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bisécrices for different wave-lengths is here superposed upon it.

In this way a highly remarkable combination of crossed and horizontal dispersions results from it, while the orthodiagonal is for some wave-lengths the direction of the first bisectrix, for other ones that of the second bisectrix. The very peculiar optical phenomena resulting from this, will be described in detail and explained in the paper to be published lateron.

*Laboratory for Inorganic and Physical Chemistry
of the University.*

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Paleontology. — “Contribution to the knowledge of the genus *Kloedenella*, ULRICH and BASSLER.” By J. H. BONNEMA. (Communicated by Prof. J. W. MOLL.)

(Communicated in the meeting of March 28, 1914).

When examining an erratic boulder, consisting of Chonetan or Beyrichian limestone and originating from Vollenhove, I found some remains of Ostracoda which, I presumed, originated from the genus which KRAUSE has called *Beyrichia hieroglyphica*¹⁾, of which besides an illustration (fig. 1) he gave the following description:

Beyrichia hieroglyphica n. sp.

Länge 0,74 mm. Höhe 0,5 mm.

Die Schale ist annähernd rechteckig mit geradem Dorsal- und Ventralrand und gerundeten Seitenrändern. Auf der Schalenoberfläche befinden sich 5 symmetrisch angeordnete grubenförmige, durch schmale Leisten von einander getrennte Vertiefungen, je eine parallel den beiden Seitenrändern vom Dorsalrande bis zum Ventralrande verlaufend, in der Mitte zwischen diesen eine kürzere, welche vom Dorsalrande bis zur Mitte der Schale reicht, und unterhalb derselben zwei rundliche Gruben am Ventralrande.

Die Art weicht von allen anderen Beyrichien unserer Geschiebe weit ab. Am nächsten scheint sie noch der *Beyrichia Halli* JONES aus der Waterlime-Gruppe von Utica N. Y., zu stehen, nur dass bei dieser die beiden unter der centralen Furche befindlichen Vertiefungen fehlen.

Ich fand die eben beschriebene Form in einem grauen, fleckigen Geschiebe zusammen mit *Beyrichia Wulckensiana*, B. aff. *Kloedeni*,

¹⁾ Zeitschr. d. deutsch. geol. Gesellsch., XLIII, p. 506, Taf. XXXII, Fig. 10, 1891.

Cypriden und Fischresten. Die einzelnen Schalen waren nur in Bruchstücken aus dem Gestein zu lösen. Fig. 10 ist ein ergänztes Bild eines der best erhaltenen Exemplare."

In order to ascertain whether the remains of Ostracoda which I had found, really originated from the genus described by KRAUSE as *Beyrichia hieroglyphica*, I looked for similar remains in an erratic boulder consisting of Chonetan or Beyrichian limestone which I had found some time ago when a pond was being dug near a villa, called Hilghestede, between Groningen and Haren. This erratic boulder is now in the collection of the Mineralogical Geological Institute of the University of Groningen. I was then fortunate enough to find not only a great number of separate valves, but also several complete carapaces.

This latter erratic boulder is a dark grey somewhat crystalline piece of Beyrichian limestone, in which among other things I found: fish-remains, *Kloedenia Wilckensiana* JONES, *Beyrichia protuberans* BOLL, *Beyrichia tuberculata* KLÖDFN sp. and *Leperditia phaseolus* HIS. The first three fossils had also been found in the erratic boulder in which KRAUSE found remains of *Beyrichia hieroglyphica*, if at least *B. aff. Kloedeni* may be identified with *Beyrichia protuberans*, which seems almost certain ¹⁾.

It appeared to me that the illustration given by KRAUSE represents a left valve, as the posterior of the two little furrows is always the bigger one (the anterior may even be absent). This figure, however, is very incomplete, for this author seems to have been ignorant of the fact that the remains found by him, had only partly been uncovered. Before the anterior lobe there is another sickle-shaped, less convex part and behind the posterior lobe a similar part tapering towards the lower end. The narrow inferior ends of the less convex parts meet at the ventral side.

The lobe along the ventral edge, which joins the other lobes, is nearly straight and not curved, as represented by KRAUSE; in his description, however, he calls it straight. The ventral edge of the carapaces is concave.

As the most striking feature of this Ostracod I found, however, that in the left valve the two anterior lobes unite at the top into a process, which lies in a notch of the right valve (figs. 3 and 4). No doubt the great number of complete carapaces which were found, is due to this arrangement.

¹⁾ Wissenschaftliche Beilage zum Programm der Luisenstädtischen Oberrealschule zu Berlin Ostern 1891, Berlin, R. Gaertners Verlagsbuchhandlung (HERMANN HEYFELDER). p. 12.

J. H. BONNEMA: "Contribution to the knowledge of the genus *Kloedenella*,
Ulrich and Bassler."



Fig. 1.
Left valve of *Kloedenella hieroglyphica*
A. KRAUSE sp. (After
KRAUSE). 20 X.



Fig. 2.
Kloedenella hieroglyphica
A. KRAUSE sp. Left side
view of complete carapace.
40 X.

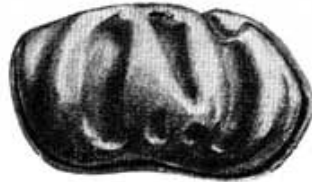


Fig. 3.
Kloedenella hieroglyphica
A. KRAUSE sp. Right side view
of complete carapace 40 X.



Fig. 4.
Kloedenella hieroglyphica
A. KRAUSE sp. Dorsal view of complete
carapace. 40 X.



Fig. 5.
Transverse section of a
carapace of *Kloedenella hieroglyphica*
A. KRAUSE through the part of the
muscle impression, as seen
from behind. 35 X.



Fig. 6.
Left valve of *Kloedenella Hallii*
JONES. X 15.
(After JONES).



Fig. 7.
Kloedenella pennsylvanica JONES
sp. Left side, end and ventral
views of complete carapace, 15 X.
(After JONES).

For the rest the hinge line is straight. Along the straight part the right valve overlaps the left one. By making sections of complete carapaces (fig. 5) I found that the sharp hinge line of the left valve lies in a deep furrow of the right one.

On the other hand the free edges of the right valve are sharp and when the carapaces are closed, these sharp edges lie in a furrow on the free edges of the left valve. So the left valve overlaps the right one except along the hinge line (fig. 2).

In the lower part of the middle-most of the three larger furrows each valve has a round spot indicating the place where the adductor was fastened.

When I had become better acquainted with *Beyrichia hieroglyphica* KRAUSE, the resemblance between this Ostracod and *Beyrichia Hallii* JONES¹⁾ (fig. 6), to which KRAUSE drew the attention, proved much greater than the latter could presume. Another thing that struck me was that in the valve represented by JONES as a right one — though in fact it is a left one — the two front lobes also seem to join into a process. In order to see in how far I was right in my supposition I applied to Dr. BASSLER, curator of the National Museum of Washington, with the request to send me some material of this Ostracod. This was kindly sent to me and I saw that the two anterior lobes on the left valve of *Beyrichia Hallii* JONES indeed unite dorsally into a process, similarly to those in *Beyrichia hieroglyphica* KRAUSE.

On further examining the literature I found that ULRICH and BASSLER²⁾ had classified *Beyrichia Hallii* JONES among their genus *Kloedenella*, of which they call the underdevonian *Kloedenella pennsylvanica* JONES (fig. 7) a typical representative.

Then I asked Dr. BASSLER to send me some material of this latter Ostracod. In the complete carapace of *Kloedenella pennsylvanica*, which was then sent me, I found the same characteristic way of connecting the two valves, which is no doubt also found in other Ostracoda, for which the two authors mentioned above have instituted a new genus *Kloedenella*, for they make special mention of the fact that of most of the representatives complete carapaces have been found.

¹⁾ The Quaterly Journal of the geological Society of London, Vol. XLVI, p. 15, Pl. IV. fig. 21. 1889.

JONES has called this Ostracod *B. Hallii* and not *B. Halli* as KRAUSE writes.

²⁾ No. 1646. — From the Proceedings of the United States National Museum. Vol. XXXV. p. 317.

Of the genus *Kloedenella* ULRICH and BASSLER give the following diagnosis:

"Carapace small, strongly convex, elongate, somewhat barrel-shaped, the length usually less than 1.5 m.m., dorsal edge nearly straight; ventral edge usually somewhat concave, ends approximately equal in height but differing in outline, the antero-dorsal angle often rectangular and always more distinct than the post-dorsal. Valves unequal, the right overlapping the left around the ends and the ventral side. Of the lobation the constant features are two sharply impressed vertical or slightly oblique furrows, separated by a narrow lobe, in the posterior half. In the more simple forms these furrows extend only about half across the valve. Anterior half may be uniformly convex, but, as a rule, is more or less clearly bisected vertically by a straight or curved furrow. When present, this anterior furrow often produces an appearance suggesting the "loop" of a *Bollia*. Surface generally smooth and polished and without ornamental markings".

Here the following remarks are to be made: first, that the way in which the two valves are connected in *Kloedenella hieroglyphica* KRAUSE, as well as in *Beyrichia tuberculata* KLODEN and *Primitia Tolti* BONNEMA, proves that what ULRICH and BASSLER called the posterior end is to be looked upon as anterior.

Secondly "dorsal edge nearly straight" ought to be replaced by "Both valves have a straight dorsal edge, the sharp dorsal edge of the left valve lies in a furrow on the dorsal edge of the right valve. On the left valve there is a process before the right dorsal edge, which fits into a notch of the right valve."

To "valves unequal" may be added that the right valve overlaps the left along the hinge-line. This is at least also the case with *Kloedenella pennsylvanica* as well as with *Kloedenella hieroglyphica*.

The criteria of the genus *Kloedenella* are accordingly.

Carapace elongate and small, the length usually less than 1.5 m.m., posterior half very convex, dorsal edge nearly straight, ventral edge usually somewhat concave, ends equal in height, anterior edge uniformly curved and passing almost invisibly into dorsal edge, forming a very obtuse angle with it, posterior edge less curved, forming a nearly rectangular angle with the dorsal edge. Valves unequal, the anterior half of the right valve has a notch in which a process of the left valve lies: this latter is located before the straight sharp hinge line, which is situated in the furrow on the straight hinge line of the right valve. The right valve overlaps the left along the hinge line. The sharp free edges of the right valve lie in a

furrow on the free edges of the left valve so that the left valve overlaps the right along the free edges.

The surface of the carapaces is different, though furrows and lobes are always present. Constant features on the anterior half of the valves are two more or less vertical furrows, separated by a narrow lobe. The posterior half may also have a furrow. Else the surface is generally smooth and without ornamental markings.

As may have been inferred from the above statements, the position which I have given to this Ostracod corresponds to the position which in my opinion¹⁾ is due to *Beyrichia tuberculata* KLODEN sp., in which there is a furrow on the free edges of the left valve, whereas the right has sharp edges. From Dr. BASSLER of Washington I received a letter the other day, in which he stated that he and Dr. ULRICH considered as posterior what I had assumed as the anterior end in *Primitia Tolli* BONNEMA, *Beyrichia tuberculata* KLODEN sp. and *Beyrichia protuberans* BOLL; but to this I cannot possibly agree. Their opinion is based on the fact that the lower of the two nodes situated at one of the two ends, which in some valves of *Beyrichia tuberculata* has widened into an "ovarian pouch", would be situated in the anterior half in the position suggested by me, whereas in recent Ostracoda this node is found in the posterior half. In my opinion, however, they disregard the fact that in the position accepted by them, the eyes would be situated at the posterior end of the animal, which seems very unlikely. They call upon me to prove that the "ovarian pouch" has been at the anterior end in paleozoic Ostracoda. I think I have sufficiently proved this with my investigations into the location of the eyes.

Next I want to state that what ULRICH and BASSLER called "ovarian pouch" has to be considered as an incubation pouch, and like KRESOW I have no objection to assume that in the paleozoic Ostracoda this was located in the anterior half of the carapace, whereas in the recent *Cythere gibba* MOLL. it is situated in the posterior half of the carapace but near the centre.

Finally I tender my best thanks to Mr. BOTKE, teacher in the "Middelbare Landbouwschool" (Secondary Agricultural School) of Groningen, who has been kind enough to make the drawings of *Kloedenella hieroglyphica* KRAUSE sp., necessary for this paper.

¹⁾ These Proc. 16, 1913, p. 67-74.