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NOTES ON
KOOTENIA SP. N. AND ASSOCIATED
PARADOXIDES SPECIES FROM THE LOWER
MIDDLE CAMBRIAN OF JEMTLAND,
SWEDEN

BY

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With one Plate

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The lowest fossiliferous beds of the first (easterly) overthrust sheet in the Jemtland Cambro-Silurian area belong to the lower Middle Cambrian. They are well exposed along the main road east of Skute railway station, 20 km S of Östersund. They consist of fairly thick dark shales, partly similar to alum shale, and contain a limestone layer with nodules of phosphorite, and lenses of limestone. As a result of a preliminary examination the writer in 1940 (p. 100) noted the following fossils in these lenses: »*Paradoxides* cf. *torelli* HOLM MS, *Dorypyge* n. sp., *Ellipsocephalus polytomus* LINRS., and *Agnostus gibbus praecurrens* WGÅRD». This trilobite fauna was regarded indicative of the presence of *Ælandicus* beds.

Westergård's description (in 1948) of *Dorypyge aenigma* (LINRS.), and the taxonomic notes on the genus *Dorypyge* accompanying it, inspired the present writer to make a reinvestigation of the above fossils. It was soon found that the fauna contains no true *Dorypyge* but a new species of *Kootenia* WALCOTT. As this species is the first representative of that genus discovered in Scandinavia it is considered notable and worth a specific description.

Of the trilobites found together with the new species a few comments on the *Paradoxides* species are added. The presence of those species, *Ellipsocephalus polytomus* LINRS., *Ptychagnostus* (*Triplagnostus*) *praecurrens* (WGÅRD) and *Micromitra* (*Iphidella*) *ornatella princeps* WGÅRD, indicates that the strata from which they were obtained belong to the uppermost part of the lower Middle Cambrian, *i. e.* of the *Ælandicus* beds. This part is probably missing in the autochthonous series of the Bay of Brunflo. At all events it is missing in the Autochthon of Northern Jemtland and Ångermanland (Asklund & Thorslund 1935, pp. 100—104), where *Ælandicus* beds are recorded from overthrust strata only.

Fam. **Corynexochidae** ANGELIN, 1854.

Subfam. **Dorypyginae** KOBAYASKI, 1935.

Genus *Kootenia* WALCOTT, 1888.

Genotype: *Bathyuriscus* (*Kootenia*) *dawsoni* WALCOTT, 1888.

This genus has a wide distribution. The genotype was described from the Burgess shale (the Stephen formation) of British Columbia. Subsequently a number of species have become known from different parts of the world, some species being originally referred to *Dorypyge*. In the northern hemisphere

it is circumpolar, and is recorded from North America (British Columbia, Utah, Southern Appalachians, New Brunswick), Greenland, Great Britain, Sibiria, and Korea. Its occurrence in Australia was reported by Whitehouse in 1936, but later on (1939) that author seems to have referred the Australian species to the genus *Notasaphus* GREGORY. According to Whitehouse the main difference between *Kootenia* and that genus is that (the genotype of) the former has axial spines on the pygidium whereas there are no spines of that kind in (the genotype of) the latter. In the writer's opinion this difference is of no great taxonomic value but it is of specific importance. This is elucidated by the new species described below, which appears to hold an intermediate position between forms with such spines and those without them. Accordingly, as far as can be learnt from the description and figures of the genotype of *Notasaphus*, this generic name ought to be considered a synonym of *Kootenia*.

In 1939 Resser erected a new family *Kootenidae* apparently including the genera *Kootenia* and *Olenoides* MEEK, but gave no diagnosis. However, these genera, *Dorypyge* DAMES and *Holleria* WALCOTT, have characters of essential taxonomic importance in common and seem to be so closely allied that a grouping of them into different families appears unnecessary and untenable, at least for the present.

Most species referable to *Kootenia* occur in (early) Middle Cambrian strata but there are some even in Lower Cambrian [Southern Appalachians, Korea(?) and Sibiria(?)].

Kootenia westergårdi sp. n. — Pl. I, Figs. 1—13.

Diagnosis: Pygidium with five short blunt spines on either side, the two posterior ones similar to incipient spines, like small knobs on the border and hardly visible in young adults. Each axial ring with a median spine or pointed tubercle, largest on the anterior ring and successively diminishing in size posteriorly.

Description: No complete cranium is available, only two small somewhat fragmentary ones and various fragments of large specimens.

Glabella subrectangular in outline, nearly three halves as long as broad, slightly broader in frontal part than posteriorly, strongly convex transversely and rather strongly convex longitudinally, steeply bent down anteriorly in young specimens, rounded in front and reaching anterior raised border of cranium. Two pairs of short and faintly depressed lateral glabellar furrows sometimes visible. Axial furrows straight, clearly impressed, deepening into a pair of (antennary) pits near the anterior border. Occipital furrow deep, at least laterally; occipital ring slightly broadening towards the middle, furnished with a median spine situated near the posterior margin and directed obliquely upwards and backwards. Fixed cheeks fairly strongly convex; eye lobes situated at a distance from axial furrows slightly more than half the width of the glabella across, and almost at the same level as the axial furrows. Palpebral lobes upturned, narrow and fairly long, situated somewhat nearer the posterior

than the anterior margin; palpebral furrows shallow. Anterior branch of facial suture directed straight forwards (on a dorsal view of a small cranium), posterior branch running obliquely outwards and backwards and cutting posterior margin at a distance from axial furrow slightly longer than the width of the occipital ring. Posterior borders of cheeks narrow and bent upwards proximally, broadening and becoming flattened distally; posterior border furrows comparatively broad and deep within, growing wider and becoming shallower laterally.

Free cheeks unknown. Hypostoma known only from the figured fragment, which is furnished with a fairly large and flat left anterior wing. Middle body convex, with the central part highly raised above the borders, defined by strong furrows, the lateral one appearing to be somewhat deeper than the anterior.

Thorax known only from a few fragments of detached segments. Axis strongly convex, bearing a median spine near posterior margin. Pleuron geniculate. Pleural furrow broad, successively decreasing in breadth laterally; anterior pleural band steeply raised above this furrow, rather ridge-like in proximal, horizontal part of pleuron, *i. e.* from the fulcrum inwards, growing wider and flatter outwards, contracting in outermost distal part and terminating in a recurved spine; posterior band almost flat, decreasing in breadth laterally, with a steep (articulating) surface at the knee.

Pygidium semicircular in outline. Axis rather narrow, width at anterior margin about one fourth that of entire pygidium, strongly convex, slightly decreasing in height and gently tapering posteriorly to rounded extremity; composed of five axial rings — of which the posterior one is incompletely defined behind — and a terminal piece. Short median axial spines or pointed tubercles present, successively decreasing in size from the anterior ring posteriorly, the posterior ring only furnished with a tubercle (or an incipient spine). Side lobes moderately arched, with a pair of rather strongly elevated half-ribs, followed by four pairs of regular, flat-topped ribs, separated by comparatively broad and flat pleural furrows and marked with very faint interpleural furrows. Border flat, almost equal in breadth throughout, with five pairs of short, slightly recurved marginal spines, the two posterior ones almost reduced and like knobs.

Ornamentation: Surface of the test on glabella, occipital ring, fixed cheeks, and on the middle body of the hypostoma with fine, short, wrinkled ridges or raised lines, sometimes anastomosing and forming a reticulate pattern; test of cranial parts sometimes finely granulated as well; anterior border of cranium and borders of hypostoma with fairly long, thready, raised lines parallel to margin; thoracic segments and pygidium granulated. Test of furrows smooth.

Dimensions: Length of the pygidium (holotype) figured on Pl. I, figs. 9—10, 5 mm; breadth about 9.5 mm. The largest pygidium found is about 28 mm broad. Sizes of the most complete cranium, Pl. I, fig. 1: length 3.1 mm, breadth between the eyes 2 mm, and at the posterior margin 5.2 mm; length of glabella 2.7 mm, breadth 1.9 mm.

Affinities: *K. westergårði* appears fairly closely to resemble the genotype (cf. Walcott 1908, Pl. III, fig. 9) as far as the cranium and thoracic segments are concerned. In the pygidium the dissimilarities are conspicuous, however, as the genotype has six pairs of comparatively long marginal spines. This is one of the main characters by which *Kootenia lakei* (Cobbold, 1911), occurring at approximately the same stratigraphical horizon as the new species, is also distinguishable from it.

K. westergårði differs from all other species known of the genus with five pairs of marginal spines on the pygidium in the shape of these spines and in having median (incipient) spines on the rings.

Occurrence: Uppermost *Ælandicus* beds, very likely belonging to the zone of *Paradoxides pinus*. Skute nappe. Road-section east of the village of Skute, Jemtland.

Family **Paradoxididae** EMMRICH, 1839.

Subfam. **Paradoxidinae** HOWELL, 1933.

Genus **Paradoxides** BRONGIART, 1882.

The portions of the above species are scattered among numerous fragments of species of *Paradoxides*. These fragments include a few pygidia which are the only parts useful for specific determination. They appear to belong to three different species of which one is formerly described. All the pygidia found agree in having the posterior margin indented, but differ in outline and in the form of the axis.

Paradoxides torelli (HOLM MS) WESTERGÅRD. — Pl. I, Fig. 14.

Paradoxides torelli, Thorslund, 1935, p. 105, Pl. 2.

Paradoxides torelli, Westergård, 1936, p. 40, Pl. VIII, Figs. 1—4.

Remarks. Two pygidia typical of this species were obtained. The one figured is on a weathered surface of limestone and is somewhat worn. The other specimen, which is broken and slightly distorted, has one axial ring, distinctly marked off by furrows. The length of the figured specimen along the middle line is 6 mm, its greatest breadth 8.5 mm.

The axis of this species is indistinctly defined posteriorly and differs in this respect from that of the two associated ones.

Occurrence. Uppermost part of the *Ælandicus* beds (zone of *Paradoxides pinus*) in Öland. Formerly found in autochthonous beds in Jemtland (at Väster-Skucku, 25 km SSW of Skute) and in overthrust beds in Ångermanland; also recorded from the Mjösen area, Norway. Basal beds of the Skute nappe, Jemtland.

Paradoxides sp. ind. a. — Pl. I, Figs. 15—16.

Description. Pygidium subquadrate in outline, broadest in posterior portion. Axis non-segmentate, slightly diminishing in breadth posteriorly, with broadly rounded extremity which does not reach the posterior margin.

Length of the large specimen 9.5 mm, width 9.8 mm. The small pygidium is somewhat distorted owing to pressure from the left side.

Occurrence. Oelandicus beds of the Skute nappe, Jemtland.

Paradoxides sp. ind. b. — Pl. I, Fig. 17.

Description. Pygidium subpyriform in outline, almost as long as wide, widest in posterior part. Axis non-segmentate, very long and broad, of nearly equal breadth throughout the length, with broadly rounded end which does not reach the posterior margin. — Length along the middle line 8.5 mm, breadth 8.8 mm.

Affinities. The pygidium of the Bohemian *P. sacheri* BARR. presents a fairly great resemblance to that of this species but differs from it in having a narrower axis in relation to the width of the lateral borders, and in the general outline of the pygidium as well.

Occurrence. Oelandicus beds of the Skute nappe, Jemtland.

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Explanation of Plate I.

All specimens figured belong to the Geological Survey of Sweden. They were photographed by C. Larsson, slightly retouched by P. Thorslund.

Kootenia westergårði sp. n.

- Fig. 1. Small imperfect cranidium. A very small pygidium of *Paradoxides* sp. is seen within the glabella.
- » 2. Fragmentary cranidium.
 - » 3. Fragment of cranidium with basal part of occipital spine and faint glabellar furrows.
 - » 4. Anterior right portion of cranidium showing ornamentation of test.
 - » 5. Fragmentary right cheek.
 - » 6. Fragment of hypostoma.
 - » 7. Pleural spine showing granulation.
 - » 8. Left portion of pleuron.
- Figs. 9, 10. Fragmentary pygidium in dorsal and lateral views. *Holotype*.
- Fig. 11. Fragment of large pygidium.
- » 12. Enlarged median portion of fig. 11.
 - » 13. Fragmentary pygidium, broken and slightly distorted.

Paradoxides torelli WESTERGÅRD.

- Fig. 14. Pygidium with weathered surface.

Paradoxides sp. ind. a.

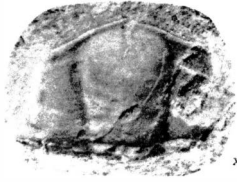
- Figs. 15, 16. Two pygidia, the smaller one somewhat distorted owing to pressure from the left side.

Paradoxides sp. ind. b.

- Fig. 17. Fragmentary pygidium with weathered surface.
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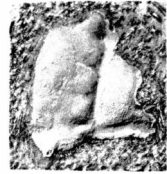


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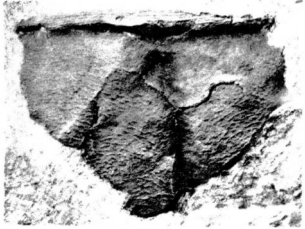
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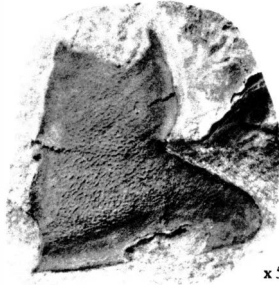
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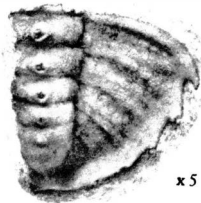
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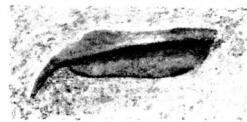
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x5

10



x2

8



x1.5

11



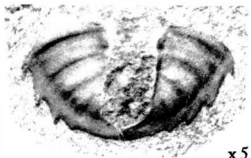
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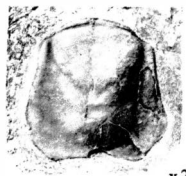
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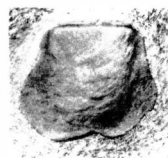
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13



x2

15



x5

16



x2

17