

Two new species of graptolite from the Telychian (upper Llandovery, Silurian), of Kallholn, Dalarna, Sweden

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ABSTRACT

Two new species of graptolite are described from the lower part of the *Spirograptus turriculatus* Biozone (lower Telychian) of Kallholn Quarry, Dalarna, Sweden. *Pristiograptus paradoxus* sp. nov. is ventrally curved and is more similar to uppermost Wenlock–Ludlow *Bohemograptus* species than to other Llandovery *Pristiograptus* species. *Torquigraptus loveridgei* sp. nov. is stratigraphically intermediate between the well-known species, *T. planus* and *T. proteus*.

KEYWORDS

Graptolite; Silurian; Llandovery; Sweden

Introduction

Numerous graptolites were collected to enable Walasek et al.'s (2018) revision of the graptolite biostratigraphy of the Llandovery of Kallholn Quarry, Dalarna, Sweden. Amongst these, two new species were encountered, both of which are from the lower part of the *Spirograptus turriculatus* Biozone (lower Telychian) of the northern quarry entrance road section (Walasek et al. 2018, fig. 1). Both are morphologically atypical for the lower Telychian, having a greater resemblance to taxa from higher in the Silurian than to contemporary species. The two new species are described and discussed below. They co-occur in two samples, in which they are accompanied by typical lower *turriculatus* Biozone species: *Spirograptus turriculatus* (Barrande), abundant *Streptograptus johnsonae* Loydell, *Monograptus marri* Perner, *Pristiograptus bjerringus* Bjerreskov, etc. All material is preserved as diagenetically flattened original periderm with no tectonic distortion; the periderm has flaked off to a variable extent, leaving all specimens as a combination of original periderm and low relief external mould. Specimens are housed in the Museum of Evolution, Uppsala University, Sweden. Section measurements below are upwards from the base of the Kallholn Formation. Thecal spacing measurements are given as two thecae repeat distances (2TRD; Howe 1983).

Systematic Palaeontology

Pristiograptus paradoxus sp. nov.

Figures 1C–E, 2A–B

Derivation of name. – From the Latin for strange, contrary to expectation.

Material. – 9 specimens, including 4 proximal ends, from the following samples: 9.56–9.61 m (4 specimens), 9.76–9.81 m (1 specimen, the holotype) and 10.54 m (1 specimen); 3 ex situ specimens were also collected.

Holotype. – PMU 35064, Fig. 1C, a proximal end bearing ten thecae, from 9.76–9.81 m above the base of the Kallholn Formation, lower *Spirograptus turriculatus* Biozone (lower Telychian), northern quarry entrance road section, Kallholn Quarry, Dalarna, Sweden.

Diagnosis. – *Pristiograptus* with ventrally curved rhabdosome, the curvature accentuated mesially. Short sicula, c. 1.1 mm long, apex reaches just below the aperture of th1. Dorso-ventral width increases gradually from 0.4 mm proximally to a distal maximum of 1 mm. Thecae are widely spaced, simple tubes, inclined at 25–30° to the rhabdosome axis, with 2TRDs of 2.0–2.5 mm proximally and 1.9–2.6 mm mesially and distally.

Description. – The longest (incomplete) specimen is 34 mm long. The rhabdosome is straight or very gently ventrally curved initially, with more pronounced ventral curvature commencing at around th4–th6, with this curvature being maintained mesially and reducing in intensity towards the distalmost part of the longest specimen collected (Fig. 2A). The sicula is 1.05–1.1 mm long, with an apertural width of 0.2 mm. The aperture is concave; the virgella is not completely preserved on any specimen. The sicular apex attains a level just below the aperture of th1. Thecae are simple tubes inclined at 25–30° to the rhabdosome axis. Thecal apertures are straight or in a few thecae very slightly concave and generally are perpendicular to the thecal axis; the exceptions are mostly proximal thecae in which the aperture is at up to 80° to the thecal axis. Thecal overlap increases from one-fifth–one-sixth of the thecal length proximally, to approximately one-half distally. Dorso-ventral width measurements are 0.4–0.45 mm (th1), 0.4–0.55 mm (th3), 0.45–0.6 mm (th5), 0.7–0.75 mm (th10) and 0.8–1.0 mm distally. 2TRD measurements are 1.9–2.25 mm (th2), 2.2–2.4 mm (th5) and 1.9–2.6 mm mesially and distally.

Remarks. – *Pristiograptus paradoxus* sp. nov. is highly distinctive, its ventral curvature being most reminiscent of later Silurian species assigned to *Bohemograptus*, in particular *B. praecox* Štorch et al., 2016 from the uppermost Wenlock and lower Ludlow. This has a similar dorso-ventral width to *P. paradoxus* sp. nov. both proximally and distally, but differs in having a wider sicular aperture (0.3–0.4 mm) and greater thecal overlap (one-third) proximally. Also very similar is *Bohemograptus garratti* Rickards et al., 1993 from the middle Ludlow. The type material of this is tectonically deformed; undeformed, well-preserved specimens from Kyrgyzstan were described by Koren' and Sujarkova (2004). *Bohemograptus garratti* also has similar proximal and distal dorso-ventral width to *Pristiograptus paradoxus*, although this increases more rapidly over the first few thecae (at th5 it is 0.65–0.7 mm). Thecae are, however, inclined at a lower angle to the rhabdosome axis, especially proximally (10° proximally, 20–25° distally) and it has more widely spaced thecae (2TRD is 2.5–3.0 mm). Finally, *Bohemograptus singularis* Koren' and Sujarkova, 2004, also from the middle Ludlow, again is similar in terms of dorso-ventral width (and in its rate of increase proximally) to *Pristiograptus paradoxus* but thecal overlap is less both mesially and distally. Of Llandovery species, *Pristiograptus variabilis* (Perner, 1897) has similar dorso-ventral width measurements, but has a straight rhabdosome and more closely spaced thecae proximally (see fig. 22AA in Loydell et al., 2015). Gentle ventral curvature is recorded in a few Telychian *Pristiograptus* species, but these are very different in terms of overall appearance. For example, in *Pristiograptus huttae* Loydell, 1993 the thecae are much more closely spaced proximally and rhabdosome dorso-ventral width immediately above thecal apertures is much greater; in *Pristiograptus macrodon* Štorch, 1992 the first two thecae are very closely spaced and the rhabdosome is much narrower immediately above the very wide thecal apertures.

Torquigraptus loveridgei sp. nov.

Figures 1A–B

Derivation of name. – After Bob Loveridge who assisted the authors with fieldwork at Kallholn and the senior author on many other occasions over many years.

Material. – 5 specimens, including 1 proximal end (the holotype) from the following samples: 9.56–9.61 m (2 specimens, including the holotype) and 9.76–9.81 m (3 specimens).

Holotype. – PMU 35062, Fig. 1A, a proximal end bearing 19 thecae, from 9.56–9.61 m above the base of the Kallholn Formation, lower *Spirograptus turriculatus* Biozone (lower Telychian), northern quarry entrance road section, Kallholn Quarry, Dalarna, Sweden.

Diagnosis. – Rhabdosome dorsally curved proximally and mesially, becoming almost straight distally. Thecae are axially elongated throughout, but especially proximally, where prothecal bases are narrow. Dorso-ventral width increases steadily from 0.3 mm at th1 to distal values of 1.3–1.5 mm. 2TRD decreases from 3.0 mm proximally to 2.4–2.6 mm mesially and distally.

Description. – The longest (incomplete) specimen is approximately 28 mm long. The rhabdosome is dorsally curved proximally and mesially, with this curvature accentuated between th4 and th10; distally the rhabdosome is straight. Only one specimen (the holotype) has the proximal end preserved. In this the sicula is 1.4 mm long with an apertural width of 0.15 mm. The sicular apex reaches about two-thirds up th1. Th1 emerges 0.25 mm above the sicular aperture which is furnished with a short (0.15 mm long, but possibly incomplete), narrow virgella. Thecae lack overlap and are axially elongated throughout the rhabdosome. The base of the protheca is very narrow in proximal thecae, about 15% of the maximum dorso-ventral width of the theca; this increases to 40% distally. In better-preserved thecae the apertures, which are slightly expanded laterally, can clearly be seen to be twisted towards the reverse side of the rhabdosome. In the proximal end dorso-ventral width increases from 0.3 mm at th1 and th2, to 0.4 mm at th3, 0.55 mm at th5, 1.05 mm at th10, 1.2 mm at th15 and 1.5 mm at th19. Thecae are widely spaced, especially proximally: 2TRD is 3.0 mm at th2, th3 and th5 and is 2.4–2.45 mm at th10, th15 and th18. The highest distal value recorded is 2.6 mm.

Remarks. – *Torquigraptus loveridgei* sp. nov. differs from the other dorsally curved *Torquigraptus* species known from the lowermost *Spirograptus turriculatus* Biozone, *T. planus* (Barrande, 1850) and *T. cavei* Loydell, 1993, in being more robust proximally and in having more widely spaced thecae that are less triangular and more axially elongated distally. Several *Torquigraptus* species are recorded from higher in the Telychian and *T. loveridgei* is more similar to some of these, e.g. *T. tullbergi* (Bouček, 1931) and *T. spiralooides* (Příbyl, 1945). However, the thecae are more widely spaced and more axially elongated distally in *T. loveridgei*. Stratigraphically in the Kallholn quarry section *T. loveridgei* is present in the interval between the last appearance of *T. planus* (8.29–8.39 m) and the first of the loosely helically coiled *T. proteus* (Barrande, 1850) at 10.54 m.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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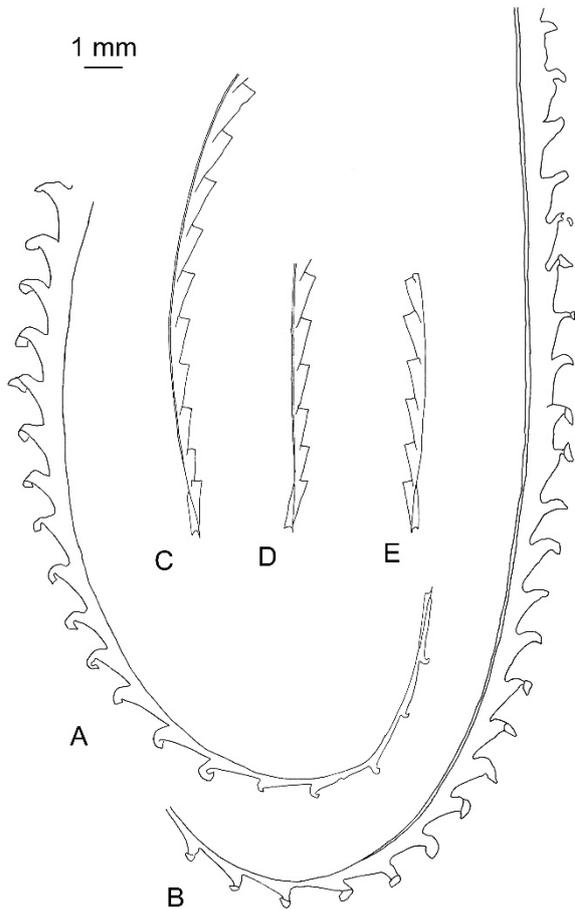


Fig. 1. New species from the lower *Spirograptus turriculatus* Biozone of Kallholn Quarry. **A, B.** *Torquigraptus loveridgei* sp. nov. **A.** Holotype, PMU 35062, from 9.56–9.61 m. **B.** PMU 35063, specimen lacking proximal end, but with long straight distal portion, from 9.76–9.81 m. **C–E.** *Pristigraptus paradoxus* sp. nov. **C.** Holotype, PMU 35064, from 9.56–9.61 m. **D.** Proximal end, PMU 35065, from 9.56–9.61 m. **E.** Proximal end, PMU 35066, ex situ specimen.



Fig. 2. *Pristiograptus paradoxus* sp. nov., specimens lacking a sicula but showing the overall rhabdosome shape. **A.** PMU 35067, ex situ specimen. **B.** PMU 35068, from 9.76–9.81 m.