General Morphology

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The morphological characters of the bacteria, while they are useful or indispensable in the recognition of many forms, have various limitations as aids in taxonomy. Indefinite distinctions and the occurrence of variation, either mutational or in response to the conditions of culture, are important limitations. The custom of giving to morphology the premier position among the attributes used in classification has created many problems.

In the Eubacteriales the form of the cell fails to provide a good separation of *Streptococcus* and *Lactobacillus* and of *Staphylococcus* and corynebacteria; cell grouping has proved unsatisfactory for distinguishing *Sarcina* and *Gaffkya* from other cocci. The question whether the position of flagella on the cell surface is a satisfactory basis of classification still remains to be clarified. The presence or absence of flagella is rarely a useful feature; motility has been detected in a few species or strains in several genera of the Gram-positive and typically non-motile bacteria (*Staphylococcus*, *Sarcina*, *Streptococcus*, *Lactobacillus*, *Corynebacterium*). The formation of heat-resistant endospores has continued to be a satisfactory taxonomic character, but its usefulness is almost confined to the segregation of the groups *Bacillus* and *Clostridium*.

The order Actinomycetales, which appears to offer wide scope for the successful utilization of morphology, presents many taxonomic perplexities. Here, generic boundaries are obscured by the transitional forms which may be isolated from natural habitats and by the stable variants which may be obtained from pure cultures. Most of the organisms in which a branched mycelial structure is a conspicuous feature are now allotted to the genera *Streptomyces*, *Micromonospora*, *Nocardia* and *Actinomyces*. This classification, which is largely morphological, is admittedly imperfect, but there is fairly general agreement that no better taxonomy is in sight. The finding that there is a smooth transition in morphology from the fungus-like *Streptomyces* to the structurally simpler corynebacteria and mycobacteria raises the problem of where to draw the line between the eubacteria and the actinomycetes.

The Myxobacteriales, in which segregation and division is based mainly on morphology, show two serious taxonomic weaknesses. First, the more complex forms of fruiting body have been detected only in natural materials where their variability cannot be assessed. Secondly, the separation of *Cytophaga* from the eubacteria has come under suspicion with the isolation from soil of organisms which appear to be identical with typical cytophagas except in a failure to show gliding motility on the surface of agar media.

It may be concluded that there are few definite boundaries separating the distinctive forms of bacteria, and that morphological characters tend to lack the precision desirable in determinative keys. Nevertheless, these conclusions need not detract from the great value of the microscope as a tool for the recognition of bacteria.