archaeal, the bacterial or the eukaryal structure. Jarrell and Albers [1] are correct to state that ‘the archaean flagellum only functionally appears similar to the bacterial flagellum’. This is true, however, for all three of the possible flagella pairs: archaean–bacterial, archaean–eukaryal, and bacterial–eukaryal. The introduction of the new term ‘archaellum’ in itself does not explain what these differences are. If Jarrell and Albers were consistent, then they would in addition have to coin the phrases ‘bacterellum’ and ‘eukarellum’ for bacterial and eukaryal flagella. All these terms, however, do not explain the very nature of these different structures. Renaming a well-defined structure with another term without adding new information serves no purpose and will lead to confusion. Even more confusion would arise from the fact that archaeflagellins were recently proposed to be renamed ‘archaellins’ (3rd International Conference on Molecular Biology of Archaea; Marburg, Germany, July 1–3, 2012). Therefore, I suggest abandoning the term ‘archaellum’: using seven characters more (six letters plus one space) in ‘archaean flagellum’ still names the structure in a correct and clear way.

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Response to Jarrell and Albers: the name says it all

Jerry Eichler

Department of Life Sciences, Ben Gurion University, PO Box 653, Beersheva 84105, Israel

In their recent Trends in Microbiology Opinion article, Jarrell and Albers make a convincing argument for renaming the archaean flagellum as the archaellum [1]. Their proposal is based on a significant body of biochemical, structural, and genomic evidence showing that the archaellum and the bacterial flagellum are two distinct motility structures that can be distinguished in terms of their composition, their modes of assembly, the processing of their subunits, and their modes of action. If anything, as Jarrell and Albers stress, archaella are more similar to bacterial type IV pili than to bacterial flagella. Indeed, archaella possess a broad and diverse range of cell-surface structures [2]. Adoption of archaellum to define the archaean cell-surface structure apparently responsible for motility would not only introduce order into the field of motility structures but would also help to strengthen the message that archaella are not a subset of bacteria, as many still wrongly believe.

Referring to both the archaellum and the functionally comparable bacterial appendage as flagella would seem to be more because of an accident of history than scientific considerations. The inaccurate use of flagellum to describe the archaellum can be looked on as a relic from when the living world was divided along eukaryote–prokaryote lines, before recognition of Archaea as a third domain, distinct from Bacteria [3]. Such historic considerations might also explain the inaccuracies in nomenclature apparent in the case of bacteriorhodopsin, the light-driven pump found not in bacteria but rather in archaea [4], and with the naming of halobacteria (the Halobacteriales) [5,6], a group of salt-loving archaea. In fact, use of the term archaeabacteria, as the Archaea were originally called, can be similarly explained [7].

Adoption of archaellum in place of archaean flagellum would not be the first example of assigning an archaea-focused name to a structure found in all forms of life, yet with the archaellum version possessing distinct traits of biological significance. Whereas bilayer membranes are based on phospholipids across all three domains, archaean phospholipids comprise two polyisoprene chains ether-linked to a sn-glycerol-1-phosphate (G1P) backbone, as opposed to the pair of fatty acyl chains ester-linked to sn-glycerol-3-phosphate, a stereoisomer of G1P, that makes up bacterial and eukaryal phospholipids [8]. Accordingly, archaenal phospholipids are derived from archaeatidic acid rather than the phosphatidic acid used by bacteria and eukaryotes [9], with the difference in nomenclature stressing the unique chemistry of the archaeflagellum molecule rather than reflecting any distinguishing functional characteristic per se. Archaeae-centered naming is
also evident in rotary ATPases across evolution. Whereas membranous ATP synthases mediate coupling of the membrane electrochemical potential to the synthesis (or hydrolysis) of ATP in each domain of life, the archaeal A$_1$A$_0$ ATPase can be distinguished from the F$_1$F$_0$ ATPase found in bacterial and eukaryal organelles of bacterial origin and from the eukaryal V$_1$V$_0$ ATPases on the basis of structural and functional considerations, and as such is uniquely named [10]. Thus, although the structures considered in these examples serve the same roles as their bacterial and/or eukaryal counterparts, assigning them archaea-based labels is useful in that it highlights their biological distinctiveness. At the same time, ubiquitous structures that contain homologous components across at least two domains and that are largely structurally, functionally, and mechanistically equivalent, such as RNA polymerase and the ribosome, for example, need not use archaea-specific terminology because this would not be justified by any biological consideration nor provide any novel insight.

As Jarrell and Albers correctly point out [1], domain-specific naming is practically the case for motility structures today. In eukaryotes, the term cilia is generally used to describe both true cilia and flagella [11]. By introducing the term archaellum to define the archaeal motility structure currently called the archaeal flagellum, flagellum would now be restricted to the bacterial structure. At the same time, Jarrell and Albers propose that the archaellum would comprise structural subunits termed archaeilins, whereas flagellins would continue to comprise the bacterial flagellum [1]. It would, however, be more complicated to rename genes encoding components of the archaellum, currently annotated as the fla genes [12]. Indeed, misnaming of genes, largely because of mistaken assumptions or historical considerations, is an unfortunate yet accepted reality in many biological systems.

In conclusion, adoption of archaellum and flagellum to describe the archaeal and bacterial motility structures, respectively, will highlight the fact that despite their common function, these two cell-surface appendages share very little in common in terms of structure, assembly, or mechanism. Replacing names in biology has often served to introduce clarity where vagueness previously existed. The case of the archaellum is no different.

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