

A NEW PLANKTONIC FORAMINIFERA SPECIES (*HANTKENINA GOHRBANDTI* NOV. SPEC.) FROM THE MIDDLE EOCENE OF THE NORTHWESTERN TETHYS (MATTSEE, AUSTRIA)

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KEYWORDS

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ABSTRACT

The newly discovered planktonic foraminifer *Hantkenina gohrbandti* nov. spec. forms the evolutionary link between the genera *Clavigerinella* and *Hantkenina*. This ancestor of the genus *Hantkenina* is characterized by pointed chamber ends with a nub (proto-tubulospines) and in some cases by the first tubulospines appearing in a juvenile growth stage. The transition from *Clavigerinella caucasica* to *Hantkenina mexicana* is observed in a 2 m thick part of the Middle Eocene Holzhäusl section (Mattsee, Austria) within planktonic foraminifera Zone E8 and calcareous nannoplankton Sub-Zone NP15b. The section was deposited in bathyal water-depths in the northwestern Tethyan realm and is now part of the Ultrahelvetic thrust unit.

Die neu entdeckte planktonische Foraminiferenart *Hantkenina gohrbandti* nov.spec. ist das evolutionäre Bindeglied zwischen den Gattungen *Clavigerinella* und *Hantkenina*. Sie ist charakterisiert durch spitze Kammerenden mit einem distalen, hohlen Knoten (Proto-Tubulospine) und in wenigen Fällen bereits mit einem echten Hohlstachel (Tubulospine) im juvenilen Wachstumsstadium. Diese Evolution findet in einem nur 2m dicken Abschnitt des mittel-eozänen Holzhäusl Profils statt, innerhalb der Foraminiferenzone E8, bzw. der kalkigen Nannoplankton Sub-Zone NP15b. Die bathyalen Sedimente des Holzhäusl-Grabens wurden in der nordwestlichen Tethys abgelagert und sind jetzt Teil des ultrahelveticen Deckenkomplexes.

1. INTRODUCTION

The planktonic foraminifer genus *Hantkenina* is characterized by planispiral coiling and hollow chamber extensions, called tubulospines. It evolved gradually from the genus *Clavigerinella*, which shows radial elongate, clavate or digitate chambers, but no tubulospines. This evolutionary trend and the transition from *Clavigerinella* to *Hantkenina* was demonstrated from the Austrian Holzhäusl section (Coxall et al., 2003) and from the Kilwa drill sites in Tanzania (Pearson et al., 2004). At both localities, a newly discovered species, which has been named *Hantkenina singanoae* by Coxall and Pearson (2006),

was considered to be the missing link between the two genera. The chambers of this species terminate in a distal hood (proto-tubulospine), and it appears unclear how, and unlikely that, straight tubulospines of the younger *Hantkenina* species could evolve from this bent feature.

The material of the Holzhäusl section used by the English working group is stored at the Natural History Museum in Vienna and was sampled by K.H. Gohrbandt in the 1960s. The precise position of his sample locations was unclear until H. Egger re-sampled the site. Rögl and Egger (2010) report on

the finding of a newly discovered *Hantkenina* species with a first occurrence (FO) slightly below the FO of *H. singanoae*. The stratigraphic ranges of both species overlap. The chambers of the *Hantkenina* nov. spec. terminate in strongly pointed tips or nubs, and in some rare juvenile specimens the first real tubulospines have been observed. This species is considered to be the real ancestor of the genus *Hantkenina*.

Our paper gives the palaeontological description of this important species, for which the new name *Hantkenina gohrbandti* is introduced. The holotype and paratypes are docu-

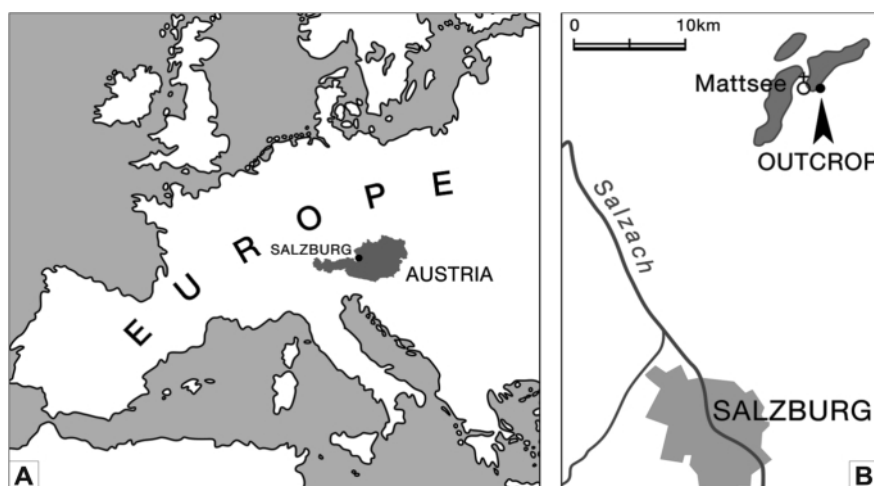


FIGURE 1: Location of the Holzhäusl section near Mattsee (Austria).

mented. The SEM stubs and thin-sections are stored in the Micropalaeontological Collection of the Department of Geology & Palaeontology of the Museum of Natural History Vienna (inventory numbers 2011/0001 to 2011/0005).

2. SETTING OF SAMPLE LOCATION

The Holzhäusl section (47°58'26"N; 13°07'09"E) is located near Mattsee, 20 km north of the town of Salzburg in Austria (Fig. 1). It is part of the Ultrahelvetetic thrust unit (UH) of the Eastern Alps. The UH originates from the passive southern margin of the European Plate and was deposited in bathyal water depths at approximately 35° northern palaeolatitude in the northwestern Tethyan realm. The Holzhäusl section is part of the informal lithostratigraphic unit "Buntmergelserie" and consists predominantly of grey marlstone displaying average carbonate content of 58wt%. In previous studies of this locality, the first records of *Clavigerinella* and *Hantkenina* in the Austrian-Bavarian Helvetikum were mentioned (Thalmann, 1951, Aberer and Braumüller, 1958, Hagn, 1960). From the abundant planktonic foraminiferal assemblage the new species *Globigerina hagni*, *Globanomalina wilcoxensis globulosa* and *Globorotalia mattseensis* were described by Gohrbandt (1967). The evolution of *Hantkenina* took place in a 2 m thick part of the succession in the lower part of the course of the Holzhäusl creek.

3. STRATIGRAPHY

Based on the planktonic foraminifera assemblage with *Gumbelitrionides nuttalli*, *Igorina broedermanni* and *Hantkenina singanoae*, the Holzhäusl section is assigned to Zone E8 in the zonation scheme of Berggren and Pearson (2005) and Wade et al. (2010). In the calcareous nannoplankton zonation scheme of Martini (1971), and its modified version by Aubry (1991), the outcrop can be assigned to Zone NP15, Sub-Zone NP15b (*Sullivania gigas* Sub-Zone), due to the occurrences of *Nannotetrina fulgens* and *Sullivania gigas*.

4. SYSTEMATIC DESCRIPTION

Order Foraminiferida Eichwald, 1830

Suborder Rotaliina Delage & Hérouard, 1896

Superfamily Globigerinaceae Carpenter, Parker & Jones, 1862

Family Hantkeninidae Cushman, 1927

Genus *Hantkenina* Cushman, 1924

Hantkenina gohrbandti Rögl & Egger, nov. spec.

Plate 1, Figs 1-7; Plate 2, Figs 1-6, 9; Plate 3, Figs 1-8; Plate 4, Figs 4-5

Description of holotype (pl. 1, fig. 1, pl. 3, fig. 1): Planispirally coiled, laterally compressed, bi-umbilicate, four and a half chambers in the final whorl, rapidly increasing in size; first chamber small and broken, second chamber rounded, third chamber ovate, fourth and fifth chambers radially elongate with pointed chamber ends, final chamber with a thickened nub; aperture a high equatorial arch with broad lips.

Test morphology: Planispirally coiled, inner whorl with a slight trochospiral tendency, laterally compressed, bi-umbilicate;

peripheral outline stellate; 4½-6 chambers in the final whorl (first and second chamber commonly crushed in our material); chambers rounded in early stage, later ovate to triangular, extend rapidly in radial direction; the final and commonly also penultimate chamber end in a sharp tip or thickened nub. The nub appears as a rounded, hollow and perforated structure (pl. 4, fig. 5). Some juvenile specimens show the first occurrences of real tubulospines (pl. 2, figs 4-6, 9, pl. 3, figs 10-11). Interestingly, after developing a tubulospine in the inner whorl, the following chambers are pointed or with a thickened nub. In thin-section the hollow tubulospine can be observed (pl. 4, fig. 4). From the material of K.H. Gohrbandt primitive tubulospines were described already by Coxall et al. (2003, pl. 6, figs 9, 16). Later, the specimens were placed in the new species *H. singanoae* (Coxall and Pearson, 2006, pl. 8.13, figs 16-17).

Type of wall: Weakly cancellate and perforate, non-spinose, pustules may be present (pl. 1, fig. 6, pl. 3, figs 6-8). In some final chambers fine furrows towards the pointed end are present (pl. 1, fig. 7, pl. 3, fig. 3).

Size: holotype: maximum diameter 684 microns; paratypes 407 to 860 microns.

Etymology: Named in honour of Klaus H. Gohrbandt (Gulf Breeze, Florida, USA; former employee of Rohöl-Aufsuchungs AG, Vienna) for his fundamental work on the Paleogene of the Helvetikum north of Salzburg.

Distinguishing features: The new species *Hantkenina gohrbandti* is distinguished from *Clavigerinella*, especially *C. caucasica* Subbotina by the development of pointed chamber ends with a nub in the youngest chambers, forming a prototubulospine in sense of Coxall and Pearson (2006). In contrast to *H. singanoae* Pearson & Coxall (in Coxall and Pearson, 2006), the straight and pointed chamber ends differ clearly from the cylindrical, commonly hood-like chamber ends in *H. singanoae* (comp. pl. 3, fig. 13 of the holotype of *H. singanoae*). Primitive forms of *H. mexicana*, originally described as *H. nuttalli* Toumarkine, have broad triangular chambers, where the chambers continue without break in the blunt tubulospines (pl. 3, figs 14-15). Intermittent forms between *H. gohrbandti* and *H. mexicana* (forma *nuttalli*) show blunt, somewhat irregular tubulospines (pl. 2, figs 7-8). The transition between both species is also visible in the small grooves along proto-tubulospines and real tubulospines (pl. 3, figs 3, 11-12), which may correspond to protoplasmatic structures.

Phylogenetic relationship: In the evolution from *Clavigerinella* to *Hantkenina* the new species is a transitional form between *C. caucasica* and *H. mexicana*. In *C. caucasica* rounded chamber ends are present throughout the final whorl (comp. pl. 4, fig. 1). The new species *H. gohrbandti* shows initially rounded chambers in the juvenile stage, followed by ovate-elongate chambers, and finally chambers with a pointed tip, ending commonly in a hollow nub (comp. pl. 4, fig. 5). In some instances a true tubulospine is already developed in juvenile chambers (comp. pl. 4, fig. 4). In *H. mexicana* true tubulospines are constantly developed in the later chambers of the final whorl.

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Discussion: Coxall and Pearson (2006) discussed the position of their new species *H. singanoae* in comparison to *Clavigerinella*. The development of proto-tubulospines and terminal nubs is different in all species of *Clavigerinella* and forms a transition to later species of *Hantkenina*. As demonstrated by Rögl & Egger (2010) in the material from the Holzhäusl section a more clear transition to *H. mexicana* can be explained by the straight and pointed chamber ends in *H. gohrbandti*. In the case of *H. gohrbandti* proto-tubulospines and terminal nubs are developed, supporting its assignment to the genus *Hantkenina*. The species *H. singanoae* is also present in our samples, but in small numbers (pl. 1, fig. 9), and the characteristic hood is rudimentarily developed (pl. 3, fig. 9).

Stratigraphic range: Middle Eocene, planktonic foraminifera Zone E8 (*Guembeltrioides nuttalli* Lowest-occurrence Zone), *Nannotetrina fulgens* Zone NP15, *Sullivania gigas* Subzone NP15b. New calibrations of Zone E8 with the younger part of magneto-chron C21n and C20r yield an estimated age span of 46.4 to 44.4 Ma (Wade et al., 2011).

Geographic distribution: At present, this species is known only from a short interval in the Holzhäusl section, township Mattsee N of Salzburg, Austria, belonging to the Ultrahelvetic thrust unit of the Eastern Alps.

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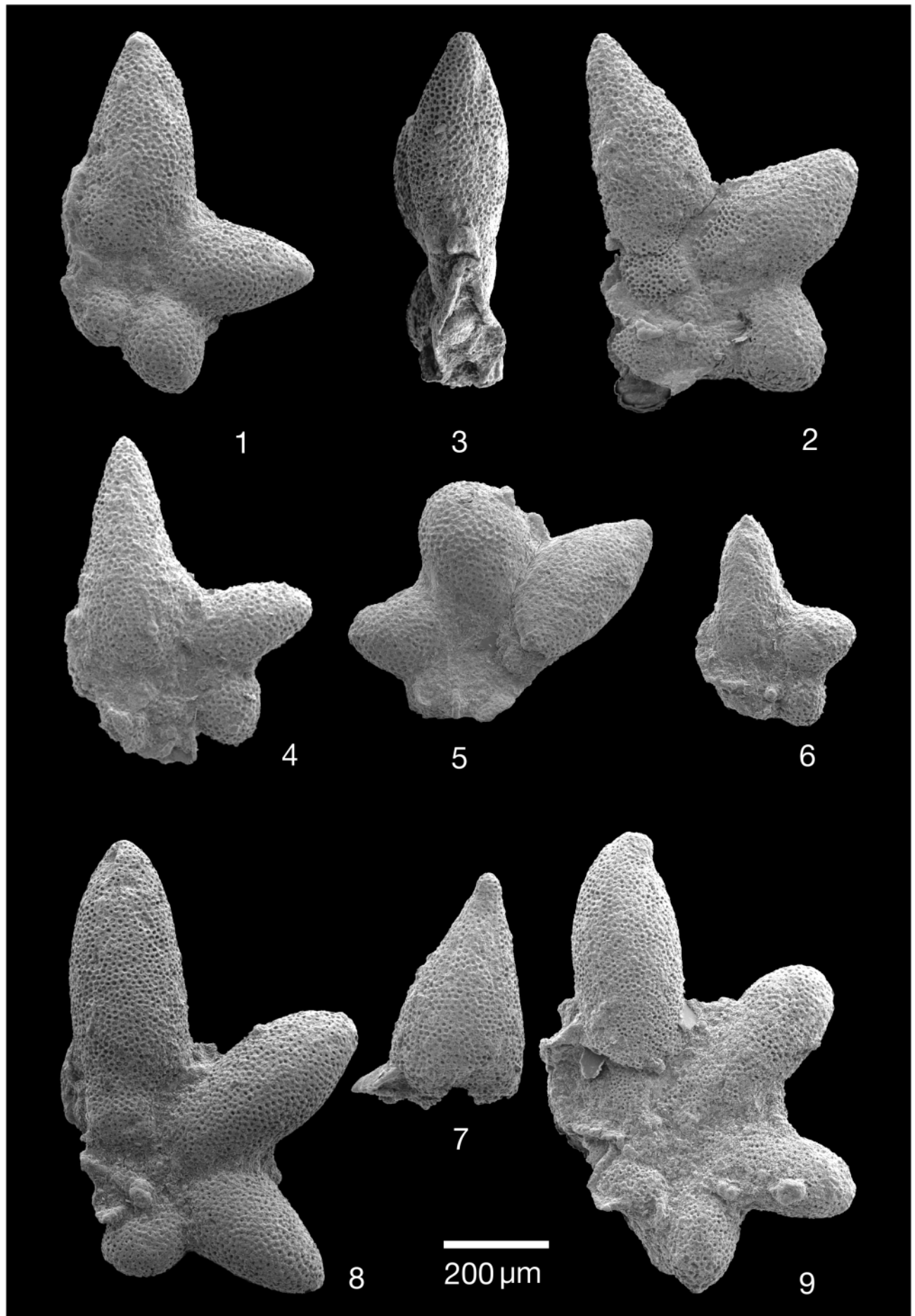
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PLATE 1:

- FIGURE 1:** *Hantkenina gohrbandti* nov. spec., holotype, lateral view, sample B5-08, inv. no. 2011/0004/0011; maximum diameter 684 microns. Detail of final chamber in pl. 3, fig. 1.
- FIGURE 2:** *Hantkenina gohrbandti* nov. spec., paratype, lateral view, sample A2h-08, inv. no. 2011/0004/0006; maximum diameter 755 microns. Detail of final chamber in pl. 3, fig. 5.
- FIGURE 3:** *Hantkenina gohrbandti* nov. spec., paratype, apertural view, sample A2d-08, inv. no. 2011/0004/0013; maximum height 679 microns.
- FIGURE 4:** *Hantkenina gohrbandti* nov. spec., paratype, lateral view, sample A2a-08, inv. no. 2011/0004/0001; maximum diameter 581 microns. Detail of final chamber in pl. 3, fig. 4.
- FIGURE 5:** *Hantkenina gohrbandti* nov. spec., paratype, lateral view, sample Go 64/1-36/0, inv. no. 2011/0003/0006; maximum diameter 600 microns. The specimen was figured in COXALL et al. (2003, pl. 6, fig. 8) as *Calvigerinella-Hantkenina* transition.
- FIGURE 6:** *Hantkenina gohrbandti* nov. spec., paratype, lateral view, sample B4-08, inv. no. 2011/0004/0010; maximum diameter 398 microns. Detail of final chamber in pl. 3, fig. 6; wall surface of earlier chamber in pl. 3, figs 7-8.
- FIGURE 7:** *Hantkenina gohrbandti* nov. spec., single chamber with distinct nub, sample A2h-08, inv. no. 2011/0004/0007; maximum height 415 microns.
- FIGURE 8:** *Clavigerinella caucasica* (Subbotina), sample B2-08, inv. no. 2011/0002/0014. Characteristic elongate, clavate chambers, rapidly increasing in height.
- FIGURE 9:** *Hantkenina singanoae* Pearson & Coxall, sample B3-08, inv. no. 2011/0001/0003. Final chamber ending with a hood (proto-tubulospine). Detail of final chamber in pl. 3, fig. 9.

All figured specimens are from the Mattsee-Holzhäusl section. Scale bar for all figures 200 microns.



A new planktonic foraminifera species (*Hantkenina gohrbandti* nov. spec.) from the Middle Eocene of the northwestern Tethys (Mattsee, Austria)

PLATE 2:

FIGURE 1: *Hantkenina gohrbandti* nov. spec., paratype, lateral view, sample A2e-08, inv. no. 2011/0004/0002; maximum diameter 707 microns.

FIGURE 2: *Hantkenina gohrbandti* nov. spec., paratype, lateral view, sample A2f-08, inv. no. 2011/0004/0005; maximum diameter 860 microns.

FIGURE 3: *Hantkenina gohrbandti* nov. spec., paratype, lateral view, sample B4-08, inv. no. 2011/0001/0020; maximum diameter 654 microns. Detail of final chamber in pl. 3, fig. 2.

FIGURE 4: *Hantkenina gohrbandti* nov. spec., paratype, lateral view, sample B3-08, inv. no. 2011/0001/0014; maximum diameter 624 microns. First chamber of the final whorl with real tubulospine, second chamber with a pointed chamber end, further chambers with broken tips (see pl. 3, fig. 10).

FIGURE 5: *Hantkenina gohrbandti* nov. spec., paratype, lateral view, sample B4-08, inv. no. 2011/0001/0019; maximum diameter 408 microns. Juvenile specimen with a tubulospine in the first chamber of final whorl; further chambers with thickened conical knobs (see pl. 3, fig. 11).

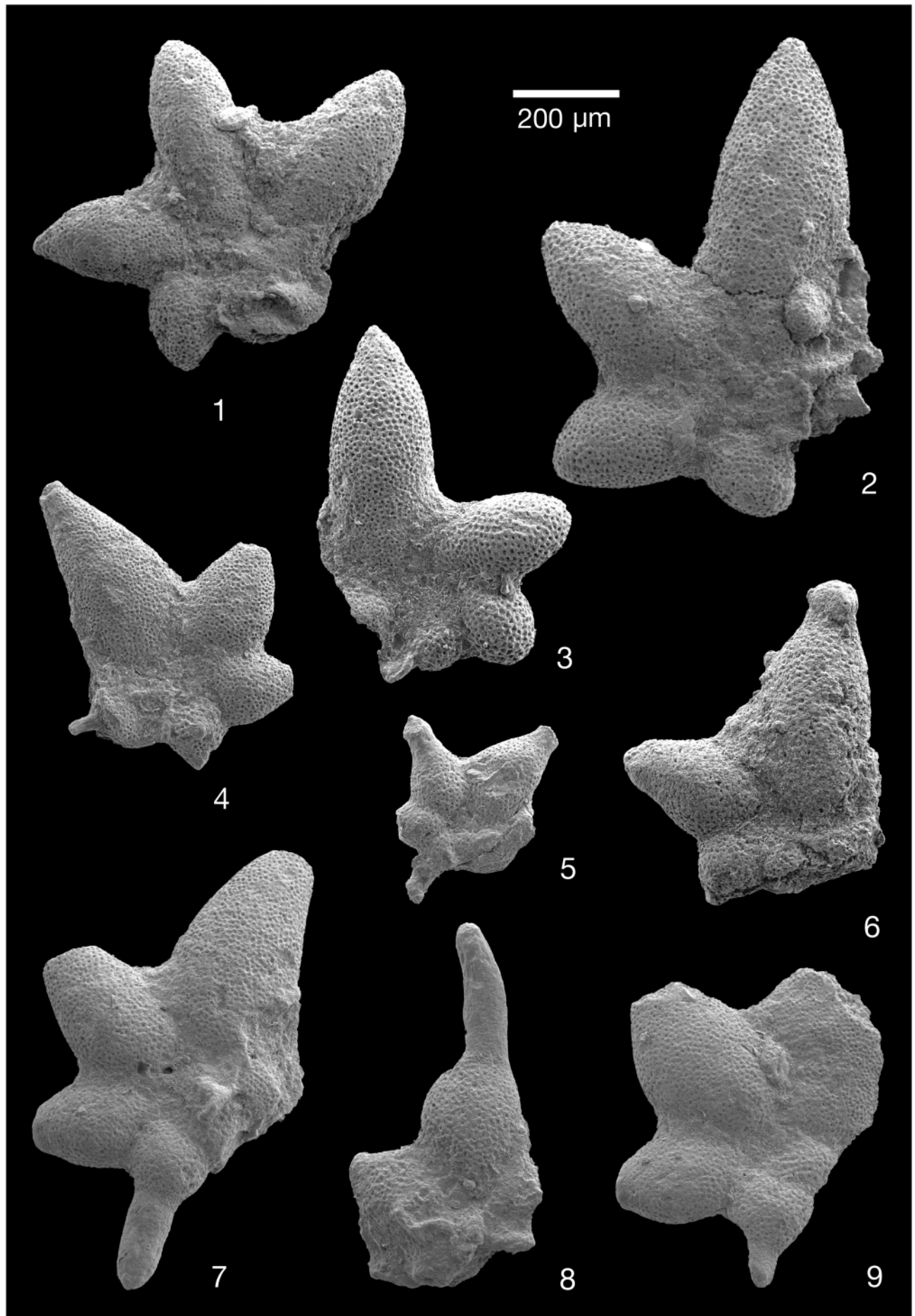
FIGURE 6: *Hantkenina gohrbandti* nov. spec., paratype, lateral view, sample A2f-08, inv. no. 2011/0002/0002; maximum diameter 636 microns. Final chamber with thickened knob, earlier chambers with pointed ends.

FIGURE 7: *Hantkenina gohrbandti* – *H. mexicana* transition, lateral view, sample Go 64/1-36/4b, inv. no. 2011/0003/0024; maximum diameter 880 microns. The blunt tubulospine in the final whorl forms a transition between the proto-tubulospine in *H. gohrbandti* and the slender tubulospine in *Hantkenina mexicana*.

FIGURE 8: *Hantkenina gohrbandti* – *H. mexicana* transition, lateral view, sample Go 64/1-36/4b, inv. no. 2011/0003/0027; maximum diameter 690 microns. The specimen was figured in COXALL et al. (2003, pl. 6, fig. 10, 17) as "primitive" *Hantkenina nuttalli*. The tubulospine is somewhat deformed comparable to that in fig. 7.

FIGURE 9: *Hantkenina gohrbandti* nov. spec., paratype, lateral view, sample Go 64/1-36/4b, inv. no. 2011/0003/0021; maximum diameter 408 microns. The specimen was figured in Coxall et al. (2003, pl. 6, fig. 9, 16) as "primitive" *Hantkenina nuttalli*. The blunt proto-tubulospine forms a transition to that in *H. cf. mexicana*. Pores are developed all along the process. Later, Coxall & Pearson (2006, pl. 8.13, figs 16-17) placed it in *H. singanoae*.

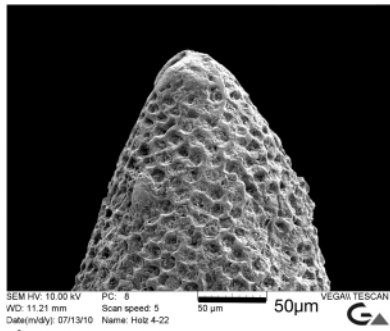
All figured specimens are from the Mattsee-Holzhäusl section. Scale bar for all figures 200 microns.



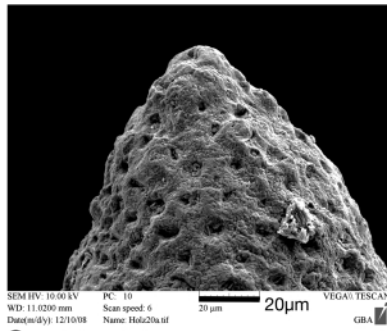
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PLATE 3:

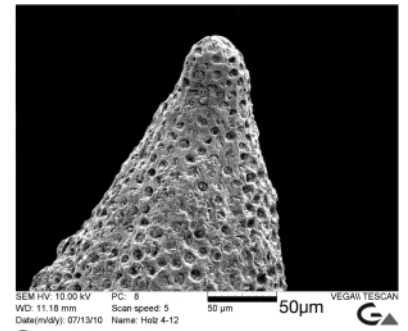
- FIGURE 1:** *Hantkenina gohrbandti* nov. spec., paratype, final chamber of specimen in pl. 1, fig. 1.
- FIGURE 2:** *Hantkenina gohrbandti* nov. spec., paratype, final chamber of specimen in pl. 2, fig. 3.
- FIGURE 3:** *Hantkenina gohrbandti* nov. spec., paratype, final chamber of specimen in pl. 1, fig. 7. The pointed end shows fine radial grooves, similar to those along the tubulospines of *H. mexicana* (comp. fig. 12).
- FIGURE 4:** *Hantkenina gohrbandti* nov. spec., paratype, final chamber of specimen in pl. 1, fig. 4.
- FIGURE 5:** *Hantkenina gohrbandti* nov. spec., paratype, final chamber of specimen in pl. 1, fig. 2.
- FIGURE 6:** *Hantkenina gohrbandti* nov. spec., paratype, final chamber of specimen in pl. 1, fig. 6.
- FIGURE 7:** *Hantkenina gohrbandti* nov. spec., paratype, first complete chamber in the final whorl of specimen in pl. 1, fig. 6, showing the development of small pustules.
- FIGURE 8:** *Hantkenina gohrbandti* nov. spec., paratype, higher magnification of the wall in fig. 7, specimen in pl. 1, fig. 6.
- FIGURE 9:** *Hantkenina singanoae* Pearson & Coxall, final chamber with a hood, specimen in pl. 1, fig. 9.
- FIGURE 10:** *Hantkenina gohrbandti* nov. spec., paratype, first and second chamber in the final whorl of specimen in pl. 2, fig. 4.
- FIGURE 11:** *Hantkenina gohrbandti* nov. spec., paratype, conical knob at the end of the prelast chamber of specimen in pl. 2, fig. 5.
- FIGURE 12:** *Hantkenina mexicana* Cushman, tubulospine of the final chamber in specimen pl. 3, fig. 15, showing fine radial grooves (protoplasmic structures?) and pores up to the compact conical end.
- FIGURE 13:** *Hantkenina singanoae* Pearson & Coxall, 2006, holotype. SEM figure kindly provided by Paul Pearson.
- FIGURE 14:** *Hantkenina* cf. *mexicana* Cushman "forma *H. nuttalli* Toumarkine", with broad chambers in the stellate arrangement of *H. mexicana*; sample A1-08, inv. no. 2011/0001/0012.
- FIGURE 15:** *Hantkenina mexicana* Cushman; sample A2f-08, inv. no. 2011/0002/0006. Primitive form with elongated chambers, continuing in stout tubulospines (comp. fig. 12).



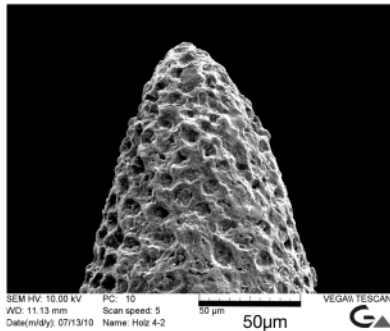
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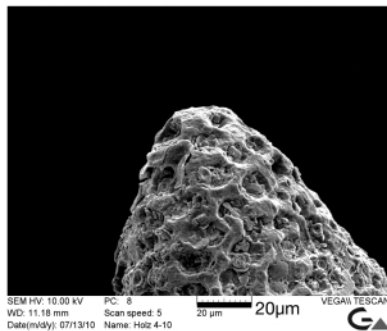
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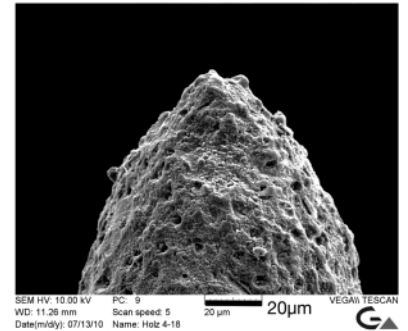
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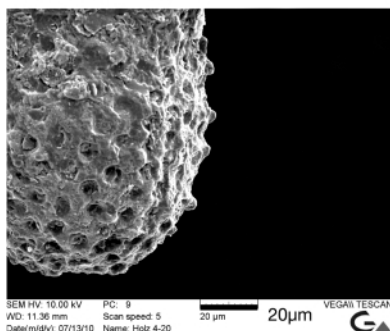
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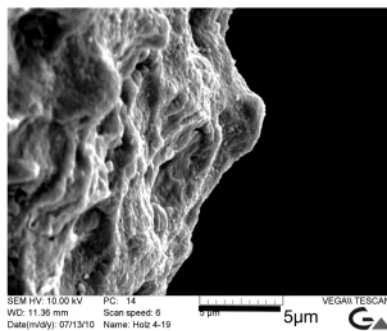
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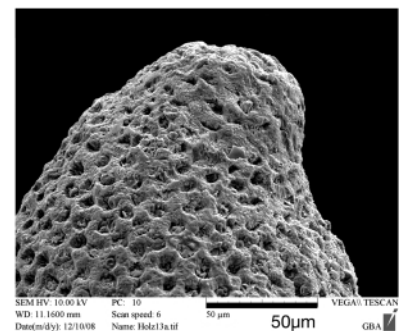
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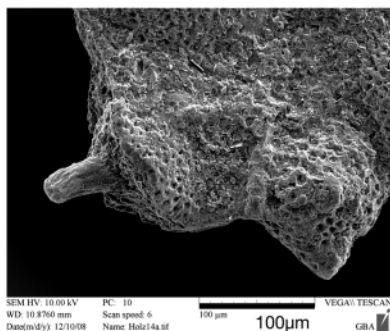
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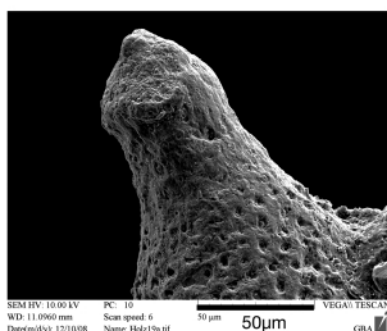
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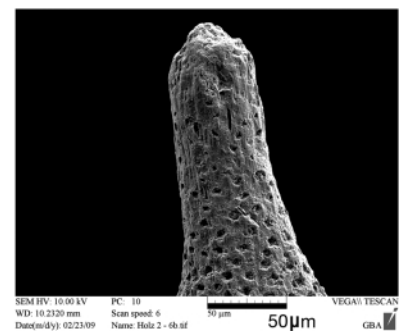
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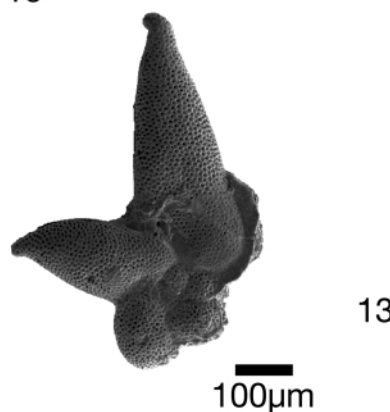
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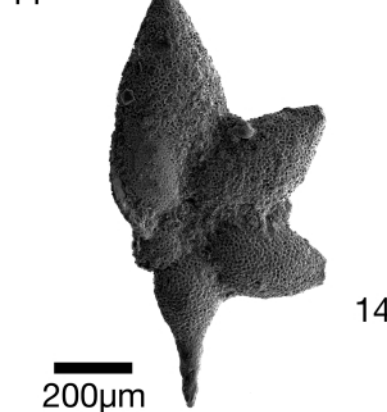
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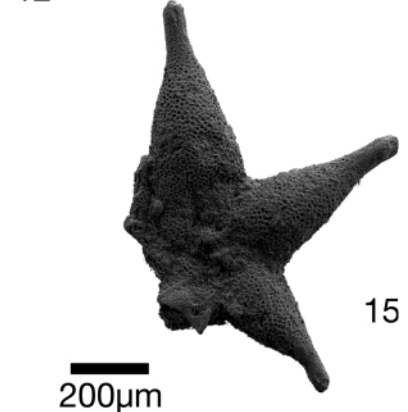
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A new planktonic foraminifera species (*Hantkenina gohrbandti* nov. spec.) from the Middle Eocene of the northwestern Tethys (Mattsee, Austria)

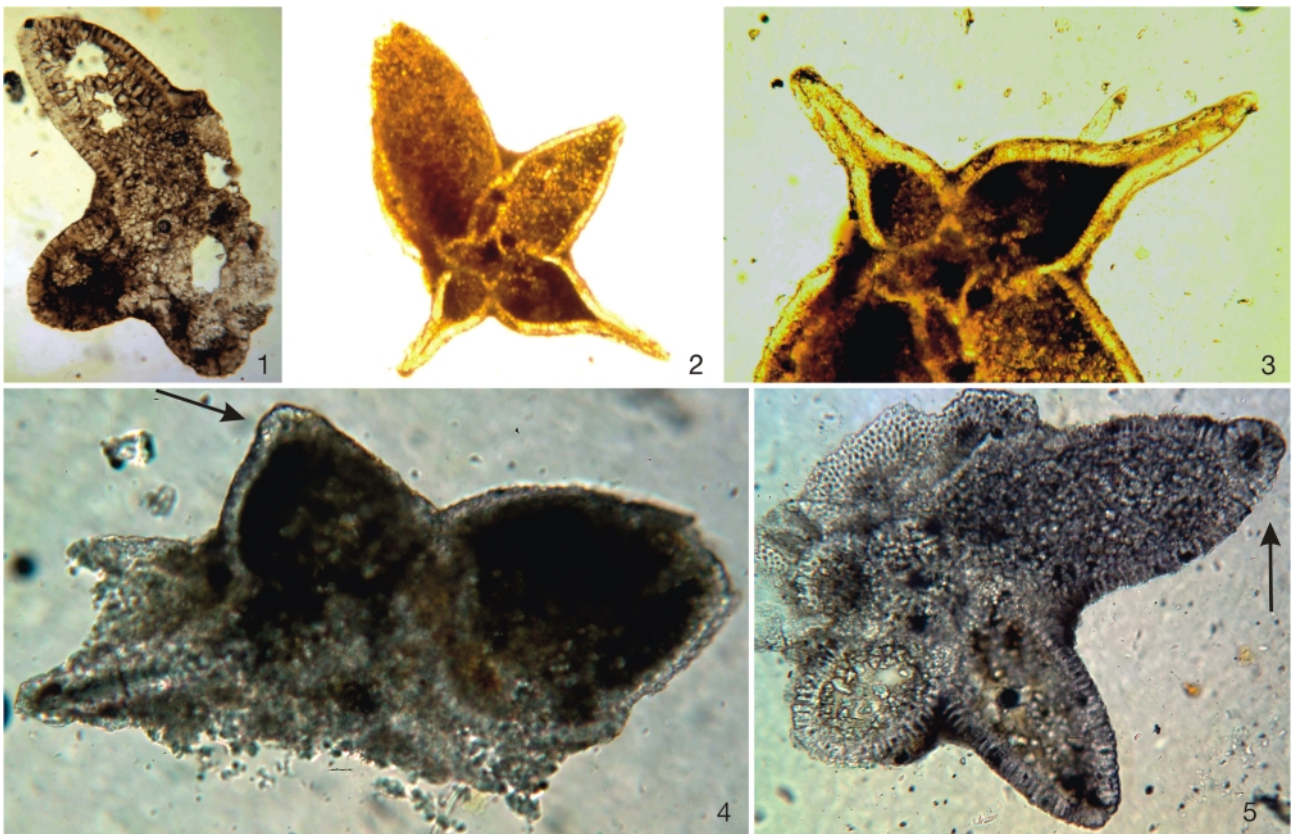


PLATE 4:

- FIGURE 1:** *Clavigerinella caucasica* (Subbotina), thin-section, sample B4-08, inv. no. 2011/0005/0001. In thin-section the chamber ends are rounded, without a thickening or a nub (maximum diameter of the specimen: 0.43 mm).
- FIGURE 2-3:** *Hantkenina mexicana* Cushman, thin-section, sample Rö 2-98, inv. no. 2011/0005/0002. The slender chambers end in a hollow tubulospine, in the inner whorl small tubulospines can be observed already (maximum diameter of the specimen: 0.72 mm).
- FIGURE 4:** *Hantkenina gohrbandti* nov. spec., thin-section of a juvenile specimen with a tubulospine and a nub (arrow); sample B4-08, inv. no. 2011/0005/0003. Maximum diameter of the specimen: 0.31 mm.
- FIGURE 5:** *Hantkenina gohrbandti* nov. spec., thin-section. Pointed chamber with nearly circular nub (arrow); sample A2e-08, inv. no. 2011/0005/0004. Maximum diameter of the specimen: 0.44 mm.

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