOR'S NOTE: Since this manuscript was received, a lengthy review and summary of Prof. Richter's article was published by J. Marvin Weller. For the benefit of readers who may not have seen the original, the reference follows: Jour. Paleon., vol. 24, no. 4, pp. 507-512, July, 1950.

15. OCCURRENCE AND ONTOGENY OF GLOBIGERINATELLA INSUETA CUSHMAN AND STAINFORTH FROM THE OLIGOCENE OF TRINIDAD,

B. W. I.

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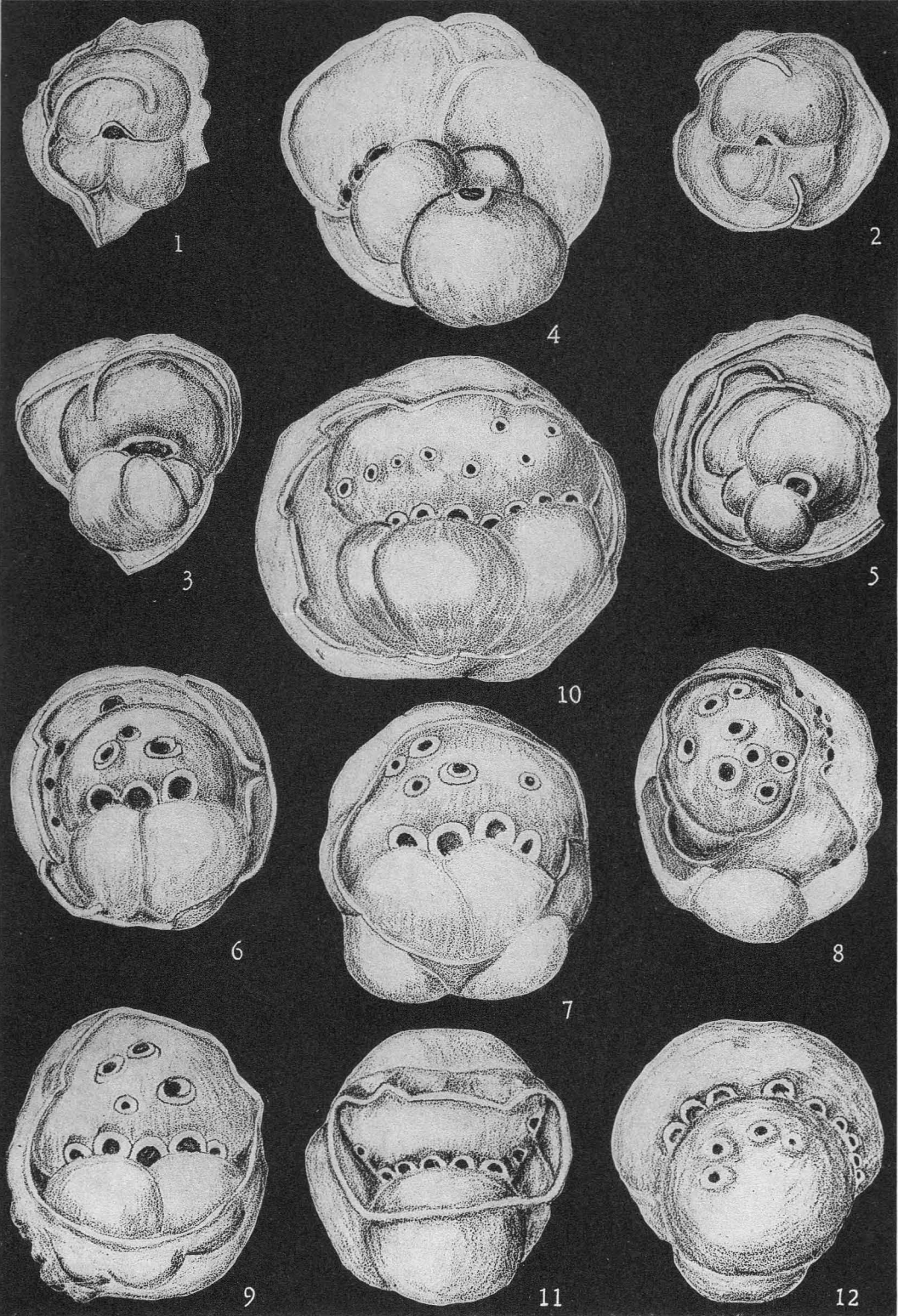
The planktonic foraminifer, *Globigerinatella insueta* Cushman and Stainforth (1945, p. 68-69, pl. 13, figs. 7-9, holotype fig. 7) originally described from the Oligocene Cipero marl formation of Trinidad, B. W. I., is diagnostic for Zone II of Cushman and Stainforth. This zone is found between the Upper Oligocene *Globorotalia fohsi* zone and the Middle Oligocene *Globigerina dissimilis* zone (Cushman and Renz 1947, p. 3). At the Cipero Coast type section (Cushman and Stainforth 1945, p. 7), the *Globigerinatella insueta* zone overlies the "Bamboo silt" or Flat Rock silt tongue, which is not younger than early Middle Oligocene as identified by the presence of *Globigerina* cf. *concinna* Reuss and the absence of the genus *Halkyardia* (Stainforth 1948b, p. 1299). However a recent re-examination of the *Globigerina* assemblages from this locality failed to

contain any indisputable specimens of *Globigerina* cf. *concinna*, but proved the presence of numerous *Globigerina apertura* Cushman and a few specimens of *Globigerina dissimilis* Cushman and Bermudez, an association which suggests basal Oligocene. This age difference obviously implies the existence of a fault between the Flat Rock silt tongue and the adjacent *Globigerinatella insueta* zone.

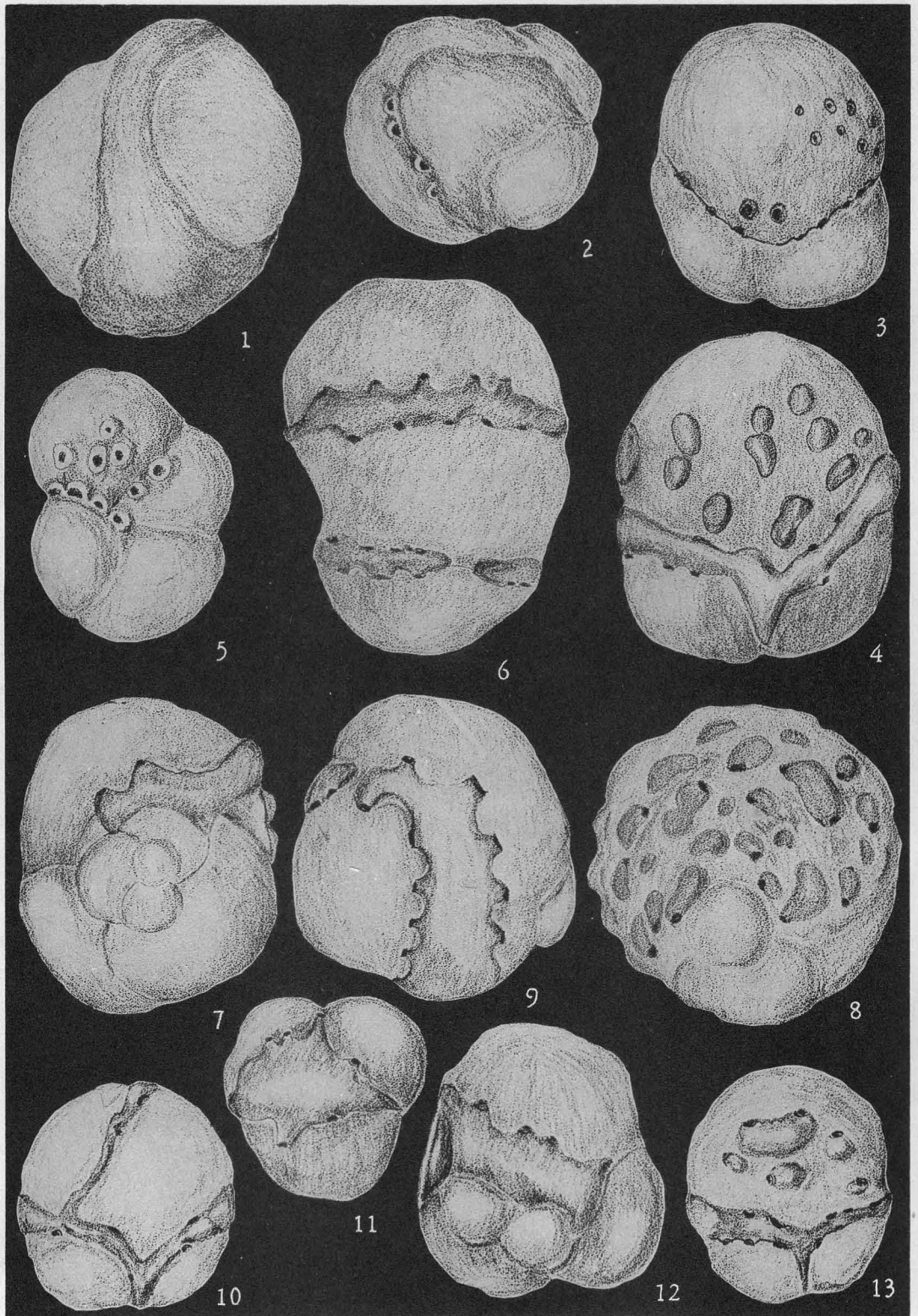
Stainforth (1948a, p. 120, 1948b, p. 1327, 1328) reported *G. insueta* from the Upper Oligocene of the Oceanic formation of Barbados and from the late Middle and early Upper Oligocene of Ecuador. H. H. Renz (1948, p. 136) recorded *G. insueta* in the lower part of the upper Acostian of the Agua Salada Group, State of Falcon, Venezuela, and Cushman and Renz (1947, p. 41) in the type locality of the Trinidad Point cal-

EXPLANATION OF PLATE 13

FIGS. 1-12. *Globigerinatella insueta* Cushman and Stainforth. Trinidad, B.W.I.; Upper Oligocene. 1-5, *Globigerina*-stage with single aperture. 6-12, *Globigerina*-stage with multiple aperture. All figures approximately $\times 120$.



Bronnimann, Oligocene *Globigerinatella*



Bronnimann, Oligocene *Globigerinatella*

careous clay at Trinidad Point, Oropouche Lagoon, southern Trinidad. *G. insueta* has recently been observed in the yellow silty calcareous clay and hard yellowish-grey limestone of the old Ste. Croix Quarry at Lothians Estate, south of Princes Town, Trinidad, which is the type locality of the Ste. Croix calcareous clay. Hence the Ste. Croix Quarry does not belong to the Upper Oligocene *Globorotalia fohsi* zone as suggested by Cushman and Renz (1947, p. 2). From the occurrence of *Globorotalia barisanensis* LeRoy, *Globorotalia mayeri* Cushman and Ellisor, rare *Globigerina dissimilis* Cushman and Bermudez and some as yet undescribed species related to *G. dissimilis*, it is believed that the Ste. Croix Quarry fauna is equivalent to the basal portion of the *Globigerinatella insueta* zone or is transitional between the *Globigerina dissimilis* and the *Globigerinatella insueta* zones.

From these records it appears that *Globigerinatella insueta* is geographically widely distributed, very restricted in time, and little affected by facies variations. As a rule this species is easily recognizable. All these qualities make *Globigerinatella insueta* an excellent marker fossil for the lower part of the Upper Oligocene of the Caribbean region.

The morphologic features of adult specimens of *G. insueta* vary considerably (pl. 14, figs. 1, 2, 4, 6-10, 12, 13) so that specific determinations based on Cushman and Stainforth's condensed description (1945, p. 68) are sometimes open to doubt. In order to arrive at more reliable determinations and at the same time reach a better understanding of the complex morphology and the variability of the adult test, the ontogeny of numerous specimens of *G. insueta* from various Trinidad localities was analyzed. The true stratigraphic position of these localities was known only where the fauna indicated a transitional position either to the *Globorotalia fohsi* zone above or to the *Globigerina dissimilis* zone below.

The ontogeny of typical representatives of *G. insueta* can be subdivided into three successive stages: (a) *Globigerina*-stage with single aperture; (b) *Globigerina*-stage with multiple aperture, and (c) *Globigerinatella*-stage.

It was not possible to isolate the small subglobular proloculus or initial chamber, which as a rule, and when not masked by supplementary chambers of the *Globigerinatella*-stage can be observed on the surface of well preserved specimens (pl. 14, fig. 7).

The *Globigerina*-stage with single aperture is composed of three to four, in some specimens possibly five

subglobular chambers, including the proloculus, which are arranged in a distinct trochoidal spire. The chambers increase rapidly in size and the last formed is usually larger than the complete preceding spire. Each chamber has a single large semi-circular aperture with a distinct lip, situated in the suture. Broken specimens display three chambered (pl. 13, figs. 1, 2) and four chambered (pl. 13, figs. 3, 4, and 5) *Globigerina*-stages with single apertures. At this stage, the later chambers do not yet tend to envelop the preceding ones.

The first chamber of the more complicated *Globigerina*-stage with multiple aperture, as shown in pl. 13, fig. 6, is perforated by three semicircular sutural and by three additional, circular non-sutural apertures, all fairly large and with distinct lips. This stage probably includes three to four subglobular chambers, trochoidally arranged as in the foregoing stage and tending to become somewhat enveloping in the last phase of growth (pl. 13, figs. 6-12, pl. 14, fig. 3).

The number of sutural and non-sutural apertures increases with the size of the chambers. From broken specimens of this cribrate *Globigerina*-stage (pl. 13, figs. 6-12) it can be seen that the surface of the last formed chamber is rather rough whereas the inner face appears quite smooth. The specimens on pl. 13, fig. 12 and pl. 14, figs. 3, 5 are representative of a growth stage prior to the development of the characteristic supplementary *Globigerinatella*-chambers.

The *Globigerinatella*-stage is typified by one or more irregularly formed and generally rather small, thin walled supplementary chambers or chamber like growths produced by the protoplasm flowing through the sutural and non-sutural apertures. The shape and distribution of these rudimentary chambers are apparently governed by the position of the apertures and possibly also by the amount of protoplasm. The following types are recognizable:

(a) a single large supplementary chamber, embracing the test completely, or incompletely in the form of a collar of irregular outlines. The supplementary chamber essentially follows the sutural depressions. Occasionally it overlaps the adjacent chamber surface (pl. 14, figs. 1, 2, 9, and 12).

(b) one or more narrow, often inter-connected supplementary chambers, filling the sutural depressions (pl. 14, figs. 6, 10).

(c) numerous small, irregularly shaped supplementary chambers, scattered over the anterior portion of the surface of the last formed chamber (pl. 14, fig. 8).

(d) supplementary chambers, occurring as a com-

EXPLANATION OF PLATE 14

FIGS. 1-10, 12, 13. *Globigerinatella insueta* Cushman and Stainforth. Trinidad, B.W.I.; Upper Oligocene. 3, 5, *Globigerina*-stage with multiple aperture. 1, 2, 4, 6-10, 12, 13, *Globigerinatella*-stage showing the various types of supplementary chambers.

FIG. 11. *Globigerinatella* aff. *insueta* Cushman and Stainforth. Trinidad, B.W.I.; Miocene (?reworked). Aberrant form with plate-like supplementary chamber. All figures approximately $\times 120$.

bination of the types (b) and (c) (pl. 14, figs. 4, 13).

(e) a single irregularly shaped supplementary chamber, covering the umbilical portion of the test and branching out into the sutural grooves (pl. 14, fig. 11). The adult test is distinctly trochoidal, three chambered and considerably smaller than that of the typical *G. insueta*. The ontogeny of this form could not be studied in detail and it is possible that the stratigraphic range of this aberrant type and that of *G. insueta* differ. At present it has been included in the genus *Globigerinatella* as *G. aff. insueta*. Future work will decide whether it is a true *Globigerinatella*.

In the *Globigerinatella*-stage the apertures are numerous, rather small and semicircular, with lips. They are situated along the margins of the supplementary chambers and often at the end of short lateral processes (pl. 14, fig. 9). Supplementary chambers of type (c) usually have a single fairly large semicircular aperture.

The relative stratigraphic position of the scattered localities from which the present specimens were obtained is not sufficiently well known to permit a study of the phylogenetic development of *Globigerinatella insueta*. This species seems to have appeared suddenly and no source is known at present from which this monotypic genus might have originated, although Cushman and Stainforth (1945, p. 69) make reference to the genera *Candorbulina* and *Globigerinoides*. *Candorbulina* can be excluded as a possible ancestor, for this highly developed genus first appeared in Trinidad at approximately the time *G. insueta* became extinct. Furthermore, the ontogenetic stages of *Candorbulina universa* Jedditschka differ from those of *G. insueta*. The genus *Globigerinoides* likewise includes highly specialized Globigerinae and thus can not be regarded as the potential ancestor of *Globigerinatella*. Based on the ontogeny, it can be assumed that the ancestor of *G. insueta* resembles a small trochoidal *Globigerina*, with a large single semicircular aperture, as represented

by the first ontogenetic stage. Typical and well developed representatives of *G. insueta* existed at the time *Globigerina dissimilis* became extinct and no distinct morphologic differences have been observed between the geologically oldest and youngest specimens. But it is to be expected that a detailed investigation of the ontogeny of specimens from localities of known stratigraphic position will reveal phylogenetically significant changes in morphologic features such as (a) reduction of the number of chambers with primitive *Globigerina* features, (b) changes in the arrangement and distribution of the apertures and supplementary chambers, (c) differences in the development of the pores, etc.

LIST OF LITERATURE

- BRONNIMANN, P., 1949, Notes on the Ecologic Interpretation of Fossil *Globigerina* Oozes from the West Indies: The Micropaleontologist, Vol. 3, no. 2, pp. 23-27.
- CUSHMAN, J. A. and STAINFORTH, R. M., 1945, The Foraminifera of the Cipero Marl Formation of Trinidad, British West Indies: Cushman Lab. Foramin. Research, Special Pub. 14.
- and RENZ, H. H., 1947, The Foraminiferal Fauna of the Oligocene, Ste. Croix Formation, of Trinidad, B. W. I.: Cushman Lab. Foramin. Research, Special Pub. 22.
- STAINFORTH, R. M., 1948a, Applied Micropaleontology in Coastal Ecuador: Jour. Paleontology, Vol. 22, no. 2, pp. 113-151.
- , 1948b, Description, Correlation, and Paleogeology of Tertiary Cipero Marl Formation, Trinidad, B. W. I.: Bull. Amer. Assoc. Petr. Geol., Vol. 32, no. 7, pp. 1292-1330.
- RENZ, H. H., 1948, Stratigraphy and Fauna of the Agua Salada Group, State of Falcon, Venezuela: Geol. Soc. America, Mem. 32.

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16. THE DIRECTION OF COILING IN THE EVOLUTION OF SOME GLOBOROTALIIDAE

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ABSTRACT—The direction of coiling of various species of *Globorotalia* and *Globotruncana* throughout their vertical range is discussed. It is found that random coiling is usually restricted to the early representatives of a species or group of related species, whereas the stratigraphically younger ones prefer a single direction, almost to the exclusion of the other, which may be either sinistral (left) or dextral (right), according to the species concerned.

INTRODUCTION

Most gastropods, some cephalopods and many families of the Foraminifera possess tests which show tro-

choidal coiling with well recognizable dorsal and umbilical sides, thus a direction of coiling is defined. With the exception of a few genera most of the gastropods coil dextrally, i. e. clockwise, when viewed from the dorsal side. Only very rarely does an individual coil in a direction opposite to that which is characteristic for the species.

Little attention has been paid thus far to the direction of coiling in Foraminifera, even when it can be easily recognized under normal magnification, e. g. in