IDENTIFICATION OF STREPTOMYCETES*

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In the course of our work with streptomycetes we have had many times the problem of identify of an isolation of our own with a known species, or of its recognition with certainty as a new species. The existing systems did not satisfy our needs.

The identification of a streptomycete with the description only is, at least, difficult. Criteria of very different systematic value are to be taken into consideration. There is no clarity as to which characters are important for species delimitation and which are only accessory (ancillary). For a long time production of a soluble pigment was considered to be a criterion of primary importance. Today many authors have replaced it by description of the colour of the vegetative and aerial mycelia and by the morphology of the aerial mycelium.

The system of classification of one author describes a certain strain in quite a different fashion than that of another author. To avoid this source of error we have concluded to rely only on comparison with known strains of culture collections. But this procedure gives rise to still other problems: a) in many cases the original (type) cultures are lost or are not available and, b) often one finds differences between the recorded description of the reference culture and his own observation. Can the differences which are found be regarded as consequences of variability?

As a result of our experiences with many culture collection strains and with our own isolations we have come to the conviction that this frequently cited variability is limited to striking but untrustworthy criteria such as a soluble pigment, antibiotic activity or the colour of the vegetative mycelium.

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However there are certain criteria which we consider as constant in the sense that they do not vary during a long observation period in the laboratory, that single spore cultures are homogeneous with respect to these criteria and that these criteria are in general independent of the medium, the culture conditions and the age of the culture.

Distinction based on characters ranked according to their different systematic value have been proposed by many authors, but in all such proposed systems these criteria served only for the characterization of a unit (rank, taxon) between the genus and the species, as Sectio, Series, and Group.

We propose a classification of species which discards all inconstant criteria and those not readily determinable. We regard the species as the lowest systematic unit which can be characterized by constant criteria.

Four groups of characters are suited to such a characterization and differentiation of the species, namely, a) the morphology of the spores under the electron microscope, b) the colour of the aerial mycelium, c) the morphology of the aerial mycelium, d) the ability to form a melanoid pigment in media containing peptone. I present a brief survey of the subdivisions of these four groups of characters.

a) As to the morphology of the spores, I must mention that it is not the form but the outline that is significant. It is important to note whether the spores are smooth or whether they show appendages. Not only the presence of appendages, but also their specific form is constant, as hairs, thorns, or prickles.

b) by the "colour of the aerial mycelium" we mean the colour of the well-developed, mature aerial mycelium, called by some authors "spores en masse." I will not discuss the differences between our colour groups and the colour groups established by other authors. I will merely give a summary of our colour groups. We distinguish

niveus	(snow-white)
griseus	(yellowish-greenish-gray)
azureus	(blue)
cinnamomeus	(pink-cinnamon)
cinereus	(gray)
prasinus	(leek green)

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Determination of the colours by use of colour tables did not prove practical, because one cannot indicate the whole range of colour. So we accepted for each colour group certain strains (we took culture collection strains), which showed good formation of aerial mycelium and which showed the certain colour in a typical shade.

c) Our system of defining the morphology of the sporophores is in principle similar to the system of Pridham, Hesseltine and Benedict. But while these authors united several types in the same section we recognized each type as an equivalent unit. Important for the recognition of the type of morphology of the aerial mycelium are the presence or absence of a sterile middle-axis, from which the fertile spore chains branch; the mode of ramification (sympodial-monopodial); the ability or inability to form whorls (it must be mentioned here that we were not able to separate single and double whorls); the ability or inability to form spirals and the kind of spiral (closed-open, regular-irregular).

d) As to the fourth point, the formation of a melanoid pigment, I will only mention that we have a method which allows one to distinguish easily between chromogenic and nonchromogenic types.

Of all the possible combinations we found only a small number realized. So, for example, the colours griseus and cinnamomeus were always associated with smooth spores and the strains with aerial mycelium having colours azureus or prasinus all had spores with hairs or thorns. All the strains with spores with appendages showed spiral formation in the aerial mycelium and finally all strains with aerial mycelium griseus showed sympodially branched tufts with flexuous branches in the aerial mycelium.

As a result of these conclusions we grouped all our strains into species. In our opinion, other criteria as, for instance, soluble pigment, antibiotic activity, colour of the vegetative mycelium, utilization of carbon sources and other physiological criteria can serve only as accessory criteria suitable below the rank of species for the description of a special strain.

In conclusion, I want to say that for us the two most important points for the systematics of the genus Streptomyces seem to be:

a) The fixation (determination) of species with help of type strains, preserved in official type culture collections.

b) The characterization of the species only by employing stable characters and as a consequence the raising of the species level to a reasonable height, so that in future not every strain will be described as a single species.