

XEROTREMA, A NEW GENUS OF ODONTOTREMOID FUNGUS FROM SCOTLAND

MARTHA A. SHERWOOD*

&

BRIAN J. COPPINS

ABSTRACT. The genus *Xerotrema* and its type species, *Xerotrema megalospora*, are described as new, based on collections from Scotland and the western United States. *Xerotrema* is differentiated from *Odontotrema*, which it resembles in most respects, by having enormous muriform ascospores in single-spored asci. The bibliographic and nomenclatural problems associated with this and other fungi which seem to form facultative associations with algae are discussed.

Odontotrema Nyl. and allied genera constitute a well-defined group of discomycetes which have been almost totally neglected by modern mycologists. Although the group is apparently a fairly large one (cf. Sherwood *et al.*, 1980), its members are inconspicuous, have no known economic importance, and tend to fruit in habitats and at times of the year not favoured by other discomycetes. Ecologically they are more similar to lichens than to typical non-lichenized ascomycetes, and some are parasymbionts on lichen thalli or are facultatively associated with algae. *Odontotrema* was originally described by a lichenologist, William Nylander, and has been incorrectly treated by some authors as a lichen.

The systematic position of *Odontotrema* and its allies has been a matter of controversy. Nannfeldt (1932) and Hein *et al.* (1971) considered the genus to belong to the Helotiales, while Sherwood (1977) regarded it as ostropalean. Recently we have discovered a hitherto unknown odontotremoid fungus with muriform spores, which lends further support to the contention that these fungi should be transferred from the Helotiales to the Ostropales. Muriform spores are almost unknown among non-lichenized discomycetes. They occur in *Claussenomyces* Kirschst., a few species of *Pezicula* Tul., and in the dubiously helotialean genera *Waltonia* Saho, *Tryblidium* Rebert. ex Fr., and *Pseudographis* Nyl. They occur, albeit sporadically, in the Ostropales (Sherwood, 1976; 1977), more frequently among lichenized discomycetes in the Lecanorales and Graphidales, and among the bitunicate Hysteriales.

There is no available generic name for a fungus which resembles an *Odontotrema* but has asci which contain a single enormous muriform spore. The distinction between transversely septate and muriform spores is generally regarded as a good character at the generic level, and there are other characters (1- hyphenium, brown epithecium, non-capitate asci) which separate the present species from the type of *Odontotrema*. Initially it was thought that the species might fit in the lichen genus *Ramonia* Stizenb., but the excipulum of *Ramonia* is composed of small-celled *textura angularis* rather than of hyphal filaments embedded in a gel, and the species does not

* Botany Department, University of Liverpool, P.O. Box 147, Liverpool L69 3BX.

seem to be genuinely lichenized. As the fungus has neither a generic name nor a specific epithet we are describing it as a new genus and species, *Xerotrema megalospora*.

***Xerotrema* Sherw. & Coppins, gen. nov.**

Apothecia immersa vel erumpescentes, minuta, atra, urceolata, poro denticulato aperta. Margo extus carbonaceo, intus periphysioideis gelatinosis praedito. Asci unitunicati, primo crassitunicati, in iodo non caerulescentes. Paraphyses numerosis, filiformes. *Odontotremae* simile, sed sporis muriformis, magnis.

SPECIES HOLOTYPICUS: *Xerotrema megalospora* Sherw. & Coppins.

Apothecia small, dark brown or black, at first immersed and closed, becoming partially erumpent, sessile, opening by an entire to dentate pore to expose the deeply urceolate disc. Margin similar to that of *Odontotrema*, composed of small-celled textura intricata in a gelatinous matrix, with an inner layer of periphysoidal hyphae and an outer layer of dense black amorphous material which is produced by melanization of the gel between the marginal hyphae and gives the surface of the fruitbody a crumbling, carbonized appearance. Paraphyses filiform, septate, simple or apically branched. Asci functionally unitunicate, at first somewhat thick-walled, 1-, the apex thin or thickened but without a definite pore or apical annulus, 1 (?-8)-spored; ascospores muriform, large, colourless, not turning blue or purple in iodine.

On weathered, scarcely decayed, wood, sometimes facultatively associated with algae but not forming a definite lichen thallus. In addition to the type species, there is another muriform-spored immersed discomycete, figured by Sherwood (1976) but not formally described, which could probably be included in *Xerotrema*. Unfortunately it is known only from fragmentary material found in a collection of *Robergea albicedrae* (Heald & Wolf) Sacc. & Trav. on decorticated wood of *Juniperus*, and the chances of obtaining better material from central Texas (USA) seem remote. It has 4-spored asci.

***Xerotrema megalospora* Sherw. & Coppins, sp. nov. (Fig. 1).**

Apothecia solitaria vel gregaria, primitus clausa et immersa, dein erumpentia et lacerato-dehiscentia, orbicularia, atra, latit 0.3-0.6 mm. Margo extus carbonaceo, intus periphysioideis gelatinosis praedito. Asci unitunicati, primo cylindrici, dein oblongati, breviter stipitati, apice non incrassati, 140-180 $\times$ 35-40 μ m, in iodo non caerulescentes, 1-spори. Sporae oblongatae, hyalinae, muriformae, 90-140(-170) $\times$ 22-40 μ m, cellulis 3-4 μ m diam. Paraphyses filiformes, septatae, apice ramosae, 1.0 μ m diam., in iodo non caerulescentes. Epithecio brunneo. In ligno decorticato *Pini* et *Arctostaphyli*, Scotia et Oregon, USA.

HOLYTYPUS: Scotia, Mid-Perth, Black Wood of Rannoch, supra ramulis decorticatis *Pini sylvestri*, Grid ref. 27/55, leg. B. J. Coppins nr. 2710, 30 iii 1977 (E).

Additional specimen seen: USA, Oregon, Linn Co., Horse Rock Ridge, on decorticate wood of shrubby *Arctostaphylos* sp., leg. M. A. Sherwood & L. H. Pike, 21 iii 1979 (E).

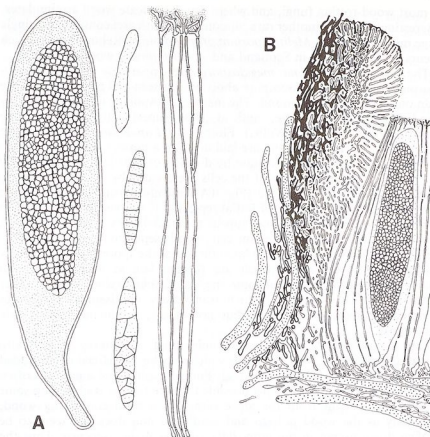


FIG. 1. *Xerotrema megalospora*. A, ascus, developing ascospores, and paraphyses, $\times 770$. B, cross section of apothecium, $\times 460$. From the holotype (E).

Ascocarps scattered on bleached decorticate wood, at first immersed, becoming partially erumpent, 0.3–0.6 mm diam., orbicular, black, opening by a dentate pore to expose the deeply sunken dark brown disc, the margin rough, with coarse radial striations. Margin in cross section c. 50 μm thick, the outermost layer heavily carbonized, lined on the inner face by unbranched septate periphysoidal hyphae c. $20 \times 1.5\text{--}2 \mu\text{m}$, widely spaced in a gel. Subhymenium colourless, c. 15 μm thick, small-celled, resting directly on disintegrating wood. Paraphyses filiform, septate, mostly unbranched below, branched apically, 1.0 μm broad, cemented in a brownish gel above to form an epithecium. Hymenial gel I–. Asci initially cylindrical, becoming saccate, initially thick-walled but becoming thin-walled at maturity, without a defined apical apparatus, I–, 1-spored, $140\text{--}180 \times 35\text{--}40 \mu\text{m}$. Ascospores colourless, muriform, $90\text{--}140(170) \times 22\text{--}40 \mu\text{m}$, the cells 3–4 μm diam.

On hard decorticate wood, Scotland and Oregon (USA). Judging from the limited collection data the fungus is uncommon and fruits in late winter when it is unlikely to be collected. It is not host specific but is probably restricted to woody plants which grow in exposed situations unfavourable

to most wood-rotting fungi, and where dry decorticate wood accumulates. Interestingly there is another rare 'discomycete' with asci containing a single large muriform spore, *Melittosporium propolidioides* (Rehm) Rehm, which occurs on *Pinus* wood in Scotland and *Arctostaphylos* wood in Oregon.

The asci of *Xerotrema megalospora* are apparently initially monosporous; no evidence of ascospore abortion was seen and no asci with more than one ascospore were found. The mature ascospore is unlike that of any non-lichenized discomycete, and at least superficially resembles the ascospores of *Phlyctis* (Wallr.) Flotow or *Lopadium* Körber in the Lecanorales. At first the septa are laid down in a normal sequence: i.e. the spore becomes transversely septate by division of cells into approximately equal halves, and later some of the cells are divided by a vertical septum, resulting in a muriform spore (Fig. 1A) resembling the spores of some Pleosporaceae. This pattern of initial septation is still visible in the mature spore, but subsequent divisions appear to occur in any plane. Moreover, when a mature spore is crushed the cells readily separate from one another. Perhaps the most reasonable explanation is that the spores have a tendency to fragment at the septa which are formed late in development. An analogous situation occurs in some species of *Schizoxylon* Pers., another genus of the Ostropales, in which transversely multiseptate ascospores fragment at some of the septa but not others, producing multiseptate part-spores.

Like a number of other odontotremoid fungi, *Xerotrema megalospora* occurs in association with algal cells which may be superficial or imbedded within the uppermost layers of wood. Fungal hyphae and algal cells often come into contact, and it seems possible that the fungus is obtaining some of its fixed carbon from the algae rather than by decomposing wood, especially as the wood is hard and weathered and does not seem to be broken down except in the immediate vicinity of the ascocarp. Thus the question arises of whether *Xerotrema* should be regarded as a lichen. Hawksworth (1978) reviewed the problem of a precise definition of the term lichen and concluded that 'one is forced to conclude that a simple definition of what biotrophic fungus-alga associations should be regarded as lichenized is not possible at the present time'. Since casual, potentially biotrophic associations between lignicolous discomycetes and algae appear to be common, it is convenient for bibliographic and nomenclatural reasons to consider such associations as non-lichenized. To give but one example of the difficulties that the alternative poses, consider the large discomycete genus *Orbilbia* Fr. At least one and perhaps more of the species are associated with algae (Benny *et al.*, 1978). Because of the provisions of Article 13 of the *International Code of Botanical Nomenclature*, regarding *Orbilbia* as a lichen would result in changes in the citation of names published between 1753 and 1821, and perhaps in the names themselves. It is illogical for a code of botanical nomenclature to apply different rules to closely related organisms because they differ in their biology. We are strongly in favour of adopting a uniform starting point date of 1753 for both lichenized and non-lichenized Ascomycetes.

Casual biotrophic associations between fungi and algae deserve more attention than they have hitherto received. In order to understand the evolutionary steps which culminate in a morphologically and physiologically

co-ordinated dual association, it would be useful to compare the biology of fungi and algae which form casual associations in nature with those isolated from advanced lichens. Unfortunately we know *Xerotrema*, *Odontotrema*, and their allies only from dried herbarium specimens and have no information on their cultural characteristics. We feel, however, that this group (and others, e.g. Calicales: see Tibell, 1978), which includes lichen parasymbionts as well as lignicolous fungi loosely associated with algae, is of potential interest to the lichen physiologist, and merits continued investigation.

ACKNOWLEDGMENTS

This work was completed during the tenure by one of us (M.A.S.) of a Science Research Council grant to the University of Liverpool for the preparation of a new checklist of British Ascomycetes.

REFERENCES

- BENNY, G. L., SAMUELSON, D. A. & KIMBROUGH, J. W. (1978). Ultrastructural studies on *Orbilbia luteorubella* (Discomycetes). *Can. J. Bot.* 56:2006–2012.
- HAWKSWORTH, D. L. (1978). The taxonomy of lichen-forming fungi: Reflections on some fundamental problems. In STREET, H. E., ed., *Essays in plant taxonomy* pp. 211–243. London, New York & San Francisco.
- HEIN, B., MÜLLER, E. & POELT, J. (1971). *Bryodiscus grimmiae*, ein neuer, moosbewohnender, helotialer Discomycet aus Lappland. *Svensk Bot. Tidskr.* 65:355–360.
- NANNFELDT, J. A. (1932). Studien über die Morphologie und Systematik der nicht-lichinisierten, inoperculaten Discomyceten. *Nova Acta Reg. Soc. Sci. Upsal.* 4, 8(2):1–368.
- SHERWOOD, M. A. (1976). The genus *Platystictia*. *Mycotaxon* 3:233–238.
- (1977). The Ostropalean fungi. *Ibid.* 5:1–277.
- , HAWKSWORTH, D. L. & COPPINS, B. J. (1980). *Skyttea*, a new genus of odontotremoid lichenicolous fungi. *Trans. Brit. mycol. Soc.* 74 (in press).
- TIBELL, L. (1978). The genus *Microcalicium*. *Bot. Notiser* 131:229–246.