Rachel SURPRENANT Report rcvd. 11.18.19
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Ediacaran test tubes: Earth's earliest experiments in multicellularity recorded in the ontogeny and ecology of three tubular taxa

Project Report

For the field portion of this project I spent a month at the Nilpena Station National Heritage Ediacara Fossil Site located in South Australia (Fig. 1). The majority of my time was spent taking observations and measurements of the tubular fossils preserved at the locality, including length, width, ecological association, taphonomic variation, and inferred life mode. While the initial foci of my data collection were the taxa *Funisia dorothea, Plexus ricei,* and *Somatohelix sinuousus* (Fig. 2A-C), I also spent time identifying additional tubes present at Nilpena. Primary to these additional tubes was the currently undescribed tubular taxon Aulozoon (Fig. 3). I collected morphological and taphonomic measurements from 106 Aulozoon specimens in order to perform a systematic description as well as to include the taxon in my review of Ediacaran tubular taxa. As a supplement to field specimens, I was also able to spend a day photographing and collecting data from museum samples of *Funisia* (Fig 2A) and Aulozoon housed in the collections at the South Australia Museum in Adelaide.

In addition to the collection of numeric and qualitative data, latex molds of tubular fossils were taken for further study (Fig. 4). This is necessary because most data must be collected at the field site due to the unique preservation of bedforms in the Ediacara Member that allows for the excavation and reconstruction of bedding planes covering over 3 m_2; while they provide valuable ecological context and allow for systematic taphonomic studies, the size of these beds prevent the removal of individual specimens from the field.

Research carried out this field season facilitated my development of a working understanding of what defines a "true" tubular organism, and which organisms fit into this new definition. While subject to change upon further data collection, my new working definition of a "true" tube, as applied to all non-mineralized Ediacaran taxa, is an organism that has an elongate morphology with a hollow or fluid-filled body showing the tendency to collapse and infill upon burial. With this definition, I determined that *Plexus ricei* (Fig. 2C), which possesses a resistant central axis that is always preserved in negative relief, cannot be classified as a "true" tube. *Plexus* does not exhibit a hollow or collapsible fluid-filled body, making it a fundamentally different form than is observed in "true" tubes such as *Funisia, Somatohelix,* and Aulozoon (Fig. 2A-B; Fig. 3).

Further observations of tubes within the context of the relative abundance and preservation of bed-scale communities at Nilpena show disparity in ecological

function of tubes contrasted with predictable taphonomic similarities. For example, my observations of tubes across different bedding planes revealed that all “true” tubes occur with visually disparate, taxon-dependent densities of individuals, but all tubes can be preserved in three ways: positive external molds, negative external molds, and internal molds. Tubes are the only taxa at Nilpena that exhibit this diversity in preservation (e.g. *Dickinsonia* occurs solely as an external mold). These observations are significant in that they strongly suggest that tubes as a group, as they are preserved at Nilpena, are solely a morphotypic grouping and are unlikely to represent phylogenetic similarity. In the future, these data and observations will help to define the nature of the abundance of tubes in the Ediacaran and constrain their significance within an evolutionary context.

Figures

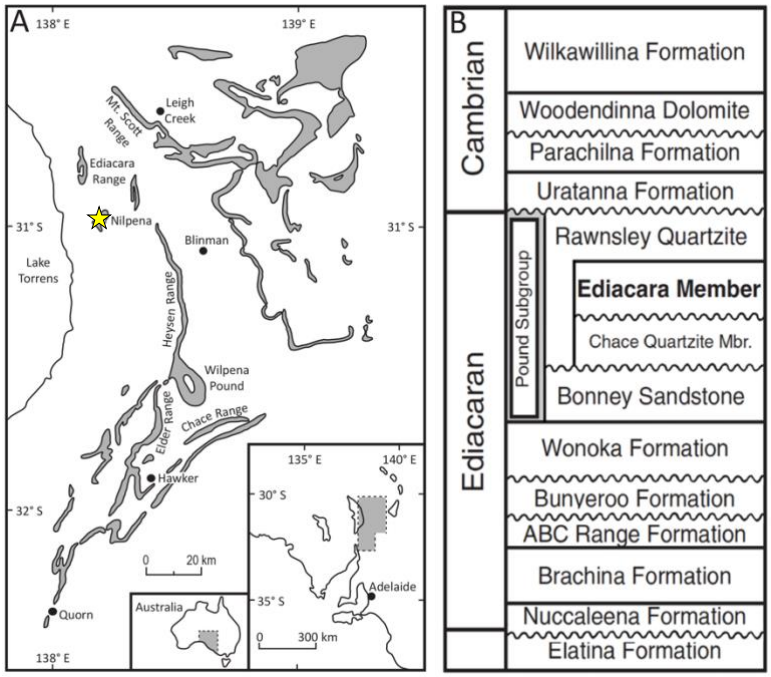

FIGURE 1: Locality map and stratigraphic section illustrating the location of the Ediacara Member (gray portions in map-view; bolded within section) and Nilpena Station (denoted by star).

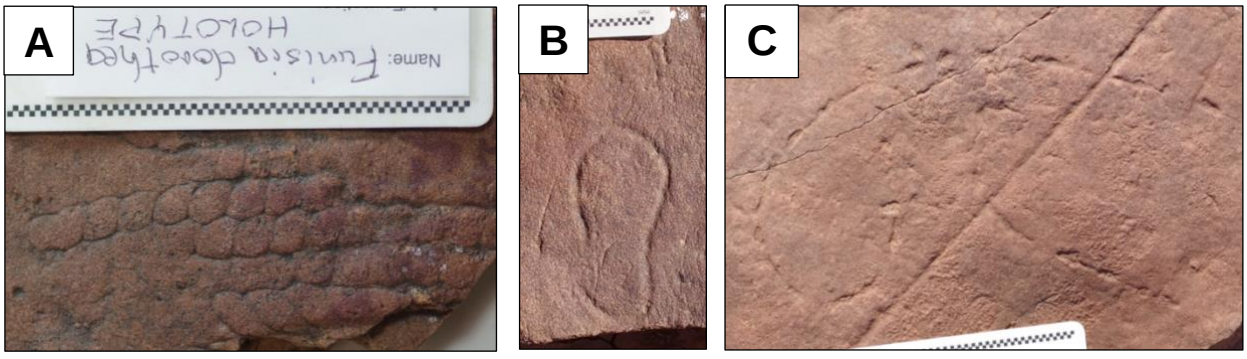

FIGURE 2: Images of the three primary taxa investigated. (A) Holotype of *Funisia dorothea,* photographed at the South Australia Museum in Adelaide. (B) Field specimen of *Somatohelix sinuous*. (C) Field specimen of *Plexus ricei.* Scale in mm.

FIGURE 3: Field specimen of Aulozoon, exhibiting characteristic two-part preservation of the tubular morphotype (i.e. undulation between positive hyporelief external mold and negative hyporelief external mold). This is suggestive of a partially collapsed, fluid-filled tube.

FIGURE 4: Image of the latexing process, wherein latex is painted over a fossiliferous surface until it is thick enough to remove from the surface and bring back to the lab for reference and further data collection. This particular latex is molding a stand of *Funisia* exhibiting dense packing of tubes and a variety of taphomorphs.