



Skolithos linearis Haldeman, 1840 at its early Cambrian type locality, Chickies Rock, Pennsylvania: Analysis and designation of a neotype

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ABSTRACT

The trace fossil *Skolithos*, with its simple, vertical to very slightly inclined, tubular form, is widely recognized and globally distributed in early Cambrian to Holocene strata, representing deep-sea to continental paleoenvironments. The type species, *Skolithos linearis*, was first described in 1840 by Samuel S. Haldeman, based on his observations of early Cambrian quartzite at Chickies Rock, a well-known landmark on the east bank of the Susquehanna River, in Pennsylvania. The original description was meager; no illustrations were published, no holotype was established, and no specimens directly associated with Haldeman are known to exist today. A “neoholotype” proposed by Howell (1943) is invalid, as it does not conform to requirements of the International Code of Zoological Nomenclature. As a result, the iconic ichnogenus *Skolithos* is inadequately characterized and some of the numerous ichnospecies that have subsequently been named are not unequivocally assignable to it. In order to stabilize this important ichnogenus and to provide a basis for the taxonomic revision it urgently requires, we have studied *S. linearis* at its type locality. Our new material is described and illustrated here, and we have designated a neotype, accessioned by the U.S. National Museum of Natural History (Smithsonian Institution). The stratigraphy and regional geologic setting of Chickies Rock, the sedimentology and environment of deposition of cross-bedded quartzite with abundant *S. linearis* constituting classic “pipe rock,” and the structural deformation of this fabric are reviewed. Given the simple morphology of *Skolithos*, disparate organisms in several phyla have been proposed as its maker. We concur in the general view that Cambrian trace fossils assigned to *S. linearis* were most probably made by burrowing phoronids or polychaete annelids. The global abundance of largely monospecific pipe rock in analogous Cambro-Ordovician settings is recognized as a characteristic feature of the ecology of shallow-marine environments of that time. The stage has now been set for a thorough re-evaluation of all existing ichnospecies assigned and related to the ichnogenus *Skolithos*.

1. Introduction

Skolithos is one of the most widely reported trace fossils. It is also one of the earliest defined valid ichnotaxa, the first named in North America, and the first based on North American material. Moreover, it characterizes the littoral to shallow sublittoral *Skolithos* Ichnofacies (Seilacher, 1967), widely recognized by sedimentary geologists. Today, *Skolithos* is reported to occur globally in Cambrian to Holocene strata, representing continental to deep-water marine paleoenvironments. Partly on this account, *Skolithos* presents challenges with respect to its diagnosis and description. According to current understanding, *Skolithos* is a simple, sub-vertical, unbranched, cylindrical tube with or without a lining, and passively filled. This characterization is problematic because of its weak diagnostic features. As a result, the

ichnogenus *Skolithos* has become a “wastebasket,” embracing forms (more than twenty of them recognized as discrete ichnospecies) that were likely produced by a variety of organisms belonging to different metazoan phyla, and possibly including even plants. Consequently, given its very general definition, *Skolithos* has lost much of its original usefulness as a paleoenvironmental indicator.

Interpretive and systematic reassessments of *Skolithos* have been undertaken (Westergård, 1931; Alpert, 1974; McIroy and Garton, 2010), but the scope of these studies was limited by the vague definition of the ichnotaxon and by the lack of a holotype, available lectotype, or appropriate neotype of the type ichnospecies, *Skolithos linearis*. In order to clarify its status, we have studied *S. linearis* at its type locality, Chickies Rock, on the east bank of the Susquehanna River, just northwest of Columbia, Pennsylvania (Fig. 1).

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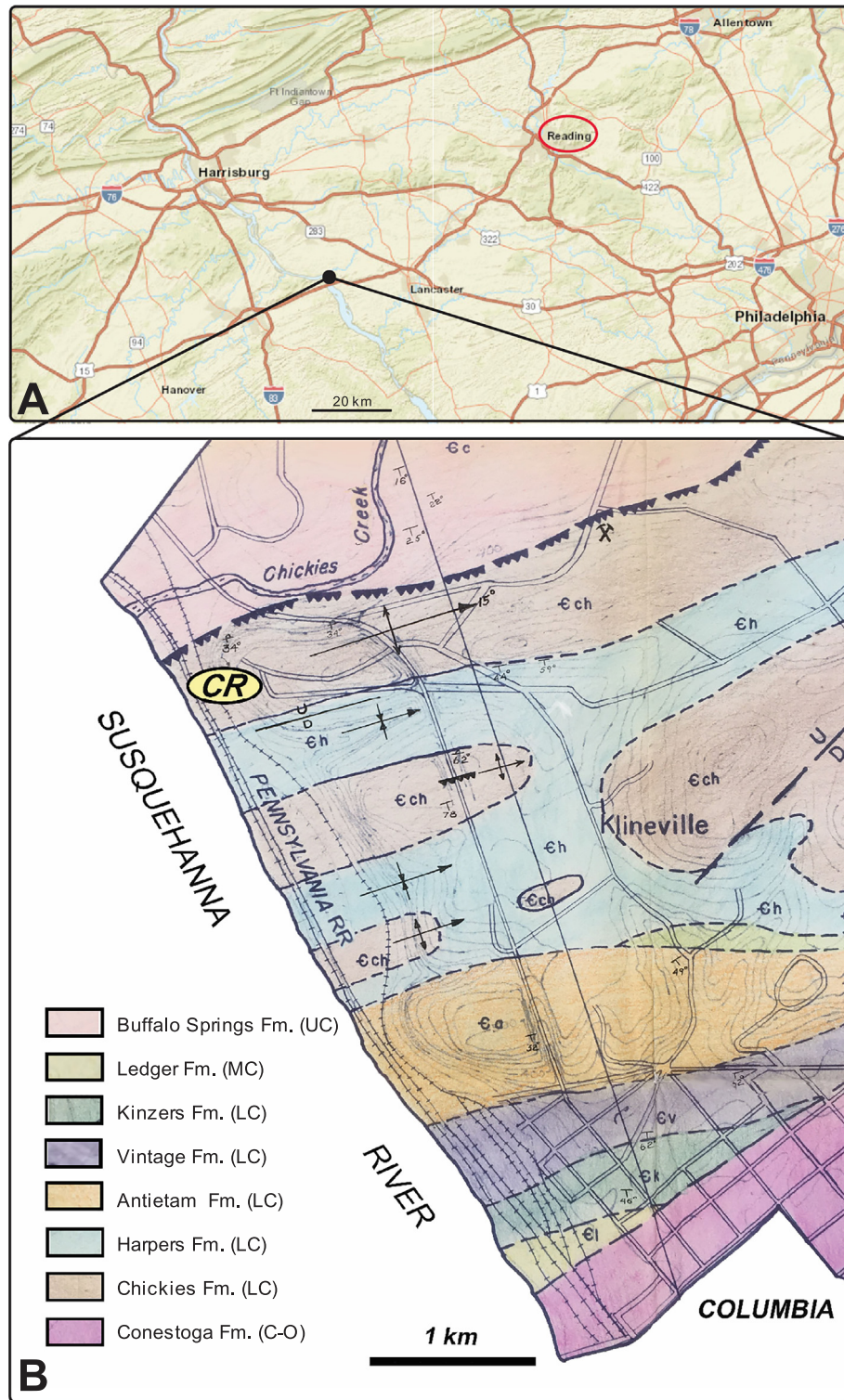


Fig. 1. Maps of SE Pennsylvania indicating the type locality of *Skolithos linearis* at Chickies Rock. **A:** Regional setting in southeastern Pennsylvania with the study area (enlarged in **B**) and the region where [Howell's \(1943\)](#) “neoholotype” was collected on Penn Mountain, east of Reading (red circle). Excerpted from *Pennsylvania Spatial Data Atlas* (<http://maps.psiee.psu.edu/paatlas/>). **B:** Geology adjacent to the east bank of the Susquehanna River at Chickies Rock (CR). Excerpt from map of [Troensgaard and Colavito \(1962\)](#), reformatted. C-O: Cambrian-Ordovician, LC: Lower Cambrian, MC: Middle Cambrian, UC: Upper Cambrian.

Here, *Skolithos* is prolific in medium- to coarse-grained, cross-bedded quartzite with shale partings, constituting the Chickies Formation of early Cambrian age. Stratigraphic control is limited. The Chickies Formation overlies either more immature clastics, locally the Hellam Conglomerate, or crystalline rocks generated by the Grenville Orogeny. It is itself overlain by the unfossiliferous Harpers Formation

and above that by the Antietam Formation, the uppermost part of which yields fossils characteristic of the *Bonnia-Olenellus* Biozone.

The goals of this work are: (1) to present a historical account of investigation of *S. linearis* in its type area; (2) to provide a succinct description of the type locality; (3) to designate and describe a neotype; (4) to outline our knowledge of the trace maker, its behavior, and its

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