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TROPIDOCARIS SALSIUSCLUS, A NEW RHINOCARIDID (CRUSTACEA: PHYLLOCARIDA) FROM THE UPPER DEVONIAN HAMPShIRE FORMATION OF WEST VIRGINIA

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ABSTRACT—A new species of phyllocarid arthropod, *Tropidocaris salsiusculus*, is described from the Upper Devonian Hampshire Formation near Rowlesburg, West Virginia. The organism was found in association with numerous trace fossils, at least one of which could have been produced by *T. salsiusculus*, and body fossils, including *Lingula* sp., several bivalve mollusks and smooth ostracods. Collectively, these organisms suggest a brackish-water environment of deposition. This report represents only the third record of phyllocarids from West Virginia.

INTRODUCTION

Phyllocarid crustaceans are rare fossils in Paleozoic rocks and, as such, the occurrence of even an isolated specimen adds substantially to our understanding of this group whose geologic range spans the entire Phanerozoic. The purposes of this paper are to describe a new species of rhinocaridid archaeostracan, *Tropidocaris salsiusculus* from the Upper Devonian Hampshire Formation near Rowlesburg, West Virginia (Figure 1), to describe an associated trace fossil of arthropod origin, and to describe the ecological setting in which *T. salsiusculus* lived.

Prior to this notice, there have been only two other records of phyllocarids from West Virginia, both referable to the genus *Echinocaris*. Williams and Kindle (1905, p. 37, chart facing p. 55) reported *Echinocaris* sp. from Devonian rocks at a locality near White Sulphur Springs, West Virginia, about 235 km south of Rowlesburg. The other report (Hannibal and Feldmann, 1985) documents the presence of *Echinocaris auricula* from the Upper Devonian Chemung Formation about 1.5 km southwest of Rowlesburg and less than 3 km south of the locality, in the Hampshire Formation, from which *Tropidocaris salsiusculus* was collected. The stratigraphic and ecologic relationships of the two lithological units will be discussed below.

SYSTEMATIC PALEONTOLOGY

Subclass PHYLLOCARIDA Packard, 1879
Order ARCHEOSTRACA Claus, 1888
Suborder RHINOCARINA
Clarke in Zittel, 1900

Family RHINOCARIDIDAE
Hall and Clarke, 1888
Genus TROPIDOCARIS Beecher, 1884
TROPIDOCARIS SALSIUSCLUS n. sp.
Figures 2, 3

Diagnosis.—Small rhinocaridid with generally smooth, bivalved carapace, subtle mesolateral carina and abdomen and telson strongly sculptured in chevron pattern.

Description.—Carapace 11.9 mm long, right valve as measured from midline to ventral border 4.5 mm wide, with greatest width at about mid-length, length along midline 10.3 mm; bivalved; anterior and ventral margins smoothly convex, anterior border more strongly convex than ventral border; posterolateral corner tightly curved, lacking spine; posterior margin gently concave, dorsal border of each valve slightly concave from posterior end to a point about 2 mm from anterior end of valve; anteriormost 2 mm of dorsal border more deeply excavated and concave; rostral plate presumed to be present, but not preserved; no evidence for presence or absence of median dorsal plate; anterior, ventral and posterolateral margins with narrow ridge and furrow; ventral and posterolateral furrows with striations perpendicular to margin in posterolateral corner and inclined posteriorly to posterolateral furrow. Mesolateral carina narrow, extending posteroventrally 3.2 mm from its junction with carapace horn, then curving to parallel midline and extending posteriorly about 7 mm. Large, 1.5 mm diameter, low swelling just posterior to inflection of mesolateral ca-
rinal; smaller, 0.8 mm long and 0.5 mm wide, swelling anterodorsad of larger swelling. Surface of carapace very finely striated by discontinuous scratches arching posteroventrally, subtle and infrequent above mesolateral carina and more pronounced above mesolateral carina and more pronounced below it.

Abdominal region represented by parts of three somites, telson and right caudal ramus. Length of anteriormost two somites measured along midline, about 1.2 mm each, height greater than 1.5 mm; last somite 3.6 mm long and tapering from about 2 mm width to 1.2 mm width at posterior. Ventral border visible on penultimate somite, nearly straight, with narrow, smooth, swollen ridge.

Telson stout, tapering uniformly from width of about 1.2 mm to sharply pointed termination over length of 3.8 mm; with distinct, smooth axial carina extending along posteriormost 3 mm of length. Furcal rami at least 0.5 mm wide and 2.5 mm long with broad, well-defined axial carina; furcae not as long as telson. Surface of abdomen, telson and furcae with distinct chevron pattern developed as step-like structures with steep posterior rises, diverging from midline at angle of about 65°, spaced at intervals of approximately 0.1 mm.

Holotype.—The holotype, and sole specimen, USNM 389793, is deposited in the National Museum of Natural History, Washington, D.C.

Etymology.—The name *salsiusculus* is Latin for brackish and is the diminutive form of *salis*, which means salt. The name refers to the brackish water environment in which *T. salsiusculus* lived.

Geographic and stratigraphic position.—The fossil assemblage containing *Tropidocaris salsiusculus* was found in the Upper Devonian Hampshire Formation near Rowlesburg, Preston County, West Virginia (Figure 1). The Hampshire Formation is exposed along the tracks of the Baltimore and Ohio Railroad northwest of Rowlesburg at latitude 39°21'1"N and longitude 79°41'18"W. The outcrop from which *T. salsiusculus* was collected is 1.9 km west northwest of the center of Rowlesburg and is approximately 30 m east of two train signal standards.

The Hampshire Formation is comprised of dominantly red-colored mudstone, shale,
siltstone and sandstone and represents part of the terrestrial portion of the Catskill delta (Oliver et al., 1967). Plant fossils from the Hampshire are Famennian in age (Gillespie, Rothwell and Schecker, 1981). At Rowlesburg, the Hampshire is 212 m thick and is underlain by the marine Chemung Formation, from which *Echinocaris auricula* has been collected (Hannibal and Feldmann, 1985), and overlain by marine beds of the Pocono Formation (Figure 4). The horizon at which *T. salsiusculus* was found is 52 m above the base of the Hampshire. Correlation into the subsurface indicates that this horizon records a minor transgression and grades westward into marine shale of the Chemung Formation over a distance of 32 km. The fossil assemblage was found within the uppermost green mudstone in a 60-cm sequence of interbedded red and green mudstone and siltstone. The probable depositional environment for this horizon is a shallow estuary, or bay, which was open to the sea on the west. The interbedded red sediments are most likely redeposited detritus supplied by streams draining the adjacent Catskill alluvial plain to the east.

Remarks. — Rolfe (1969, p. R322) observed that the distinction between genera in the Rhinocarididae was difficult, that many of the points of differentiation are probably of significance only at the species level and that the family was due for careful revision. Examination, description and naming of this specimen of *Tropidocaris salsiusculus* n. sp. as well as examination of literature on the family confirms that the carefully rendered generic diagnoses in the Treatise do not define mutually exclusive groupings. Further, the revision has yet to be undertaken. Although the generic designation is not indicated to be questionable, certain reservations must be stated.

The prevailing concept of *Tropidocaris* would embrace rhinocaridids with generally strong and multiple carinae on the carapace, no posterolateral spines, well-defined and striated ventral and posterior borders, and abdomen ornamented in a chevron pattern (Beecher, 1884, 1902; Hall and Clarke, 1888; Rolfe, 1969). Carapace swellings in rhinocaridids, including the carapace adductor muscle insertion area and the anterior tubercle, were described by Beecher (1884, p. 15) as characteristic of the genus, a point not reiterated by Rolfe (1969). Recently, however, the concept of the taxon has been broadened by the tentative inclusion of *Tropidocaris? britannica* Morzadec and Rolfe, 1968. This species has only a single carina on the otherwise delicately sculptured carapace and it possesses posterolateral spines. In these regards, *T. ? britannica* more closely resembles species of *Rhinocaris* and *Dithyrocaris*. A spined posteroventral corner was previously
known on only a single species, *T. alternata* Beecher, 1884. Considering this broadening of the definition of the genus, and recognizing the reservation that the genera of the *Rhinocarididae* continue to require redefinition, this new species conforms readily to the definition of *Tropidocaris*; also, it possesses features that distinguish it from other named species of the genus. All other species, with the exception of *T.? britannica*, possess multiple lateral carinae. The only other taxa that had been referred to *Tropidocaris* possessing a single carina have been reassigned recently to other genera (Monadec and Rolfe, 1968, p. 190). *Tropidocaris hamiltonensis* has been assigned to *Dithyrocaris* on the basis of the presence of a well-developed doublure wall and *T. monocarinata* has been referred to the genus *Ptychocaris*, a ceratiocarinid related to *Echinocaris*.

The single specimen described herein is preserved in right lateral view (Figure 2). The two carapace halves have been separated and the left half has been displaced dorsally so that a part of the interior of that valve can be seen above the trace of the midline of the right valve. The rostral plate is not preserved but the presence of a depression near the anterior end of the dorsum would seem to confirm that the structure was present. Similarly, the median dorsal plate is not preserved but is presumed to have existed owing to the gently concave outline of the dorsal margin of the right valve (Figure 3). The presence of the median dorsal plate is not nearly as certain as that of the rostral plate.

The ornamentation of the abdominal surface is of particular note. The chevron pattern is developed as a series of surfaces sloping upward gently toward the posterior; each surface is, in turn, truncated by a nearly vertical posterior surface (Figures 2 and 3). This pattern is very similar to that on *Nahecaris sturtzi*, as illustrated by Rolfe (1969, fig. 146.1). Although the functional significance of this ornamentation is speculative, it is possible that the surface would have tended to anchor the organism in fine sediment, restricting backward movement. Such an adaptation would permit plowing through soft sediment in a forward direction while preventing unnecessary backward movement when the walking appendages were recovered. Clearly, this interpretation would apply only under the condition that the organism lived infaunally, at least part of the time.

That the organism fed on the substrate, probably as a scavenger or detritus feeder, is suggested by the rather flattened body form and the absence, throughout the entire family, of stout limbs adapted for predation. This life style is even more strongly suggested by the preservation, within about 2 cm of the specimen described above, of an *Isopodichnus*-like trace (Figure 5) of appropriate size to have been made by *Tropidocaris salsiusculus*.

It should be emphasized that the identity of the trace is tentative and that the identity of the trace maker is equally speculative. The morphology of the trace differs from that of the typical “coffee-bean” form of the quadrate *Isopodichnus* in that it is quadrilobed, rather than bilobed. This would suggest that the lobes were excavated by motion of both endopods and exopods of an arthropod. Recognizing that phyllocarids have relatively weak appendages, the excavations could only have been made in water-charged, fine-grained sediment. This quadrilobed feature has not, to our knowledge, been described on *Rusophycus* traces but is consistent with Osgood’s observation (1970, p. 303) that the name, *Isopodichnus*, should be applied to
non-trilobite *Rusophycus*-like traces. The unit from which *Tropidocaris salsiusculus* was collected contains a diverse assemblage of trace fossils, including simple cuspate excavations and vermiform trails; however, only the *Isopodichnus*-like trace appears to have been made by an arthropod.

**Paleoecology.**—The specimen of *Tropidocaris salsiusculus* was found with the following organisms: *Lingula* sp., the pteriomorph bivalves *Parallelodon* sp. and *Ptychopteria* sp., the pholadomyoid bivalve *Sanguinolites* sp., abundant smooth-shelled ostracods and nondescript carbonized plant fossils. The collective evidence of the associated fauna, and stratigraphic position within the Hampshire Formation, indicate a brackish water environment. Modern *Lingula* and mytilids are common in brackish water and smooth-shelled ostracods are often very abundant also (Dodd and Stanton, 1981). The *Isopodichnus* trace is an indicator of nonmarine conditions (Seilacher, 1970, p. 456).

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