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## Brachiopods *Terebratulina delheidi* Vincent in the Nummulite Eocene of the Tatra Mts

**ABSTRACT:** An analysis of the brachiopod fauna which occurs as the lumachelle layers in the Upper Lutetian and Lower Bartonian detrital dolomites of the Tatra Mts allows one to settle the systematic position and individual variability of the species *Terebratulina delheidi* Vincent and to examine the ecological and environmental conditions which then predominated.

### INTRODUCTION

Beds containing numerous brachiopods in the Nummulite Eocene of the Tatra Mts have been discovered by Kuźniar (1910) on the slope of Mt. Hruby Regiel during the construction of the Zakopane-Kiry road. Later on, the outcrop became subject to a complete creep and its area was included in a nature reserve. The brachiopod fauna from the Nummulite Eocene of the Tatra Mts is also known from the Pod Capkami quarry at Zakopane, where there occur single specimens of species indentified by Zejszner (1846) as *Terebratula Zietheni* Bron. and by Kuźniar (1910) as *Liothyryna Hilarionis* Maneghini?, *Terebratulina striatula* Sow. (var. ?) and *Rhynchonella polymorpha* Massalongo.

Beds of detrital dolomites with brachiopods, recently discovered by Roniewicz (1969) on Mt. Hruby Regiel, abound in brachiopods (cf. Pl. 2) accompanied by large foraminifers and scallops, the latter occurring, however, as accessory elements. Here occurring nummulites allow one to determine the age the detrital dolomites as being Upper Lutetian and Lower Bartonian (Roniewicz 1969).

After collecting by the present writer on Mt. Hruby Regiel of a quantitatively rich but not very well preserved material, it turned out these beds contained only one species of brachiopods, tentatively but

incorrectly determined by the writer in the paper by Roniewicz (1969) as *Terebratula picta* Schafhäütl.

*Acknowledgements.* The writer's thanks are extended to the Management of the Tatra National Park at Zakopane for permitting him to collect the fossils discussed, to Docent P. Roniewicz for indicating the outcrops with brachiopod fauna on Mt. Hruby Regiel and to Mrs M. Kleiber-Małachowska for making available her private collection of brachiopods from that locality.

#### DESCRIPTION OF THE MATERIAL

Superfamily **Terebratulacea** Gray, 1840

Family **Cancellothyrididae** Thomson, 1926

Subfamily **Cancellothyrididinae** Thomson, 1926

Genus **TEREBRATULINA** d'Orbigny, 1847

Type species: *Anomia caput-serpentis* Linnaeus, 1767

*Occurrence.* — Upper Jurassic through Recent.

*Diagnosis.* — Shells small, biconvex, pentagonal or ovaly elongate in outline. Surface of both valves covered with fine costae, frequently dichotomously divided. Lateral commissure substraight. Anterior commissure rectimarginate or uniplicate. Umbo short, blunt, of the erect type. Pedicle foramen mesothyrid, provided with pedicle collar. Cardinal process distinct, with its myophore part only slightly outlined. Brachidium in the form of a short loop, which mostly makes up a closed ring resulting from a fusion of crural processes.

*Terebratulina delheidi* Vincent, 1893

(Pl. 1, Figs 1—9)

1852. *Terebratulina striatula* Sow.; T. Davidson, p. 14, Pl. 1, Fig. 16.

1865. *Terebratulina striatula* Davidson; v. Koenen, p. 518.

1893. *Terebratulina Delheidi* nov. sp.; E. Vincent, p. 48, Pl. 3, Figs 5—7.

1910. *Terebratulina striatula* Sow. (var. ?); W. Kuźniar, p. 57.

*Material.* — About 3,000 specimens mostly preserved as internal moulds; the interiors of 23 specimens were investigated in thin sections.

*Dimensions* (in mm):

No.	Length	Width	Thickness	Indexes	
	L	W	T	W/L	T/L
MGE-301	13.4	10.7	6.4	80	47
MGE-3	12.4	11.4	6.6	93	54
MGE-35	11.4	12.0	5.8	105	51
MGE-40	10.4	11.2	4.8	107	46
MGE-319	10.4	8.6	4.4	83	42
MGE-324	9.2	8.6	3.8	94	42
MGE-162	8.6	8.3	3.6	97	45
MGE-168	7.9	8.2	3.5	103	45
MGE-354	6.5	6.6	3.4	101	53
MGE-200	5.6	4.8	2.2	86	40

*Description.* — Shell biconvex, pentagonal in outline, with strongly rounded corners, the widest and the thickest at one-third of its length, the W/L ratio fluctuating within limits of 80 and 107. The specimens which longer than wide

( $W/L = 80$ ) are on the whole thinner than those with  $W/L < 100$ . A small depression distinctly outlined by the trace of the anterior commissure is observed on the pedicle valve. Anterior commissure with a slightly outlined sinus of the uniplicate type.

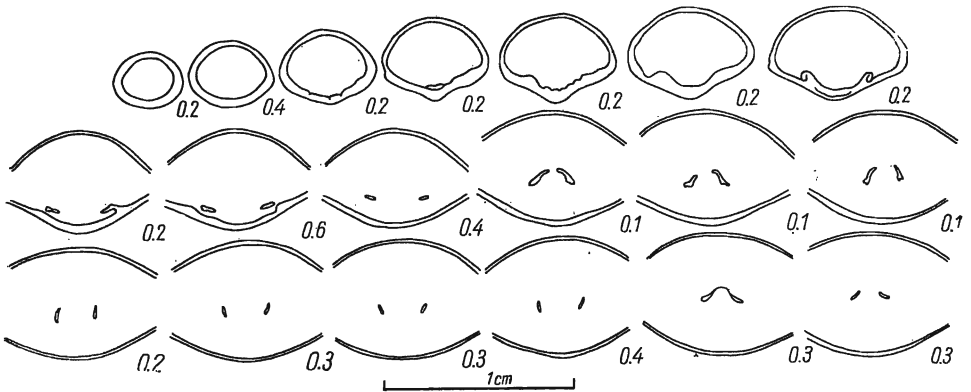


Fig. 1

*Terebratulina delheidi* Vincent — specimens of widened pentagonal outline; transverse sections

Lateral commissures substraight or slightly bent towards the pedicle valve, whose beak is also substraight and bluntly terminating. Area distinct. Pedicle foramen small, limited by non-fused deltidial plates. The surface of both valves densely covered by very fine costae which radially diverge from the umbo (Pl. 1, Fig. 9). In most specimens, costae are divided dichotomously. A costa occurring in the umbo-nal part of the surface of shell is very fine and slightly thickening towards the anterior commissure. A distinct granulation of costae may be observed in the vicinity of the anterior commissure. Concentric growth lines are also visible.

*Internal morphology:* Crural process small, situated centrally, with a slightly marked myophore part. Dental sockets limited by distinct ridges. Inner socket ridge low, massive, outer raised high above dental sockets. Massive crurae, the processes of which are very long and nearly contact each other forming the posterior part of a not fully closed ring of the loop (Figs 1—4), detach themselves from the cardinal margin. The anterior part of the ring of loop is formed by the connection of the

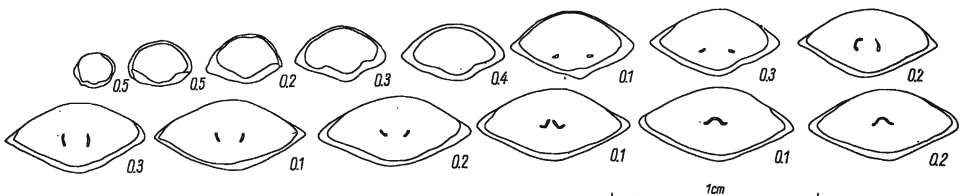


Fig. 2

*Terebratulina delheidi* Vincent — specimens of elongated pentagonal outline; transverse sections

descending branches of the loop with the transverse band. The entire loop of brachidium is very short. Its length reaches one-sixth of the length of the brachial valve. Teeth long, massive, smooth, in the form of triangular processes.

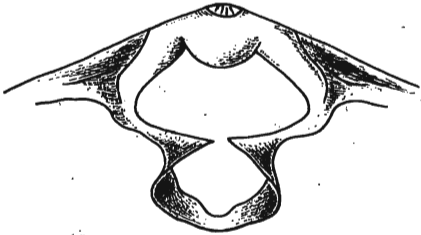


Fig. 3

*Terebratulina delheidi* Vincent; reconstruction of brachidium in specimens of widened pentagonal outline

**Individual variability:** Within the species *Terebratulina delheidi* Vincent, the individual variability is mostly related with a change in the  $W/L$  ratio of the shell (Fig. 5 and Pl. 1, Figs 1—8). On the studies of a sample consisting of 300 specimens,

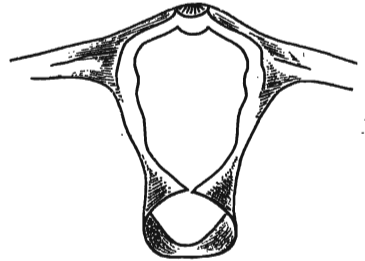


Fig. 4

*Terebratulina delheidi* Vincent; reconstruction of brachidium in specimens of elongated pentagonal outline

the following two fundamental morphological types have been distinguished by the writer who also determined their percentage composition:

1. Shells, pentagonal-elongate in outline, including specimens which  $W/L$  ratio is always less than 100 and amounts to 80 (Pl. 1, Figs 1—4); the collection contains about 30 per cent of such specimens.

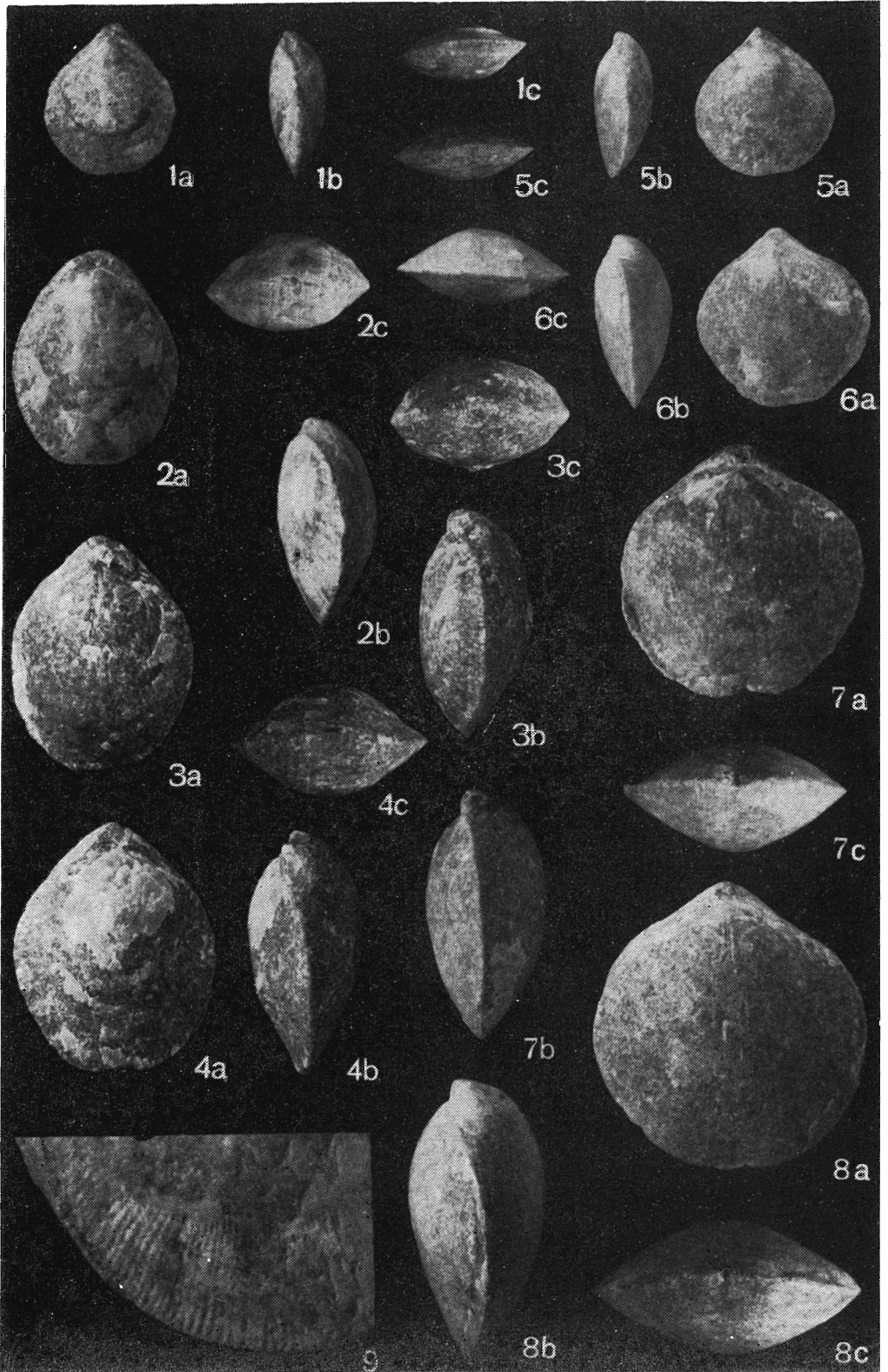
2. Shells pentagonal in outline, widened or subcircular, which  $W/L$  ratio is equal to or larger than 100, averaging 105 (Pl. 1, Figs 5—8); the collection contains about 70 per cent of such specimens.

The thickness of specimens is an additional character underscoring differences in external shape. Specimens assigned to the first morphological group are always marked by a smaller thickness than those of the second group. It amounts to less than a half of the length of shell in contrast to the second group, in which the  $T/L$  ratio equals or even exceeds a half of the length.

A change in the external shape is also marked in the general outline of brachidium. In specimens which are pentagonal in outline and elongate, the loop of brachidium is distinctly elongate (Figs 2 and 4), while in those which are pentagonal and widened, extended becomes the crural part of brachidium (Figs 1 and 3). These changes are conspicuously connected with the width of shell and may be observed in

#### PLATE 1

*Terebratulina delheidi* Vincent; Eocene, Mt. Hruby Regiel in the Tatra Mts;  $\times 5$   
 1—4 specimens of elongated pentagonal outline, 5—8 specimens of widened pentagonal outline, 9 fragment of brachial valve with preserved sculpture ( $\times 10$ )  
 a pedicle valve view, b lateral commissure view, c anterior commissure view





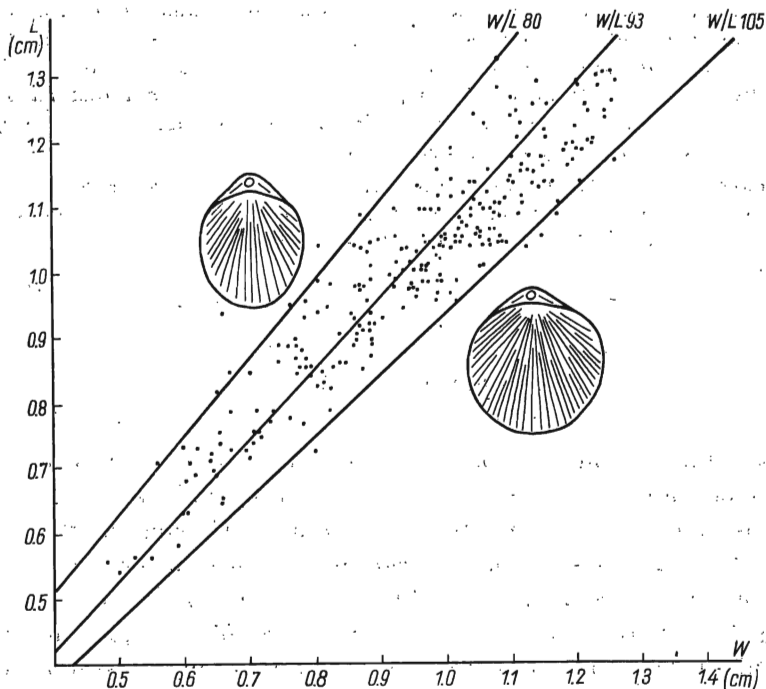


Fig. 5

*Terebratulina delheidi* Vincent; graphic relation between length ( $L$ ) and width ( $W$ ) of the shell

both juvenile and adult individuals of two morphological types. Despite distinct changes in the external morphology of shell, there is no foundation for distinguishing two separate species, since in the collection consisting of 3,000 specimens we may trace all transitional forms between these two extreme morphological types.

*Remarks.* — The species *Terebratulina delheidi* Vincent displays a considerable relationship to *Terebratulina striatula* Sowerby. It was as early as in the case of Kuźniar (1910), who, comparing the Tatra specimens with the English ones from Isle of Sheppy, had some doubts (cf. synonymy) if the Tatra specimens might be for certain assigned to *Terebratulina striatula* Sow. and who even doubted whether all of the specimens presented by Davidson (1852) should be assigned to one definite species. According to a supplement to the description of the species *Terebratulina striatula* Sowerby, given by Davidson (1852) who stressed the varying thickness of costae (every fourth costa more strongly marked) as a characteristic feature of the species, it should be, however, assumed that the specimens from the Eocene of the

## PLATE 2

A layer of detrital dolomites loaded with *Terebratulina delheidi* Vincent; Nummulite Eocene at Mt. Hruby Regiel in the Tatra Mts; taken  $\times 2$ , by B. Drozd, M. Sc.



Tatra Mts ought to be excluded from the species *Terebratulina striatula* and assigned to the species *Terebratulina delheidi*, described by Vincent (1893) from the Oligocene of Belgium. *Terebratulina delheidi* Vincent displays a considerable similarity in the structure of brachidium to *Terebratulina kiiensis* var. *heteroctena* Zezina, a Recent form living in the abyssal zone of the Kurilian Trough (Zezina 1970), which, however, differs considerably in the size of shell and its sculpture.

**Occurrence.** — Middle and Upper Eocene of Italy, Lower Eocene (London Clay) of England, Lower Oligocene of Belgium (Vincent 1893) and the Nummulite Eocene of the Tatra Mts in Poland (Lutetian-Bartonian; Kuźniar 1910, Roniewicz 1969).

#### ENVIRONMENTAL REMARKS

As follows from the observations on Recent terebratulines, they are cosmopolitan forms which may live under strongly varying conditions, in various marine environments and at widely differing depths. They are known from the coastal zone of South America, where they occur at depths varying between 18 and 340 m, from the southern regions of the Behring Sea where they live in deeper waters (664 to 1,258 m) and from the Kurilian Trough, where they are found in the abyssal zone (Zezina 1970).

From the lithological profile of the Eocene deposits of the Tatra Mts, between Mała Łąka and Kościeliska valleys (cf. Roniewicz 1969, Text-fig. 14), the conclusions may be drawn on the conditions in the Eocene sea. The profile begins therein with conglomerates overlaid with detrital dolomites, within which one may distinguish beds containing, *i.a.* terrestrial flora, algal limestones and organodetrital layers, the last-named with large foraminifers and beds filled with the brachiopods under study (Pl. 2). Most shells lie parallel to the bedding and rest on their pedicle or brachial valve. The profile indicates that it is an area of the littoral zone. Locally, the conditions of sedimentation were calmed, the rate of depositing of the terrigenous material slowed down and the bottom became locally consolidated, all of which provided favorable conditions to the development of benthic fauna, the terebratulines included. Periodical increases in the rate of sedimentation caused that the brachiopod communities were covered with sand and, consequently, destroyed to death. On the data presented, one may assume that the fauna of terebratulines which lived in the Eocene sea of the Tatra region existed under ecological conditions similar to those of such faunas along present-day coasts of South America.



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**BRACHIOPODY *TEREBRATULINA DELHEIDI* VINCENT  
Z EOCENU NUMULITOWEGO TATR**

(Streszczenie)

Bogata fauna brachiopodowa występująca ławicowo (por. pl. 2) w obrębie piaskowców dolomitowych eocenu numulitowego (górný lutet — dolny barton) z Hrubego Regla w Tatrach (por. Roniewicz 1969, fig. 14 oraz s. 563) reprezentowana jest tylko przez jeden gatunek, *Terebratulina delheidi* Vincent. W pracy rozpatrzono zmienność tego gatunku (por. fig. 1—5 oraz pl. 1), a także jego warunki życiowe w morzu eoceńskim.

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