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SPORE DEVELOPMENT IN THE FORM-GENUS PHOMA

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(With 31 Text-figures)

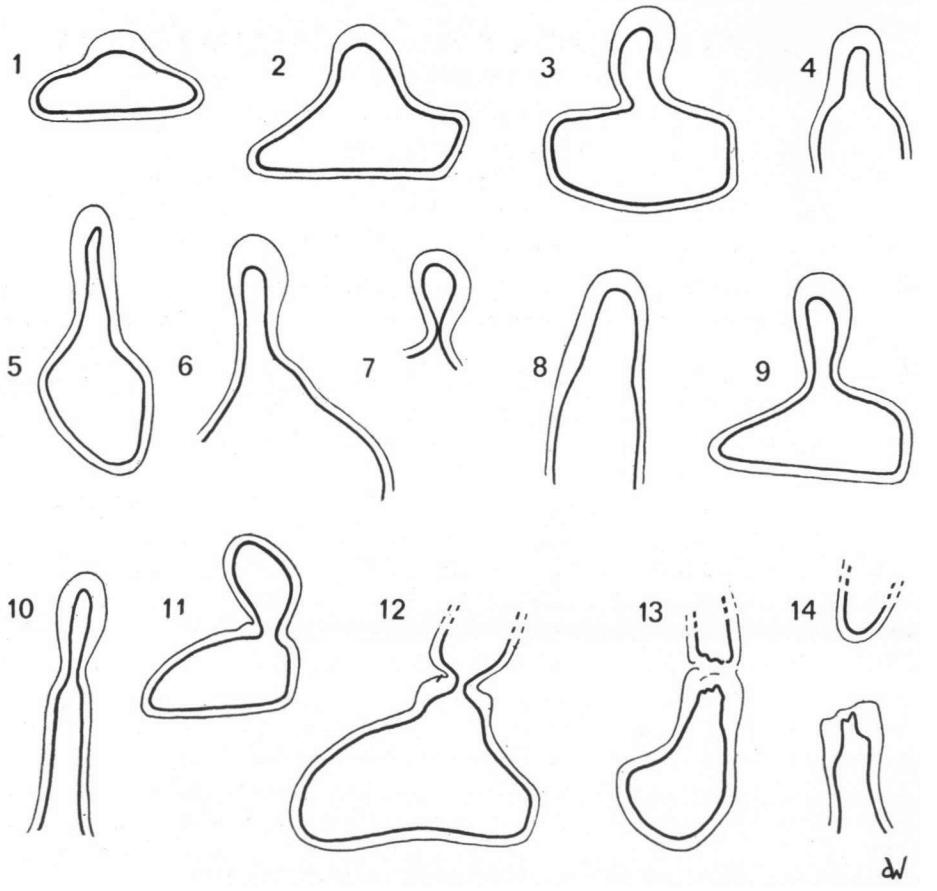
Diagrams drawn after electron-micrographs of the spore formation in *Phoma* spp. are shown. The manner in which the spores are formed, called here the 'monopolar repetitive budding process', is discussed.

In the present paper a number of diagrams are given of the spore-forming process in *Phoma* spp. drawn after numerous micrographs obtained by Ir. J. G. Brewer (see Brewer & Boerema, 1965[1] in an electron-microscopic study. These diagrams explain the various pictures of the spore formation in the form-genus *Phoma* as seen with the light-microscope.

The sporogenous tissue in the pycnidia of *Phoma*-like fungi is extremely small-celled and hyaline. This explains the differences in interpretation of the light-microscope observations on the spore-forming process in this kind of fungi (Klebahn, 1933; Goidànich & Ruggieri, 1947; Boerema, 1964; Boerema & van Kesteren, 1964; Sutton, 1965). It is rather like the case of a Papua who sees a Western style house for the first time from a distance. In spite of his sharp eyes he must look at it more closely to understand the details he is seeing. In the case of the spore formation in *Phoma*-like fungi such an inspection at close quarters was made possible through the electron-microscope.

As described by Brewer & Boerema (l.c.) the spore-forming process in *Phoma* spp. may be characterized as a monopolar repetitive budding of the small, undifferentiated inner cells of the pycnidial wall. Chains of more than ten spores can be born by a single parent cell (Figs. 24, 28). In the electron-micrographs the spore first produced by the parent cell can always be recognized by the fact that the outer (electron-transparent) layer of the bud is not connected with the slimy coat of the other spores in the pycnidial cavity. The development of the first spore starts as a papilla-like protrusion which gradually acquires the shape of a bud (Figs. 1–10). On abstriction of the first spore, the wall at the top of the parent cell expands into a more or less thick, rim-like fold (Figs. 11–14). The initials of the subsequent spores are shaped like a bud from the start (Figs. 15, 16). With the repetition of the budding process either the apical fold of the wall of the parent cell becomes increasingly thicker or a complex of folds is seen to develop (Figs. 17–23). This structure seen under the light-microscope makes the parent cell often resemble a phialide (Sutton, 1965) or even an annellophore. The gradual thickening of the wall at the top of the parent cell may also be the cause

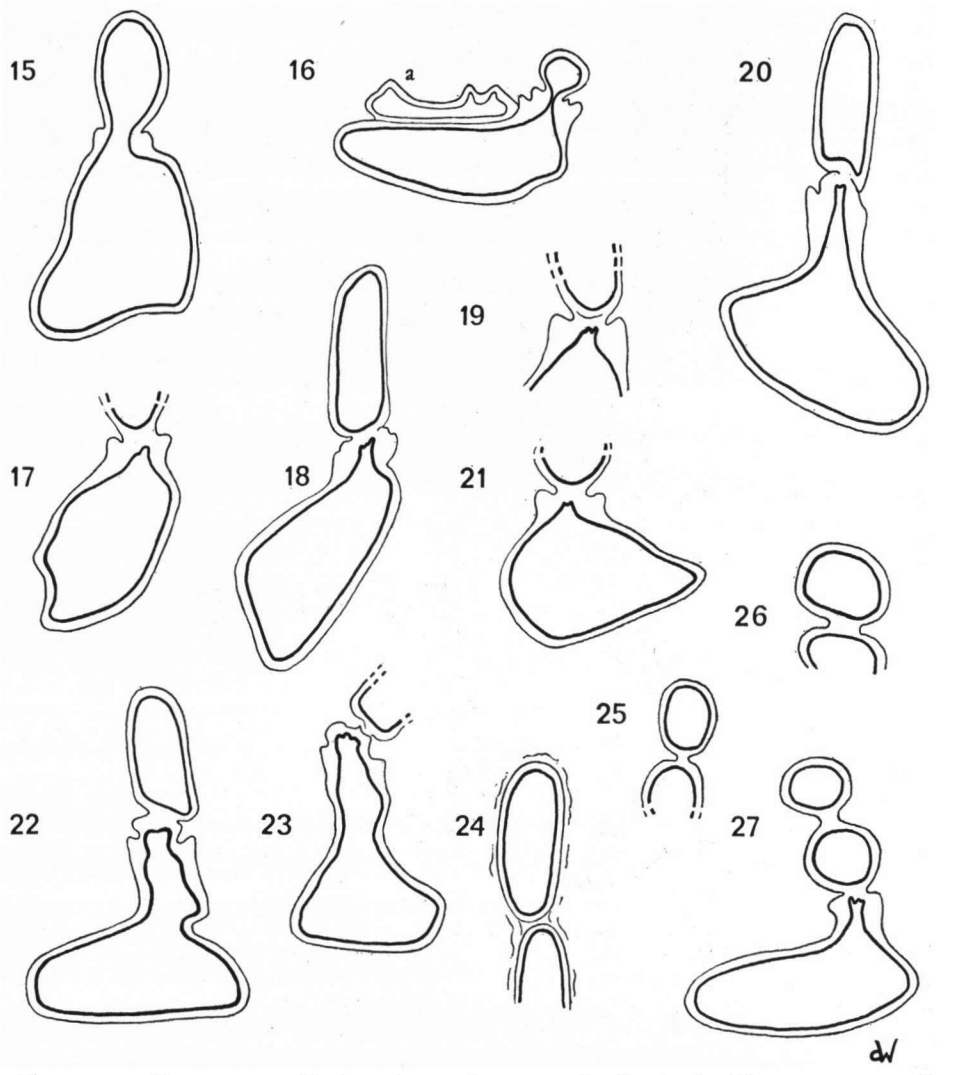
[1] Except in Figures 24, 28, the slimy matter surrounding the spores (the disintegrated electron-transparent layer of the spore-initial + the 'cloudy substance') has not been drawn.



Figs. 1–14. *Phoma* spp. — Various stages of spore formation by budding on "virginal" parent cells.
Diagrams drawn after electron-micrographs; magnification ca. × 2500.

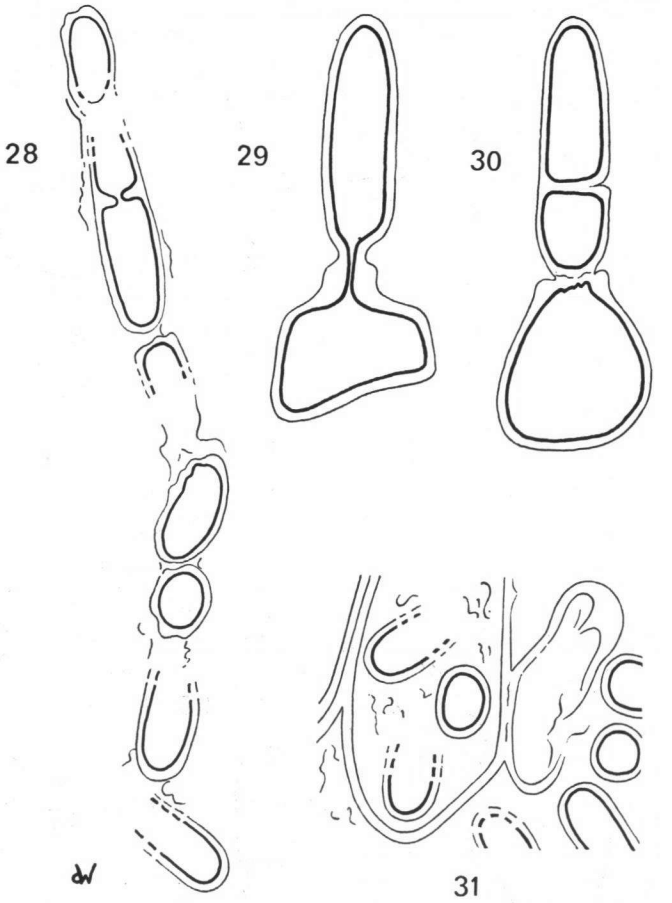
of the phenomenon that a bud, seen under the light-microscope, seems to be connected with the parent cell only by a thin thread of plasm (Figs. 16, 19).

The electron-microscopic study by Brewer & Boerema (l.c.) reveals that the differentiation of the spore-wall during the process of budding takes place in very gradual stages. This may explain why, under the light-microscope, the wall of the spore-initial is often difficult to distinguish. This is particularly true in cases in which the protoplasm has been stained. Under the light-microscope the spore then gives rather the impression of having been produced by an extrusion of a part of the plasm through a small pore in the thickened apex of the parent cell (Goidànich & Ruggieri, 1947; Boerema, 1964: "porogenous").



Figs. 15–27. *Phoma* spp. — Various stages of spore production by budding on parent cells which have previously produced spores. — 16a. Old collapsed parent cell. — 22, 23. Deeply seated parent cells with neck-like outgrowths resembling sporophores. — 24. Two spores connected by a slimy mass. — 20, 21. Deformed "double" spores produced by extremely rapid budding.
Diagrams drawn after electron-micrographs; magnification ca. × 2500.

Spore-forming cells deeply seated in the meristematic tissue develop protuberances (pseudo-sporophores), on which the spores arise by budding (Figs. 22, 23). If spore formation is carried out in rapid succession, a new bud may be produced



Figs. 28–31. *Phoma* spp. — 28. A chain of spores connected by a slimy mass, showing one large, septate spore between smaller, continuous ones. — 29, 30. Production of large spores which on abstriction usually become more-celled by "euseptation". — 31. Central part of a pycnidial primordium, a loose cell containing three (endogenous?) spores.
Diagrams drawn after electron-micrographs; magnification ca. × 2500.

at the top of the parent cell before the former has been detached, which may give rise to deformed "double" spores (Figs. 25–27).

In mature pycnidia of *Phoma* spp. septate spores also often occur.[2] These more-celled spores develop in the same way as the continuous ones (Fig. 28), generally appearing as relatively large buds (Fig. 29) which become septate immediately on abstriction (Fig. 30) or else later: euseptation, see Brewer & Boerema (l.c.).

[2] The percentage of more-celled spores is influenced by conditions governing the growth, inclusive of the matrix, but specific and racial features are also involved. Some species *in vivo* produce chiefly septate spores, whereas *in vitro* the spores are for the greater part continuous.

Finally, it should be noted that the electron-microscope observations have strengthened the opinion that the first spores in a pycnidium of a species of *Phoma* may be of endogenous origin (Fig. 31; compare Boerema, 1964).

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