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Sighting the Alien Within: a New Look at *Bdellovibrio*▽

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Bdellovibrio bacteriovorus is a solitary hunter that uses a single polar flagellum to stalk other Gram-negative bacteria. Using appendages located at the nonflagellated pole, this tiny predator binds its prey tightly. Secreted enzymes now permit the predator to burrow through the surface of its prey, where it wedges between the outer membrane and the peptidoglycan wall. Here, it begins to reprogram both itself and its prey. This includes partial degradation of the prey peptidoglycan wall, which causes the prey to round up into a structure called the bdelloplast. Nestled within the confines of this bdelloplast, the predator now literally consumes its poor unfortunate host from the inside out (for reviews, see references 9, 15, 17, and 19).

Within the bdelloplast, the bdellovibrio reprograms itself from the free-living, motile, and nonreplicative "attack-phase" predator into a nonmotile, replicative "growth-phase" cell. Growth occurs exclusively at the expense of the host, resulting in formation of a spiral aseptate filament, whose length depends on the mass of the host. This process is extremely efficient, as one host cell provides all the nutrients necessary to produce multiple progeny, each of which possesses a genome approximately the same size as that of the host. When some presently unknown host signal becomes limiting, the filament septates and separates into motile progeny (for reviews, see references 9, 15, and 17–19).

For years, full knowledge of this process had been stymied by its location within the host. While electron microscopy produced exquisite discrete images, this technique necessitated the death of the imaged cells, precluding continuous visualization of the process. In contrast, light microscopy lacked the necessary magnification and contrast (for examples, see references 1–4 and 14). While immensely valuable in many respects, the study of host-independent mutants (for examples, see references 6, 11, and 13) and the examination of the artificial premature release of growth-phase cells (for examples, see reference 10) also failed to satisfactorily clarify the process. Thus, many aspects of the developmental process had remained controversial.

In this issue of the *Journal of Bacteriology*, Fenton et al. (7) resolve many of those controversies. Using engineered *Escherichia coli* hosts that express a periplasmic fluorescent protein to backlight nonfluorescent predatory cells, the authors continuously follow the entire predatory process, from the initial attack, through elongation, septation, and separation of the growth-phase filament, to the escape of the attack-phase progeny.

It has long been known that *Bdellovibrio* filaments do not divide by binary fission (12). Whether septation occurred sequentially or synchronously, however, remained unclear. Using their fluorescent backlit approach, Fenton et al. (7) now convincingly demonstrate that septation occurs synchronously. Furthermore, they show that synchrony is maintained even when two attack-phase cells invade a single host and elongate into two independent filaments. This observation suggests the existence of some mechanism that coordinates the timing of septation.

The authors also definitively demonstrate that the number of progeny can be either odd or even, strong evidence that division does not occur by binary fission. The authors propose that this unusual pattern of septation evolved to permit full use of a finite resource (the host) to yield the maximum number of progeny (7). More importantly, perhaps, this intriguing behavior raises the inevitable question of mechanism: how does the *Bdellovibrio* filament "know" when to stop elongating?

Lysis of the prey cell causes a rapid loss of fluorescence. This permits the authors to measure the time interval between septation and lysis, which they find correlates with the number of progeny per prey cell. Since lysis occurs more rapidly when there are more progeny, it is likely that each nascent bdellovibrio contributes equally to lysis, regardless of the size of the host and the resultant number of progeny. Fortuitously, the loss of fluorescence also provides evidence that lysis does not result from a catastrophic disintegration of the host membrane, but rather from the construction of discrete pores through which the progeny exit (7).

Finally, the authors verify that newly released progeny continue to elongate in the external environment (21). This appears to occur by straightening of the curved progeny and not by additional growth (7).

In the past, *Bdellovibrio* was often viewed as a microbiological curiosity. Today, its ability to attack other Gram-negative bacteria could potentially contribute to solutions for many of our planet's persistent problems, e.g., the need to clean our water supplies, to protect our crops, and to develop new clinical therapeutic agents (5, 8, 16, 20). In light of this potential, development of *B. bacteriovorus* as a genetically facile model system for related bacterial parasites is clearly warranted.

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