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Discovering Spriggina: South Australia's Window into Life's Beginnings

80 years ago, it was 1946. On the 27th of March, the unsuspecting but perceptive 27-year-old geologist Reginald Claude Sprigg was evaluating an old, abandoned mine site at the Ediacara Hills when he discovered distinctive imprints on the underside of sandstone. Although doubted by many unconvinced geologists and scientists including Sir Douglas Mawson, Sprigg recognised these traces as fossils of ancient multicellular organisms.

Among these fossils was one that would later be named *Spriggina floundersi*, a soft-bodied organism that lived on the Ediacaran seafloor. Today, it is one of the most famous and significant Ediacaran fossils that helped reshape scientific understanding of life before the Cambrian period.

Figure 1: Spriggina floundersi fossil imprint (Flinders Ranges Ediacara Foundation 2024).

Spriggina is one of the first animals to have displayed a segmented body with glide symmetry, meaning its left and right sides closely resembled mirror images but had slightly staggered segments (Luskin 2021). This interpretation, devised from later specimens, contradicted the previous understanding that *Spriggina* possessed true bilateral symmetry. Growing approximately 2 to 5 centimetres long, it is widely understood as an example of early cephalisation, with a defined head-like region and tapered tail. Evidence suggests that this indicated signs of basic sensory structures and simple nervous system development (Currie n.d.).

Early palaeontologists initially believed that these features could indicate a possible evolutionary relationship linking *Spriggina* and later animal phyla such as arthropods; however, it was later placed in the later established extinct phylum of Proarticulata, recognised by Mikhail Fedonkin in 1985 (Ivantsov n.d.). This widely accepted scientific consensus was supported by evidence that *Spriggina* lacked bilateral symmetry and was soft-bodied. Nonetheless, its true phylogenetic affinity remains uncertain.

Spriggina and numerous other Ediacaran fossils helped support the understanding that soft-tissue organisms can be preserved, helping to demonstrate that the fossil record is not limited to hard-bodied organisms (Department of Climate Change, Energy, the Environment and Water 2026).

In the process of fossilisation, the soft tissues of the organism typically decompose, leaving only hard bones or shells behind to be preserved. However, in some rare situations, soft-bodied organisms can also be fossilised. Fossils like these require specific circumstances to occur, such as the rapid burial or encasing of an entire organism in material (Australian Museum 2025).

Fossils of *Spriggina* have been found only within the Rawnsley Quartzite, the upper Ediacaran units, which is preserved across a substantial region of the Flinders Ranges in South Australia (Droser et al. 2020). This is because the organism lived on the Ediacaran seafloor, an environment characterised by widespread microbial mats. Microbial mats are complex, vertically stratified communities consisting of diverse microorganisms such as bacteria. With a lineage dating back 3.5 billion years, they are common in aquatic biomes including coral reefs (Biology Insights 2025). These communities adhere to solid surfaces at solid-liquid interfaces, often

surviving through photosynthesis or chemosynthesis, which involves obtaining energy through the oxidation of inorganic compounds such as hydrogen sulphide (H_2S), then using this energy to convert carbon dioxide (CO_2) into organic molecules that function as nutrients for growth (Ocean Exploration 2022). This creates a survival strategy that allows microorganisms to survive abiotic stresses such as extreme temperatures, pressure and water currents (Hawes et al. 2024). The mucilaginous structure of microbial mats also allowed rapid sediment coverage of Spriggina and various other soft-bodied Ediacaran organisms, increasing the chance of fossil preservation (Monash University n.d.). These mats on the Ediacaran seafloor acted like a natural mould over the organism, growing over or around the deceased organism, the body leaving a detailed impression before it fully decayed.

During the Cambrian explosion, a time of rapid evolution, major recognisable animal groups became more clearly identified in fossils, including Arthropoda, Mollusca, and Annelida (Dunning, Osterloff n.d.). Among these newly evolved organisms were a range of distinct vertically burrowing species, initiating intense bioturbation that churned up the seafloor and microbial mats (Bottjer, Hagadorn, Dornbos 2000). Known as the Cambrian Substrate Revolution or the Agronomic Revolution, this event explains why soft-bodied organism preservation became scarce after the Cambrian Period, and why many scientists historically believed that hard-bodied organisms constituted the majority of the fossil record.

Before 1959, scientists believed that multicellular organisms appeared abruptly during the Cambrian Period and that complex life did not exist before. Because Precambrian life consisted of mostly soft-bodied animals that lacked bones, shells, or hard exoskeletons, their bodies often decomposed and left behind little to no fossil impressions.

The ages of rock layers and the fossils found within them are determined by numerous geologic principles. Examples of fundamental principles in geochronology are the Law of Superposition – which states that in an undisturbed sequence of rock strata, the layers are superimposed and the oldest rock layers will be on the bottom and grow younger progressively toward the top, and biostratigraphy (National Geographic 2023). Professor Martin Glaessner at the University of Adelaide demonstrated that Ediacaran biota, including *Spriggina*, were of Precambrian age, supporting Reg Sprigg's earlier interpretation that the organisms existed before the Cambrian Period (Flinders Ranges Ediacara Foundation n.d.).

Radiometric dating is a modern method of finding the exact numerical age of strata by measuring radioactive decay in minerals found within volcanic ash. This is done by selecting a parent radioactive isotope based on an age range estimate of the rock, then identifying the daughter isotope that is created as a result of the parent's half-life radioactive decay, which is then measured to calculate the exact age of the rock in years (Graham 2020). Geologists determined the age of the strata *Spriggina* fossils were discovered in with an estimated age range of approximately 550 million years old, using Uranium-Lead radiometric dating on zircon crystals in volcanic ash layers found above and below the strata (Ray et al. 2002). This means that the parent isotope selected was Uranium-238 (^{238}U) and the matching daughter isotope was Lead-206 (^{206}Pb), allowing geologists to determine that *Spriggina* had an absolute age of 550 to 560 million years old (The City University of New York n.d.).

Therefore, using these methods, geologists were able to determine that the strata in which *Spriggina* and other Ediacaran fossils were found predated the Cambrian Period by millions of years, challenging the belief that multicellular life first appeared during the Cambrian explosion.

These fossils influenced the recognition of the first new period to be established on the Geological Time Scale in 120 years – the Ediacaran Period, named after the Ediacara Hills in the Flinders Ranges of South Australia and covering a period from around 635 to 538.8 million years ago (International Commission on Stratigraphy 2026). *Spriggina* was made South Australia's official state fossil emblem on 14 February 2017, and has since been featured in various forms of media such as Sir David Attenborough's *First Life* documentary series, as well as commemorated as a statue at the University of Adelaide and exhibited at Government House in Adelaide (Department of the Premier and Cabinet n.d.; National Parks and Wildlife Service South Australia n.d.; Flinders Ranges Ediacara Foundation 2020; Government House Adelaide n.d.).

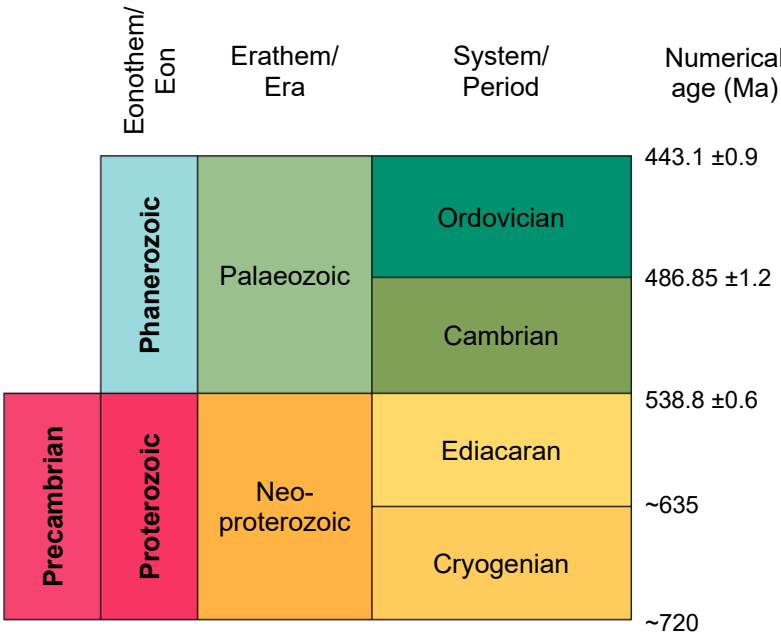

Figure 2: A subset of the International Chronostratigraphic Chart, focusing on the sections from the Cryogenian through to the Ordovician period (International Commission on Stratigraphy 2026).

The discovery of *Spriggina floundersi* demonstrated how different branches of science work together to support scientific discovery and research. Studies from palaeontology, geology, biology, and geochronology all contributed to expanding understanding of the Ediacaran period and biota. The enduring impact is seen in *Spriggina floundersi*, an ancient fossil that demonstrated multicellular life existed long before previously believed, reshaping our understanding of evolution and the history of life on Earth.

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