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EDITORIAL

Classic Spotlight: Dawn of the Molecular Era of Bacterial Chemotaxis

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Chemotaxis—movement toward or away from a chemical—is a universal behavior of motile cells and organisms. Pioneering work in the last few decades of the 1800s, notably by Engelmann, Pfeffer, and Beijerinck, first demonstrated chemotactic and aerotactic behaviors in bacteria. See reference 1 for an intriguing summary of those early studies, which were largely overlooked for the next 50 years or more. In 1960, Julius Adler began his faculty career in the Biochemistry Department at the University of Wisconsin—Madison and chose to study bacterial chemotaxis. Because chemotactic behavior in any organism requires detection of a chemical gradient and conversion of stimulus information to internal signals that elicit appropriate locomotor responses, Adler reasoned that it should be possible to uncover basic principles of signal transduction by studying the chemotaxis machinery of a bacterium. He chose *Escherichia coli* as his experimental subject "because the vast knowledge of its biochemistry and genetics could be brought to bear on the problem."

Adler's initial report on *E. coli* chemotaxis appeared in the *Journal of Bacteriology* (2). In a series of elegantly simple experiments, he observed cells moving through medium in a closed capillary tube and showed that they were chemotactic toward oxygen and the amino acid serine. The choice of *E. coli* strain for this initial work proved to be most serendipitous. The strain had auxotrophic requirements for the amino acids threonine, leucine, and methionine, but Adler noted that "only methionine had to be added [to the medium] to get the bands to form readily and to travel." Subsequent study of the methionine requirement for *E. coli* chemotaxis revealed that the critical compound was *S*-adenosylmethionine and that it served as the methyl donor for a protein methylation reaction involved in sensory adaptation and temporal sensing of chemoeffector gradients (3). We now know that methyl-accepting chemotaxis proteins (MCPs) are the most abundant and important transmembrane chemoreceptors in the microbial world (4). Who can say how long their discovery would have been delayed if Adler hadn't fortuitously chosen a methionine auxotroph as his test subject.

Adler's initial paper set the stage for subsequent work by thousands of bacterial behaviorists that has made the *E. coli* chemotaxis machinery the best-understood signal transduction system in all of biology.

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