

FORAMINIFERA FROM THE CRETACEOUS OF SOUTH-LIMBURG, NETHERLANDS, LXXIX.

Planktonic Foraminifera in a sample taken from the holes in the hard ground on top of the Md in the quarry Curfs, near Houthem South-Limburg, Netherlands.

by J. HOFKER

A sample, taken by B. J. Romein in hollows in the hard ground at the top of the Md in new excavation of the quarry Curfs, near Houthem, planktonic specimens are abundant and could be analysed thoroughly due to the excellent preservation of the Foraminifera in that sample.

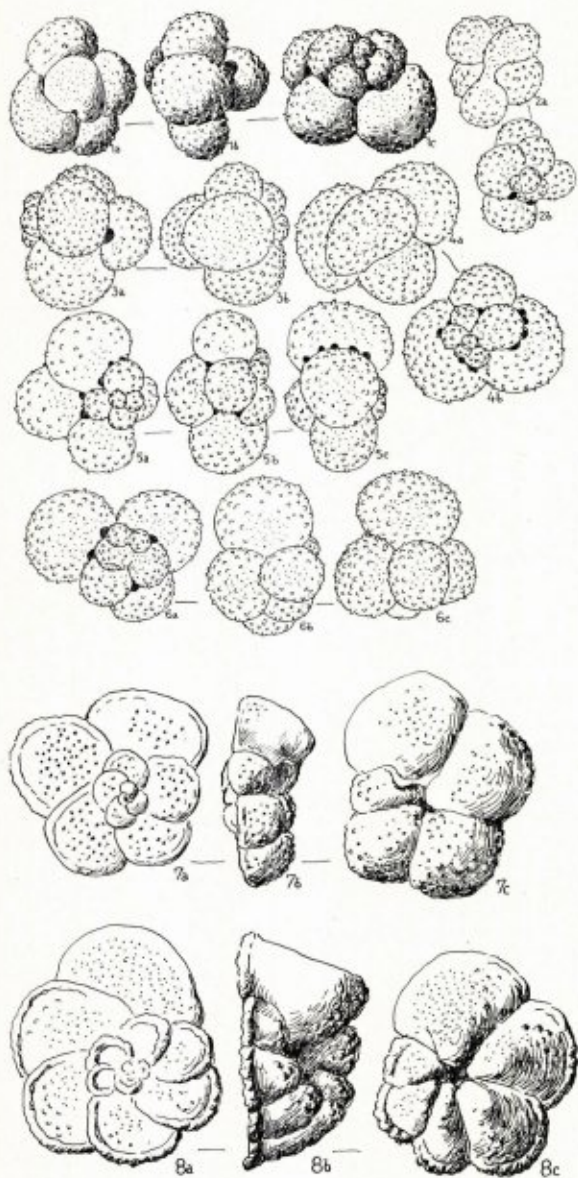
The most abundant forms belong to the group *Globigerina daubjergensis* Brönnimann. The specimens are large, with a mean diameter of 300 μ . In my paper on the planktonic Foraminifera of the Danian of Denmark, I showed that this species gradually increases in diameter and that the largest specimens there have a diameter of 270 μ with an average of 180 μ , in the lowest Paleocene above the Danian. So, the specimens found in this sample are distinctly larger than those found in the highest Danian and the lowest Paleocene (Seelandian) in Denmark.

Moreover I showed in that paper 1960 (Contr. Cushman Found. For. Res.; vol. 11, pp. 73-86) that for these largest forms of *Globigerina daubjergensis* a chamber is typical which covers the umbilical hollow, forming a bulla. I called this latest form of *Globigerina daubjergensis* its *Catapsydrax*-form. Most of the specimens found in the sample from Curfs also show the *Catapsydrax*-form, with a distinct bulla. Moreover, several specimens show abnormally arranged chambers.

I pointed out in that paper and also in several later papers, that *Globigerina daubjergensis* in the first part of its evolution during time only shows the ventral small umbilical aperture, but that later evolutionary forms within the Danian begin to develop dorsal openings at the sutures, just where the suture between two chambers attains the spiral suture of the former whorl. Such openings also are found in the „genus” *Globigerinoides*, so that the whole evolu-

tion during late Maestrichtian, Danian and early Paleocene runs through three „genera”, *Globigerina*, *Globigerinoides* and *Catapsydrax*. All specimens observed in this sample from Curfs show at least these openings at the dorsal side.

The walls of the specimens, covered with short spines as it is typical for this species, are very thin so that they are extremely hyaline in a clarifier. Many specimens distinctly show, along the spiral sutures of the last formed chambers at the dorsal side more than one opening, even 3-6 of them pro chamber. These openings have distinct thickened borders to the left and right of each of them, so cannot be caused by bad preservation; moreover, all other Foraminifera show the excellent preservation mentioned above. The bulla often shows several openings at its sutures. Such characteristics also have been described by Brotzen and Pozaryska in samples from Poland from Middle Paleocene; they called this form, (which is nothing but a yet more developed form (and a later one) of *Globigerina daubjergensis*) *Globigerina kozlowskii* (1961, Rev. Micropal., vol. 4, pp. 155-166, pl. 1-3). The author already described this form from the highest Post-Maestrichtian of the Canal Albert, Belgium, also under the name of *G. kozlowskii* (Natuurhist. Maandblad, 1962, vol. 51, 129-130, fig. a-c). But the author earlier also stated such a hyaline form with closing bulla and more sutural dorsal openings in 1956, Natuurh. Maandblad, vol. 45, p. 53, fig. 18 as a new form, *Globigerinoides hyalina* Hofker, also from the same locality and level. The finding now of a multitude of these forms enables the author to identify *Globigerina hyalina* Hofker with *Globigerina kozlowskii* Brotzen and Pozaryska, as the figures given here will show very clearly. So, *Globigerina kozlowskii* becomes a later synonym of *Globigerina hyalina* Hofker. The occurrence of normal forms of the latest stage of *Globigerina daubjergensis* Brönnimann (*Catapsydrax*-form) with these forms with many more dorsal openings, *Globigerina hyalina* Hofker (*G. kozlowskii* Brotzen and Pozaryska) strongly points to the continuance of the evolution from *daubjergensis* into *hyalina* (*kozlowskii*), and, since these evolved specimens of this gens (trend) have not been found in any sample of the lowest Seelandium of Denmark above the Danian, there cannot be



All individuals figured from one sample taken in holes in the hard ground on top of the Md and below the Lower Paleocene, quarry Curfs, near Houthem. All x 70.

Fig. 1. *Globigerina daubjergensis* Brönnimann; test with ventral bulla covering the umbilical hollow; at dorsal side only openings where three sutures meet (*Catapsydrax*-stage).

Fig. 2. *Globigerina daubjergensis* Brönnimann; test with abnormally formed bulla.

Fig. 3. Sideview and ventral side of *Globigerina daubjergensis* Brönnimann, *Catapsydrax*-stage.

Fig. 4. *Catapsydrax*-stage of *Globigerina hyalina* Hofker (*G. kozlowskii* Brotzen and Pozaryska), with more than one dorsal opening pro chamber.

Fig. 5. Typical specimen of *Globigerina hyalina* Hofker (*G. kozlowskii* Brotzen and Pozaryska) from dorsal side, side view and ventral side, with bulla.

Fig. 6. *Globigerina daubjergensis* Brönnimann, *Catapsydrax*-stage, with tendency to become *G. hyalina* Hofker (*G. kozlowskii* Brotzen and Pozaryska) since it shows two dorsal openings at the last formed chamber.

These forms, all found in one sample, indicate that here the origin of the later form of *G. daubjergensis* (*G. hyalina* Hofker or *G. kozlowskii* Brotzen and Pozaryska) is found; the sample, found at the base of the Lower Paleocene, already indicates that Paleocene is younger than the Danian and is already close to the Montian, found about 7-8 m above these holes, in which in Poland *G. kozlowskii* was found by Brotzen and Pozaryska. It shows definitely that *G. hyalina* Hofker (*G. kozlowskii* Brotzen and Pozaryska) is the continuation of *G. daubjergensis*. Bullae also were found in *G. kozlowskii* by Brotzen and Pozaryska.

Fig. 7. *Globorotalia perclara* Loeblich and Tappan from three sides (possibly a form of *Globorotalia aequa* Cushman). x 100.

Fig. 8. *Globorotalia angulata* (White), from three sides. x 100.

Such forms are found rarely in several samples taken from the hard ground as mentioned above; they indicate without doubt, that keeled *Globorotalia* is found there, which excludes the Danian age which has been supposed by other authors (Meyer, Berggren).

any doubt as to the fact, that even the fillings of the hard ground at the top of the Md in Holland are of an age, distinctly later than the type-Danian.

In the same sample, some other planktonic species were found, more rarely; the author will point here to the publication from 1956, quoted above, where he found in the Paleocene *Globigerina compacta* Hofker, also described in 1961 (Natuurh. Maandblad, vol. 50, p. 66, fig. 8) *Globorotalia compressa* Plummer, 1956, fig. 22, which now seems to be another species (see for comparison Hofker, 1958, Natuurh. Maandblad, vol. 47, p. 42 fig. 2, which in reality is

identical with the type) and *Globorotalia lobata* Brotzen, 1956, l.c., p. 53, fig. 23.

Two more species found in the sample will be described and figured here.

Globorotalia perclara Loeblich and Tappan, 1957, U.S. Nat. Mus., Bull. 215, p. 191, pl. 40, fig. 7; 41, fig. 8, 42, fig. 4, 45, fig. 11, 46, fig. 3; 47, fig. 6; 50, fig. 1; 54, fig. 6, 7; 57, fig. 3, 4; 60, fig. 5.

Dorsal side flattened, ventral side slightly more inflated. Periphery distinctly lobate, margin rounded to sub-acute, without distinct poreless keel, or with a more distinct acute part just beneath the dorsal side. 5 Chambers in the last formed whorl with distinctly rounded sutures which are only slightly depressed. At the ventral side radial sutures, distinctly depressed, with small umbilical hollow and sutural crescent-shaped aperture under a small lip. Pores fine but scattered, near the periphery and near the umbilicus the wall is distinctly pustulate.

This species is known from many localities in America, but not from the type-Danian; it was found in localities where the latest forms of the „*Globigerina*-assemblage is found, but also in the localities where the keeled *Globorotalia*-species are common.

Globorotalia angulata (White), 1928, Journ. Paleont., vol. 2, p. 191, pl. 27, fig. 13.

Dorsal side flat, ventral one strongly convex, each chamber with more or less distinct pointed part near to the umbilicus. Periphery lobulate, but not strongly, margin distinctly keeled at the periphery. At the dorsal side about 5-6 chambers in the last formed whorl, often even 4 of them. Sutures distinctly curved at the dorsal side, at the periphery going into the keel which is irregularly pustulate. Umbilicus deep with narrow opening, ventral sutures radial and deeply depressed. Wall at both sides distinctly pustulate, pores fine and scattered.

This species is known in America only from the zone with keeled *Globorotalia* in the Paleocene and thus strongly points to an age younger than the Danian.

Conclusion. The planktonic species found in the holes of the hardground of the quarry Curfs,

which holes are found beneath the 6 m of Lower Paleocene found above this hard ground, all point to distinct Lower Paleocene and not to Danian as has been suggested by several authors. There even are indications that this Paleocene is slightly younger than the basal Paleocene found in Denmark above the Danian, called by Brotzen the Lower Seelandian, the more, since in the Dutch Paleocene also the first evolution-stages of *Globorotalia pseudomenardii* Bolli are found (*Globorotalia prae-pseudomenardii* Hofker, 1961, Natuurh. Maandblad, vol. 50, p. 85, fig. 1).

BOEKBESPREKING

Spuren tierischer Tätigkeit in Boden des Buchenwaldes von Dr. Gerhard Zachariae. Forstwissenschaftliche Forschungen. Beihefte zum Forstwissenschaftlichen Centralblatt. Heft 20, 1965. 68 Seiten mit 20 Abbildungen. Kartiert 16,— DM, für Bezieher des „Forstw. Centralblatt“ 12,80 DM. Verlag Paul Parey, Hamburg und Berlin, Postverlagsort Hamburg.

Diese Arbeit gibt zunächst einen Ueberblick über die Tierspuren im Boden des Buchenwaldes und daran ablesbare, allgemeingültige Regeln. Das erstrebte Ziel ist die Beantwortung der Frage: „Was leisten Bodentiere für die forstliche Humuswirtschaft?“ Erst danach lässt sich beurteilen, welchen Wert die Organismen für die praktische Humuswirtschaft haben und wie man sie zur Steigerung der Bodenfruchtbarkeit einsetzen kann. Mit dieser Arbeit wird versucht einen umfassenden Ueberblick über Streuverarbeitung und Strukturbildung durch die Tiere des Waldbodens zu geben. Der Autor liegt hier das Ergebnis seiner Beobachtung vor, die in sieben Jahren an zahlreichen, unterschiedlichsten Standorten und in allen Jahreszeiten durchgeführt wurden. Rotbuchenbestände eignen sich besonders gut zum Beschreiben vieler Einzelheiten und zur Klärung grundsätzlicher Fragen.

Die Darstellung verfolgt, wie schon gesagt, in erster Linie das Schicksal des Streumaterials und schildert die Leistung der Tiere bei einzelnen Prozessen der Verarbeitung. Mit diesem Vorgehen konnten ausserdem neue Erkenntnisse zur Biologie der Bodentiere gewonnen werden. Das Wirken wird an Dünnschliffaufnahmen und Zeichnungen anschaulich demonstriert. In der Diskussion werden die Anwendung von Schliffpräparaten in der Bodenbiologie, die Folgerungen für die Systematik der Humusformen und die Bedeutung der Bodentiere für die praktische Humuswirtschaft kritisch behandelt.

Das Heft ist für die Fachgebiete Land- und Forstwirtschaft, angewandte Zoologie, Pflanzenschutz und Bodenkunde gleichermaßen zu empfehlen.

K.