Adolf Seilacher

(1925–2014)

Palaeontologist who pioneered analysis of trace fossils.

Adolf Seilacher used the simplest of methods — careful observation — to transform our understanding of ancient organisms. His interpretations of the enigmatic Ediacara fossils, which date from about 578 million years ago, before the appearance of the major animal phyla during the Cambrian explosion, explained forms found among the earliest large organisms.

Seilacher also showed how trace fossils — those that record biological activity such as the burrowing of marine animals — reveal behavioural traits. He analysed the influences that shape invertebrate morphology and showed how exceptionally preserved fossil assemblages (for which he used the term *Lagerstätten*) are the result of conditions such as low oxygen, rapid burial and the effect of microbial films that seal the sediment surface.

In a career that straddled the Atlantic, Seilacher influenced palaeontology as much with his personality as with his publications. With a commanding yet engaging presence, he had a way of asking questions that caught speakers off guard — an occurrence referred to as being 'Dolfed'.

Seilacher, who died on 26 April aged 89, was born in 1925 near Stuttgart in Germany. He found his first fossil at the age of 14 and published his first paper, on fossil sharks from local rocks, at 18. He served in the German navy in the last years of the Second World War before entering the University of Tübingen in 1945.

There, palaeontologist Friedrich von Huene taught him to use the camera lucida, an apparatus with a prism and mirror that projects the image of a specimen onto a sheet of paper so that it can be traced. Over the rest of his career, Seilacher made thousands of drawings in this way, both as illustrations for his publications, and as an aid to understanding fossils. He favoured a portable camera lucida that once belonged to von Huene rather than the modern versions that attach to binocular microscopes.

Seilacher remained at Tübingen for his doctorate to study Jurassic and Triassic trace fossils (dating from about 252 million to 145 million years ago). He spent time at the Senckenberg marine station on the Baltic Sea, where he learned 'actuopalaeontology' — using the behaviour of living organisms as a guide to interpreting fossils. In 1951, on an expedition to the Salt Range in Pakistan, Seilacher and his PhD adviser

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Otto Schindewolf discovered trilobite tracks in early Cambrian rocks, conveying clues about the animals' lifestyle. In later years, Seilacher's advice was sought by oil companies exploring sandstones in North Africa and the southwestern United States, because he could use trace fossils to interpret the age and depositional environment of the rocks.

Seilacher spent much of his career at Tübingen, retiring as a professor in 1990. From 1987 to 2009 he spent autumns teaching at Yale University in New Haven, Connecticut. In 1992, he was awarded the Crafoord Prize of the Royal Swedish Academy of Sciences. This enabled him to travel the world, often with his wife, Edith, making replicas of surfaces that preserve an extraordinary range of trace and other fossils and sedimentary structures such as ripples. This collection became his own international touring exhibition, entitled Fossil Art.

Seilacher's insights fundamentally changed the analysis of the evolution of form. He broke away from the prevailing idea that all morphological features are adaptations for some function. He mined collections, particularly those of the Peabody Museum of Natural History at Yale, for convergent morphologies that provided evidence of other influences. No Seilacher course on invertebrates was complete without his demonstration that a water-filled balloon automatically assumes a form similar to that of a regular sea urchin, to show that not every shape has adaptive significance.

Seilacher's ability to interpret morphology from first principles is best demonstrated by his research on the strange fossils of the Ediacaran period, with shapes such as fronds, spindles and discs. He saw in these "an exotic principle of organismic construction" consisting of quilted chambers that maximize the surface available for feeding and respiration. He assigned the Ediacara organisms to an extinct kingdom of life that he called Vendobionta. The relationships of these organisms remain controversial, but many examples investigated by Seilacher on Mistaken Point in Newfoundland, Canada, show a fractal organization that defies easy assignment to any living group.

Among the trace fossils, Seilacher was particularly fascinated by *Paleodictyon*, a regular, often hexagonal, mesh-like structure that is connected to the sediment surface by short vertical tunnels, and occurs in rocks from as far back as the Cambrian. Seilacher interpreted this marine burrow as a 'farm' for raising bacteria.

In 1976, modern examples of *Paleodictyon* were discovered in the deep sea by oceanographer Peter Rona. Almost 30 years later, Seilacher and Rona boarded the submersible vessel *Alvin* and retrieved samples from the Mid-Atlantic Ridge at a depth of 3.4 kilometres. Stephen Low's 2003 film *Volcanoes of the Deep Sea* pictures the two of them slicing soft sediments containing the burrow system — sadly, the animal proved elusive.

An inveterate traveller, Dolf taught and did field work on every continent except Antarctica. He collected not only fossils, but also rugs, ancient cylinder seals and pre-Columbian art, and loved to share stories while enjoying a glass of wine and a cigar. He published works on an extraordinary range of fossils over his 70-year career, notably his 2007 text *Trace Fossil Analysis* (Springer) and his forthcoming *Morphodynamics* (CRC Press).

His iconic drawings and interpretations will remain inspirational for teachers and students for years to come. ■

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