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FEATURE ARTICLE

THE RELEVANCE OF MICROBIAL PHYSIOLOGY TO APPLIED PROBLEM SOLVING

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There is a shady, nebulous zone separating the sanctuary of the university microbial physiologist from the orderly universe of the applied microbiologist. This separation is unfortunate and promotes the misconception, for example, that the mode of action of biocides has little relevance to applied problem-solving and, as another example, that solutions to practical problems cast little if any light upon basic questions of microbial physiology.

One of the most significant differences, it seems to me, between the modus operandi of the microbial physiologist and the applied microbiologist is that the physiologist usually insists upon studies using pure cultures under rigorously defined conditions, whereas the applied microbiologist usually must use mixed, naturally-occurring, microbial populations studied under conditions that lack the rigorous controls afforded by pure culture studies. It would be foolhardy to suggest that pure culture studies have not made their mark, but it would also be foolish to refuse to recognize that microorganisms do not live alone. But even the most ruddy-cheeked microbial physiologist feels some twinge of insecurity when considering the complexity of mixed culture studies.

Can the accumulated knowledge of microbial physiology be effectively applied to "real" situations? I am one who stands with one foot on each side of the nebulous zone. One eye sees the need for pure culture studies (to determine the role of sulfate reduction in the precipitation of geologically important minerals, for example), but the other eye knows that sulfate-reducing bacteria are never found alone in natural environments.

There is, I believe, a partial blindness that results from viewing reality with either one eye or the other. Consider the iron-oxidizing bacterium *Gallionella*. Hanert claims that the cultivation and handling of *Gallionella* is "in no way more difficult than for other microorganisms, if attention is paid to only a few fundamental peculiarities . . ." If precisely 28.3 cm^3 of CO_2 is bubbled into 9 ml of mineral salts media *and* if sufficient concentrations of dissolved ferrous iron are maintained *and* if a temperature of 17 C is maintained *and* if an atmosphere of 94% N_2 – 5% CO_2 and 1% O_2 is provided, *then* (possibly) *Gallionella* will grow. It has been my experience to observe these exotic bacteria flourishing in their natural (and mixed culture) environments, but to have had only modest success growing them in the laboratory (the term "modest" is a slight overstatement).

I have asked myself, particularly after an unsuccessful growth trial, what is the relevance of pure culture studies of *Gallionella*? Will the information gained help us to understand how these bacteria corrode and clog iron pipes? Will the electron transport chain that conducts electrons from iron to oxygen be the same in a pure culture as one that is found when *Gallionella* grows in cooperation with the sulfate-reducing bacteria *Desulfovibrio* or an iron-reducing *Pseudomonas*?

It is important, in a practical sense, to understand the mechanism of iron oxidation by *Gallionella* or silica precipitation by *Desulfovibrio*, but do we lose more than we gain when we blind ourselves to reality in our insistence upon pure culture studies? Although Winogradsky was no more right than Robert Koch, both the mixed culture and pure culture points of view are necessary, isn't it time that studies of microbial physiology be done under more natural conditions? Applied and industrial microbiologists must be the ones that bridge the nebulous zone. They must be the ones who find the relevance of microbial physiology and apply this relevance to effective problem-solving.