

Molecular Marine Microbiology

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The following thirteen minireviews introduce some of the exciting milestones being covered in molecular marine microbiology today, and in many cases, their biomedical or biotechnological relevance. The issues covered include quorum and anti-quorum sensing, selected symbioses, DNA shuffling in the environment, the evolution and development of novel motility mechanisms, hydrocarbon degradation, the interactions of microbes with metals, and adaptations to extremes of pressure and temperature. Although most of these topics are not exclusive to marine realms, they all have as a common thread a profound relevance to the ocean environment.

One of the great contributions of marine microbiology to all of microbiology has been the discovery of the importance of acylated homoserine lactones in cell density or "quorum" sensing by bacteria. The paradigm for this mode of regulation, the control of bioluminescence in *Vibrio fischeri*, is described by Paul Dunlap. An entirely new light on *V. fischeri* is provided by Ned Ruby, who describes how this microorganism, along with a squid host with which it has established a mutualistic association, is providing new clues to bacterial colonization of animal epithelial tissue. A fascinating twist on quorum sensing is presented by Rice *et al.* who describe the synthesis of an inhibitor of bacterial quorum sensing systems by a species of red algae. The inhibitor appears to represent a chemical strategy used by the algae to limit bacterial colonization of its surfaces. Additional aspects of bioactive metabolites involved in the symbiotic interactions of marine microorganisms is described by Haygood *et al.* who describe potential biomedical applications of microbes obtained from marine invertebrates.

Of course microbes take in much more than cell-cell signaling molecules. Many prokaryotes can also take in DNA, and thus re-tailor their genetic identities. John Paul describes gene transfer among indigenous microbes in the environment and the significance of transformation, conjugation and transduction to phylogenetics. Additional microbial processing reactions which are of biotechnological relevance concern the applications of marine prokaryotes to environmental clean up and nano-scale biofabrication. Harayama *et al.* describe the fate of various petroleum components in seawater, and the significance of *Alcanivorax* in marine bioremediation. Francis and Tebo explore the details of manganese oxidation, progressing from genes to enzyme kinetics and applications to toxic metal removal. Finally, Dirk Schüller

describes the bacterial manufacturing of magnetic iron containing organelles (magnetosomes) within certain benthic bacteria and their biotechnological promise in products ranging from magnetic tapes to magnetic resonance imaging devices.

Two articles deal with mysterious motility mechanisms operating in marine microbes. Linda McCarter introduces surface-regulated phenomena, including swarming motility via lateral flagella, in the human pathogen and marine resident, *V. parahaemolyticus*. Bianca Brahmsha details the only known case of liquid motility in the absence of flagella, a phenotype displayed by many marine *Synechococcus* species.

The minireviews end with descriptions of the adaptations of certain deep-sea prokaryotes to extremes of pressure and temperature. Kato and Qureshi present a taxonomic overview of deep-sea bacteria and genetic and biophysical analyses of respiratory chain adaptations to elevated pressure. My article describes genetic evidence for the role of additional membrane components in pressure-sensing and adaptation, the discovery of a DNA recombination enzyme which is also required for life at low volume change, and the potential of deep-sea bacteria as a source of genes for the biosynthesis of polyunsaturated fatty acids. Finally, Robb and Clark end our written symposium with a discussion of the biochemical bases of thermostability in proteins from hyperthermophiles, most of which are members of the domain Archaea.

Although this admittedly eclectic collection of articles is hardly representative of all of molecular marine microbiology (for example, no articles dealing with viruses or protists are included), the accompanying articles do provide a valuable glimpse into many of the exciting developments taking place in this broad field. Readers will find these articles useful both as reference sources and as introductions to topics yet to be explored.

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