Think big: Bacteria breach cell division size limit

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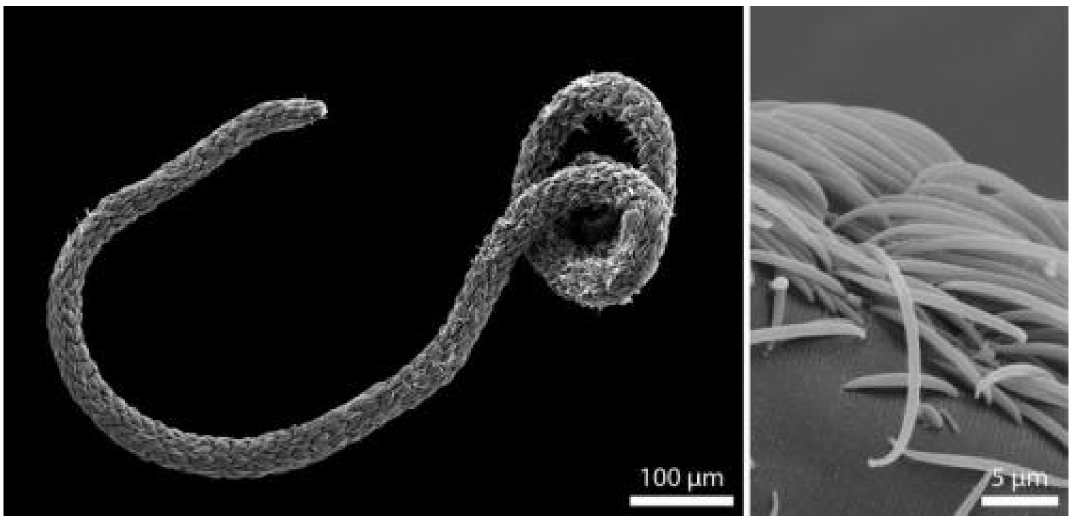


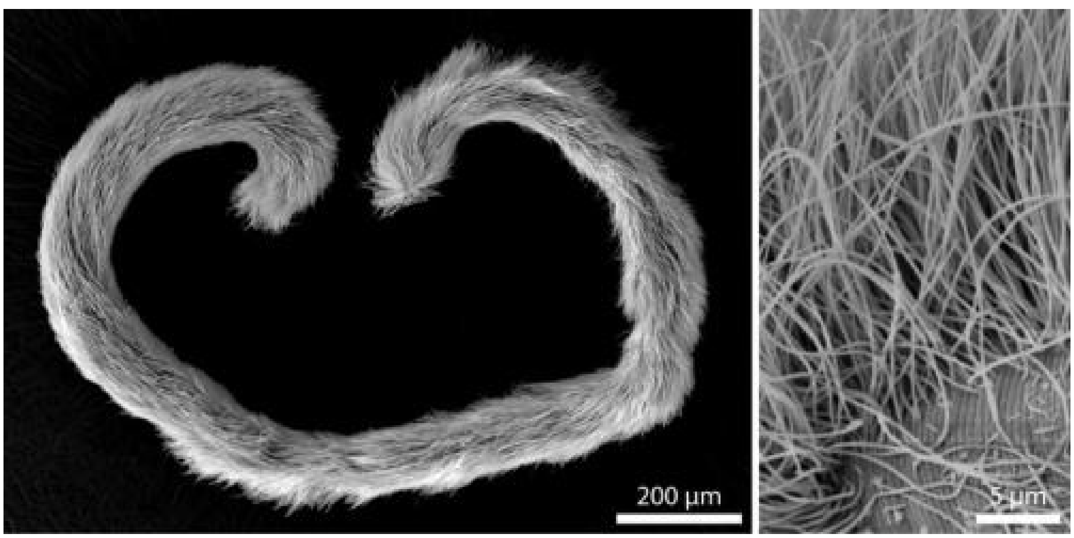
A scanning electron microscopy image of a *Eubostrichus fertilis* worm (left) and its crescent-shaped bacterial partners arranged on its surface like the layers of an onion (right). Credit: Copyright: Silvia Bulgheresi

The life of a cell is straightforward: it doubles, divides in the middle and originates two identical daughter cells. Therefore, it has been long assumed that cells of the same kind are similarly sized and big cells cannot divide symmetrically. Silvia Bulgheresi's team, University of Vienna, revealed that two non-model bacteria divide regularly despite growing so long to be perceivable by the naked eye. These findings have been published in the renowned journal *Nature Communications*.

"The microorganisms thriving on the surface of marine tropical worms are an inexhaustible source of wonder!" exclaims the environmental microbiologist Silvia Bulgheresi. After showing in 2012 that some rod-shaped bacteria are capable of dividing lengthwise – a fascinating alternative to what we knew about cell division so far – her team has been taken again by surprise. The crescent-shaped filamentous bacteria covering the surface of the *Eubostrichus fertilis* worm are attached with both ends to its surface, making it look like a rope (Fig. 1). A closer look at this peculiar arrangement reveals, that the shortest crescents are closest to the worm's surface and, like the layers of an onion, up to ten-fold longer crescents are stacked on top of them. By imaging thousands of these cells, the scientist could show that this unprecedented size variability arises because they divide at every length comprised between 3 and 45 micrometer. "We adults may vary from 0.6 to 2.6 m in height. If we were to be bacteria standing on an *E. fertilis*, our height would range from 0.6 m to over 6 m and, perhaps even more astounding, our chance to meet a 0.6 m-tall person would be fairly similar to that of meeting a 6 m-tall one", enthusiastically explains PhD student Nikolaus Leisch, first author of the scientific paper together with PhD student Nika Pende.

But what about the tiny little friends of the closely related *E. dianeae* worm? Here, the filamentous bacteria are attached to the worm host with only one end, as if to form a fur (Fig. 2). How long can one bacterium, that is a fur hair be? Over a tenth of a millimeter, roughly the human vision lower limit. "Our study showed that the up to 120 micrometer long microbial partner of *E. dianeae* is the longest known bacterium capable to divide just like the more familiar, but much shorter (~ 2 micrometer), Escherichia coli", states Phd student Nika Pende with amazement "What we really want to know, now, is how these huge cells manage to find their exact middle and give rise to two identical daughter cells!"

What supersizes the bacteria associated to the two *Eubostrichus* worms? Why are they differently arranged on their respective animal partners? These are the key questions that the microbiologists' team is currently tackling, by using state-of-the-art microscopic techniques and in cooperation with Prof. Tanneke den Blaauwen from the University of Amsterdam. One possible explanation is that each bacterial arrangement evolved to make the most out of its faithful partnership with the worm. Microorganisms make up to 1 kg of our body weight and may dramatically affect our health. Therefore, to learn whether yet unknown animal-derived factors may time bacterial proliferation might come in very handy.



A scanning electron microscopy image of a *Eubostrichus dianeae* (left) and its fur made of filamentous bacterial cells, each attached with one end to the surface of the worm (right). Credit: Silvia Bulgheresi

More information: Pende N., Leisch N., Gruber-Vodicka H.R., Heindl N.R., Ott J.A., den Blaauwen T. and Bulgheresi S. Sizeindependent symmetric division in extraordinarily long cells. 2014. *Nature Communications*. doi.10.1038/ncomm5803

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