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ULTRASTRUCTURE OF BASIDIOSPORES

1. Beenakia

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The ultrastructure of the spore walls of *Beenakia dacostae* (Beenakiaceae, Gomphales) has been studied. Spore walls are mainly composed of a distinct episporium and a thick, dark, ornamented ectosporium. The general structure is identical with that of other members of the Gomphales, such as *Gomphus* and *Ramaria*

In a series of papers, the spore-wall ultrastructure of certain taxa of Basidiomycetes will be discussed. Fresh as well as dried herbarium material has been studied, and although it was found that fresh specimens show somewhat more detail, dried specimens are also worthy of study. The technical, time consuming part of these studies was performed by the second author.

Unfortunately, a large number of descriptive terms have been introduced in the literature for the different wall layers of spores. Since no general consensus seems to be in sight, I have hesitatingly used a few of them. Without wishing to enter into a discussion of the correctness of these terms, I refer the reader to the photos for illustration, and to the relevant literature in which the terminology is discussed (Clémençon, 1970, 1977; Keller, 1974; Kühner, 1980; Perreau, 1967, 1976).

METHODS

Samples of spores from herbarium specimens were rehydrated in 0.1% glutaraldehyde in 0.1 M Na-cacodylate-HCl buffer (pH = 7.3), to which the wetting agent invadine was added. After several washings in buffer the samples were post-fixed for two hours in 1% OsO_4 in 0.1 M cacodylate buffer, washed in buffer, and dehydrated in a graded ethanol series. During dehydration the material was stained with 1% uranyl acetate in 30, 50, 70 and 96% ethanol. Samples were embedded via propylene oxide in Epon (Luft, 1961) or via acetone in Spurr's low viscosity embedding medium (Spurr, 1969) with the additive dibuthylphthalate (Clémençon, 1973). Sections were cut with a diamond knife on a LKB ultramicrotome III, and were poststained with uranyl acetate (Glauert, 1967) and/or lead citrate (Reynolds, 1963).

Preparations were viewed with a Philips EM 300 electron microscope.

Beenakia dacostae Reid

Material studied: Australia, Victoria, Dandenong Ranges, Sherbrooke Forest, 8 Sept. 1956, *H. H. Willis* (L).

The genus *Beenakia*, with the single species *B. dacostae*, was described by Reid (1956) based on a specimen from Australia. The genus, characterized by small, stipitate basidiocarps with hydnoid hymenophores and brown, ornamented spores, was placed in the family Hydnaceae sensu lato.

The type species was subsequently found several times in New Zealand and was redescribed by Cunningham (1958) who placed the genus also in the Hydnaceae.

Beenakia was restudied by Maas Geesteranus (1963) who gave a detailed analysis of the hyphal structure of *B. dacostae*.

In his discussion of the systematic position of the genus, he emphasized the *Ramaria*-like, cyanophilous spores, very slender basidia, and fragile, inflating hyphae, and consequently placed the genus in the family Gomphaceae. With the arrangement of the Aphyllophorales and the recognition of the Gomphales as a distinct order, *Beenakia* was placed in a special family Beenakiaceae (together with *Kavinia, Psathyrodon* and *Ramaricium*), differing from the Gomphaceae and Ramariaceae in the construction of the basidiocarps (Jülich, 1981).

The genus is still very small and comprises but three species: *B. dacostae* Reid from Australasia, *B. fricta* Maas G. from Africa, and *B. informis* (Rick) Maas G. from South America.

ULTRASTRUCTURE OF THE SPORE WALLS

The spores are brown, elongate, ellipsoid, 7–10 × 3.4–4 μm, thin- to slightly thick-walled, and are covered with small, cyanophilous warts. Ultra-thin sections show an essentially two-layered structure:

i) The inner layer, the episporium, appears greyish and slightly granular. In most sections it seems to be uniform, although sometimes a faint stratification is visible. The episporium is separated from the cytoplasm by a thin, not always preserved, dark layer. In some spores the greyish episporium overlies a thick, almost hyaline layer which is more or less well delimited from the cytoplasm. We can offer no explanation for this thick, innermost layer; it might be the strongly inflated and in other spores almost invisible endosporium, but it might also be an artifact.

ii) The outer, rather thick, ornamented layer of the spore wall, the ectosporium, appears black, homogeneous, and is abruptly separated from the episporium. The ectosporium forms a continuous layer with local thickenings which appear as warts under light and scanning electron microscopy.

RESULTS

We conclude that the spore-wall structure illustrated for *Beenakia dacostae* is identical with the structures known for spores of *Gomphus* and *Ramaria* (Perreau, 1967). In

all three genera a greyish episporium surrounded by a black, continuous ectosporium is found. Light and electron microscopy, therefore, leave no doubt that the correct systematic position of the genus *Beenakia* is within the Gomphales.

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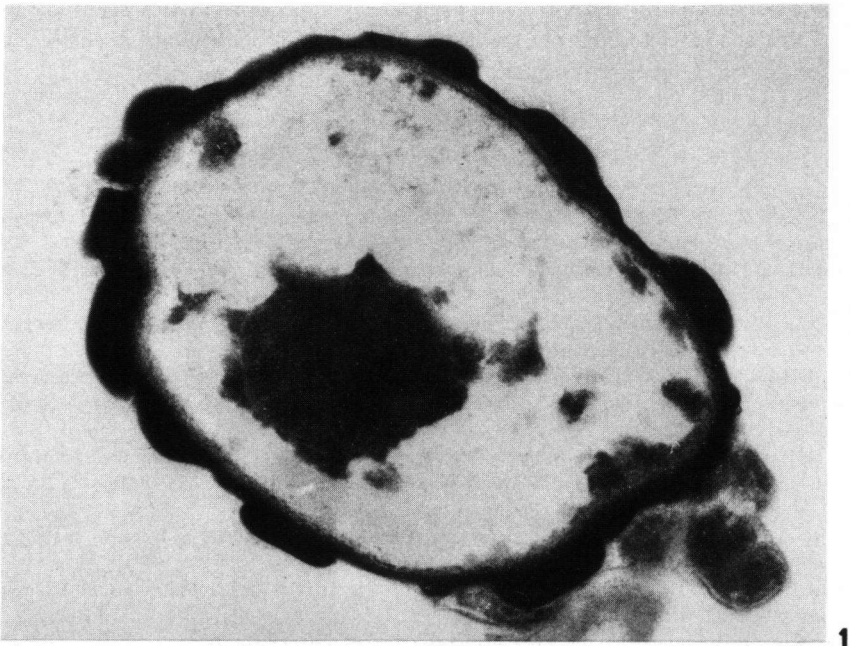
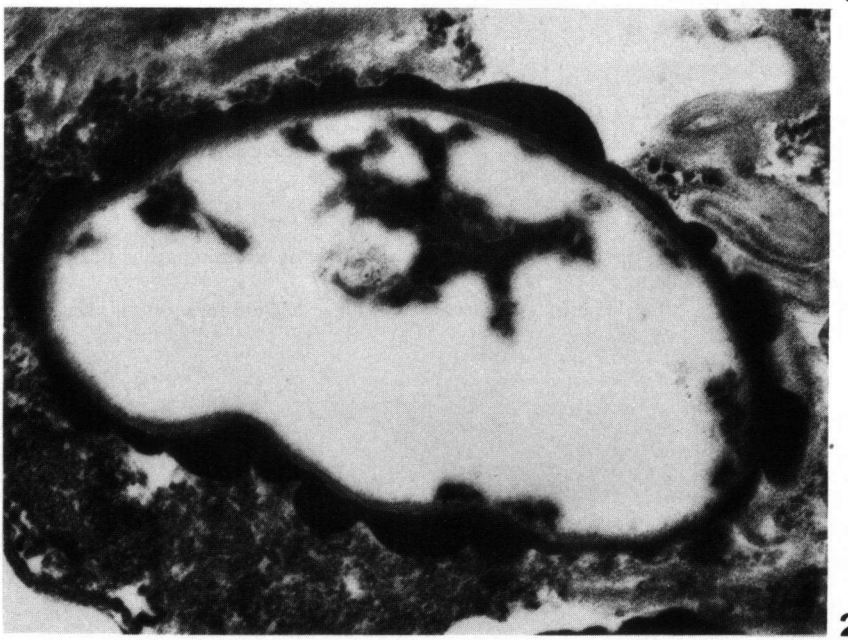
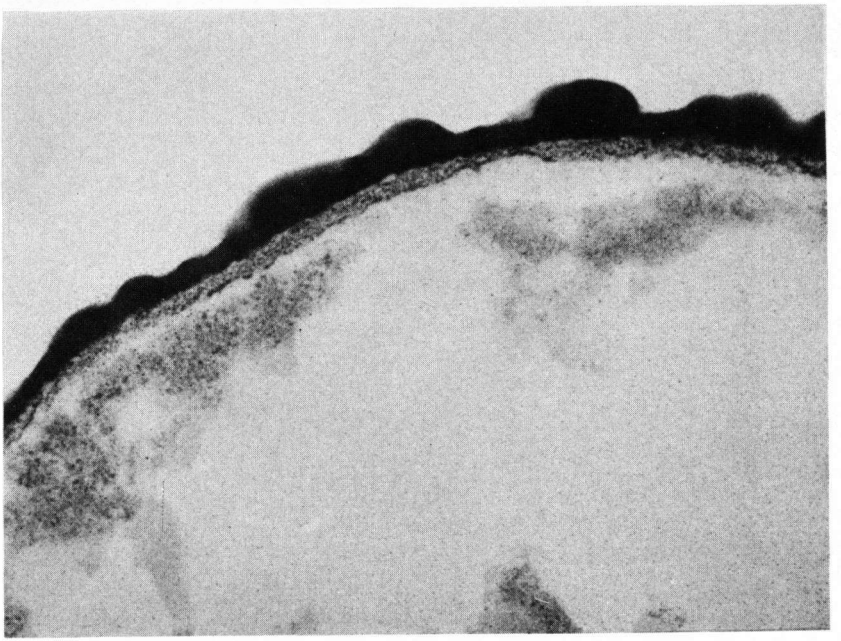




Figs. 1–2. *Beenakia dacostae*; spores with two-layered wall, × 27300. — In Fig. 1 with nucleus.



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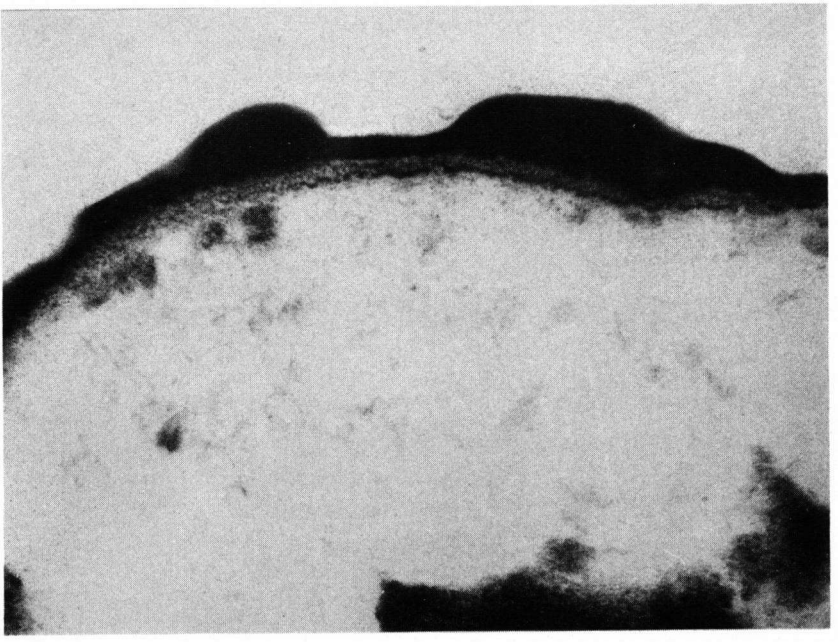

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Figs. 3–4. *Beenakia dacostae*; spore walls with epi- and ectosporium, × 57200.

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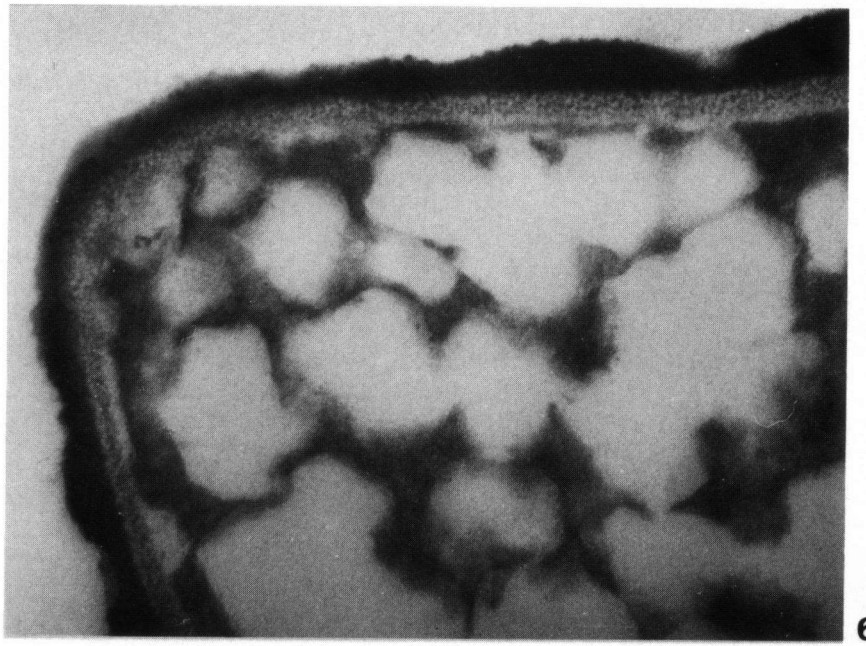

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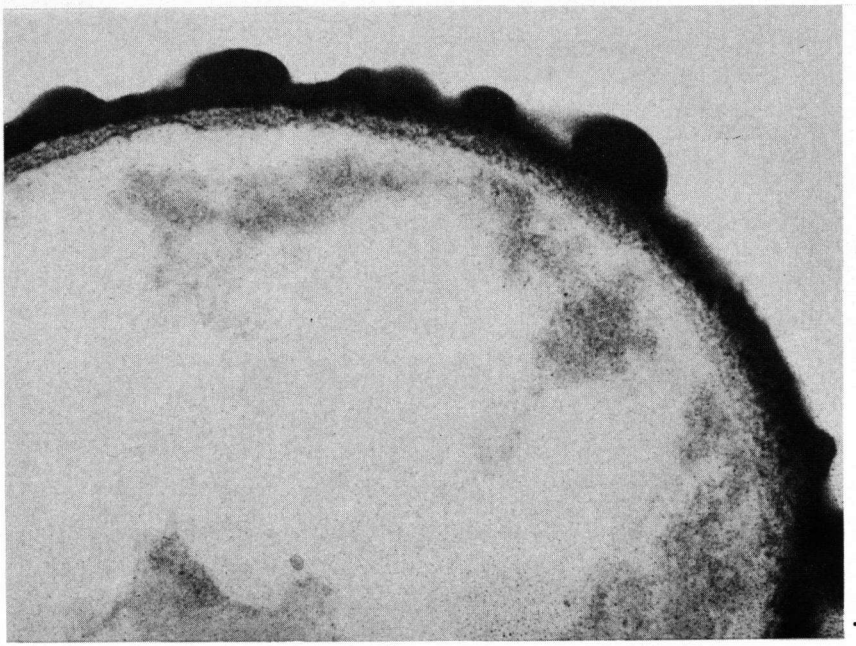
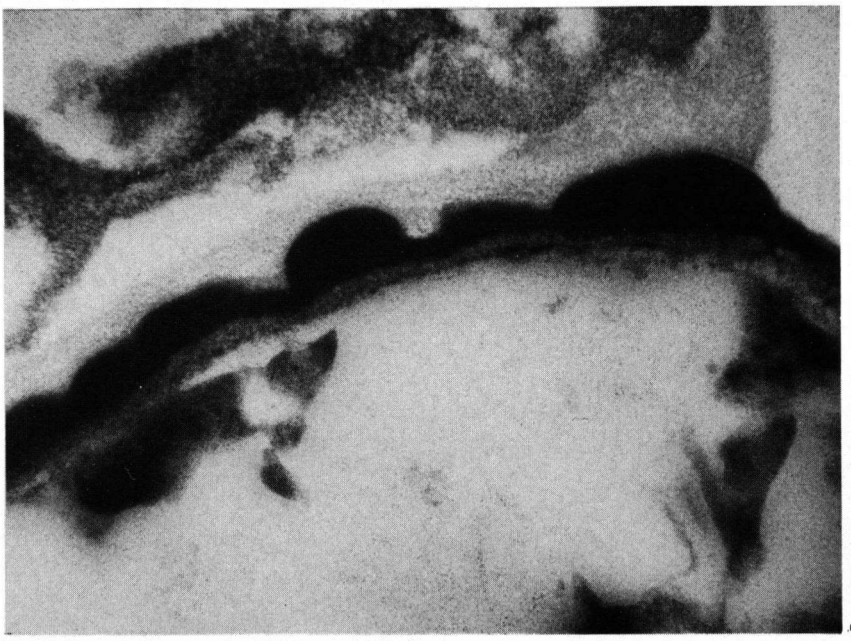
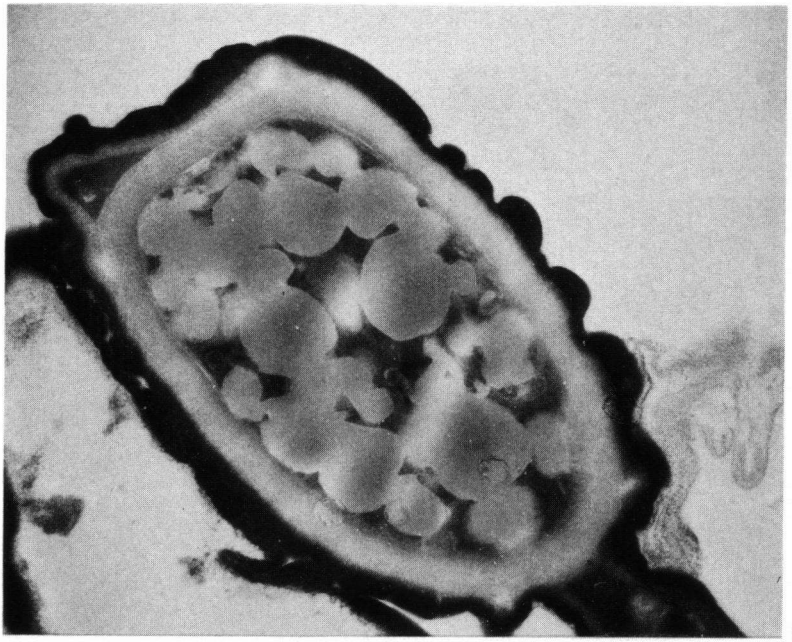
Figs. 5–6. *Beenakia dacostae*; spore walls with epi- and ectosporium, × 57200.— In Fig. 6 with vacuolated cytoplasma.





Figs. 7–8. *Beenakia dacostae;* spore walls with epi- and ectosporium, × 57200.



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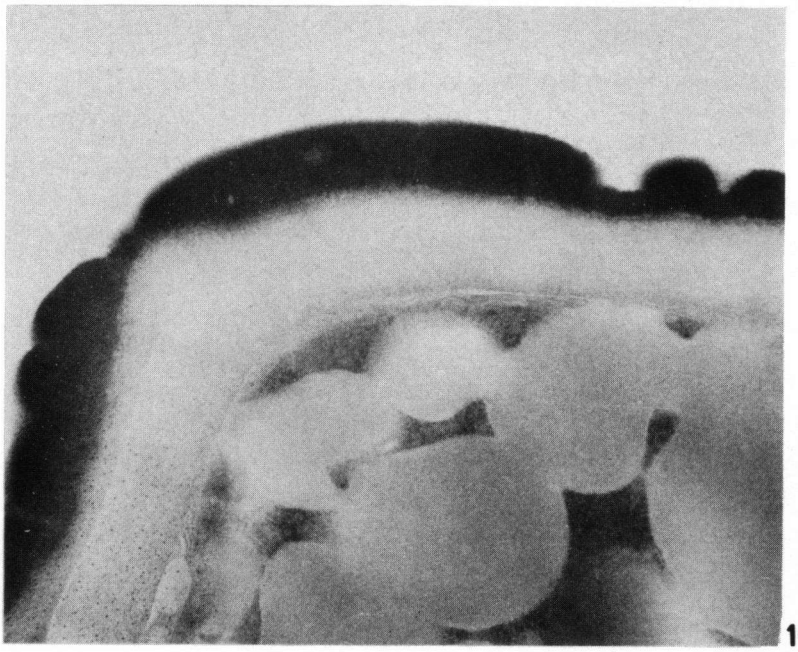

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Figs. 9–10. *Beenakia dacostae*; spore walls with ?endo-, epi-, and ectosporium; the cytoplasma with numerous vacuoles. — Fig. 9 × 23100. — Fig. 10. × 57200.