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A new Early Ordovician trilobite from the Broken River region, northeastern Australia: taxonomy and palaeogeographic implications

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Abstract – A trilobite from an olistolithic slab of Ordovician shallow water limestone in the Big Stockyard Creek area south of Greenvale in the Broken River Province, northeastern Australia, is a new representative of the subfamily Asaphinae: *Norasaphus (Shergoldina) greenvalensis* subgen. nov. and sp. nov. Due to close morphological relation to previously described Norasaphus from the Nora Formation of central Australia, a late Early Ordovician age is inferred for the trilobite-bearing horizon—the first record of Early Ordovician shelly faunas from northeastern Australia. The age-spectrum of Ordovician-Silurian carbonate olistoliths and clasts in debris flows of the Broken River region is increased by the recognition of a late Early Ordovician age for the host olistolith. The "lost" Georgetown Block carbonate platform is now inferred from this occurrence to have been in existence through much or all of the time-interval from late Early Ordovician until at least earliest Wenlock times. Autochthonous and allochthonous carbonate units in the southwestern Broken River Province (west of the Grey Creek Fault Zone) confirm that a carbonate platform (or platforms) persisted, intermittently, in the Broken River Province/Georgetown Province until at least two-thirds of the way through Devonian times, until around the Givetian-Frasnian boundary.

GEOLOGIC AND PALAEOGEOGRAPHIC SETTING (JAT)

The limestone body (Figure 1), source of the trilobite described herein, is one of several limestone occurrences, all regarded by us as allochthonous, within a sequence of volcaniclastic arenites and breccias, siltstones, mudstones and cherts with, locally, quartzose arenites, referred to as the Carriers Well Formation by Withnall et al. (1988, 1992, 1993). Most areas shown as substantial limestone bodies on previous mapping have proved to consist of limestone cobbles and blocks in a matrix of clastics, as in the tract of "Carriers Well Formation" west of and running parallel to Grey Creek between Dinner Creek and Greenvale, and extending southwards across Little Stockyard and Big Stockyard Creeks for about 12 km. Adjacent tracts of mudstone, quartzose arenite and minor altered basalt and jasper, seemingly without limestone olistoliths, have been referred to as Wairuna Formation (Withnall *et al.* 1988, 1992, 1993).

Ordovician limestones occur also as allochthonous slabs in the Crooked Creek Conglomerate (Withnall et al. 1992, 1993) about 17 km west of the olistolithic slab from which the trilobite described here was obtained, and as cobbles and small olistoliths in the Perry Creek Formation, notably in Thatch Creek (Sloan *et al.* 1995) about 45 km east of the Big Stockyard Creek limestone olistoliths. These occurrences we view as having been derived from a now-lost carbonate platform, formerly located on the Georgetown Block west of the Grey Creek Fault Zone and Halls Reward Fault (the northwest boundary of the Broken River Province).

The trilobite, a single cranidium, is the first report of Early Ordovician trilobites from northeastern Australia. Though representing a new taxon, its relationships with asaphines described by Fortey and Shergold (1984) from the lower Nora Formation (Toko Syncline, Central Australia) indicate a late Early Ordovician age for the horizon.

This occurrence dates the particular olistolithic slab as being substantially older than the age-spectrum presently assumed for limestones in the Grey Creek–Dinner Creek–Greenvale tract of "Carriers Well Formation" from which Late Ordovician Caradoc-Ashgill-?earliest Llandovery conodonts have been reported (Withnall *et al.* 1993; Andrew Simpson, pers. comm). It is also older than the Ashgill-latest Llandovery\earliest Wenlock age of clasts and olistoliths in the Perry Creek Formation (Sloan *et al.* 1995) of the

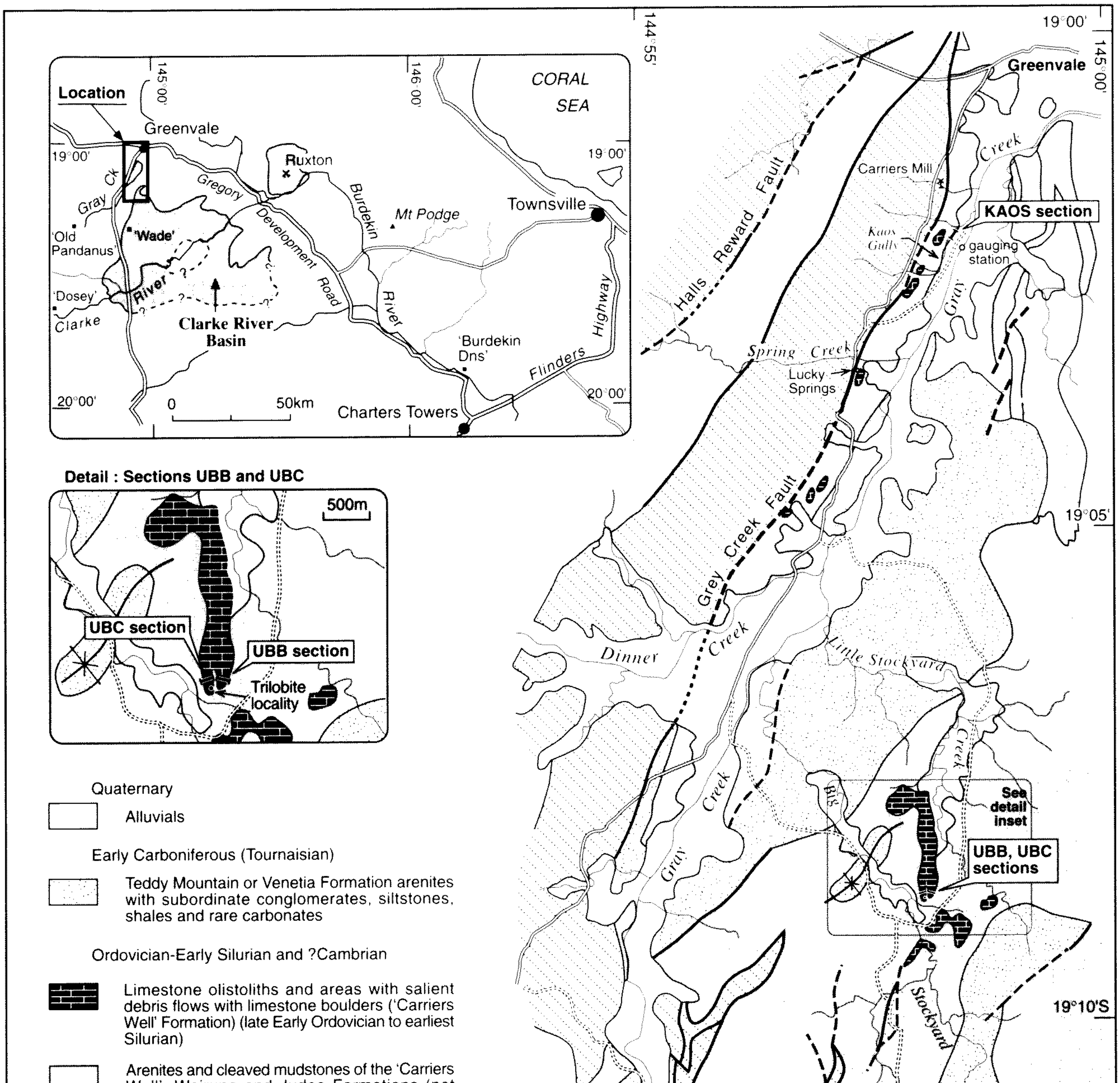

Figure 1 Distribution of Ordovician limestones in relation to stratigraphy in the Gray Creek–Big Stockyard Creek area south of Greenvale, northeastern Queensland (modified from Withnall *et al.* 1992).

Christmas Creek-Thatch Creek area 45 km to the east, and the Llandovery-earliest Wenlock limestone clasts in the Quinton Fomation 15 km to the south-southwest (Simpson 1999). All these allochthonous limestones are inferred to have been derived from the "lost" Georgetown Carbonate Platform to the west. The age-spectrum of Ordovician-Silurian carbonate olistoliths and clasts in debris flows of the Broken River region is thus increased by the recognition of a late Early Ordovician age for the host olistolith. The "lost" Georgetown Block carbonate platform is now inferred from such data to have been in existence through much or all of the time-interval from late Early Ordovician until at least earliest Wenlock times and, from the record of autochthonous and allochthonous carbonate units in the southwestern Broken River region, to have continued to exist until at least two-thirds of the way through Devonian time¾until around the Givetian-Frasnian boundary (Mawson and Talent 1989, 1997; Sloan *et al.* 1995; Feist and Talent, 2000).

SYSTEMATIC DESCRIPTION (R.F.)

Family ASAPHIDAE Burmeister 1843

Subfamily Asaphinae Burmeister 1843

Genus Norasaphus Fortey and Shergold 1984

Type species
N. (N.) skalis Fortey and Shergold 1984

Subgenus Shergoldina subgen.nov.

Type species
N. (Shergoldina) greenvalensis sp. nov.

Diagnosis
A subgenus of *Norasaphus* with quadrangular, axially keeled glabellar frontal lobe and with striated surface sculpture.

Derivation of name
After John H. Shergold who made major contributions to the knowledge of Australian Early Palaeozoic trilobites

Discussion
The new taxon is an asphid related to *Basiliella* Kobayashi 1934 and allies, especially as regards the overall shape of the forwardly expanding glabella, disposition of the groove-like 1P apodemal furrows, and the clearly demarcated occipital ring. It is characterised by the surface sculpture of its exoskeleton. Indeed it is so far the only known asaphid displaying terrace lines parallel to the axis on the entire cranidial prosopon. The original concept of the sculpturless nature of as aphids, as diagnosed by Jaanusson (in Moore 1959: 334) was challenged by Fortey and Shergold (1984:328) when they described *Norasaphus* and *Norasaphites* from Central Australia, both with tuberculate prosopons. The orientation of terrace ridges parallel to the sagittal line in the new taxon is exceptional as these ridges are generally arranged transversely (for example, in *Ningkianites* Lu 1975: 317)

A further peculiarity of *Shergoldina* is the presence of a keeled glabella. This is unusual in asaphines but, due to incomplete knowledge of the taxon, it is not clear if this feature is specific or supraspecific. Most other cranidial traits indicate close relationship to *Norasaphus*, so it is regarded as a subgenus of the latter. This attribution should be reconsidered when information becomes available regarding the librigena and pygidium.

Features such as the forwardly expanding glabella with modified glabella furrows that characterise Norasaphus have been considered to be a morphological adaptation (of phacomorph type) often found in trilobites adapted to inshore carbonate facies of epeiric seas (Fortey and Shergold 1984, Fortey and Owens 1990). Occurrence of the new phacomorph taxon in shallow water Ordovician limestones in the Broken River region is taken to be another example of this phenomenon.

Norasaphus (Shergoldina) greenvalensis sp.nov.
Figures 2A–D, 3

Diagnosis
As for the subgenus.

Derivation of name
From discovery south of Greenvale, northeastern Australia.

Holotype
Cranidium, Australian Museum, Sydney, AMF 107560, Figures 2A–D, 3.

Material
A single undeformed cranidium of adult size displaying the external cuticular surface, preserved in limestone, deposited in the Australian Museum, Sydney (AMF 0000).

Locality and age
Big Stockyard Creek, south of Greenvale, northeastern Queensland, Australia (Figure 1); Early Ordovician.

Description
Cranidium elongate rectangular, anteriorly as wide as the width across the palpebral lobes, with protruding posterior fixigenae. Anterior glabella lobe quadrangular, with broadly curved, slightly truncate outline anteriorly, sharply delimited laterally by deep dorsal furrows parallel to the sagittal line, and to the rear by the anterior terminations of large, rather deep axial furrows (1P) that converge slightly backwards on both sides of

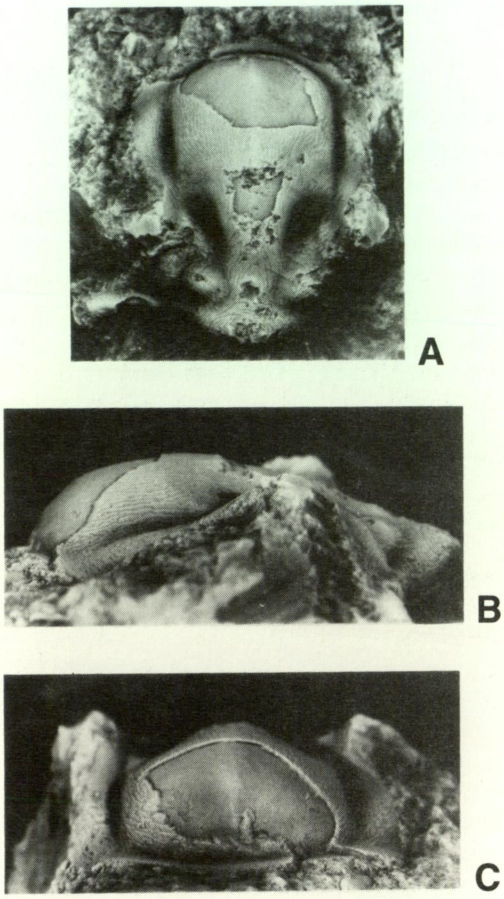

Figure 2 *Norasaphus (Shergoldina) greenvalensis* sp.nov. Holotype, Australian Museum, Sydney, AMF 107560. A, dorsal view, external mould, x 3.2; B, lateral view, x 4.7; C, frontal view, x 4.2

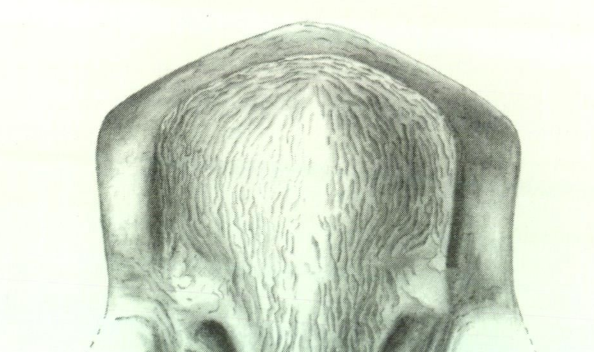

Figure 3 *Norasaphus (Shergoldina) greenvalensis* sp.nov. Reconstruction of the cranidium. Bar scale: 1 mm.

the transversely arched, narrow, elongate basal glabella lobe. Inflated ovoid, lateral lobes of innerglabellar origin are separated from central part of basal glabella lobe by continuous, curved grooves that merge with the posterior ends of the 1P furrows and meet the occipital furrow. In lateral view, the frontal lobe of the glabella is elevated, highest at its posterior end, steeply down bent anteriorly. Posterior part of glabella continuously declining to the rear, merging centrally with the occipital lobe. Crestline of glabella defined by a narrow keel that runs from the front to the rear, vanishing behind; glabella in frontal view roof like centrally, down curved abaxially. Genal lobes inflated, elongate, converging anteriorly and extending to the anterior end of the palpebral lobes, separated from basal glabella by shallow, outwardly curved dorsal furrows running into 1P grooves anteriorly and meeting the lateral ends of the occipital furrow. Occipital furrow very shallow medially, deepening behind lateral lobes of glabella base. Occipital ring cylindrical, of uniform width, slightly inflated abaxially. Palpebral lobes small, elevated above highest level of frontal glabella lobe, steeply inclined adaxially, close to dorsal furrows. Preoccular sutures, parallel to each other, meet the anterior border at an obtuse angle. Anterior fixigenae narrow, of equal width from rear to front, slightly vaulted traversely, gently declining forwards then strongly bent downwards in front to the narrow, slightly concave anterior border. Border in front of glabella slightly declining forward with anterior edges that meet at mid-line with a large obtuse angle. Border furrow continuously deep; preglabellar field absent. Entire surface sculptured with dense, slightly anastomosing, long terrace ridges of equal strength, all orientated parallel to the sagittal line.

Comparison

The new species resembles the type species of *Norasaphus*, *N. (Norasaphus) skalis* Fortey and Shergold 1984 in the general outline of the forwardly expanding glabella and the deep 1P apodemal furrows. However, there are major traits distinguishing the new taxon, such as the quadrangular, keeled anterior glabella, the swollen basal glabella lobes, and the narrow, parallel-sided anterior fixigenae. Unlike all species of Norasaphus from central Australia, no tubercular sculpture is developed. It is anticipated that the new taxon will eventually be accorded full generic status; however, this should be considered only when the pygidium is known.

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