REMARKS ON THE CLASSIFICATION OF
STREPTOMYCES*

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Any single character of a microorganism is likely to vary within more or less wide limits. Therefore (a) a large number of different characters should be used, and (b) more weight should be given to characters that experience has shown to be least variable. The latter will usually be well-chosen morphological features whose presence is governed by the interaction of many different genes.

With only a few of the characters discussed at the Conference have I had personal experience.

- a) Antibiotic production: This type of property can have at most a secondary value only, since it is subject to wide quantitative variations and since a given antibiotic can be produced by several completely unrelated organisms.
- b) Antibiotic sensitivity: This type of property can be more useful. Admittedly, mutants resistant to any antibiotic can be obtained by proper techniques. However, the appearance of such mutants and their selection under natural conditions (i.e., in the absence of laboratory manipulations) is not likely to occur to any appreciable extent when it must be the result of multiplestep mutations, as is usually the case.

In fact, studying Corynebacteria isolated from the human respiratory tract, the frequency-distribution of sensitivity to several antibiotics was found to be different for groups of strains considered, on other grounds, to belong to distinct species (Welsch et Thibaut, *Ant. v. Leeuwenhoek*, 14:193, 1948; *C. R. Soc. Biol.* 143:1284, 1949; Thibaut, *C. R. Soc. Biol.* 146:143, 1952).

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- c) Production of specific actinophages (lysogeny) and sensitivity to actinophages: Again these properties are subject to wide variation when the organisms are subjected to appropriate laboratory procedures, but the occurrence of such variations under natural conditions is probably much rarer.

A review of the literature shows that many actinophages have a very wide spectrum of activity. They cannot be very useful for identification and classification of species. However, a recent paper (Bradley and Anderson, *Science* 128:413, 1958) demonstrated by their use the affinity of species placed in two genera, Streptomyces and Nocardia included in two different families.

On the other hand, actinophages with a much more restricted range of activity are also known. A group of phages was shown to act exclusively on strains belonging to the Streptomyces griseus group (Welsch, Corbaz and Ettlinger, *Schweiz. Z. Path. Bakt.* 20:454, 1957; Welsch et Pinkaers, *C.R. Soc. Biol.* 151:1283, 1957) as defined by Ettlinger and co-workers (*Giorn. Microbiol.* 2:91, 1956).

One of the viruses (Welsch, *Giorn. Microbiol.* 1:339, 1956; Ant. v. Leeuwenhoek, 23:59, 1956) acted, although with quantitative differences, upon all the organisms of the group which were tested (but one which proved to be a lysogenic strain carrying a related prophage) and had no action except in a few cases even when used in a high concentration, on unrelated streptomycetes.

We therefore believe that phage sensitivity and prophage carrying (Welsch, *Virology*, 2:703, 1956; Bull. Res. Counc. Israel, 7E:141, 1958) are properties likely to help the taxonomist. However, much remains to be done in order to define a proper methodology for their use and we are not now able to propose a technique. Quantitative rather than purely qualitative methods will be necessary. It must also be stressed that most of the actinophages known at present are griseus-phages.

Obviously phages for unrelated actinomycetes should be obtained (Welsch, Minon and Schönfeld, *Experientia* 11:24, 1955) and studied before a definite opinion about their use can be offered.

BACTERIOLOGICAL NOMENCLATURE
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- d) Genetic interactions between strains: Recent work has clearly shown that heterokaryons and, more rarely, true hybrids can be obtained following the mating of two different mutant strains of an actinomycete. The possibility of mating between organisms considered to be related should strengthen this opinion, and conversely. Perhaps, in the near future, mating will offer a convenient criterion for the practical definition of a species. An eminent French zoologist, once was asked by a friend of mine whether he was right in according species status to a newly described copepod. The answer was: it is a distinct species if it does not cross, or gives only infertile crosses with the other species which it resembles. The criterion was, of course, impractical in the case under consideration since the only representative of the would-be new species had been in alcohol for many years, but techniques could be devised to have this test applied in the case of streptomycetes.