

BOOKS: MICROBIOLOGY

# No Longer Alone

Roberto Kolter

**Bacteria as Multicellular Organisms.** JAMES A. SHAPIRO and MARTIN DWORKIN, Eds. Oxford University Press, New York, 1997. xiv, 466 pp., illus. \$95 or £69.50. ISBN 0-19-509159-0.

Specialized cells dedicated to a specific task... or cells that receive and send signals to nearby cells for coordinating of complex behaviors such as migration and survival under stress. Are such cells the exclusive domain of plants, animals, and fungi? Not at all! So argues this compelling volume edited by Jim Shapiro and Marty Dworkin, long-time supporters of the view that bacteria display many, if not most, of the attributes of multicellular organisms. The editors organized two meetings in Woods Hole, Massachusetts, in 1991 and 1993 that focused on the multicellular behavior of bacteria. Out of these meetings, as well as from the growing evidence in support of bacterial multicellularity, emerged the concept of this text. The result is pleasing, but only time will tell whether it succeeds in its stated intention: "to persuade microbiologists that the view of bacteria as exclusively unicellular organisms has serious drawbacks."

"Microbiology is on the verge of a paradigm shift." So begins Dworkin's opening chapter, setting the stage for the possibly revolutionary impact of the contents of the book. This statement might be viewed as exaggerated, but it has its merits. Although this "paradigm shift" currently under way in microbiology is clearly not of the same magnitude as those that shook chemistry after the discovery of oxygen or physics after quantum mechanics, there is change afoot in world view among many molecular microbiologists who are embracing the concept that bacteria are multicellular organisms.

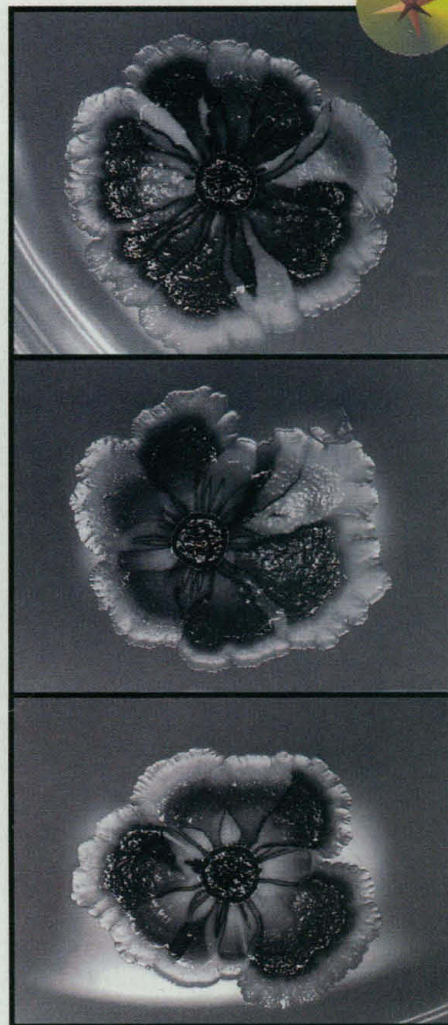
No doubt that molecular microbiology, inspired by the amazing attributes of the single bacterial cell and steeped in the pure culture tradition dating back to Koch and Pasteur, has blossomed under the view that bacteria are unicellular organisms. Environmental microbiology, on the other hand, has successfully appreciated the view put forth by Winogradsky of the innumerable interactions among members of the microbial communities in nature. The paradigm shift under way concerns the fact that molecular microbiologists are beginning to open up to the view that the complexity of

multicellularity can indeed be appreciated and, most importantly, dissected and understood through the analysis of bacteria.

This volume goes a long way in describing systems where this has been shown to be the case and it provides a text for the intellectual development of future generations of microbiologists. Examples of such systems include intercellular communication via acylated homoserine lactones and peptides, pattern formation in colonies, and fruiting body development in the *Myxobacteria*. Although some may find fault in that the work presented is already out of date, this is not the point at all. Any such volume will necessarily be out of date the moment it is conceived. Rather, the aim is to allow for the appreciation of the fact that bacteria can indeed be seen as multicellular organisms in a multitude of settings. The book accomplishes this goal, although at times some of the authors do get bogged down in describing minutiae—which should be forgiven because these are molecular biologists, reductionists at heart, still on the verge of the paradigm shift.

The volume contains sections describing cell-cell communication, multicellular life styles, methodologies, and the physical aspects of multicellularity. From the perspective of this molecular microbiologist, the last section, which contains formal mathematical treatment of pattern formation, was particularly revealing. There is indeed order underlying the beauty inherent in microbial patterns, and it is refreshing to see this brought out through the application of mathematics.

Taking license to paraphrase the title of the wonderful McClintock biography by Evelyn Fox Keller, one cannot end up but with a distinct and delightful "feeling for the multicellular microorganism" after reading



**A flowering field.** Colonies of identical single-celled *Escherichia coli*, stained for  $\beta$ -galactosidase, show spatial organization.

this volume. The editors should be pleased with the results of their efforts, as should those—ardent followers and neophytes alike—who peruse the pages of this text. Indeed, the study of mixed bacterial cultures should no longer be grounds for excommunication among molecular microbiologists.

## Vignette

### Citation Patterns

There is substantive similarity between the methodology of the Jewish Oral Law (Talmud, commentaries, responsa) and science in that they share a commitment to close analysis and a tradition of citation. There is also a great difference between scientific patterns of citation, and those of Jewish religious discourse. In the rabbinical responsa, the opinion of the later decisors/scholars is normative. But the older, indeed, the very old, decisions are *always* cited, with great veneration. In science, the cult of the new reigns. Seldom is a citation more than twenty years old. It could be the pace of advance; we think it's in part a culture of valuation of the new. The Oedipal urge is stronger in science.

—Roald Hoffmann and Shira Leibowitz Schmidt, in *Old Wine, New Flasks: Reflections on Science and Jewish Tradition* (Freeman)

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