INTRODUCTION

Spores of bacterial or fungal origin are more and more utilized by experimental biologists as models for cell differentiation studies (Gould et al., 1969; Sussman & Halvorson, 1966; Turian, 1969).

*Neurospora*, the "red bread mold" of the geneticists, can differentiate two main types of spores, namely those of asexual origin, the conidia, which form in mass an orange-red powder, and those of sexual origin, the black ascospores. These last spores undergo a dormancy period and require an activation process to germinate (Sussman, 1966). In the laboratory routine, the *Neurospora* life cycle is usually initiated by the germination of semidormant cells, the conidia. Most commonly, the large multinucleate asexual spore, the macroconidium, is used rather than the asexual microconidium, which can be distinguished by its small size and single nucleus. The microconidia are produced later in the growth cycle and in restricted numbers.

Macroconidia can occasionally function as sexual, male cells donating nuclei to receptive hyphae (dicaryotization) of the opposite mating type. Microconidia, with their high nucleo-cytoplasmic ratio, are structurally spermastia-like elements and are functionally better adapted for mating in direct contact with the trichogyne, the specialized and chemotropically oriented prolongation of the female ascogonial coil (Backus, 1939). It must be noted that the production of at least macroconidia is confined to the most classical species of the genus
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(Backus, 1939). It must be noted that the production of at least macroconidia is confined to the most classical species of the genus *Neurospora*, such as *N. crassa*, *N. sitophila*, and *N. tetrasperma* (Dodge, 1930). The more recently discovered species appear as normally aconidial (Nelson et al., 1964; Mahoney et al., 1969; Frederick et al., 1969).

In this review, we focus our interest on the better known macroconidia. Our elementary knowledge of the microconidia has been discussed elsewhere (Turian & Viswanath-Reddy, 1971). During these last ten years, numerous studies have been aimed at elucidating the factors controlling differentiation of macroconidia in *N. crassa*. These efforts are justified by the fact that the mold producing them is one of only a few well known eucaryotic microorganisms, from a genetic and biochemical point of view (Beadle & Tatum, 1941; Wagner & Mitchell, 1965). We consider successively, and try to show whenever possible, relationships between the morphological and physiological aspects of macroconidial differentiation, the process usually called conidiation in *Neurospora*.

MORPHOLOGY AND GENETICS

Developmental Sequence

The concept of a macroconidium has only a superficially descriptive and convenient value for distinguishing one of the asexual types of the *Neurospora* sporal alternative. The term “macroconidium” does not convey any meaning from the dynamic point of view of sporogenesis. So-called macroconidia are also formed in the asexual phase of other Ascomycetes like the Dermatophytes and the Fusaria, where they are long, plurisepetate spores.

In a first attempt to designate the usual conidia of *Neurospora* by a morphogenetically more significant name, Langeron & Talice (1932) applied the natural classification scale proposed by Vuillemin (1910, 1911) and considered them as thallo-arthrospores, i.e., sporal elements formed by disarticulation of preformed hyphae. *Neurospora* conidia would thus have some analogy with the spores of Geotrichum, Trichosporum, and others.

The morphological aspect of conidiation implies a time sequence of events starting with the simple elongation of vegetative hyphae and ending with the rounding up of more or less ovoid, maturing conidia. Extension of the hyphae occurs first into solid or liquid medium or along the medium-air interphase. As such, these can be called, by analogy with the thinner procaryotic vegetative filaments of the Streptomycetales, “substrate hyphae.” Following some type of “triggering,” some relatively narrow vegetative hyphae (Bianchi & Turian, 1967a) change their orientation and elongate into the ambient air, somewhat perpendicularly to the substrate (Fig. 1), thus deserving their descriptive but also physiologically meaningful name of “aerial hyphae” (Dodge, 1931; Grigg, 1960a; Turian, 1966a). This term is also well