Conjugate Nuclei in the Ascomycetes.

BY

E. J. WELSFORD, F.L.S.,

Assistant in the Department of Plant Physiology and Pathology, Imperial College of Science and Technology.

With four Figures in the Text.

DURING the last few months an investigation of the process of infection by *Botrytis cinerea* has revealed the fact that the nuclei in the multinucleate hyphae of this fungus, produced by the germinating conidia, are very generally arranged in pairs. Such hyphae were very well nourished, having developed at a temperature of 26° C. either in strong turnip juice or in the tissues of the leaf of *Vicia Faba*. Mycelia from conidia grown in water or much-diluted turnip juice (1 in 16) did not show paired nuclei, neither were these found in the narrow ill-nourished hyphae which occasionally occur in the parasitic mycelium in the Bean leaf. The paired condition of the nuclei is only found in well-nourished fast-growing filaments, and hence it seems to be correlated with rapid growth. The pairing can be explained by the fact that nuclear divisions follow one another so rapidly that the sister nuclei formed by one division have not time to move apart to any considerable distance before they start dividing again.

Fig. 1 is a drawing of a conidium growing in strong turnip juice; all the nuclei are in the paired condition; the members of the pairs in the germ tube are farther apart than those in the conidium; the separation is no doubt preparatory to division. An older stage is shown in Fig. 4; only part of the hypha is drawn; it had entered its host plant and was thriving on nourishment obtained from the epidermal cells. The pairs of nuclei marked *a* have recently divided, those marked *b* have no doubt moved apart in preparation for further division. The fact that an unpaired nucleus is rare in a well-nourished filament indicates that the sister nuclei divide simultaneously. A striking contrast to these well-nourished hyphae is shown in Figs. 2 and 3. Fig. 2 represents a germinating conidium twenty-four hours after sowing in a drop of distilled water on a glass plate; the germ tube which can only draw nourishment from the conidium has very few

nuclei, and the conjugate character is not well marked. As the reserve food of the conidium is used up the paired condition becomes still less evident. Fig. 3 shows an older and more starved hypha grown in *very dilute* turnip juice; in the second cell no indication can be seen of the nuclei being in pairs.

A similar phenomenon has been found in the mycelium of *Sclerotinia Libertiana*. The nuclei in well-nourished hyphae growing in the stem of *Vicia Faba* are arranged in pairs, whilst in starved hyphae the nuclei are unpaired.

As pointed out by Fraser¹ in 1913, conjugate divisions are not at all uncommon in the different parts of the Ascomycetes. They have been observed by various writers: in the conidial mycelium of *Hypomyces perniciosum* (Masse); in the germ tubes of the ascospores of *Ceratostoma*

FIGS. 1-4. Conjugate nuclei in *Botrytis cinerea*. All figs. $\times 1200$.

brevirostra (Nichols); in the paraphyses of *Helvella crispa* (Carruthers); in the large storage cells of *Helvella elastica* (McCubbin); and in the ascogenous hyphae of a large number of Ascomycetes (Maire, Guillermond, Claussen, Faull, &c.). The presence of conjugate nuclei in the ascogenous hyphae has been very frequently noticed, and it has been regarded by certain authors (Guillermond, &c.) as a special sexual phenomenon. Both Claussen² and Faull³ lay great emphasis on this arrangement of the nuclei in the ascogenous hyphae, regarding the synkarion which they find there as consisting of a male and a female nucleus. Faull asserts that the 'conjugate

¹ Fraser, H. C. I. (Gwynne Vaughan): Development of the Ascocarp of *Lachnea Cretea*. Ann. Bot., xxvii, 1913, p. 559. Full references are given in this paper.

² Claussen, P.: Zur Entwicklungsgeschichte des Ascomyceten *Pyronema confluens*. Zeit. f. Bot., iv, 1912, p. 1.

³ Faull, J. H.: The Cytology of *Laboulbenia chaetophora* and *L. Gyrinidarum*. Ann. Bot., xxvi, 1912, p. 325.

divisions play an important part' in the life cycle of the plant, and considers that 'cognizance of the phenomenon' must be taken in all investigations into the sexuality and phylogeny of the Ascomycetes.

If, however, the results here described are shown to be general for the Ascomycetes, and there is some evidence of this, the observation of conjugate nuclei in the ascogenous hyphae would give us no help in elucidating the sexual phenomena of the group. The paired condition of the nuclei may simply be the response to the physiological conditions usually found in such hyphae, that of high nutrition associated with rapid growth.

Welsford, E. J. 1916. "Conjugate nuclei in the Ascomycetes." *Annals of botany* 30, 415–417. <https://doi.org/10.1093/oxfordjournals.aob.a089611>.

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