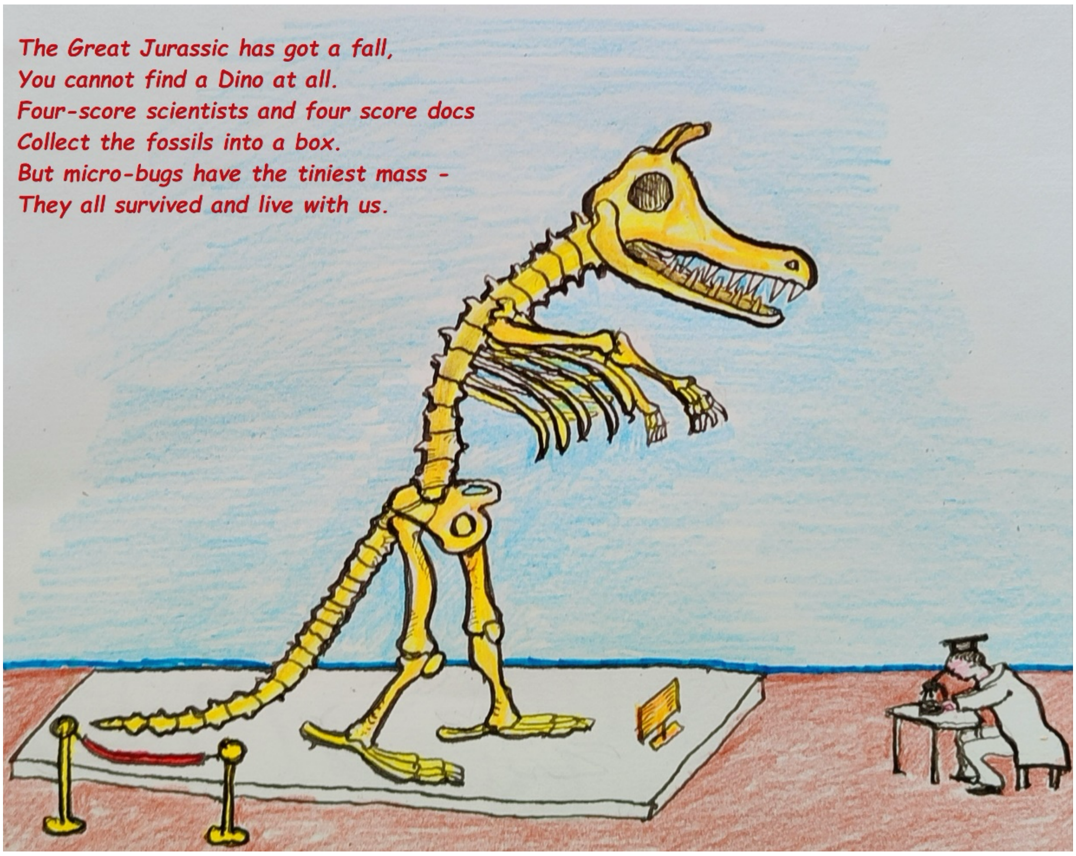
# The Survival Artist MicroStars:
# Old bug MacDesulfo, the centenarian (*Desulfomicrobium macestii*)

(M. Vainshtein)



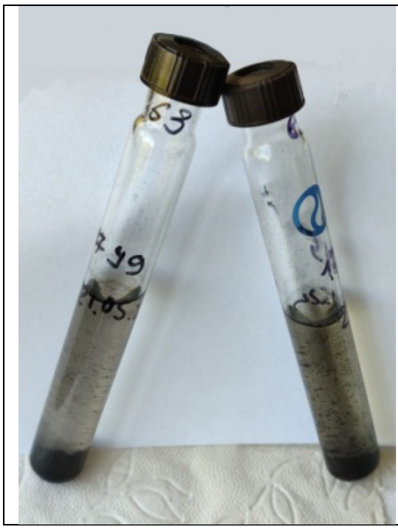

**Claim to fame: lives in an isolated ancient Jurassic Sea**

*To breathe without air.* We are accustomed to the fact that most organisms breathe oxygen and use it to generate energy from food. However, under oxygen-free – anaerobic – conditions (underground, in bottom sediments, in wells, and so on), there are microorganisms that, instead of oxygen, use sulfur, nitrogen or other chemical elements as oxidizing agents.

But, before photosynthetic microbes evolved, there was no oxygen on our planet. Therefore, the first microorganisms were anaerobic. Some of the first anaerobic microbes used sulfate to gain energy from their food – a process called sulfate reduction.

*Diversity and distribution of sulfate reducers.* So where is sulfate to be found?

As far as sulfate reducers need sulfate, they mainly habit in marine sediments or marine deep waters. They are also wide distributed in sediments of soda lakes or other lakes with sulfates. The diversity of sulfate reducers is huge, and bacteria of various genera have all manner of forms, including cocci, rods, bulbus, vibrio. Commonly, the genera names begin with *Desulfo-* which mean degradation of sulfate. The final product of this sulfate reduction is hydrogen sulfide which can react with various metals forming insoluble precipitates.



Lab culture of sulfate-reducing bacteria in the Hungate tubes. The tubes are hermetically closed and blown through with nitogen to exclude any presence of oxygen. The nutrient medium contains dissolved iron which reacts with the hydrogen sulfide produced by the bacteria to form an insoluble black precipitate.

*Helpful use of sulfate-reducing bacteria*

Some sulfate-reducing bacteria form silty bottom sediments in lakes. This sludge is black from the iron sulfide formed, oily to the touch, and contains many biologically active compounds. People use this silt as a healing mud / mud bath.

Other sulfate-reducing bacteria are used to remove toxic metals from natural ecosystems or industrial wastewater. For example, Baihua Lake (Guizhou Province, China) is polluted with mercury, but some *Desulfobulbus* bacteria precipitate it in the form of insoluble sulfide and bury it in bottom sediments [1].

*Longevity champion*

There is a very interesting question in microbiology: how long can bacteria live if they are isolated. Many believe that their existence is limited in time because they will exhaust all organic substrates.

In the Caucasus region of Russia, there is a medical resort called Matsesta, which is famous for its healing hydrogen sulfide waters. These waters flow upward under the pressure of the Earth stratum through drilled wells. The source is an isolated ("sealed") ancient deposit: these waters have the chemical and isotopic composition of the Jurassic Sea and do not contain organic substrates. Can you imagine surprise of the microbiologists who isolated previously unknown sulfate-reducing bacteria from these waters - *Desulfomicrobium macestii*! This bug, our hero MacDesulfo did not need organic substrates because it can grow as chemolithoautotrophy: it gets energy by oxidation of dissolved hydrogen with sulfate and syntheses organic compounds from inorganic carbon compounds, itself [2]. This suggests that MacDesulfo comes from a source at least as old as the dinosaurs and that it may also be very old. It could surely tell us some interesting stories about the creatures that populated the world at that time.

***MacDesulfo is one of the great microbial survival artists!***

[1] Fishman, K.S., Akimov, V.N., Suzina, N.E. *et al.* Sulfate-reducing bacteria *Desulfobulbus* sp. strain BH from a freshwater lake in Guizhou Province, China. *Inland Water Biol.* 2013. V. 6. P. 13–17. https://doi.org/10.1134/S1995082913010045

[2] Hippe, H., Vainshtein, M., Gogotova. G., Stackebrandt. E. Reclassification of *Desulfobacterium macestii* as *Desulfomicrobium macestii* comb. nov. *Int. J. Syst. Evol. Microbiol.* 2003. V. 53 (4). P. 1127-1130. doi: 10.1099/ijs.0.02574-0