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NOTES AND BRIEF ARTICLES

(With Plates 22-26 and 6 Text-figures)

BALLOCEPHALA VERRUCOSPORA SP. NOV., PARASITIZING TARDIGRADES

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Sheep dung, collected in the Pentland Hills, near Edinburgh, for coprophilous fungi, developed small white clumps of conidiophores, which on mounting were seen to be growing from the dorsal surface of dead tardigrades. Although the literature on predaceous fungi is large only *Ballocephala* seems to have been fully described from tardigrades. The only other references to fungi in tardigrades are in the zoological literature, where early works occasionally refer to moulds being observed in them, and a paper by Reukauf (1912) describing *Macrobotophthora vimariensis*.

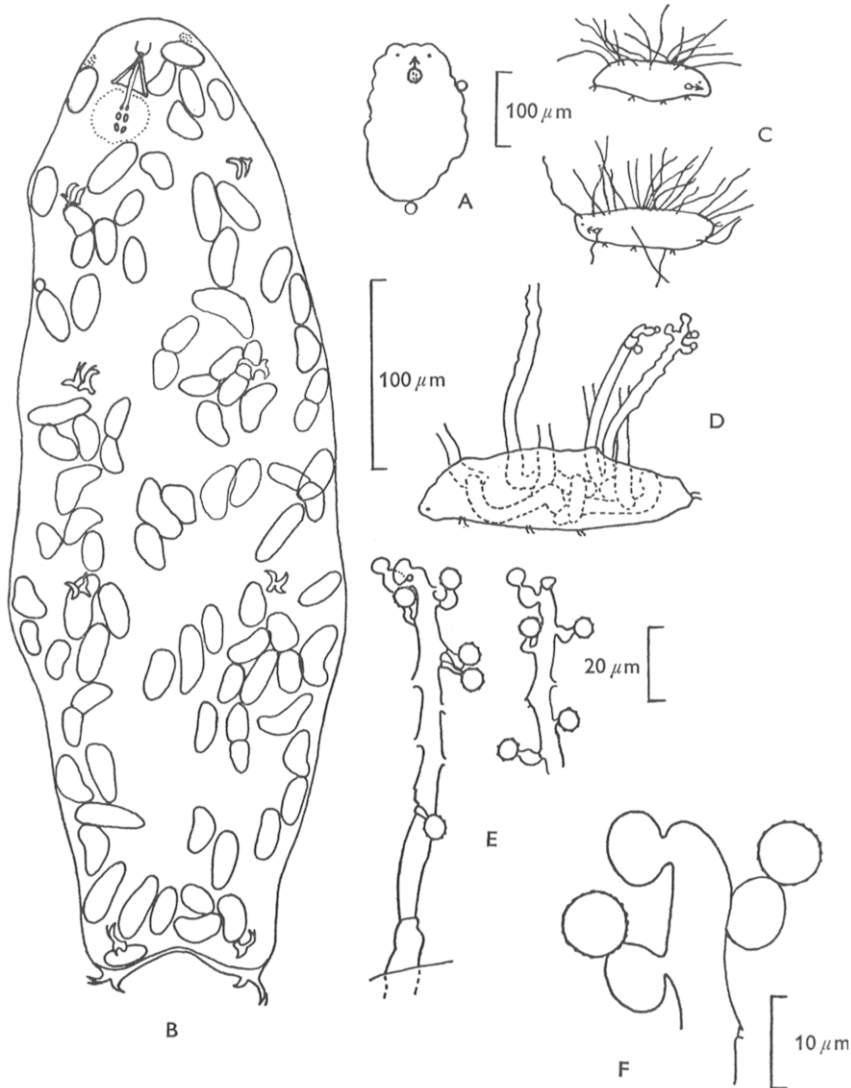
Drechsler (1951) described *Ballocephala sphaerospora*, the type species of *Ballocephala* Drechsler, from parasitized microscopic bear animalcules, *Macrobotus* (Arthropoda: Tardigrada) in cultures from leaf litter in Pennsylvania, U.S.A. The genus has so far remained monotypic. The Scottish material was readily assigned to *Ballocephala*, but differed from *B. sphaerospora*. In *B. sphaerospora* spores were smooth and 3-4.5 μm diam, and hyphal cells 5-80 \times 5-10 μm , whereas in the Scottish fungus they were minutely verrucose, and 4.5-6 μm diam with hyphal cells 20-40 \times 10-12 μm .

The conidiophores illustrated by Drechsler were consistently more densely spicate than the rather lax spikes produced by the Scottish material, but this may have been the result of cultural conditions. The spore ornamentation was difficult to see in water, but was readily observed when mounted in lactophenol with cotton blue. Attempts to obtain fresh material for scanning electron microscopy were unsuccessful. The stereoscan electron micrographs (Pl. 22, fig. 1) were therefore made from a specimen recovered from a lactophenol mount, and demonstrate the difference between the smooth sporangiophore and vesicles, and the verrucose sporangial wall.

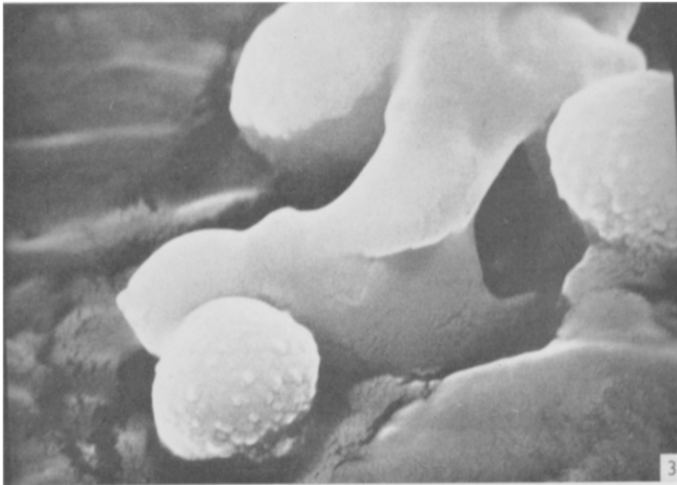
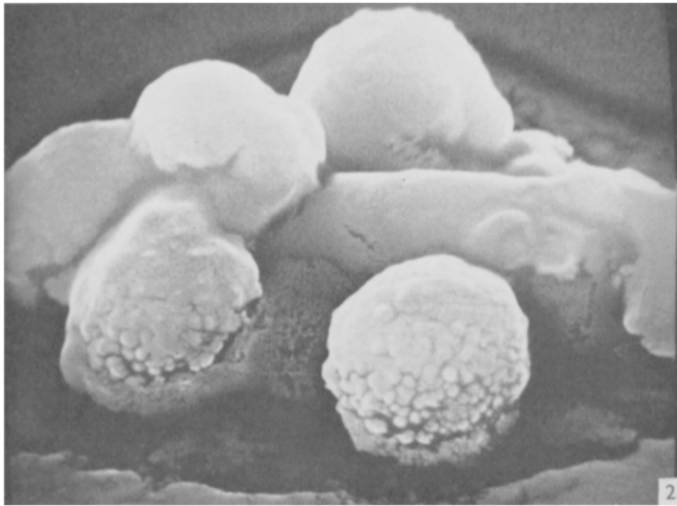
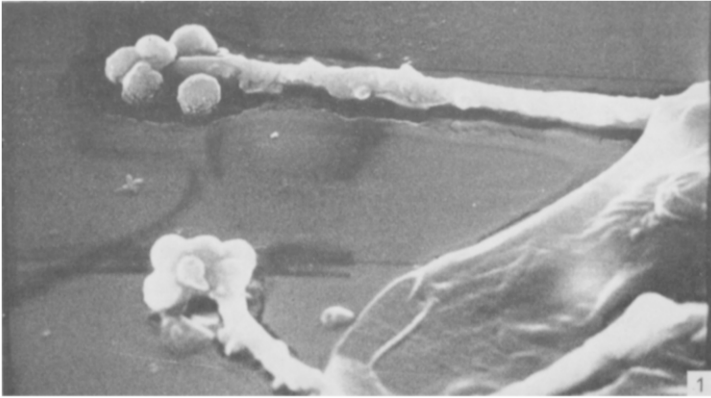
Although Drechsler designated no type, and no material has been traced, from the extensive original description and illustrations it is evident that the Scottish material differs sufficiently in its spore characters to justify its consideration as a distinct taxon.

Balloecephala verrucospora sp.nov. (Text-fig. 1)

Hyphae hyalinae, inclusae in corpore hospitis, constantes de cellis secedentibus $20-40 \times 10-12 \mu\text{m}$ diam. Sporangiphora crescentia per superficiem dorsalis hospitalis, $50-150 \mu\text{m}$ alta $\times 5-7 \mu\text{m}$ diam, septata solum ad basem. Sporangia singula parta ad apices vesicularum quae singulatum formantur in successione acropetali. Vesiculae asymmetricales, primum ascendentes, deinde pendentes factae, $5-7 \mu\text{m}$ longae $\times 5-7 \mu\text{m}$ diam, c



Text-fig. 1. *Balloecephala verrucospora*. (A) Spores adhering to the surface of a tardigrade; (B) hyphae within body cavity; (C, D) habit of sporophores; (E) sporophores; (F) detail of sporangia and vesicles.



sporangiophoris saepto divisae; in terminus formatae, repulsae autem ut prosequitur conidiophori incrementum, visae ita laterales. Sporangia globosae, 4·5–6 μm diam, minute verrucosa.

Habitat parasitus in Tardigradis (*Macrobotus?*). In fimo ovino, West Kip (550 m), Midlothian, Scotland, 11. i. 1969. Typus **IMI** 148042.

Hyphae hyaline, internal in the body of the host, composed of disjointed cells 20–40 \times 10–12 μm diam. Sporangiohores growing through the dorsal surface of the host, 50–150 μm high \times 5–7 μm diam, septate only at the base. Sporangia produced singly at the apex of vesicles which are formed at intervals, in acropetal succession, on the sporangiophores. Vesicles asymmetrical, ascending at first, becoming pendant, 5–7 μm long \times 5–7 μm diam, separated from the sporangiophore by a septum; formed terminally but pushed aside as the growth of the conidiophore continues, thus appearing lateral. Sporangia globose, 4·5–6 μm diam, minutely verrucose.

Attempts were made to culture the fungus, both in pure culture and with its host, but since few unparasitized tardigrades were seen, these were unsuccessful. For the same reason it was not possible to identify the tardigrade with certainty, but it resembled many illustrations of the genus *Macrobotus*; the pharynx and claw morphology are illustrated in Text-fig. 1 B. Most are described from aquatic habitats or amongst mosses and similar vegetation, so it is possible that the coprophilous tardigrades, if specialized, are poorly known.

The life cycle of the fungus seems very similar to that described by Drechsler for *B. sphaerospora*, but was not followed in such detail. Sporangia are attached to the outer surface of tardigrades at the anterior end (Text-fig. 1 A), and would seem to adhere as the animal comes in contact during its movements. Body cavities were filled with large, broadly ellipsoidal hyphal segments, 20–40 \times 10–12 μm (Text-fig. 1 B). Sporangiohores develop (Text-fig. 1 D–F) after the animal dies. A dead tardigrade with its cluster of pure white sporangiophores was readily visible at a magnification of $\times 16$. No zygospores were seen.

I am grateful to Mr J. Goodall of the Department of Electrical Engineering, University of Edinburgh, for taking the stereoscan electron-micrographs, and to Mrs I. Degan for the Latin diagnosis.

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EXPLANATION OF PLATE 22

Ballocephala verrucospora

- Fig. 1. Two sporangiophores with sporangia. Host body wall at bottom right. ($\times 1200$).
 Figs. 2–3. Sporangia (verrucose) and subsporangial vesicles and sporangiophore (smooth). ($\times 6000$).