FORAMINIFERA OF THE CRETACEOUS OF SOUTH-LIMBURG, NETHERLANDS. LXVII.

THE TAXONOMIC POSITION OF *SIDEROLITES CALCITRAPOIDES* Lamarck

by J. HOFKER

The author described *Siderolites calcitrapoides* Lamarck in two former papers: *Calcarina calcitrapoides* Lamarck, Natuurhist. Maandblad, 1926, vol. 15, No. 2, pp. 14—17, fig. 1—14; Mem. Inst. Roy. Sci. Nat. Belgique, Mem. 112, 1949, *Baculogypsina calcitrapoides* (Lamarck), pp. 26—40, fig. 15—17.

In the Tuff Chalk of Maestricht, the species first appears in the lowest Mb, just above the Ma; it ends in the holes of the hard ground in the upper Md. The first specimens are very small, have 4 spines, and all are megalospheric with a proloculus not messuring above 40 mu. It is a remarkable fact that several species are known to the author which, when suddenly appearing in a region obviously migrating from another region, begin their evolution in the region in which they migrated with the microspheric form, and mostly in very small specimens only. Since it is apparent that migration of Foraminifera took place by planktonic, individuals, and since it is known that in most benthonic Foraminifera at least the beginning of the microspheric generation has a planktonic first stage (microspores!) it is obvious, that the tentative migration into a new region may take place by that generation and, in the case that the specimens only occur in minute forms, this shows that the species could not acclimatise from the beginning, so that many times the tentative was repeated till in the end the species found the surroundings in which it could live, or when the surrounding remained unfavorable, extinguished in that region in due course. The latter instance is known to the author in the case of *Orbitolina lenticularis* (Blumenbach) in some parts of the Aquitaine Basin, in *Bolivinoides draco* (Marsson) in South Limburg and North Eastern Belgium, in *Pararotalia tuberculifera* at the Ma; a fourth instance is known in *Planorbulinella cretae* (Marsson).

But in the case of *Siderolites calcitrapoides*, this phenomenon seems different. Here too we have a first tentative migration, since the first individuals in the lower Mb remain very small, but they are megalospheric, though with a relatively small proloculus. After the lowest Mb the species vanishes, to reappear in the lowest Mc. In the Md another form of *Siderolites* appears, which differs from *Siderolites calcitrapoides* Lamarck in having more compressed spines which often fuse together forming a flange around the test; such tests somewhat resemble those of the oldest species known, *Siderolites vidali* Douvillé from the Aquitaine Basin (from Santonian to Maestrichtian); yet the latter never developed spines; this form from the Md is *Siderolites laevigata* Douvillé, in my paper of 1949 regarded at as a variety of *S. calcitrapoides*.

In the Mc and Md, the B-forms become very large, with many spines which often fuse; but the first rows of chambers in these multispinate forms develop only 4 spines (fig. 4), as was the case in the minute B-forms in the lowest Mb (fig. 5). During the Mb, Mc and Md, *S. calcitrapoides* gradually increases in size. This too is a typical characteristic of many foraminiferal gentes; this phenomenon is known to the author of *Bolivinoides decorata-gigantea, B. draco, Orbitolina lenticularis, Globigerina daubjergensis, G. pseudobulloides, Gevelinella danica, Rotalia trochidiformis*, species of *Lepidocyclina*, species of *Globotruncana, Pararotalia tuberculifera*, etc., whereas very fine instances have been shown by Staub in *Nummulites* (Evolutionary trends in Foraminifera, Elsevier, 1963, pp. 282—297, fig. 2—5).

The author proved in 1949, that the individuals with 2—4 spines had the largest proloculus; they always are megalospheric, and form together the A_2-generation; specimens with 5—8 spines, when outgrown, also are megalospheric but have a smaller proloculus (A_1-generation). When we statistically measure the size of the proloculi of individuals with 4 spines, we thus measure only one generation; it was found, that during the Mb, Mc and Md, in *Siderolites calcitrapoides* the A_2 proloculus gradually increases in size; this increase in size during the evolution of a gens in common among Foraminifera; the author proved in this in 1957 (Geol. Jahrb. Beiheft 27, p. 269) for *Bolivinoides decorata-gigantea;* it is known to occur also in the *Orbitolina lenti-*

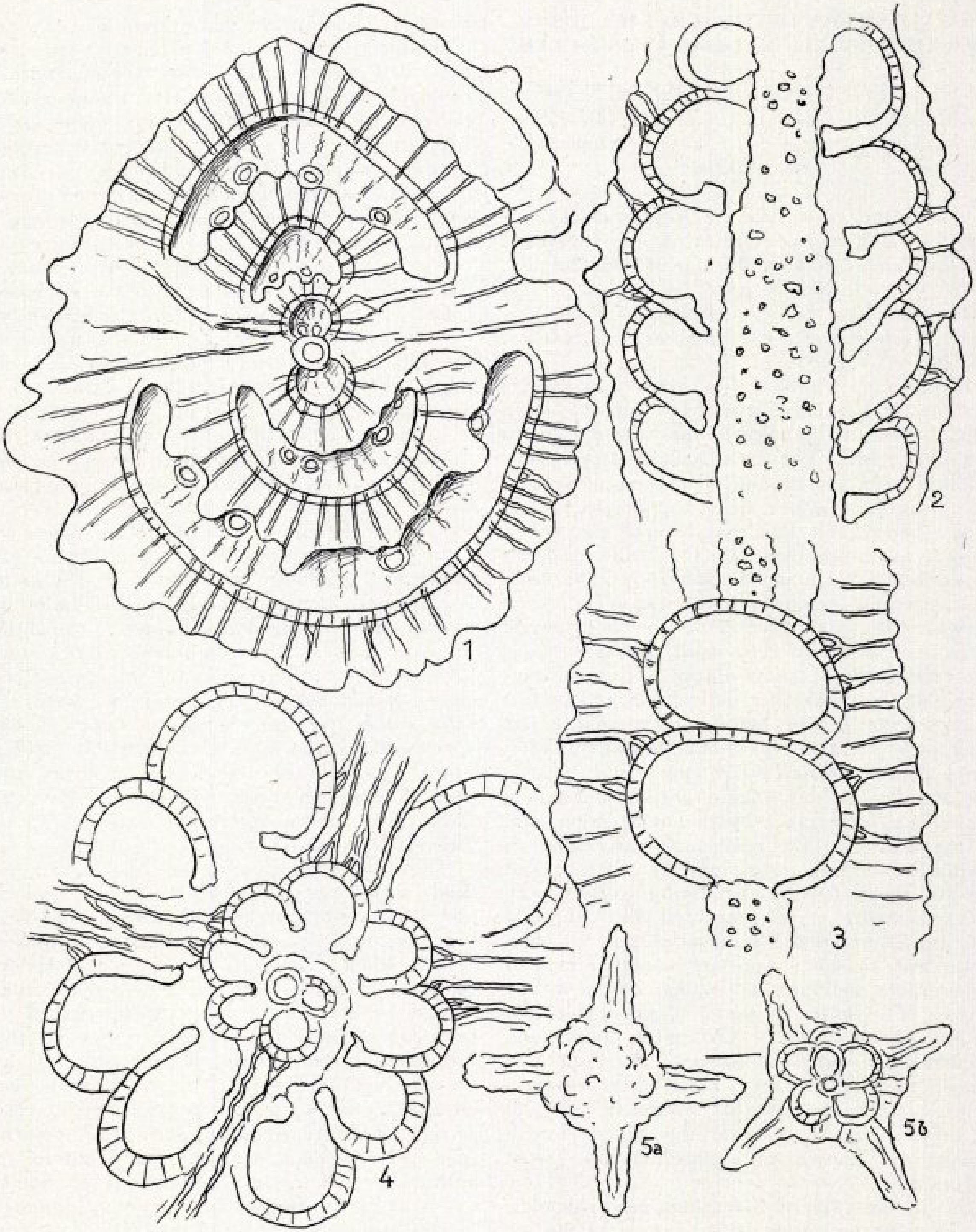

1
2
3
4
5a
5b

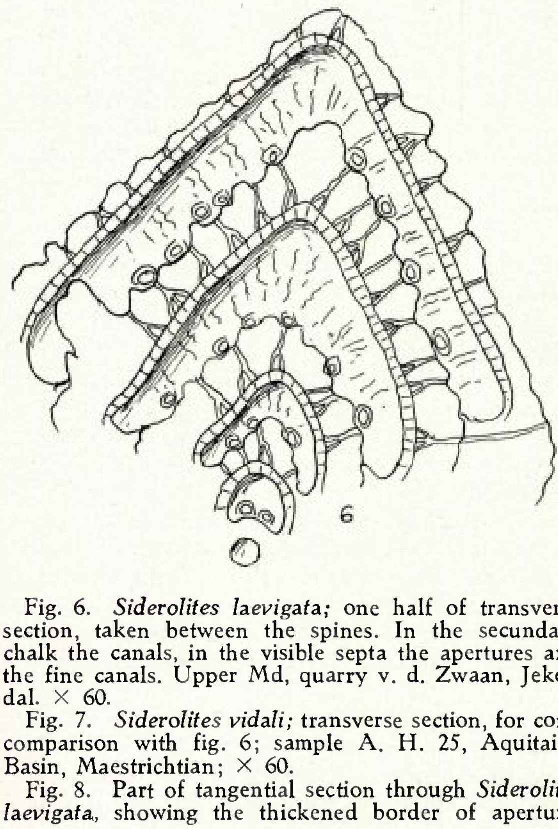
Fig. 1. *Siderolites calcitrapoides;* transverse section taken between the spines of individual with 4 spines; hard ground Mc—Md, quarry Curfs, Houthem; × 80.

Fig. 2. *Siderolites laevigata;* tangential section between the spines; in the middle the marginal flange of a former coil with its canals in the secondary chalk, flanked by the overlapping chambers with some apertures; upper Md, upper bryozoic layer, quarry v. d. Zwaan, Jekerdal; × 80.

Fig. 3. *Siderolites laevigata;* section transverse, but yet more tangential than in Fig. 2, showing two chambers, proving that the septa in reality are not double; same locality; × 80.

Fig. 4. *Siderolites calcitrapoides;* horizontal section through the centre of a microspheric individual, showing that, though the whole specimen has many spines, only 4 of them are found in the initial part of the test and that the canal system of these spines is formed by the primary pores. Hard ground Mc—Md in quarry Curfs, Houthem; × 300.

Fig. 5. *Siderolites calcitrapoides;* one of the small specimens as they are found in lowermost Mb, at the base of the Tuff Chalk; here no larger specimens are found. The specimen may be megalospheric or microspheric; sample gathered by Calembert, numbered A 17, boundary Cr 4 with Mb, Canal Albert (here Ma is missing); × 100.

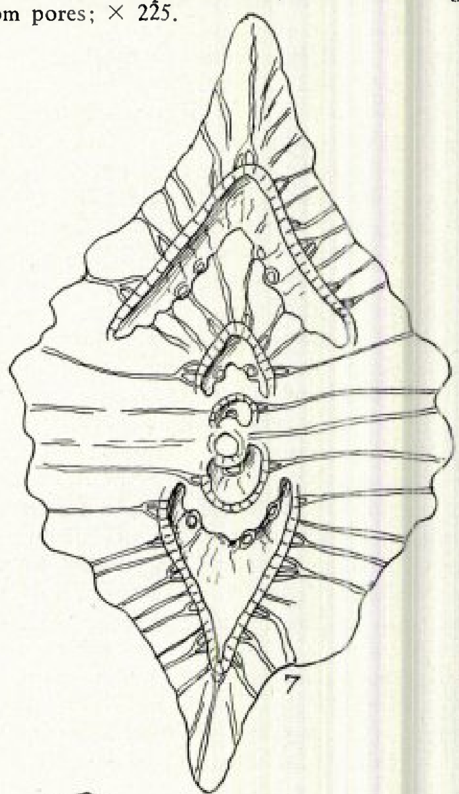


6

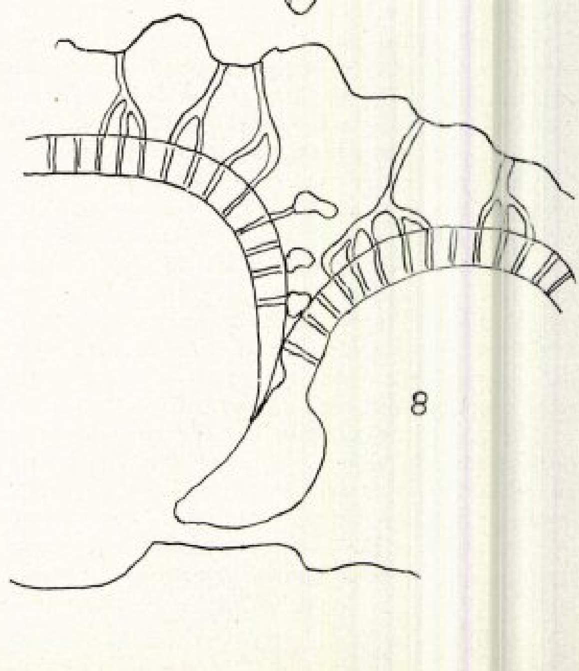
Fig. 6. *Siderolites laevigata;* one half of transverse section, taken between the spines. In the secundary chalk the canals, in the visible septa the apertures and the fine canals. Upper Md, quarry v. d. Zwaan, Jekerdal. × 60.

Fig. 7. *Siderolites vidali;* transverse section, for comcomparison with fig. 6; sample A. H. 25, Aquitaine Basin, Maestrichtian; × 60.

Fig. 8. Part of tangential section through *Siderolites laevigata*, showing the thickened border of aperture, formed by a distal wall, and the wall of the next chamber, not reaching the aperture; in the secondary chalk between the "septal" canals, and canals originating from pores; × 225.



7



8

cularis gens, it occurs in *Lepidocyclina,* and was stated by Staub (l.c. 295) in *Mummulites.*

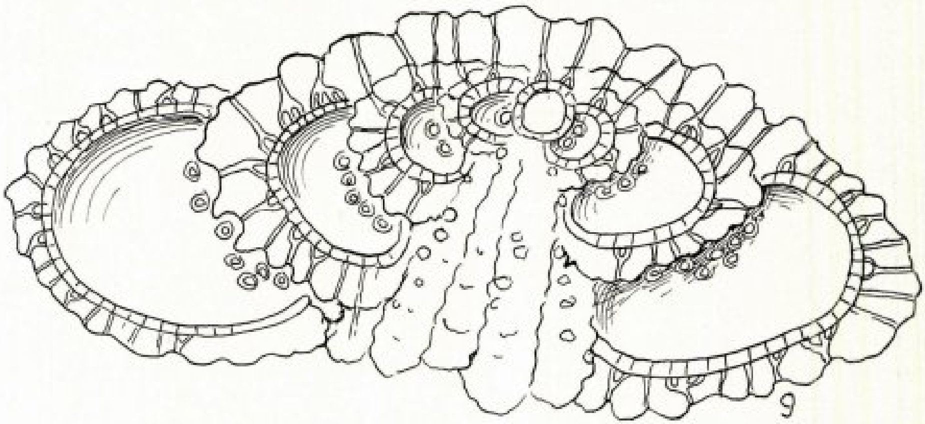
In the mentioned former papers, the author especially gave atention to the structure of the chambers and the canals in the tests of *S. calcitrapoides* and *S. laevigata,* made visible by means of his canada-balsam method. In the new investigation, the author laid special stress on the structure of the chamber walls of these two species, which are closely allied. In random sections especially in horizontal sections, some of the septa seen are "double", whereas other sections seem to be simple. A close examination revealed that this peculiarity was caused by the fact that the promary walls (older walls get a strong secondary thickening) strongly bend inward at the septa (fig. 8), which easily can be stated in tangential sections. Thus each next chamber's proximal wall adheares at the former wall, but never reaches the aperture of that wall, whereas at the proximal side the septum remains single. Between these two walls, often a kind of canals remains open, which canals run between the two walls from the chamberwall of a former row towards the chamberwall of the next row, thus forming a kind of striae which radiate in transverse section which has been taken between two spines (fig. 1, 6). These canals are connected with the main canal system (fig. 8), which consists of canals in the secondary thickening of the walls, and mostly are formed by fusing of some pores of the primary walls. Often in this way also canals are formed which run spirally between the secondary thickened walls of a former row and the primary walls of the next row, thus forming the spiral canals.

Since the outer apertural wall of the last formed chamber, when seen in undamaged specimens (which in reality are rare and only can be found in good preservation in the holes of the hard grounds) shows distinct groves running from the suture towards the margin, radiating, it is suggested that the canals in he septa are formed by these groves, when the next chamber adheres to its wall.

The apertures could be studied in many well-preserved specimens. Invariably in the first chambers there is one single aperture, situated marginally and areally, surrounded by a distinct lip. But even in the chambers of the first whorl, the number of those sutural apertures increases, first two, later more, till in the much embracing chambers a row of apertures is formed (fig. 1, 6). This is already so in the small specimens found in the lower Mc. In *Siderolites vidali* from the Aquitaine Basin, in the oldest, small specimens (Santonian) even in the outer whorls the aperture is found marginally and simple. In the higher advanced specimens of this species (Maestrichtian) in the last formed rows there also is a row of apertures (fig. 7). This may lead to the conclusion, that *Siderolites calcitrapoides* and *S. laevigata* are higher advanced species than *S. vidali.* Since the total structure of the test walls, the forming of the canals, and the situation of the apertures, in *S. vidali* is very similar to those found in the type species of the genus, *S. calcitrapoides,* there cannot be any doubt as to the belonging of all these forms to one species, *Siderolites.*

Smout (1955, Journ. Wash. Acad. Sci., vol. 45) was of the opinion that *S. vidali* should not necessary be included into the same genus as *S. calcitrapoides;* the identity of the wall structure of both species strongly indicates that they belong together. Moreover he suggested, that the Miscellaneidae, in which he incorporated *Siderolites,* might have derived from *Pararotalia (Neorotalia),* p. 206. In general, the wall structures of both genera, with the chamberwalls bending inward at the septa is the same and the typical feature of all species of *Pararotalia,* the areal aperture, is also found in *Siderolites.* Reiss (1958, Bull. geol. Survey, Israel, Bull. 21, p. 17) states that *Pararotalia* evidently is the ancestor of the Miscellaneidae; the author believes that this is evident. Reiss (p. 15) points to a paper by Brown and Brönnimann from 1957 (Micropal. vol. 4, No. 1, pp. 29—38, fig. 1—30), in which several species have been described, occurring in the Maestrichtian of the Caribean region, which have been described as *Siderolites vanbelleni* (vandenbold) and *Siderolites skourensis* (Pfender); but both species in reality seem to belong to the genus *Pararotalia,* so that they may form a transition towards *Siderolites calcitrapoides,* as Brown and Brönnimann suggest.

As was pointed out, in 1926 I named the species *Calcarina calcitrapoides.* This was according to Carpenter (Introduction Foraminifera, 1862, p. 223; Reuss, Sitzber. Akad. Wiss. Wien,



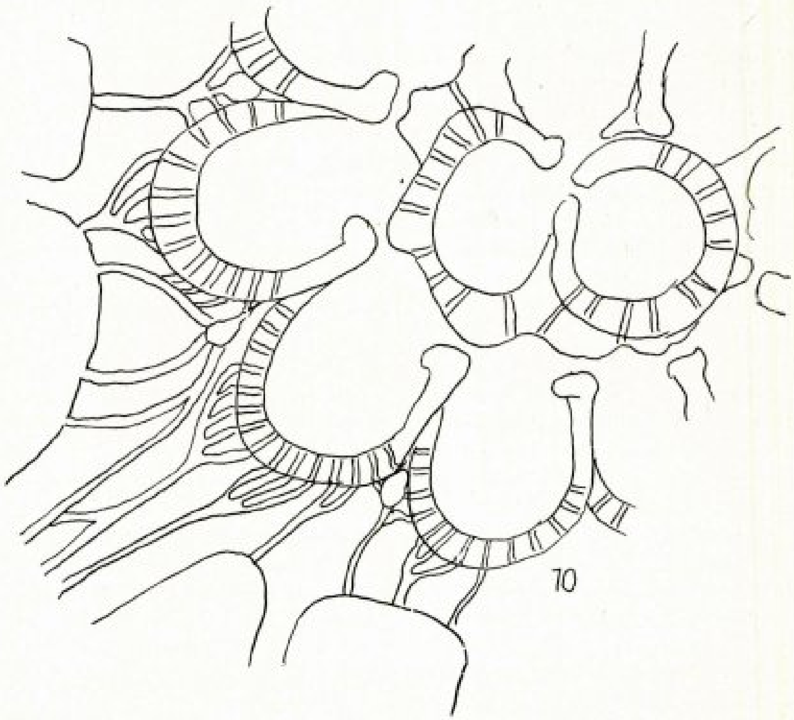


Fig. 9. *Calcarina spengleri;* transverse section, showing canals in the umbilical plug, canals in the secondary chalk arising from the primary pores, and areal apertures in the septa; beach of Timor, Pacific, Recent; × 75.

Fig. 10. Part of horizontal section through *Calcarina spengleri,* central part, showing megalospheric proloculus, some adjoining chambers, canals in the secondary chalk and canals of a spine, also originating from the primary pores; same locality, × 280.

1862, pp. 315—316). Faujas Saint Fond (Histoire naturelle de la Montagne de Saint Pierre de Maestricht, 1799, Paris, pl. 34, fig. 5—12) described it as „Polypier étoilé"; he says (p. 188): „Lamarck, a qui j'avois communiqué ces jolis petits polypiers fossiles, en a formé un genre sous la dénomination de *Siderolites;* c'est le 20me genre des polypes à rayons, et il désigne celui de Maestricht sous le nom de *Siderolites calcitrapoides."* (Silvestri, 1929, Atti Pont. Accad. Sci. Nuovi Lincei, vol. 82, suppl., pp. 327—343, pl. 1, fig. 1—10).

Osimo (Accad. Reale Sci. Torino, 1907, vol. 62, pp. 273—285, fig. 1—25) calls the genus *Siderolithes*, which must be, according to Silvestri, a wrong name for *Siderolites*. The different forms of *Siderolites calcitrapoides* were separated by him as *Siderolithes preveri* Osimo, *S. nummulitispira* Osimo, *S. calcitrapoides* Lamarck, *S. calcitrapoides* var. *brevispina* Osimo; whereas in his series B, the group which has to be named *Siderolites laevigata* Douvillé, he distinguished *Siderolithes rhomboidalis* Osimo, *S. rhomboidalis* var. *crassissima* Osimo, *S. rhomboidalis* var. *latispina* Osimo, *S. vandenbroecki* Osimo. All these names, however, are synonyms to *Siderolites calcitrapoides* and *S. laevigata*.

In what way, however, is *Calcarina*, d'Orbigny, 1826, allied to *Siderolites?* The type-species, as Smout (1955, p. 206) pointed out, has to be *Nautilus spengleri* Gmelin, 1756. This pacific species had been analysed by the author in 1951 (Siboga-Report, IVa, Foraminifera, pt. I, pp. 45—47, pl. 21, fig. 3—6, 8—19; pl. 22). It was then found, that the inner structure was that of *„Calcarina" calcitrapoides (Siderolites)*, but for the fact, that *C. spengleri* was wholly trochoid. A new investigation has confirmed that view (fig. 9, 10). The canal systems of both genera are formed in the secondary chalk mass and originate from the pores; in both forms at the connecting areas between two adjacent chambers and the secondary chalk canals are left open, forming a kind of spiral canals. In both genera the primary chamber walls bend inward at the septa, forming "double" septa which, however, never are seen just at the apertures. In both genera the apertures are situated in rows along the inner sutures and are areal, with thickened lips. Moreover, it is a striking fact, that as well in *Siderolites calcitrapoides* as in *Calcarina spengleri* the B-forms are characterised by a multitude of spines which often broaden and are bifurcating, and that in both genera the canal systems of the spines originate from the pores of primary walls too. Moreover, in both genera chambers at the periphery are connected with chambers of former whorls by the canals in the secondary chalk.

This leads to the conclusion, that *Calcarina spengleri* Gmelin and *Siderolites calcitrapoides* Lamarck, both genotypes, are very closely allied, the more, since it is known that especially in the microspheric generation of *Siderolites* the first whorls are distinctly trochoid.

Conclusions.

Siderolites calcitrapoides, type of the genus *Siderolites*, shows strong resemblance to *Pararotalia* (areal foramina, "double" septa, secondary chalk with canals originating from the primary pores); there is one difference: in *Pararotalia* the margin always is poreless; this never is in *Siderolites* and *Calcarina*.

Calcarina spengleri, type of the genus *Calcarina*, strongly reminds of *Siderolites* in all typical features. *Calcarina* is a trochoid *Siderolites*. Since the first name mentioned is *Siderolites*, gathering of both types into one genus would lead to the suppresion of *Calcarina* as a genus (Smout, l.c., p. 206).

Siderolites vidali Douvillé is a true *Siderolites* with all characteristics of the genotype but for the forming of spines, which are replaced by a total flange, as also is found in some forms of *Siderolites laevigata*. There is no necessity for the genus *Pseudosiderolites* Smout (l.c., p. 206), the more, since several species of *Calcarina*, believed by Smout to belong to *Siderolites* also, have forms without spines, which is believed by Smout to be essential for his new genus.

BOEKBESPREKING

Op zoek naar de eerste mens door Herbert Wendt. 1963. VIII, 316 bladz. met talrijke platen en figuren. Uitg. W. De Haan, Zeist, van Loghum Slaterus, Arnhem en Standaard Boekhandel, Antwerpen. Prijs *f* 7,90.

Dit is de tweede druk van het in 1954 uitgegeven boek „Ik zocht Adam. In het voetspoor van de eerste