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A newly evolved *W*(*olbachia*) sex chromosome in pillbug!

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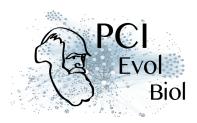
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A recommendation of

Leclercq S, Thézé J, Chebbi MA, Giraud I, Moumen B, Ernenwein L, Grève P, Gilbert C, Cordaux R. 2016. Birth of a W sex chromosome by horizontal transfer of Wolbachia bacterial symbiont genome. Proceedings of the National Academy of Sciences USA. 113: 15036-15041. doi: 10.1073/pnas.1608979113

Published: 24 January 2017 Copyright: This work is licensed under the Creative Commons Attribution-NoDerivatives 4.0 International License. To view a copy of this license, visit http:// creativecommons.org/licenses/by-pd/40/ In some taxa such as fish and arthropods, closely related species can have different mechanisms of sex determination and in particular different sex chromosomes, which implies that new sex chromosomes are constantly evolving [1]. Several models have been developed to explain this pattern but empirical data are lacking and the causes of the fast sex chromosome turn over remain mysterious [2-4]. Leclerq et al. [5] in a paper that just came out in PNAS have focused on one possible explanation: Wolbachia. This widespread intracellular symbiont of arthropods can manipulate its host reproduction in a number of ways, often by biasing the allocation of resources toward females, the transmitting sex. Perhaps the most spectacular example is seen in pillbugs, where Wolbachia commonly turns infected males into females, thus doubling its effective transmission to grandchildren. Extensive investigations on this phenomenon were initiated 30 years ago in the host species Armadillidium vulgare. The recent paper by Leclerq et al. beautifully validates an hypothesis formulated in these pioneer studies [6], namely, that a nuclear insertion of the Wolbachia genome caused the emergence of new female determining chromosome, that is, a new sex chromosome.

Many populations of A. vulgare are infected by the feminising Wolbachia strain wVulC, where the spread of the bacterium has also induced the loss of the ancestral female determining W chromosome (because feminized ZZ individuals produce females without transmitting any W). In these populations, all individuals carry two Z chromosomes, so that the bacterium is effectively the new sexdetermining factor: specimens that received Wolbachia from their mother become



females, while the occasional loss of *Wolbachia* from mothers to eggs allows the production of males. Intriguingly, studies from natural populations also report that some females are devoid both of *Wolbachia* and the ancestral W chromosome, suggesting the existence of new female determining nuclear factor, the hypothetical "f element".

Leclerq et al. [5] found the f element and decrypted its origin. By sequencing the genome of a strain carrying the putative f element, they found that a nearly complete wVulC genome got inserted in the nuclear genome and that the chromosome carrying the insertion has effectively become a new W chromosome. The insertion is indeed found only in females, PCRs and pedigree analysis tell. Although the Wolbachia-derived gene(s) that became sex-determining gene(s) remain to be identified among many possible candidates, the genomic and genetic evidence are clear that this Wolbachia insertion is determining sex in this pillbug strain. Leclerq et al. [5] also found that although this insertion is quite recent, many structural changes (rearrangements, duplications) have occurred compared to the wVulC genome, which study will probably help understand which bacterial gene(s) have retained a function in the nucleus of the pillbug. Also, in the future, it will be interesting to understand how and why exactly the nuclear inserted Wolbachia rose in frequency in the pillbug population and how the cytoplasmic Wolbachia was lost, and to tease apart the roles of selection and drift in this event. We highly recommend this paper, which provides clear evidence that Wolbachia has caused sex chromosome turn over in one species, opening the conjecture that it might have done so in many others.

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