THE GENERA BROTZENIA AND VOORTHUYSENIA
(FORAMINIFERA) AND HOFKER’S CLASSIFICATION
OF THE EPISTOMARIIDAE

by W. G. CORDEY

ABSTRACT. Perfectly preserved specimens of the Rotaliid species Brotzenia muenchianus Ulig 1883 and B. parasquillifera Hofker 1954 from the Oxford Clay of England, show dental plates of the Voorthuyzenia type. These species were assigned by Hofker, on the basis of the dental plates, to Brotzenia. Hofker’s (1954) classification is therefore invalid. The genus Voorthuyzenia is considered synonymous with Brotzenia and the latter is emended. The genera Höglundina Brogren 1948 and Hiltneramina Hofker 1954 are briefly discussed in relation to Hofker’s classification.

Hofker’s classification of the Epistomariidae. Hofker (1954) considered the genus Epistominata to be invalid, stating that the type species E. regularis (Terquem 1883) did not fit this group as it is understood at present, the type species showing neither the characteristic protofoaminal and deuterofoaminal apertures or dental plates (text-fig. 1a-c). Hofker (1954) suggested that Terquem (1883) may have described badly damaged specimens, or possibly that Terquem’s specimens belonged to the genus Conorbeides Hofker 1954. He therefore proposed a complete revision of the foraminifera with dental plates previously assigned to Epistomina, erecting three new genera, Brotzenia and Voorthuyzenia (Jurassic-Lower Cretaceous), and Hiltneramina (upper Lower Cretaceous), and also including Brogren’s genus Höglundina (Cretaceous-Recent). The key to the recognition of these genera (and the basis of the classification) was the form of the dental-plate.

Hofker’s classification has not been widely adopted by workers on Jurassic foraminifera, e.g. Lutze (1960), Bielecka (1960). However, Seibold and Seibold (1960), Gordon (1962), and Lloyd (1962) have used it, but with the exception of Lloyd make no reference to the use of thin sections. However, Lloyd’s figures of B. porcellana (Bruckmann), particularly text-fig. 7d, are of limited value since only part of the dental-plate is shown and the species could therefore belong either to Brotzenia or Voorthuyzenia.

Briefly, the characteristics of the tooth-plates of the genera referred to are as follows:

Brotzenia. Tooth-plates in all chambers, narrow, smooth, partly attached to the proximal chamber wall, not reaching the marginal distal angle. Type species: Epistominata spinulifera Reuss.

Voorthuyzenia. Plates in all chambers, large, smooth, attached entirely along the proximal chamber wall, reaching the marginal distal angle. Type species: Epistominata tenuecostata Bartenstein.

Hiltneramina. Plates as in Brotzenia but occurring in the final chamber only, resorbed in earlier chambers, plates frequently pustulose (‘Höckchen’). Type species: Epistominata chapmani Ten Dam.

Höglundina. Plates as in Voorthuyzenia, occurring only in the final chamber, resorbed in earlier ones, plates frequently pustulose. Type species: Epistominata elegans’ d’Orbigny.

Foraminifera with dental plates from the Oxford Clay of England. The author’s material
was obtained from two exposures, one at Stewartry (Bedfordshire) in the Lower Oxford Clay and the other at Purton (Wilts) in the Upper Oxford Clay (see Arkell 1941). Approximately 250 specimens of *Brotzenia mosquensis* were obtained in several samples from the Purton section, being exceptionally well preserved, particularly those obtained from Beds 4 and 5 (of Arkell 1941); and about 300 specimens of *B. parastelligera* in several samples from both the Purton and Stewartry sections. As most of the specimens were not infilled, a three-dimensional view of the plates could be obtained by embedding them in a resin, Lakeside 70, and removing the dorsal surface with a sharp needle. This contrasts with the frosted-glass method (van Morkhoven 1958) used by Hofker, where preservation did not permit the former technique.

TEXT-FIG. 1. Diagram illustrating the morphology of *Brotzenia*. a, Parallel section; b, peripheral view with the terminal face of the final chambers removed; c, ventral view. Abbreviations: mda—marginal distal angle; dp—dental-plate; pcw—proximal chamber wall; pf—prototroch fenestra; df—deuterotheca fenestra.

The dental-plates in all the specimens of *B. mosquensis* and *B. parastelligera* occur in all chambers (except where damaged in preparation). They are always smooth and attached along the entire length of the proximal chamber wall (text-fig. 2a-c), and extend into the distal marginal angle of each chamber. The plates correspond exactly to the type described by Hofker (1954) for the genus *Voorhuyzenia*. However, *B. mosquensis* and *B. parastelligera* were assigned by Hofker to the genus *Brotzenia*. It would thus appear that these two species, at least, are capable of possessing two distinct forms of dental plate, i.e. in the case of Hofker’s 1954 material the *Brotzenia* type of plate, and in the present material the *Voorhuyzenia* type.

These conclusions agree with those made by the author (1962) on material from the Oxford Clay of Skye. In view of the better preserved and more abundant material now available, the author considers that Hofker’s genera *Brotzenia* and *Voorhuyzenia* are not distinct and that his classification (1954) is invalid. It is therefore proposed that the genus *Voorhuyzenia* be considered synonymous with *Brotzenia* and the latter emended to include it.

With regard to the author’s ornamented forms (i.e. *B. mosquensis*), Hofker (in litt.) states that on the basis of the plates they should be assigned to *Voorhuyzenia praecornata*.
(Bartenstein and Brand 1951), the two species being identical externally. However, the author has examined paratypes of *V. procoronta* (Pl. 93, figs. 1–3) and the species can be distinguished from *B. mosquensis* (Pl. 93, fig. 4a–c) in having sharply convex dorsal sutures; distinct pustulose ornament on each chamber; and less intense sutural and intersutural ornament. Furthermore, the author has compared his specimens with some


c–e, *Brotzenia mosquensis* (Uhlig 1885). *Cordatum* Zone, Oxford Clay, Purton, Wiltshire, England. c, Peripheral view showing the dental-plate, deuteroforamen situated on the dorsal side of the dental plate, BMNH P45157, ×55. d, Parallel section showing well-developed plates in the earliest chambers, BMNH P45158, ×57. e, Parallel section, earlier chambers removed in preparation, BMNH P45160, ×57.

of Hofker's (1954) material, which is identical. Specimens of this species loaned by Lutze are also identical, though preservation did not permit a study of the plates.

Specimens identified by Hofker and Lutze as *Brotzenia parasitelligena* have also been examined, and are identical to the author's specimens. The Oxford Clay material also agrees closely with the figures and descriptions of this species by Seibold and Seibold (1960), Bielecka (1960), and Lutze (1960).

**Systematic Description**

**Genus Brotzenia** Hofker 1954

*Type species.* *Brotzenia spinulifera* (Reuss).

*Emended diagnosis.* Test calcareous, perforate, trochoïd, dextrally or sinistrally coiled, smooth or ornamented, having latero-marginal apertures (protoforamen) (text-fig. 1) on
the ventral side of the test in each chamber, together with areal apertures (deuteroforamen or septal foramen) on the dorsal side of the dental plate. The dental plates are smooth, usually convex towards the ventral side, the plates being either attached along the entire length of the proximal chamber wall or only partly so; plates occurring in all chambers.

The following species are included in the genus Brotzentia:

- *Brotzenia ranquensis* (Ulbrig 1883)
- *Brotzenia parastelligera* Hofker 1954
- *Brotzenia ornata* (Roemer 1841)
- *Brotzenia spinifera* (Reuss 1862)
- *Voorhuyzenia pravornata* (Bartenstein 1951)
- *Voorhuyzenia brandi* Hofker 1954
- *Voorhuyzenia parafavosoides* Hofker 1954
- *Voorhuyzenia sutoralis* (Ten Darm 1949)
- *Voorhuyzenia trunctostata* (Bartenstein 1951)
- *Voorhuyzenia pochlermis* Hofker 1954

Remarks. In the Cretaceous species *caracolla* (Epistominia of earlier authors, *Högladina* Hofker 1954) from the Speeton Clay of Lincolnshire, England, the author observed plates in chambers other than the final chamber. This throws doubt on Hofker’s definition of *Högladina*, and it is possible that species assigned to this genus should be referred to *Brotzenia* (here emended).

The distinction between *Högladina* and *Hiltermannia* on the basis of dental plates is similar to that between *Brotzenia* and *Voorhuyzenia*. The fact that the distinctions between the latter genera cannot be sustained casts some doubt on the validity of the genus *Hiltermannia*. However, the species assigned to this genus have not been studied.

Even if Hofker’s tooth-plate groups were proved to be valid, his classification, being dependent on the study of the dental plates, is impracticable, since preservation often prevents the plates being exposed, making it impossible to assign specimens to a genus. Vella (1961) commented on the practical difficulties of such a classification with respect to uvgirind foraminifera, where, however, it was possible (Vella 1961, p. 468) to use external morphology to recognize the dental plate groups. Unfortunately, this is of limited value only in the group considered here since many of the species have a similar external morphology, e.g., *Högladina caracolla* (Roemer) and *Brotzenia parastelligera* Hofker.

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**Explanation of Plate 93**


Fig. 6a–c. *B. parastelligera* Hofker 1954. a. Dorsal view; b. peripheral view; c. ventral view. *Cordatum* Zone, Oxford Clay, Purton, Wiltshire, England. BMNH P45163, ×68.
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W. G. CORDEY
Texaco Trinidad Inc., Pointe-à-Pierre,
Trinidad, W.I.

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