

This Week's Citation Classic

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Fenchel T. The ecology of marine microbenthos. IV. Structure and function of the benthic ecosystem, its chemical and physical factors and the microfauna communities with special reference to the ciliated protozoa.

Ophelia 6:1-182, 1969.

[Marine Biological Laboratory, Univ. Copenhagen, Denmark]

The microbial ecology of marine sediments is treated. Special emphasis is on protozoa and their relationships to the vertical chemical gradients maintained by the activities of different physiological types of bacteria. The microbial sulfur cycle plays an especially important role in marine sediments. [The SCI® indicates that this paper has been cited in over 240 publications since 1969.]

Tom M. Fenchel
Department of Ecology and Genetics
University of Aarhus
DK-8000 Aarhus C
Denmark

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"I initiated this work soon after my graduation from the University of Copenhagen (as a taxonomic specialist on protozoa) at the University of Copenhagen Marine Biological Laboratory in Elsinore. Supported by the late G. Thorson, I set out to investigate the quantitative role of protozoa in marine sediments. I quickly found characteristic vertical zonation patterns of protozoan communities within the sediments which correlated with a chemical zonation maintained by the activities of bacteria. In aquatic sediments, oxygen is mainly supplied from the overlying water by molecular diffusion. Due to microbial consumption coupled to the degradation of dead organic material, the interstitial water becomes completely anoxic a few mm or cm beneath the sediment surface. Certain bacteria in this anoxic zone still mineralize organic material completely using nitrate as a hydrogen acceptor and when the supply of nitrate is exhausted, still other types of bacteria utilize sulfate and eventually CO₂ as hydrogen acceptors. Among the end products of these processes, hydrogen sulfide, deriving from sulfate reduction, is of

special interest. It diffuses upward in the sediment and is reoxidized by chemolithotrophic or photolithotrophic bacteria. At the time I carried out my work, these physiological types of bacteria were mostly well known from the laboratory, but few had considered their roles and spatial niches in nature, or their importance for the overall metabolism of aquatic environments. It also remained to be shown how eukaryote microorganisms specialize on these bacteria as food and to the chemical environments they create.

"The Marine Biological Laboratory was not geared for experimental or microbiological work and I felt somewhat isolated during my tenure there. This had advantages: I was not disturbed much and various equipment I either had to construct myself or do without. This trained me to think and economize before performing experiments; something which is easily neglected among an abundance of black boxes.

"At the laboratory, one was subject to a little more than mild pressure to publish in the 'house journal,' *Ophelia*. Otherwise, I would probably have submitted my work to other journals in the form of several shorter papers, none of which would have received so many citations. The combination of thorough natural history and a modern experimental approach to ecology is certainly another ground for my work being cited so often; also several new ideas were presented, some of which later even turned out to be correct.

"The paper was well received soon after publication and has given me many international contacts. I was also awarded the degree of Dr.Phil. (roughly equivalent to the British D.Sc.) by the University of Copenhagen on the basis of this work. Another consequence was that I became a full professor at the University of Aarhus about a year later and thus had the opportunity to build up a research group. Here the microbial ecology of marine sediments remains a central area of research and many current projects stem from my early work."¹⁻³

1. Fenchel T M & Iørgensen B B. Detritus food chains of aquatic ecosystems: the role of bacteria. *Advan. Microbial Ecol.* 1:1-58, 1977.
2. Fenchel T M. The ecology of micro- and meiobenthos. *Annu. Rev. Ecol. Syst.* 9:99-121, 1978.
3. Fenchel T & Blackburn T H. *Bacteria and mineral cycling*. London: Academic Press, 1979. 225 p.