the fact that rotenone persists for weeks or even months in natural waters and thus necessitates extended delays or special detoxification, for example, with permanganate, before restocking. The extreme potency of antimycin against goldfish coupled with its rapid degradation and much lower toxicity to higher animals suggests that it may be useful in fish management. Much more extensive investigations on various species of fish and other aquatic organisms have been carried out elsewhere and will be separately reported¹⁰.

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PHILIP H. DERSE

Wisconsin Alumni Research Foundation Laboratory,

F. M. STRONG

Department of Biochemistry,
University of Wisconsin,
Madison 6, Wisconsin.

¹ Van Tamelen, E. E., Dickie, J. P., Loomans, M. E., Dewey, R. S., and Strong, F. M., *J. Amer. Chem. Soc.*, **83**, 1639 (1961).

² Strong, F. M., *Topics in Microbial Chemistry*, 33 (John Wiley and Sons, Inc., New York, 1956).

³ Liu, W., and Strong, F. M., *J. Amer. Chem. Soc.*, **81**, 4387 (1959).

⁴ Wen-Chih Liu, Ph.D. thesis, Univ. Wisconsin (1958).

⁵ Reference 2, p. 39-41; Green, D. E., Mii, S., and Kohout, P. M., *J. Biol. Chem.*, **217**, 561 (1955).

⁶ Bevelander, G., *J. Morphol.*, **57**, 335 (1935).

⁷ Wood, E. M., and Yasutake, W. T., *The Progressive Fish-Culturist*, **19**, 7 (1957).

⁸ Ahmad, K., Schnelder, H. G., and Strong, F. M., *Arch. Biochem.*, **28**, 281 (1950).

⁹ Sharp, R. D., *Soap and Chem. Specialties*, **37**, 159 (1961).

¹⁰ Walker, Charles R., and Lennon, Robert E., Fish Control Laboratory, LaCrosse, Wisconsin (unpublished work).

Development of the Ascospore and its Appendages in the Marine Fungus *Ceriosporopsis*

I HAVE previously pointed out¹ that the mucilaginous material of which the ascospore appendages of *Ceriosporopsis cambrensis* is composed is accumulated in the cytoplasm at each end of the young spore. This mucilaginous area is probably not cut off as an appendage from the rest of the spore by a septum as is the primary spore appendage of *Pleuraea* according to Moreau².

The interpretation of the development of the ascospore and its appendages in *C. halima*, based on observations of microchemical tests, is shown in Fig. 1, A-F. Details of the methods used will be published elsewhere.

When the spore is first cut out of the ascus cytoplasm it contains a single nucleus and is surrounded by a delicate cell wall. As it enlarges, the nucleus (Fig. 1, *n*) moves to one side of the spore, divides mitotically, and one daughter nucleus moves to each end of the spore. The young spore contains numerous small oil globules (Fig. 1, *o*) which eventually merge so that when, after nuclear division, a septum (Fig. 1, *s*) is formed as an ingrowing ring separating the spore into two cells, there is one large oil drop close to the septum in each cell. Meanwhile, however, while the spore is still one-celled and uninucleate it can be seen that the spore wall consists of two membranes, the episporium (Fig. 1, *C*, *ep*) and endospore (Fig. 1, *C*, *end*), and there is a minute pore (Fig. 1, *C*, *p*) in the latter at each end of the spore. The young spore becomes spindle-shaped (Fig. 1, *B*) and mucilaginous material (Fig. 1, *B*, *C*, *m*) accumulates at each end. This material is then extruded through the pores in the endospore and causes the separation of the episporium and endospore at these points and the formation of the appendages encased in the episporium. The inner layer of the wall which had been stretched by the accumulation of mucilage at each end of the cell (Fig. 1, *C*, *end*) contracts as the mucilage is extruded into the appendages (Fig. 1, *D*, *end*). The pore is later closed by a pore plug (Fig. 1, *F*, *pl*).

Surrounding each of the eight ascospores in the ascus of *C. halima* there is a mucilaginous envelope or perisporium formed from the epiplasm of the ascus and shown in the series illustrated only in Fig. 1, *E*, *per*. In *C. halima* this does not much impede the extrusion of the appendages which, although sometimes curved to one side during development (Fig. 1, *E*), usually project straight out at each end of the spore at maturity (Fig. 1, *F*).

Fig. 1. A-F, Development of ascospore and its appendages in *C. halima*. *c*, Cytoplasm; *end*, endospore; *ep*, episporium; *g*, granules; *m*, mucilage; *n*, nucleus; *o*, oil; *p*, pore; *per*, perisporium; *pl*, pore plug; *s*, septum

The appendages are formed in the same way in *C. cambrensis* and *C. hamata* as in *C. halima*, but the perisporium imposes some differences. In *C. cambrensis* the appendages, extruded within its dense mass, are forced to form folded against one side of the spore and only stretch out when the mucilaginous perisporium dissolves in the sea. In *C. hamata* the appendages are very short and folded against the spore in any direction and some may remain bent.

In contact with sea water, first the perisporium swells and dissolves and the appendages may straighten out. The appendages remain firm and intact for a while, their mucilaginous interior protected by the episporium from direct contact with water during spore dispersal. Soon, however, the tip of the appendage becomes soft and sticky (perhaps there is a minute apical pore in the episporium as well as in the endospore which allows contact with water at these points), and the soft mucilage in the appendage can then be drawn out to form a long string when touched with any solid object.

The role of the appendages in spore dispersal followed by their entanglement and attachment to any substrate encountered is nicely correlated with the structure of the spore and the successive exposure of different mechanisms after contact with water.

IRENE M. WILSON

Department of Botany,
University College of Wales,
Aberystwyth.

¹ Wilson, I. M., *Trans. Brit. Mycol. Soc.*, **37**, 272 (1954).

² Moreau, C., *Encycl. Mycol.*, Paris, **25**, 1 (1953).