

REPORTS



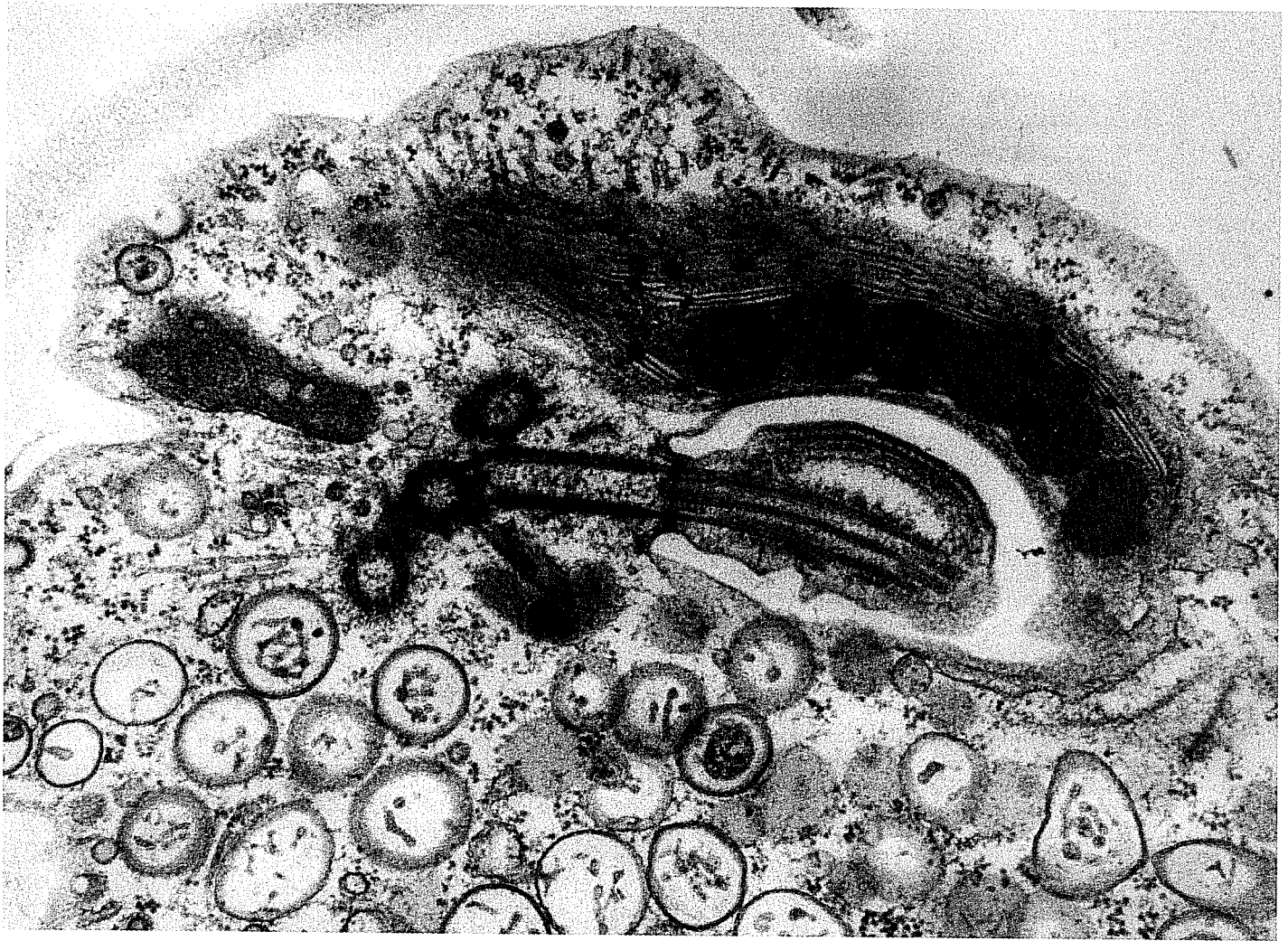
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PALLEN AND MATZKE ON THE BACTERIAL FLAGELLUM

Appearing in the October 2006 issue of *Nature Reviews Microbiology*, one of the leading journals in its field, was "From *The Origin of Species* to the origin of bacterial flagella" (4: 784–90). The article, by Mark J Pallen of the University of Birmingham and Nicholas J Matzke of NCSE, reviews the evidence for the evolution of the bacterial flagellum — which proponents of "intelligent design" (particularly Michael Behe, in *Darwin's Black Box*) notoriously adduce as a clear example of a designed rather than evolved structure. In the words of the abstract:

In the recent Dover trial, and elsewhere, the "Intelligent Design" movement has championed the bacterial flagellum as an irreducibly complex system that, it is claimed, could not have evolved through natural selection. Here we explore the arguments in favour of viewing bacterial flagella as evolved, rather than designed, entities. We dismiss the need for any great conceptual leaps in creating a model of flagellar evolution and speculate as to how an experimental programme focused on this topic might look.

Pallen and Matzke begin by reminding microbiologists of the way in which their discipline became relevant to the *Kitzmiller v Dover* trial, "where the term 'flagellum' and its cognates appeared 385 times in the transcripts of the 6-week trial." Proponents of "intelligent design" such as Michael Behe and Scott Minnich — both of whom testified for the defense in *Kitzmiller* — have contended that "irreducibly complex" systems such as the bacterial flagellum could not have evolved. At the trial, Kenneth R Miller, testifying for the plaintiffs, effectively dismantled such contentions.

After describing Miller's arguments, Pallen and Matzke note that talk about "the" bacterial flagellum is incorrect: "By even the most conservative estimate, there must therefore be thousands of different bacterial flagellar systems, perhaps even millions. Therefore, there is no point discussing the creation or ID of 'the' bacterial flagellum. Instead, one is faced with two options: either there were thousands or even millions of individual creation events, which strains Occam's razor to breaking point, or one has to accept that all the highly diverse contemporary flagellar systems have evolved from a common ancestor."

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Evidence for the evolution of bacterial flagella includes the existence of vestigial flagella, intermediate forms of flagella, and, importantly, the pattern of similarities among flagella protein sequences. Pallen and Matzke demonstrate that almost all of the core flagellar proteins have known homologies with non-flagellar proteins — contrary to repeated claims from the “intelligent design” movement, such as Minnich’s claim in his expert report that “the other thirty proteins in the flagellar motor (that are not present in the type III secretion system) are unique to the motor and are not found in any other living system.” In a September 7, 2006, post at The Panda’s Thumb blog (<http://www.pandasthumb.org/archives/2006/09/flagellum_evolu.html>), Matzke quotes a number of “intelligent design” proponents as offering estimates of unique proteins in the flagellar motor, summarizing, “All the IDists think that $\frac{2}{3}$ of the flagellum proteins are ‘unique’, [that is] do not share homologies with other proteins. All they are aware of is the homologies to T3SS, which they usually mention while rebutting Kenneth Miller. Casey Luskin, a late example, cuts the number to $\frac{1}{3}$, probably because he is dimly aware that there are some other homologous proteins out there, perhaps because several of us ID skeptics have been mentioning this point repeatedly for several years.”

In fact, as Pallen and Matzke’s article shows, there

are only two flagellar proteins that are presently thought to be indispensable and for which no homologies are presently known. Matzke comments on the implications in his blog post: “Scott Minnich, the leading flagellum expert in the ID camp, was severely wrong about the most basic data relevant to the origins of the flagellum, the flagship system of the ID movement. ... Minnich promoted his mistaken view in the video *Unlocking the Mystery of Life*, which has been widely promoted by ID advocates across the country, viewed in countless church basements, IDEA club meetings, [and so on]. ... The error propagated further in Minnich’s expert report.” He concludes, with regard to the bacterial flagellum, “Apparently, everyone in the ID movement just mindlessly copies everyone else’s talking points.”

In their *Nature Reviews Microbiology* article, Pallen and Matzke offer a call for continued research on flagellar evolution, citing both the need to debunk “the suspicion among members of the public that maybe there is some mystery here, that maybe the ID proponents do have a point” and the prospect of thereby gaining further understanding of bacterial flagella. After sketching a few avenues for future research, they pointedly comment, “Like Darwin, we have found that careful attention to homology, analogy and diversity yields substantial insights into the origin of even the most complex systems.”

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