minste gedruis onmiddellijk vluchten, was het zelfs op sommige plaatsen verboden de klokken te luiden, wanneer men ter visvangst trok. In Meckelenburg werden dikwijls in een trek 5000 stuks gevangen. In het Spirdingmeer eens 260 ton met de winternetten. Zo was ook het Liventinermeer een rijke vindplaats en Lötzen voerde zelfs 3 Brasems in zijn wapen. De sportvisser zal zeggen wat was dat een tijd! wat een viswater!

Heden ten dage is het dan ook een zeldzaamheid, wanneer een sportvisser op een dag 3 à 4 stuks kan verschalken en, hebben deze een gewicht van zo om en om 3 à 4 pond, dan kan hij gerust zeggen, dat het een recorddag was.

In de paaitijd trekken zij naar plaatsen met een lage waterstand en veel waterplanten. Op dergelijke plaatsen heb ik deze vissen bij het paaien diverse malen kunnen gade slaan, maar van het eigenlijke paaien kreeg ik nooit wat te zien; alleen kon ik waarnemen dat zij met hun rugvin, zelfs met hun rug boven water uitstaken en dat een en ander met veel leven gepaard ging. Het eigenlijke paaien heb ik wel waargenomen in de jaren 1957 en 1958 in het grottenaquarium Aqua-Fauna. In een aquarium van ruim 1800 liter waren einde 1955 7 jonge Brasems ondergebracht. De waterstand bedroeg 90 cm, de temperatuur 15° C., de beplanting bestond uit *Myriophyllum* en enige *Vallisneria*, de oppervlakte was gedeeltelijk bedekt met *Ricciella* en Eendekroos. De vissen hadden in 1957 een grootte van ± 25 cm. Het paaien had telkens plaats omstreeks 29 juni. Enige dagen hiervoor was het mij opgevallen dat de vissen veel levendiger waren, een dag voor het paaien zag ik ze telkens zijde aan zijde door het water schieten. De geslachten waren alleen te onderkennen doordat de vrouwtjes iets meer buikpartij vertoonden, aan de kleur was niets te zien. De dag van het paaien zwommen zij paarsgewijs zij aan zij langzaam in een spiraal omhoog tot enige cm onder de waterspiegel; daar stonden zij als het ware enige seconden stil, waarbij het mannetje heftig begon te sidderen; hierna gingen zij weer spiraalsgewijze naar beneden en weken, aldaar aangekomen, eerst uit elkaar. Nu ging het vrouwtje alleen in een spiraal omhoog, zwom op deze manier tot een 10 cm onder de waterspiegel, sloeg kopje over en zwom dan op haar rug met haar buik langs de oppervlakte, waarbij haar lichaam telkens een siddering doorvoer. Zo op het eerste gezicht moest ik toen denken, dat visje is er geweest. Even later echter duikelde zij weer om en zwom weer op dezelfde manier omlaag. Ook heb ik waargenomen dat zo nu en dan 2 mannetjes met een vrouwtje paaiden, waarbij de mannetjes het vrouwtje tussen zich in namen. Een en ander mocht ik in die 2 jaren zeker 7 maal beleven. Na ± 14 dagen meende ik aan de oppervlakte kleine muggenlarven waar te nemen maar na goed gekeken te hebben constateerde ik, dat het vissenеitjes waren, die aan het uitkomen waren. De larfjes waren in de eitjes goed te zien, zij maakten telkens een knipperende beweging; bij het openspringen kreeg ik niet meer te zien dan het flitsen van een glassplintertje. In 1957 telde ik na ±14 dagen 69 jonge visjes, in 1958 maar 24 stuks. Dit kleine aantal en het niet gelukken van het opkweken zal waarschijnlijk te wijten zijn geweest aan de te lage temperatuur.

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

THE APERTURE OF *PARAROTALIA TUBERCULIFERA* (Reuss)

by J. HOFKER

In their monograph on the genus *Pararotalia* Le Calvez, Loeblich and Tappan (Smithsonian misc. Coll., vol. 135, No. 2, 1957) stress the typical condition of the aperture of that genus.

In my paper on *Pararotalia tuberculifera* (Natuurhist. Maandblad, vol. 46, 1957, pp. 32—39). I gave figures of the typical loop-shaped aperture with its small toothplate, of the genotype, *Pararotalia inermis* (Terquem) and showed that the genus is congeneric with *Neorotalia* Bermudez 1952.

Loeblich and Tappan believe the oldest forms to be *P. macneilli* Loeblich and Tappan and *P. ishamae* Loeblich and Tappan, both from the upper Paleocene; *Pararotalia tuberculifera* (Reuss), however, is much older, since it already occurs in the type-Campanian of the Aquitaine-Basin in France, as has been proved in another paper,

and for the first time appears in the Upper Santonian of that locality.[1])

Since the oldest forms known to Loeblich and Tappan were degenerated forms, they believe that the apertures shown by those forms were the most primitive ones; but, in the Paleocene several other very small species are known to the author, occurring in the Tuffeau de Ciply and the Calcaire de Mons, which show a similar degenerative aperture and which are very much resembling those species of Loeblich and Tappan. Since, however, *Pararotalia inermis* is the genotype, and since that species shows the typical aperture as also described by Loeblich and Tappan, we have to regard that aperture as typical for the genus. They describe the apertural conditions as follows (p. 7):

„Aperture on the umbilical side, originally interiomarginal and extra umbilical-umbilical, with a lip above; a thin and delicate secondary umbilical plate is then formed before the development of the next chamber, covering the umbilical portion of the aperture and leaving visible only a narrow, elongate, comma-shaped or slitlike areal portion of the aperture roughly paralleling the base of the apertural face, an internal septum being formed at the junction of the umbilical plate and the chamber wall, and the septum may be reflected at the surface by a more or less distinct suture; this thin umbilical plate may be very narrow and almost unnoticeable or relatively large and commonly broken away after developments, showing only the interiomarginal aperture".

These conditions, as described by Loeblich and Tappan, very much resemble those of the building of toothplates as found in *Ceratobulimina* or *Lamarckina*, where also the toothplates are formed before the forming of the next chamber. *Pararotalia tuberculifera* shows them all, often in very well preserved condition. Most specimens observed show the areal aperture with the typical lamella over it, but in some specimens also the thin toothplate or secondary umbilical plate was very well observable. Not only in specimens in which the last formed chamberwall was broken away, but also in several individuals the thin toothplate could be seen protruding from the undamaged surface of the apertural face. In most samples of the Mc and Md the incrustation of chalk is so heavy that these fine structures cannot be found; but in the well-preserved specimens found in the soft marls filling up the hard ground-holes at the base of the Md, all structures mentioned by Loeblich and Tappan coud be seen.

It is very remarkable that in the type-Campanian of Northern Aquitaine Basin in South Western France, the species adready is common; even in Santonian samples it could be traced; it continues through the whole Santonian, Campanian and Dordonian, without changing the structure of its aperture, as the figure shows, given herewith, from a specimen from the Lower Campanian of France. In any case this proves that the development of these apertural structures as given by Loeblich and Tappan cannot be correct; the species found by them in the Paleocene, having „simple" apertures, in reality are degenerated species of a stock which already was present in the Santonian of France.

But not only the range of the genus is extended towards the french Santonian; it runs up into present time; to the author are known at least two definite species from the tropical coasts of Africa, and the well-known „*Calcarina*" *calcar* d'Orbigny (See Hofker, Siboga-I, 1927, pp. 37—39, pl. 17; *Rotalia calcar*) belongs

[1]) See: Hofker, Les Foraminifères des craies tuffoides de Charente et Dordogne de l'Aquitaine, France du Sud-Ouest; 84e Congrès des Sociétés Savantes, Dijon, 1959, pp. 253—368.

PLATE 1.

Fig. 1—6. Apertural conditions of *Pararotalia tuberculifera* (Reuss), from undamaged tests, all from the filling of holes in a hard banc 3 m above the base of the quarry Curfs, near Houthem, South Limburg. All × 120.1,2: small specimens, the toothplate scarcely developed; 3—6: larger specimens, with well-developed toothplates. The figures indicate that the toothplate is formed at first at the sutural part of the aperture, then runs over its dorsal part, and flares off at the distal part of the aperture, thus, as Reiss believes, forming the poreless part of the double septum in case that a next chambers is formed.

Fig. 7. Specimen of *Pararotalia tuberculifera* (Reuss), from the Lower Campanian of Northern Aquitaine Basin, France. a, dorsal side; b, apertural face; c, transverse section, showing the typical slightly areal apertures, and the poreless rim at the margin.


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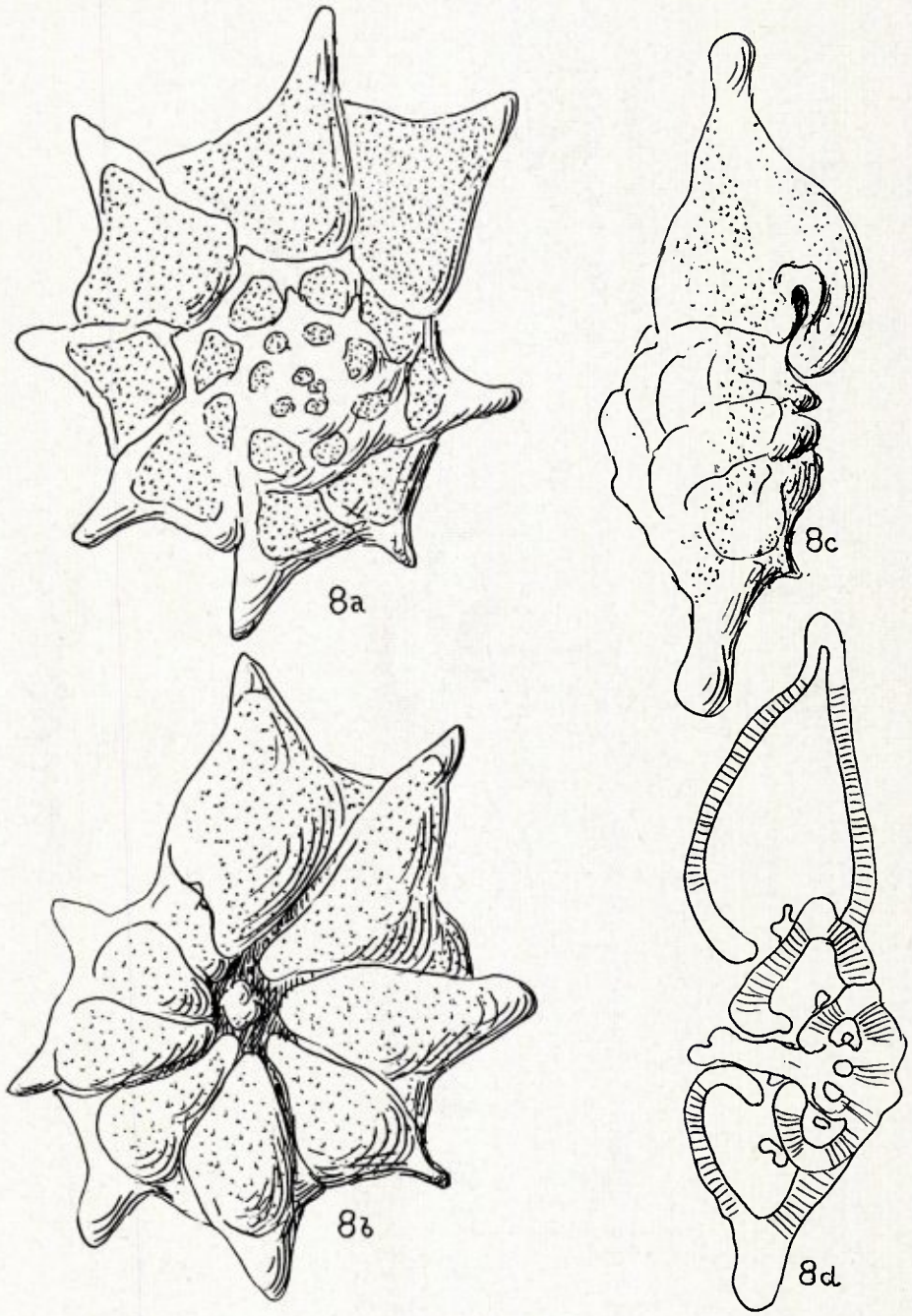

PLATE 2.

Pararotalia calcar (d'Orbigny), from recent beach sand, Merak, Indonesian Archipelago. Showing a recent form of the genus *Pararotalia*. a, dorsal side; b, ventral side; c, apertural face; d, transverse section, showing the umbilical openings at the ventral side of the chambers, the typical apertures, the umbilical filling, and the poreless rim at the margin. × 54.

to the genus, as a careful study of the aperture and of a section reveals, as given here in figure. In this recent species all typical features of the genus are clearly seen: the protruding points of the chambers at the margin; the fine but distinct pores, the poreless margin running at the last formed chamber up from the toothplate to the margin; the umbilical openings of the chambers at the ventral side; the filling of the umbilicus with a chalky bud; the typical sutural to areal aperture. All these characters point to a remarkable resemblence with *Globorotalia*.

In this way we can resume the characters of the genus *Pararotalia* as follows:

Test lenticular, trochoid. At dorsal side mostly all chambers visible with sutures of the chambers always more or less oblique and bent backward. Sutures always hyaline, poreless, fusing with the poreless margin as in *Globorotalia* or *Globotruncana*. Pores on the whole surface of each chamberwall, fine, distinct. In many species the margin shows spines, one at each chamber; these spines are hollow or massive, never with canals. At the ventral side in most species the sutures between the chambers are depressed, radiant, and the chamberwalls between somewhat inflated. In many cases observed the septal walls are double, and, when pustules or costae are formed, canals may have been spared out between the two walls. In that case these canals may fuse into a more or less developed spiral canal, formed by the space between the chamberwalls and the central chalk knob, filling up the umbilical hollow. Transverse sections show that invariably each chamber lumen connects with the umbilical hollow by a narrow slit, the imbilical foramen. Walls of ventral side likewise pierced by fine but distinct pores. Aperture consisting of a sutural to areal loop-shaped opening near to the margin at the ventral sutures, often provided with a distinct lip which may develop into a more or less distinct toothplate preformed at the aperture. A second aperture opening into the hollow slit between the ventral chamber wall and the umbilical chalk knob. Especially in outgrown specimens the aperture becomes areal.

The genus ranges from the Santonian (Aquitaine Basin, France) up to recent times. It seems that during that time always in shallow seas or near to the coasts, the genus was present. Recent species are known from the Pacific coasts, both East and West African tropical coasts, and probably from the Caribian Sea, always in the tropics. The occurrence of *Pararotalia aculeata* (d'Orbigny) in the Pliocene of Belgium, Holland and England (Hofker, Mém. Inst. Roy. Sci. Nat., No. 142, 1958, p. 63) closes the range. The genus is common also in the Flysch in Southern Europe, and in the Oligocene of South America. Species known as *Rotalia choctawensis* Cushman and Mc Glamery, *Rotorbinella tholus* (Galloway and Heminway), and several other species belong undoubtedly to the genus, of which *Neorotalia* Bermudez 1952 is a synonym (Hofker, l.c. 1958, p. 62). The genus is closely allied to *Globorotalia:* distinct, fine pores; hyaline dorsal poreless sutures bending backward; hyaline poreless margin; umbilical aperture of each chamber; poreless lip at the border of the septal aperture. Differences are: the tending of the aperture to become areal, with consequently change of the conditions of the apertural lip; often filling of the umbilical hollow by a distinct chalk knob, though always a canal is left free.

After having finished this study, the author received a paper by Reiss (Geological Survey, Israel, Bull. 21, 1958) who not only confirms the author's view that *Rotalia tuberculifera* Reuss is a true *Pararotalia,* but also gives fine figures of the toothplate-conditions of *Pararotalia mexicana* (Pl. 5, figs. 19, 20) very much resembling those of *Pararotalia tuberculifera;* Reiss also states the occurrence of canals between the toothplate, forming the second lamella of each septum, and the original apertural wall; these canals the author stated also in *Pararotalia tuberculifera* (Hofker, Publ. Natuurhist. Genootschap, IV, 1951, figs. 16—18, p. 15—16; also: Inst. Roy Sci, Nat. Belgique, mém. 112, 1949, p. 27, fig. 14).

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