FORAMINIFERA FROM THE CRETACEOUS OF SOUTHERN LIMBURG, NETHERLANDS, III.

GAVELINELLA DANICA (Brotzen).

by J. HOFKER

Anomalina grosserugosa Franke (non Gümbel), 1927, p. 37, pl. 4, fig. 3.

Cibicides danica Brotzen, Sver. geol. Unders. 1940, p. 61, figs. 7, 2.

Anomalina grosserugosa ten Dam, 1944, Med. Geol. St., p. 130, pl. 5, fig. 2.

Anomalinoides danica (Brotzen) Brotzen 1948, p. 87, pl. 14, fig. 1, textfig. 22.

Anomalina granosa van Bellen (non Hantken), Med. geol. St., 1946, p. 74, fig. 4—6.

Anomalina grosserugosa (Gümbel) Brady, Visser, 1950, p. 287, pl. 6, fig. 2.

Anomalinoides van belleni ten Dam en Sigal, C. C. Found. 1950, p. 36, fig. 26.

Anomalina longi McLean, 1952, p. 11, pl. 2, figs. 9—12.

Test rounded to slightly oval, dorsal side with all chambers visible, though those of the last formed whorl may overlap the former whorl. Periphery lobulated, at least at the last formed chambers. Margin rounded. At ventral side only the chambers of the last formed whorl visible, 5—8 of them, leaving a more or less open umbilical cavity free, often with distinct umbilical flabs, which may, however, be scarcely distinct. Pores always large and distinct, and the clear wall-substance often forming knob-like protuberances between the pores, especially at the centre of the ventral side. Chambers distinctly inflated, with clear, thick, poreless and depressed sutures. Sutures at the dorsal side slightly curved backward, at the ventral side nearly radial. Aperture a distinct halfmoon-slit at the ventral suture, near to the margin or even marginally placed, running downward ventrally towards the umbilical aperture which is in most later chambers open, under a thickened lip. Walls very thick, with pores at ventral sides of all chambers, and at the dorsal side only pores in the walls of the chambers of the last formed whorl. Initial chambers always without dorsal pores. Septal walls double in horizontal section.

Length 0,40—0,80 mm, thickness 0,25—0,30 mm.

This species is found in the Cr 4, rarely in the Ma, in the whole M-complex, always rarely. Visser also mentions it from the oppermost Md, and I found a form which may be identical with this species in the quarry of Curfs, Houthem, just underneath the Tertiary. It is typical for the *Pseudotextularia*-zone of Stevns Klint and the whole Danian of Denmark. It has been described from the Vincentown area, New Yersey, North America, by McLean, as *Anomalina longi*. Franke and others made the error, to compare this species with the recent species described by Brady as *Anomalina grosserugosa* Gümbel. But this species from the Eocene of Central Europe from which I had topotypes, is a different one, though it may have been derived from *G. danica*. The species, mentioned by Ten Dam and Hiltermann and Staesche as *Anomalina grosserugosa* from the Lower Eocene of Northern Germany and Holland is *G. danica;* this species also occurs in the Montian of Holland, and is slightly different from *G. danica*, since here the umbilical hollow is nearly closed and the chambers overlap much more at the dorsal side; this species, however, is not identical with Gümbel's species from the Stockletten chalk *(Tr. grosserugosa)*.

Visser described the species as *Anomalina grosserugosa,* but evidently meant *G. danica*.

The vertical range of the species now is known from the *Pseudotextularia*-zone (uppermost Maestrichtian) throughout the danish Danian and into the Vincentown marl and the Montian. This distribution once more shows, that the Vincentown formation is allied to the danish Danian as well as to the M-layers of Holland and the Montian. It may be, that Vincentown is in time slightly younger than Danian, since many other species found in the Danian also occur there. Moreover many species of the dutch M-layers are identical with those from the danish Danian as well as with the Vincentown formation.

Careful study of specimens from the Montian of Holland revealed, that here the same species is found, described by Van Bellen as *Anomalina granosa* Hantken, in his treatise on on the species of Bunde which is not, as Marie has pointed out, of Eocene age, but typical

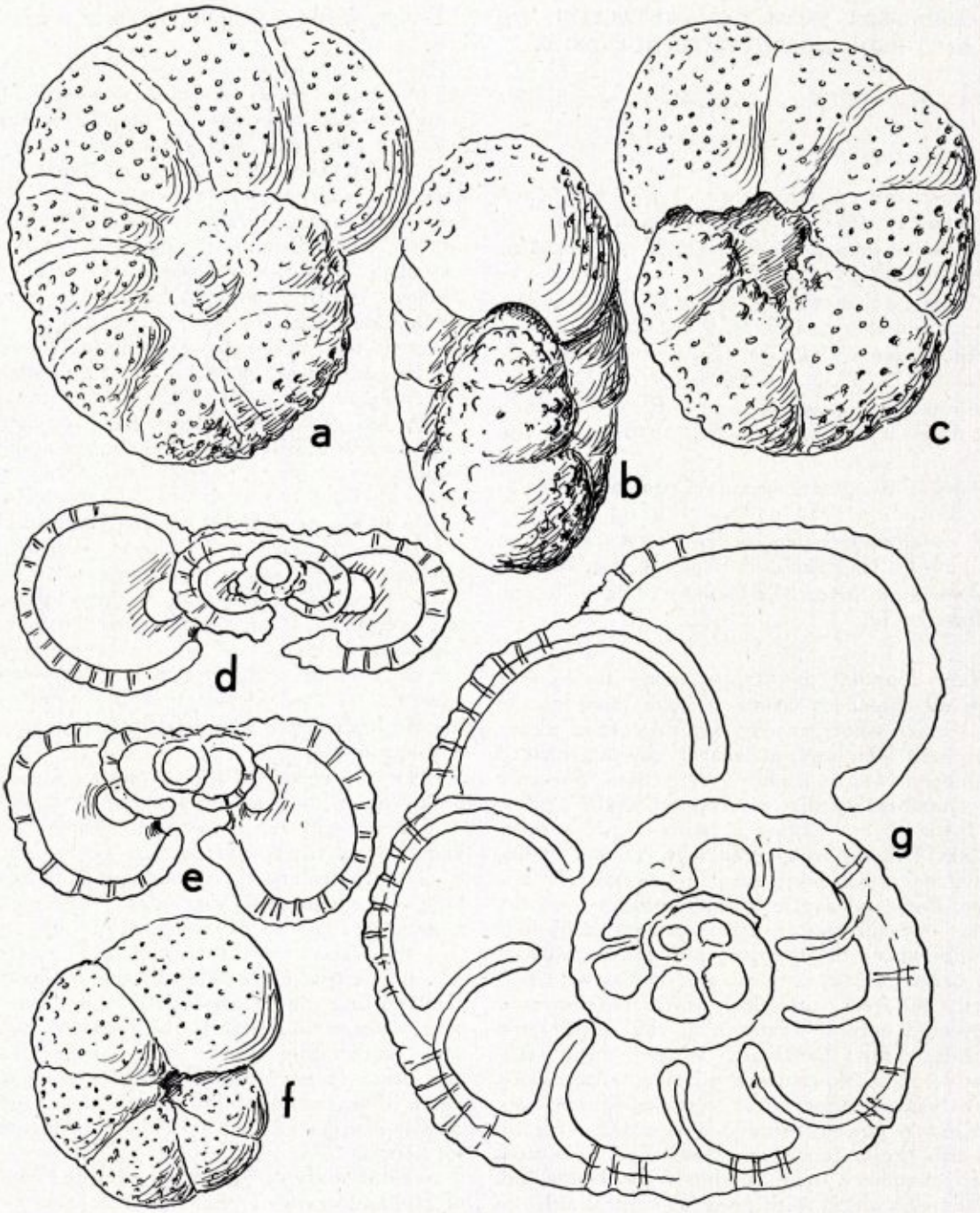

Fig. 1. a, b, c, GAVELINELLA DANICA (Brotzen), from Vincentown, New Yersey, Lowest Paleocene. a, dorsal side; b, apertural face; c, ventral side. × 80. d, transverse section through this test, with septal and umbilical apertures; × 80. e, transverse section through test from Hyttehusvej, Denmark, Copenhagen, Danian; × 80. f, ventral side of test from *Pseudotextularia*-zone, Stevns Klint, Denmark; × 80. g, horizontal section through test from Vincentown with double septal walls; × 170.

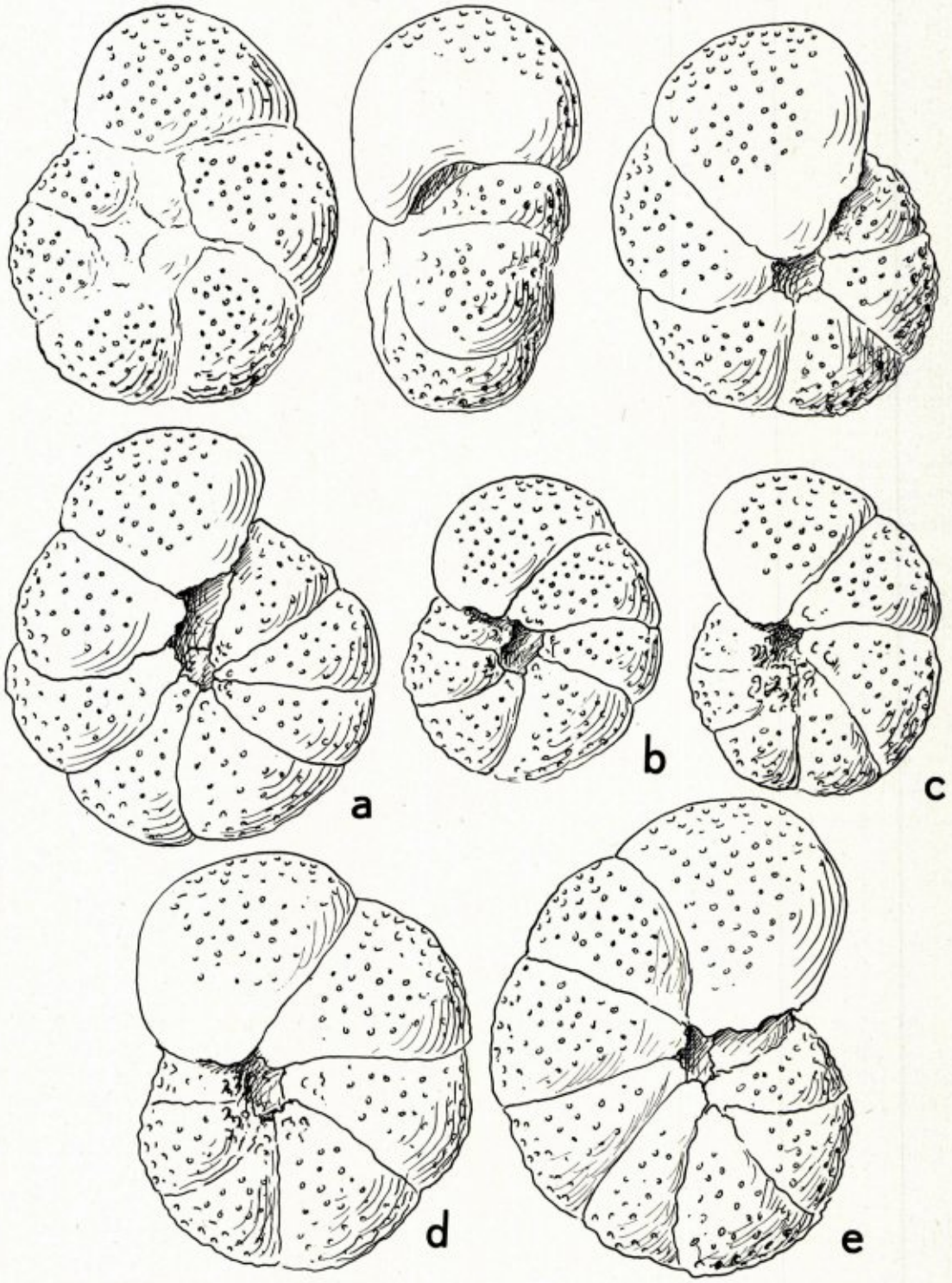

Fig. 2. GAVELINELLA DANICA (Brotzen). Upper row: test from the mine Oranje Nassau I, G.B. 23, pile 14 upbreak 114, 700 m west from shaft, Md, × 80, in three views. Ventral sides of a, specimen from Eben Emael, Cr 4, Belgium; b, coll. Kruit 329, drilling O.B. 1905, 40—61,5 m, Cr. 4; c, coll. Kruit 471, quarry ENCI, prae-Mb; d, Hyttehusvej, Copenhagen, Denmark, Danian; e, from the Montian of the drilling Beatrix, Peel, Holland. All × 80.

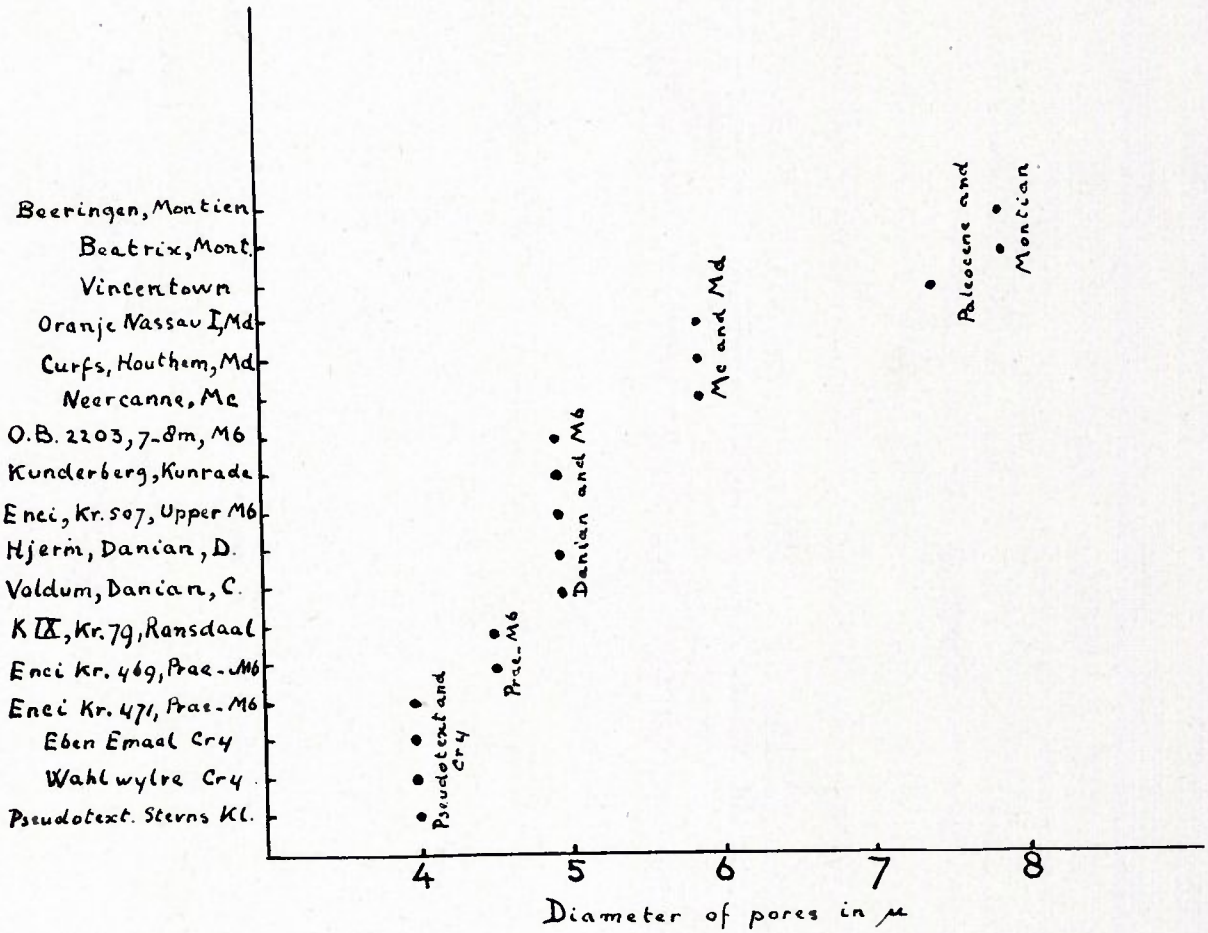

Fig. 3. Diagram, showing the increase of the size of pores in the walls of specimens from different horizons. Specimens from *Pseudotextularia*-zone and Cr 4 have the same size; this can also be said of specimens deriving from Mb and Danian. Then there is a small gap between Mb and Mc, which corresponds with a transgression-zone between Mb and Mc, found in many quarries. A larger gap seems to exist between Md and ,Montian, whereas the Paleocene of Vincentown and the dutch Montian show the same size of pores. Since the author could prove, that this increase of pore-size is found in many species of GAVELINELLIDAE, this increase will be of importance to stratigraphy.

Montian; the species is found in the Montian of the Paris Basin also, as could be found in a sample from Meudon, and in the Montian of Ciply. Marie gave his correction of Van Bellen's error (Van Bellen, R. C., Foraminifera from the Middle Eocene in the Southern part of the Netherlands Province of Limburg; Med. Geol. Stichting, Ser. C, No. 4, 1946) in Extr. C. R. S. Soc. Géol. France, Apr. 1947, p. 145—146.

This gives the range of this remarkable fossil from the *Pseudotextularia*-zone through the Danien and the Paleocene in Europe.

Most species of *Gavelinella* during their development show an increase of the size of their pores in the walls. This species also shows this increase, and with this changing character in hand we may be able to identify the age of the several layers in which it is found. Since the author could prove that within a species this increase of pores in independant of the area in which the tests are deposited, it may even be possible to give the relative age of these deposits. Following data were found in this respect (See fig. 3).

Pseudotextularia-zone Stevns Klint: pore-diameter ..... 4 μ.
Outcrop Wahlwylre, Cr 4: ..... 4 μ.
Outcrop Enci, coll. Kruit 471, prae Mb 4 μ.
Outcrop Eben Emael, Belgium Cr 4: 4 μ.
Outcrop K IX, K 79, Ransdaal. Mb: 4-5 μ.
Voldum, Denmark, Zone III, Danian (± Zone C): ..... 5 μ.
Hjerm, Denmark, Zone D, Danian ... 5 μ.
Outcrop Enci, Coll. Kruit, 507, Mb (Upper): ..... 5 μ.
Outcrop Enci, Coll. Kruit, 469, Prae-Mb: ..... 5 μ.
Outcrop Kunderberg, 10 m from top: 5 μ.
Drilling-hole OB 2203, 7—8 m, Mb: 5 μ.
Quarry Neercanne, Mc: ..... 6 μ.
Outcrop Curfs, Houthem, Upper Md: 6 μ.
Oranje Nassau I, above layer I, G.B. 23; Md: ..... 6 μ.
Outcrop Vincentown, New-Yersey: 7-8 μ.
Drilling-hole Beatrix, Peel, Montian: 8 μ.
Drilling-hole Beeringen, Peel, Montian: ..... 8 μ.

These sizes would indicate, that the *Pseudotextularia*-zone and the upper layers of the Cr 4 are of the same age; that the danish Danian and the Mb are of the same age; that the Kunrade Chalk in its lower layers is of Mb-age; that the Md is younger than the upper zones of the danish Danian; that the outcrop at Vincentown which is considered as Lower Paleocene, is older than the Montian of Holland, which likewise is Lower Paleocene.

These parallelisations are in striking agreement with many other data yeilded by Foraminifera, as will be proved elsewhere.

Ten Dam and Sigal (Contr. Cushman Foundation, I, p. 36—37) mention many species which are, to their belief, closely related to *Gavelinella danica* (Brotzen); their *Anomalinoides van Belleni,* however, is the same species; the species varies in some extend in the number of chambers and the size; it is typical for the Danian-Montian of Algeria. *Anomalinoides pinguis* Jennings seems to be identical with *Gavelinella danica* (Brotzen) without any doubt; it is from the Vincentown Formation, New Yersey, U.S.A.

Anomalina midwayensis Plummer seems to be a different species; yet it is very much alike to some specimens from Vincentown. It may be, that *Cibicides grosserugosa* (non Gümbel) Staesche-Hiltermann (Abh. Reichsstelle Bodenf., N.F., 201, 1940, Taf. 49, Figs. 7—8) belongs to this species *G. danica;* but *Cibicides grosserugosa* from the Stockletten of Bavaria is, as was proved at topotypical material, a different species, though possibly derived from it.

Truncatulina granosa Hantken from the Kleinzeller Tegel, Hungaria, could be studied also; it seems closely related to *G. danica,* but it is not the same species either.

Further investigation revealed that *G. danica* also occurs in the Cr 3 C which is slightly older than the Cr 4, but belonging also to the Maestrichtian; it was found in the Cr 3 C in a quarry at Mesch and in the upper layers (Cr 3 C) of the quarry at Vijlen. Here and in Mesch the size of the pores was 3 μ.