Classic Spotlight: Quorum Sensing and the Multicellular Life of Unicellular Organisms

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The discovery of quorum sensing by Ken Nealson, Terry Platt, and Woody Hastings (1) foreshadowed a revolution in microbiology, transforming our thinking about microbes. The second sentence of their publication in the *Journal of Bacteriology* (JB) in 1970 gets directly to the point: “The matter of interest in this paper is that the growth of the bacteria and the development of luminescence do not occur in concert in liquid cultures.” That is, they described the very rapid production of light by the organism called, at the time, *Photobacterium fischeri* (now called *Vibrio fischeri*) only after “conditioning” of the medium by the growing cells, leading to the activation of light production by an endogenously produced signal. As opposed to other activities known to increase in abundance in concert with growth of the cells, light production occurred very rapidly and not as a function of cell growth; they referred to this phenomenon as “autoinduction,” a term we still use today. Furthermore, while autoinduction was first recognized in an environmental *Vibrio* sp., it was eventually recognized that this phenomenon is conserved across microbes, including pathogens. Gambello and Iglewski reported the cloning and mutant characterization of the *lasR* gene, a homolog of the *Vibrio* autoinduction regulator, in JB in 1994 (2) and proposed that its gene product, LasR, like LuxR, “also functions in a cell-density-dependent manner,” thus helping to trigger the use of *Pseudomonas aeruginosa* as a key model pathogen for studying autoinduction. Furthermore, while autoinduction is a useful term, it helps to have a name that readily conveys this concept to a broad audience. A minireview by Fuqua, Winans, and Greenberg published in JB in 1994 (3) was first to introduce the term “quorum sensing” in print. There, the authors state that “certain bacterial behaviors can be performed efficiently only by a sufficiently large population of

bacteria. We describe this minimum behavioral unit as a quorum of bacteria.” More recently, the 1997 paper in JB by Bassler, Greenberg, and Stevens (4) articulated the concept that quorum sensing can occur between species. As stated in their article, their “studies show that *V. harveyi* is capable of responding . . . to substances produced by other species of bacteria,” an observation that triggered a second explosion of studies in this field. The implication of the work published in these papers in JB over ~25 years is that bacteria could no longer be considered unicellular “loners” but instead are capable of social behaviors analogous to those observed for bees, naked mole rats, and people.

REFERENCES

1. Nealson KH, Platt T, Hastings JW. 1970. Cellular control of the synthesis and activity of the bacterial luminescent system. *J Bacteriol* 104:313–322.
2. Gambello MJ, Iglewski BH. 1991. Cloning and characterization of the *Pseudomonas aeruginosa lasR* gene, a transcriptional activator of elastase expression. *J Bacteriol* 173:3000–3009.
3. Fuqua WC, Winans SC, Greenberg EP. 1994. Quorum sensing in bacteria: the LuxR-LuxI family of cell density-responsive transcriptional regulators. *J Bacteriol* 176:269–275.
4. Bassler BL, Greenberg EP, Stevens AM. 1997. Cross-species induction of luminescence in the quorum-sensing bacterium *Vibrio harveyi*. *J Bacteriol* 179:4043–4045.

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