CONTRIBUTION TO AN ESSAY ON THE MORE
RATIONAL CLASSIFICATION OF ACTINOMYCETES*

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1. Present chaos in the classification of the actinomycetes derives to a great extent from the concept of a majority of microbiologists regarding species in general and especially with respect to microorganisms. The point of view should be finally abandoned that species are not realities in nature, that is, that they are solely taxonomic conceptions. Such ideas have led to the splitting of species on the basis of a few and unstable characteristics and to the formation of "splinter, artificial species" which actually do not exist in nature. Therefore, we should start from the principle that species are realities in nature, that they are representatives of a definite stage in the evolution of living things under determined ecological conditions, that they represent a group of generations derived from a common ancestor. These generations in the course of their struggle for existence and through natural selection have been distinguished from other representatives by a complex of different characteristics (morphological, physiological, biochemical, serological). In reality we are concerned with larger "lumped natural species" which comprise a series of varieties, biotypes, and strains. This concept in fact gives a picture of the real state in nature, since these forms actually delimit the species in nature.

2. It is evident that the immense amount of reference material, collected during the past decades of studies on actinomycetes, cannot be filed and classified within the present narrow framework now used for these microorganisms. Because of this increasing mass of material there is need to widen the present scope and format. Therefore, we propose that classification units should be extended below and

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above the present species level in accordance with the International Code of Microbiological Nomenclature. Certain transitory systematic categories should be introduced also, if such are found to be necessary. In this way it would be possible to arrive at "more natural" systems of biological classification of these microorganisms based on thorough and extensive knowledge of their properties.

3. It is necessary to introduce a definite hierarchy of characteristics on the basis of which the classification of the actinomycetes and other microorganisms may be elaborated. These criteria should be based exclusively on their constancy: the more constant properties should constitute the basis for higher categories of taxa, and the less constant for the lower categories. It is believed to be evident that under natural living conditions of microorganisms and on the basis of changes in the ecological factors of the surroundings, there occur certain less significant changes of the ferment systems and biochemical properties of microorganisms. These changes are, however, reflected in changed physiological properties, so that their morphological properties finally become manifest. We should, therefore, consider the morphological characteristics as the most constant and take them as a basis for higher systematic categories. Morphological characters would be followed by macroscopic physiological characteristics in nature, and these by the biochemical characteristics as most subject to change. On these latter the infraspecific systematic categories should be based.

4. We are proposing, therefore, that the classification of the actinomycetes should start with the determination of their morphological properties (microscopic structure of the mycelium, sporophores, spores) thus enabling one to determine certain higher systematic categories. One can then proceed with the determination of the physiological properties (macroscopic aspect of the cultures, pigmentation), and finally deal with the biochemical properties (production of antibiotics, vitamins, etc.) upon which the grouping of varieties, biotypes and strains of the particular larger "natural" species should be based. The relationship between the microorganisms and the ecological factors (temperature, oxygen, hosts, etc.) should not be taken as a basis for their classification (especially with regard to the higher systematic categories), since this relationship is

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in general already reflected in the properties noted above. Not even the economic significance of each strain of these microorganisms should have any influence on the nature of their biological classification.

5. Finally, we completely agree that the creation of a collection of type cultures should be made possible for these microorganisms also. We should then proceed with the selection and establishment of the standard culture media (mostly synthetic in nature) and of the conditions for their laboratory studies. The electron microscope, although giving reliable information, is not always accessible to many microbiological laboratories of the world, and it is too early to base the classification of the actinomycetes on data derived from them. Ultimately, our aim should be the realization of a simpler system of classification of these microorganisms. Should we take some of the above mentioned principles as a basis, we believe that even then we should not have to deal with such a great number of the larger natural species of actinomycetes as some microbiologists have envisioned. However, the number of varieties, biotypes and strains, particularly those of great economic significance would, no doubt, be increased, but this is quite justifiable. In view of this fact, we are submitting a simplified schema of such a system of classification of these microorganisms for discussion.

Class I. -ACTINOMYCETALIA-(Actinomycetes) Mycelium absent or present

Subclass I. -ACTINOMYCETINEAE - Mycelium present in early stage of cultures

Order I. -Proactinomycetales - Mycelium septate

Family I. - Proactinomycetaceae - "Spores" in chains

Genus I. - Proactinomyces - Aerial hyphae ("sporophores") absent

Genus II. - Nocardia - Aerial hyphae ("sporophores") present

Order II. -Actinomycetales - Mycelium nonseptate

Family I. - Micromonosporaceae - Spores single

Genus I. - Micromonospora - Sporophores short

- Family II. - Actinomycetaceae - Spores in chains
- Genus I. - Actinomyces - Sporophores straight
- Genus II. - Streptomyces - Sporophores spiral

Subclass II. -MYCOBACTERIINEAE - Mycelium absent in
early stage of cultures

In summary, a class is defined by the presence or absence of mycelium; subclasses, however, by the presence of mycelium in early stages of cultures; orders by septate or nonseptate mycelium; families by the groupings of the spores; genera by the presence and shape of sporophores, while the determination of the species, varieties, biotypes and particular strains is based on the shapes and structure of the spores themselves, the colour of the aerial and substrate mycelium and the production of pigments, as well as the other physiological and biochemical characteristics (sources of carbon, of nitrogen, of ferment systems; production of antibiotics and biotics, etc.).