

Classic Spotlight: Genetics of *Escherichia coli* Chemotaxis

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A recent classic spotlight about the pioneering work of Julius Adler, which marked the beginning of the molecular era of bacterial chemotaxis (1), was written by John (Sandy) Parkinson, who became interested in bacterial chemotaxis during his post-doctoral studies in Adler's lab. At that time, little was known about either the biochemistry or the genetics of this amazing form of bacterial behavior. A 1967 *Journal of Bacteriology* (JB) paper by John B. Armstrong, Adler, and Margaret M. Dahl (2) described three classes of *Escherichia coli* chemotaxis mutants: *cheA*, *cheB*, and *cheC* mutants. Sandy Parkinson began his own work on the genetics of chemotaxis by isolating and analyzing nearly 200 independent mutants exhibiting aberrant behavior on soft agar "swarm" plates. He reported specific phenotypes of *cheA* and *cheB* mutants, showed that *cheC* mutants represented special alleles of a flagellar gene, and identified another chemotaxis gene, *cheD*, in his first JB paper on the subject (3). Meticulous genetic experiments and construction of deletion mutants in Parkinson's lab produced a constellation of JB papers (4–8) that showed that *cheA* mutants defined two genes (now known as *cheR*, *cheB*, *cheY*, and *cheZ*), and *cheD* mutants represented special alleles of the serine chemoreceptor gene *tsr* (9). That work, along with complementary efforts from Mel Simon's lab (10, 11), led to our current understanding of the organization and roles of chemotaxis genes in *E. coli*. Well, almost. . .

The last component of the *E. coli* chemosensory machinery escaped identification until the complete genome sequence was generated a decade later. Bioinformatician Ken Rudd, who identified a gene homologous to previously known *E. coli* chemoreceptor genes in the newly published genome, teamed up with—guess who?—Sandy Parkinson in order to reveal the function of the *orf506* product: a chemoreceptor for aerotaxis, Aer. The identification of the last chemotaxis gene in *E. coli* was published (12) . . . guess where?

REFERENCES

1. Parkinson JS. 2016. Classic spotlight: dawn of the molecular era of bacterial chemotaxis. *J Bacteriol* 198:1796. <http://dx.doi.org/10.1128/JB.00297-16>.
2. Armstrong JB, Adler J, Dahl MM. 1967. Nonchemotactic mutants of *Escherichia coli*. *J Bacteriol* 93:390–398.
3. Parkinson JS. 1976. *cheA*, *cheB*, and *cheC* genes of *Escherichia coli* and their role in chemotaxis. *J Bacteriol* 126:758–770.
4. Parkinson JS. 1978. Complementation analysis and deletion mapping of *Escherichia coli* mutants defective in chemotaxis. *J Bacteriol* 135:45–53.
5. DeFranco AL, Parkinson JS, Koshland DE, Jr. 1979. Functional homology of chemotaxis genes in *Escherichia coli* and *Salmonella typhimurium*. *J Bacteriol* 139:107–114.
6. Parkinson JS. 1980. Novel mutations affecting a signaling component for chemotaxis of *Escherichia coli*. *J Bacteriol* 142:953–961.
7. Parkinson JS, Houts SE. 1982. Isolation and behavior of *Escherichia coli* deletion mutants lacking chemotaxis functions. *J Bacteriol* 151:106–113.
8. Parkinson JS, Parker SR, Talbert PB, Houts SE. 1983. Interactions between chemotaxis genes and flagellar genes in *Escherichia coli*. *J Bacteriol* 155:265–274.
9. Callahan AM, Parkinson JS. 1985. Genetics of methyl-accepting chemotaxis proteins in *Escherichia coli*: *cheD* mutations affect the structure and function of the Tsr transducer. *J Bacteriol* 161:96–104.
10. Silverman M, Simon M. 1976. Operon controlling motility and chemotaxis in *E. coli*. *Nature* 264:577–580. <http://dx.doi.org/10.1038/264577a0>.
11. Boyd A, Krikos A, Simon M. 1981. Sensory transducers of *E. coli* are encoded by homologous genes. *Cell* 26:333–343. [http://dx.doi.org/10.1016/0092-8674\(81\)90202-6](http://dx.doi.org/10.1016/0092-8674(81)90202-6).
12. Bibikov SI, Biran R, Rudd KE, Parkinson JS. 1997. A signal transducer for aerotaxis in *Escherichia coli*. *J Bacteriol* 179:4075–4079.

Citation Zhulin IB. 2016. Classic spotlight: genetics of *Escherichia coli* chemotaxis. *J Bacteriol* 198:3041. [doi:10.1128/JB.00687-16](https://doi.org/10.1128/JB.00687-16).

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