# AN INTRODUCTION TO CORTICIOID FUNGI

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This article is addressed to those who find it difficult to identify any corticioid fungus with confidence. 'Corticiology' is always likely to remain a minority interest even within the minority interest that is mycology since there are major hurdles to be jumped to get into the subject. Once in however, it is a fascinating and rewarding field.

**What are corticioids and where do they fit?**

It doesn't do to question too closely just what is meant by a corticioid fungus. The only sensible answer to "What is a Fungus?" is well known to be "Anything studied by mycologists". In a similar vein the only sensible answer to "What is a corticioid?" is "Anything included in *Corticiaceae of North Europe* (CNE)". There is, in fact, a continuum from smooth through merulioid to poroid forms connecting corticioids such as *Phlebia* or *Phanerochaete* to pored fungi such as *Gleoporus* or *Ceriporia*. Any demarcation line will be arbitrary and the question of where to draw it is not one of importance.

If the limits of corticioids are vague, so too are the relationships between them, which provide a fascinating puzzle that is only just beginning to be resolved. In the traditional treatment offered by Rea (*British Basidiomycetae*, 1922) the corticioids (broadly defined) were a unit, a single family Thelephoraceae, taking their place alongside other families of the Aphyllophorales, such as Clavariaceae, Polyporaceae and Hydnaceae, based on general fruitbody morphology. It is now realised that such groupings are only skin deep. The 'Gasteromycetes', for instance, are known to have evolved along several different lines from different groups of agarics and other fungi. They cannot be accommodated in a single taxonomic group. Thc corticioids and polypores are similar cases. Relationships are still so little understood that in CNE, the genera are merely treated alphabetically. In Nordic Macromycetes Vol. 3 (NM3) corticioids are more boldly grouped in various places throughout the book reflecting their supposed relationships, interspersed with polypores etc.

Some corticioids have been suspected to have close relatives with very different morphology. Thus *Ramaricium* is a corticioid genus with all the microscopic characters of *Ramaria*, while *Gloiothele lactescens* has amyloid ornamented spores and emits a whitish liquid when squashed which even smells and tastes like the milk of *Lactarius quietus*. Molecular studies are now beginning to confirm that some of these 'anecdotal' relationships are in fact absolutely real. There is then the further question whether in these cases the corticioids are 'reduced forms' of the more structured species (comparable to the various genera of minute gill-less reduced agarics) or whether, as seems more likely, evolution led in the opposite direction and *Ramaria*, *Lactarius* etc. evolved from different groups of corticioid ancestors. While such questions have in the past been entirely matters of speculation, they seem likely soon to receive incontrovertible answers. If the whole aggregate of the Agaricales, the Aphyllophorales and the Gasteromycetes do indeed have a single common ancestor, there is a good chance it was some lignicolous saprophyte with a corticioid growth form.

There are about 350 corticioid species known in Britain, around a half of all the 'Aphyllophorales'. Only round numbers are appropriate as both groups are artificial and without precise boundaries. Quite a number of species have only been added to the British list in the last ten years or so. There must be many more to come. The total compares with around 500 species in Scandinavia, where they have been studied fairly intensively over the last forty years.

**Arguments in favour**

When compared with agaricology, corticiology has much to recommend it:

• The chances of making significant finds are much higher. Over large parts of the country almost any record will be a new county record!

• This is an all-the-year-round subject. Prime sites for corticioids are the undersides of large logs. These will only be found unrewarding during long periods of drought.

• Collections do not have to be looked at with the same urgency as freshly gathered agarics. This is not to say they should be left around for a week, either inside or outside the fridge. Such treatment leads to collapsed basidia, strange hyphal outgrowths and much wasted time when identification is belatedly attempted. However if they are promptly dried, they will lose few of their characters and be no harder to identify under a microscope than when fresh.

• While even the experienced corticiologist will identify relatively few species in the field, they are rather more likely than agarics to display striking features under the microscope. A *Clitocybe* unidentified in the field is apt to remain so in the lab; not so with a corticioid.

• The literature is much less extensive and contradictory than for the agarics. There are fewer synonyms and doubtfully defined species to deal with. Species concepts are often broader.

**Getting started**

This is the problem area. Excellent identification literature exists in the form of *Corticiaceae of North Europe* (CNE), complete in eight softback volumes, with superb microscopic drawings of all the species covered (including almost everything British). Unfortunately there are two major drawbacks. Most volumes of the set are now out of print, and even once obtained the keys to genera in Vol. l are off-putting to the beginner. The good news is that a replacement is in preparation, based on this work but extended to all of Europe. It is planned to come out in two volumes in the near future.

In the meantime, identification will remain a problem. There are now good keys available within each genus in *Nordic Macromycetes* Vo1. 3 (NM3), which includes almost everything British and is highly recommended, but arriving at the right genus is often difficult. Inevitably, in a work of this size, there is insufficient information about each species to give the user much confidence, having arrived at a determination, that it is, in fact, the correct one. The frequency information in NM3 is a decided asset. To a large extent, species recorded as common in Denmark will also be common here, while species unknown in Denmark will be rare or unknown here. If you reach an apparently rare species, be suspicious! NM3 cites illustrations from Breitenbach & Kränzlin, *Fungi of Switzerland* Vo1. 2, which provides further essential reading. It gives photos, drawings and quite full descriptions of around half the British species.

**On not getting discouraged**

There is an interesting passage in CNE l:36 that reads: "It is no use to wander over vast areas turning one log here and another there. It is better to do some walking before you start collecting and then find a place you feel is suitable. Then stay there and act as a vacuum cleaner. If it is a good collecting place you will find new specimens for at least half the day amounting to some 50-100 samples." The present writer remembers first reading this at a time when he was apt to spend a long evening struggling with no more than three specimens, only to end up with one probable identification, one long shot and one still with no clues at all. Even 50 samples cheerfully collected in a morning looked like providing a month's hard work. You have to have faith that the process does very soon become much quicker with experience. Even so, a half-day in the field can easily generate two days at the microscope and still leave some issues unresolved.

There are several prerequisites for achieving a fast enough work rate to make the whole exercise rewarding:

• To see the essential structures at all clearly, you will need a good cell-wall stain (e.g. Congo Red), either that or phase contrast optics on your microscope.

• You will also need some self-confidence in

your microscope technique. Any key will inevitably ask whether clamps and cystidia are present (clamps are much easier to see than on the swollen hyphae of agarics). You need to believe you would have seen cystidia if any had been present, etc. etc.

• It is probably also essential to own a dissecting microscope. Slides made with a fine scalpel under a magnification of x20 or x30 are likely to be far more informative than squashes of arbitrary chunks picked off the hymenium at random.

• Don't waste time struggling with poor material. Collections that don't promptly reveal basidia and spores will seldom be identifiable with confidence and should usually be discarded without more ado.

• More than anything, what is needed is simply more experience. Fairly soon a number of species will become familiar. Inspection under the dissecting microscope will suggest a possibility and one slide will confirm it.This speeds things up enormously.

If you are considering a first dip in the corticioid water, don't take it after a dry day just because agarics were in short supply. A few twigs with corticioids on (*Peniophora*?), collected because there was nothing else about, do not make the ideal starting point. Such species have evolved to cope with dry conditions. Your collections are hard. They refuse to soften. They break cover slips. Eventually, they reveal mainly amorphous or crystalline matter. You give up, but in fact you haven't given yourself a chance. This material probably fruited a month ago. You can't identify it, not from any inadequacy in yourself or your literature, or your microscope, but because it long ago ceased to be in an identifiable state. Choose instead something thin and soft from under a log. A small portion will lift off easily onto a moistened scalpel and give a really informative slide with no trouble at all. Now you are in business!

**Where to collect?**

For many a field mycologist, the answer will be obvious: it will be in their favourite woods where they have already recorded widely in other groups. But if the choice is wide open, there are other factors to consider. Many species favour wood that has rotted beyond a point where its identity is at all clear. But, other things being equal, a record on a named host is that little bit more valuable than one from 'indet. wood'. So collect in monocultural stands and the host will not be in doubt. Even boring spruce plantations usually give a good range of species. Few corticioids are narrowly host specific and few are strongly seasonal. Conifer wood will have

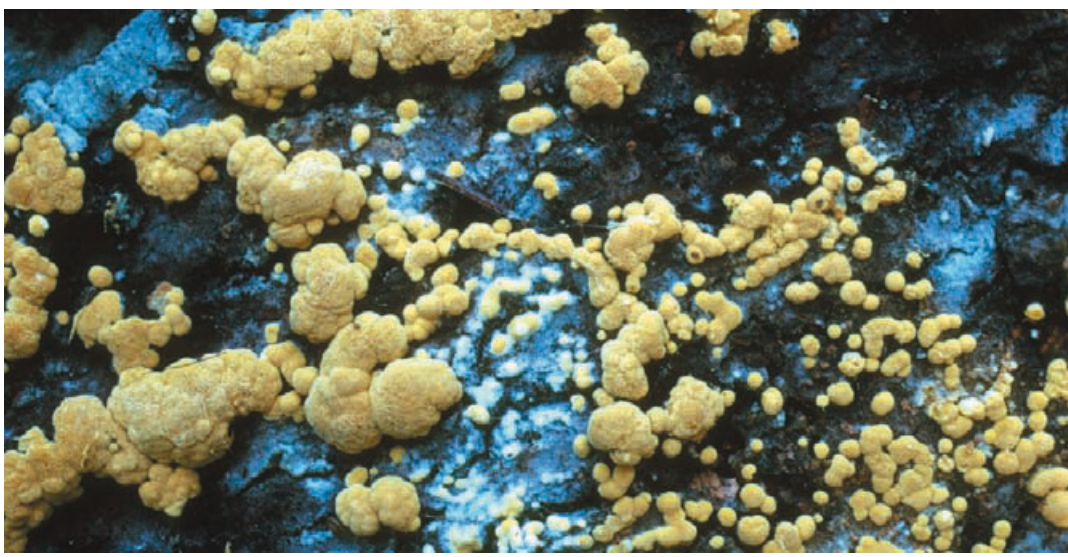

Fig. 1 *Botryobasidium aureum*: The yellow-orange cushions are the *Haplotrichum* conidial state (also known as *Alysidium aureum*) very common on damp rotten deciduous wood. Also visible is the white corticioid perfect state, much less often found. Photograph: on very rotten wood of *Fagus*, Burley Old Inclosure, New Forest, Hampshire, England, 25 September, 1998. © N.W. Legon.

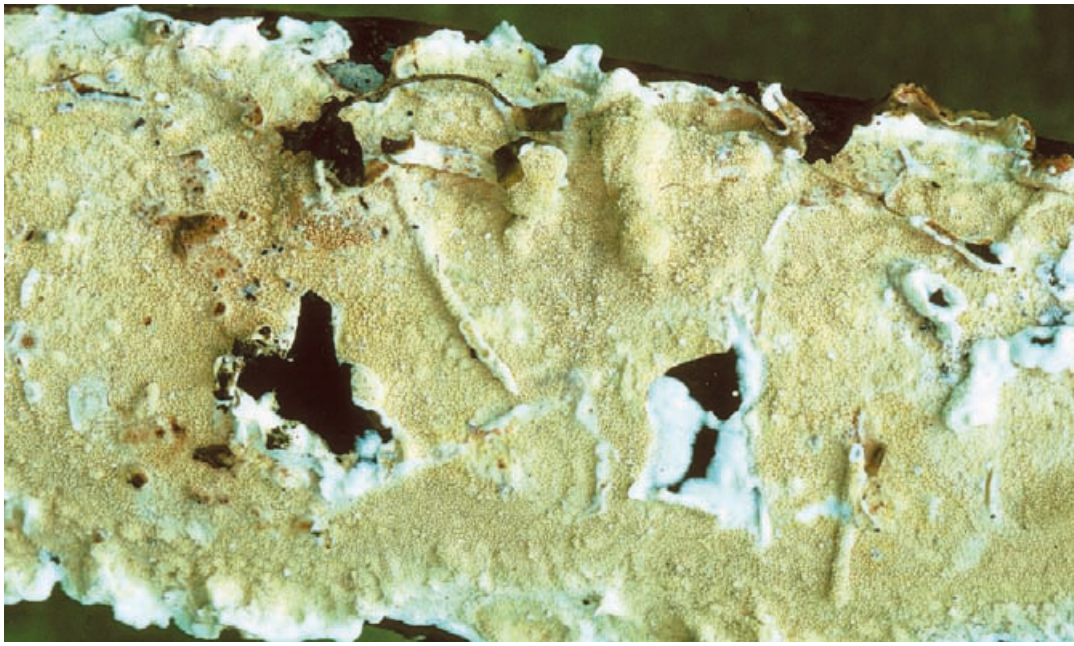

Fig. 2 *Byssomerulius corium*: Common and easily recognised when wrinkled, but often, as here, the surface remains smooth. The byssoid (= cottony) margin and growth form along deciduous twigs give other recognition clues. Photograph: on fallen branch of *Fraxinus*, Norbury Park, Mickleham, Surrey, England, 2 May 1992. © N.W. Legon.

a different range of species from deciduous, with only a few in common. Different deciduous ecosystems will have their own specialities (e.g. willow/alder carrs). A few species are specific to ferns or grow on marsh plants; these tend to be very little recorded. Almost anywhere is likely to provide something of interest.

**Back to basics**

Some deliberately fairly simplistic keys are appended, covering only the few most frequently recorded British corticioids. Familiarity with any group is in reality only gained one species at a time. These are species likely to be met with early on by anyone attempting to name corticioids. Once you can recognise most of these, you should have acquired enough points of reference for the group as a whole to seem less overwhelming. Be warned: the corticioids are a large enough subject in themselves but there are other resupinate basidiomycetes. Once you start collecting them, you will find yourself also collecting resupinate polypores, the large and difficult genus *Tomentella* (= resupinate *Thelephora*) and the bulk of the Heterobasidiomycetes, many of which are indistinguishable from some corticioids in the field. All can occur on the same logs. One thing leads to another and all will lead to busy evenings.

It was suggested in the opening paragraph that the reader might be currently unable to identify any corticioids. On reflection, there are two that should cause no trouble. If it is bright blue, it is *Pulcherricium caeruleum*, but this is rare or absent in most of Britain; it likes an Atlantic or Mediterranean climate and is common only in South Devon (see photo on back cover). If it's chalk-white and round the base of an elder and it is not in fact white paint, then it will be *Hyphodontia sambuci*, which also occurs less abundantly and conspicuously on a wide range of other hosts.

For readers who have progressed beyond these two and got stuck or want suspected rarities verified, I am happy to operate a limited identification service. Material should be either really fresh or else dried soon after collection. Unnamed material should be accompanied by evidence that a serious attempt at naming has taken place!

## Informal keys to some of the commonest British corticioids

Warning: These introductory keys are designed to help the corticioid novice to acquire a few points of reference. Any day's collecting is sure to turn up species that are not included. These should fail to key out! Anyone taking up the subject is soon going to get tired of this. The hope is that by that time they will have become familiar with enough species to allow use of much fuller keys without getting bogged down.

In these keys some common features are assumed. Except where stated otherwise, all species are typically white to cream, common on a wide range of deciduous hosts (though most can also occur occasionally on conifers,) and with spores that are smooth and inamyloid. The numbers in ( ) refer to descriptions in B&K Vo1. 2 which includes everything here except *Peniophora lycii*. This or some other work giving more details should always be used to check on any verdict reached.

Species with a ± pileate or strongly wrinkled hymenium are omitted as being only borderline 'corticioids' and for the most part already widely familiar. See, in particular, *Chondrostereum* (198), *Stereum* (199-204), *Phlebia* p.p. (175-177). A few species with a strongly hydnoid hymenium (spines over 0.5mm), though in reality forming a continuum with other verrucose and smooth species, are here treated separately in Key 4.

**Species with plentiful, large, thick-walled and heavily encrusted cystidia (metuloids): . Key 1**

**Species with cystidia thin-walled or absent. Spores globose or allantoid: . . . . Key 2**

**Cystidia thin-walled or absent. Spores smooth, hyaline, inamyloid, not globose or allantoid: . . . . . Key 3**

**The commonest strongly hydnoid corticioids: . . . . . Key 4**

### Key 1

**A** Tough dull pinkish grey to blue-grey species, developing on dead attached twigs or branches. Spores elongated, allantoid to cylindric. The genus ***Peniophora***. Not easy. Only the three commonest species are keyed here:

**1** Cystidia ± ellipsoid. Much-branched hyphae ['dendrohyphidia'] at margins of hymenium; spores 9-13 × 3.5-5µm. . . . . .***P. lycii*** (Phillips 240)

**2** Cystidia elongated, the encrusted portion conical. Dendrohyphidia absent.

**a** Tightly attached; spores short, 7.5-9 × 3-3.5µm . . . . . .***P. cinerea*** (156)

**b** Rolling back from bark when mature, showing a dark underside; spores 9-13 x 3-4µm. On oak and beech . . . . . .***P. quercina*** (153) [Some species have gloeocystidia as well as or instead of metuloids] [If on conifers and spores amyloid see *Amylostereum* (195-197)]

**B** Softer white to cream species, on stumps or fallen wood. Spores narrow ellipsoid.

**1** Spores under 7µm long, clamps absent (but texture very dense, so this is not always easy to verify)

**a** Spores 3.5-4 × 1.5-2µm, surface waxy with pimples (distinctive and soon recognisable in the field with a hand lens) . . . . . .***Scopuloides rimosa*** (166)

**b** Spores 5-7 × 2.5-3µm

* Covering conifer stumps. Texture very dense throughout, hyphae strongly agglutinated . . . . . .***Phlebiopsis gigantea*** (165)

** Normally on deciduous wood. With a subiculum of broader more separable hyphae . . . . . .***Phanerochaete velutina*** (164)

**2** Spores larger, 7-10 × 3.5-5µm, clamps present

**a** Cystidia cylindric, septate, with clamps at the septa just about visible through the encrustations . . . . . .***Hyphoderma setigerum*** (129)

**b** Cystidia tapered, abundant, non-septate . . . . . .***Hyphoderma puberum*** (127) [Most other *Hyphoderma* species have unencrusted cystidia]

## Key 2

**A** Spores long cylindric, 12-15 × 2.5-3µm. Cystidia narrow, encrusted, sharply pointed, abundant. Thin greyish patches on very rotten deciduous logs, esp. elm.....
. . . . . .***Subulicystidium longisporum*** (206)

**B** Spores globose to subglobose

**1** Spores ornamented

**a** With clamps; with cylindric cystidia; spores warted 6-8 × 5-7µm [Other similar species vary in spore size] . . .***Hypochnicium punctulatum*** s.l.(135)

**b** No clamps or cystidia; spores spiny 5-6.5µm; fruit-body soft, yellowish. On very rotten wood . . . . . .***Tomentellopsis echinospora*** (252)

**2** Spores smooth, cystidia absent

**a** Spores 8-10 × 6-8µm, Hygrophanous, drying pale and smooth, but grey, opalescent, waxy, tuberculate when fresh. Abundant on fallen deciduous branches, esp. *Fagus* (in B&K as *Cerocorticium* c.) . . . . . .***Radulomyces confluens*** (93)

**b** Spores 4-5 × 3-4µm, somewhat irregular. Hymenium cream tinged greenish, smooth with isolated warts. Basidia and hyphal segments notably short
. . . . . .***Brevicellicium olivascens*** (116)

**C** Spores allantoid

**1** Spores very large, 15-19 × 5.5-6µm. Recognisable in the field as a thin greasy film pushing back the bark of dead attached twigs . . . . . .***Vuilleminia comedens*** (217)
[Some heteros, eg *Eichleriella deglubens* (17), have similar spores]

**2** Spores small 4-5 × 2-2.5µm. Hymenium verrucose, full of crystals and difficult to make out until vigorously squashed, then revealing 6-8 spored basidia with swollen bases ('urniform') typical of the genus. On wood or often growing over old polypores. Commonest member of a large genus . . . . . .***Sistotrema brinkmannii*** (188)

**D** Spores otherwise (ellipsoid, cylindric, etc.)

**1** Spores pale brown, 9-13 × 6-8µm

**a** Thin, spores dextrinoid . . . . . .***Coniophora arida*** (236)
[*Membranomyces spurius* sensu B&K (137) appears also to be merely young material of this species.]

**b** Relatively thick, spores scarcely dextrinoid . . . . . .***C. puteana*** (238)

**2** Spores hyaline, smaller

**a** A high proportion of the hymenium made up of enclosed gloeocystidia (showing up most clearly in Melzer's)

* Spores amyloid, cystidia to 100µm long or more (often forming extensive growths over old decid. stumps etc.)

\+ Spores cylindric, 4.5-5.5 × 2.5-3µm, finely warted, strongly amyloid
. . . . . .***Gloeocystidiellum porosum*** (105)

\++ Spores ellipsoid, 6-8 × 4-5µm, smooth. Luxuriant growths will emit a watery/milky juice when bruised (in B&K as *Megalocystidium 1*.)
. . . . . .***Gloiothele lactescens*** (107)

** Spores inamyloid, 8-10 × 3.5-4.5µm, ± cylindric. Gloeocystidia normally under 100µm with pointed apex. Other exserted cystidia with encrusted swollen heads usually also present; a third type of cystidia (± globose 'stephanocysts') seldom seen except in v.young material. Rather variable but very common everywhere
. . . . . .***Hyphoderma praetermissum*** (125)

**b** Gloeocystidia absent

* Spores small and spiny

\+ Spores under 5µm long; basal hyphae often strongly swollen at the septa. Often with a finely hydnoid hymenium . . . . . .***Trechispora farinacea***(112)
[Several less common species have a smooth hymenium]

\++Spores 4.5-5.5µm long, basidia pleural (ie developing laterally on their hyphae).

Usually recognisable in the field from its fans of lemon yellow sterile hyphae, but these may be absent and the hymenium is pale brown. (in B&K as *Trechispora* v., in NM3 as *Ph. sulphurea*) . . .***Phlebiella vaga*** (117)

**Spores smooth . . . . . .**see continuation as Key 3**

## Key 3

**A** Spores under 5µm long

**1** On deciduous wood; cystidia absent

**a** Spores 3.5-4 × 3-3.5µm, ± thick-walled. Basidia with granules which stain in cotton blue. Hyphal strands running through the hymenium . . . .***Cristinia helvetica*** (89)

**b** Spores 3-5 × 2.5-4µm. Basidia unremarkable, (B&K photo is upside down) [A similar species, *T. confinis*, is distinguished in NM3] . . . . . .***Trechispora cohaerens*** s.l. (111)

**2** Usually on coniferous wood; cystidia numerous, narrow, projecting, usually septate with clamps, often ± capitate

**a** With also plentiful 'lagenocystidia' (small encrusted needles) (in B&K as *Grandinia*.) . . . . . .***Hyphodontia alutaria*** (76)

**b** Very similar but ± lacking lagenocystidia . . . . . .***H. pallidula*** (84)

**B** Spores larger

**1** Thin cobwebby species, easily detachable from the substrate (wood or leaf-litter)

**a** Hyphae broad, 6-9µm wide, tending to branch at right-angles, very distinctive; basidia 6- 8-spored, soon collapsing

* Clamps at all septa . . . . . .***Botryobasidium subcoronatum*** (67)

** Clamps absent; several further common *Botryobasidium* spp., some only distinguishable by their anamorph states, e.g. . . . . .***B. aureum*** - see Fig 1.

**b** Hyphae narrower, 3-6µm wide, basidia 2- 4-spored, clamps largely absent, but occasional on basal hyphae

* 2-spored, spores 8-10 × 4-5µm . . . . . .***Athelia arachnoidea*** (49)

** 4-spored, spores 6-8 × 2.5-3.5µm . . . . . .***Athelia epiphylla*** s.l. (52)

**2** Denser and usually thicker, tightly attached species

**a** Hymenium verrucose to shortly spiny

* Cystidia with 'haloes' and other cystidia bearing stellate crystals, spores 6-7.5 × 2.5-3.5µm on conifer logs . . . . . .***Resinicium bicolor*** (178)

** Cystidia otherwise or absent. Hyphae ± thick-walled with prominent clamps. Crystals often present in hymenium (in B&K as *Grandinia*) . . . . . .***Hyphodontia*** spp.(76-86) [Large genus with several fairly common species not always easy to distinguish. See key in NM3 and also Key 4 below.]

**b** Hymenium smooth when young, becoming wrinkled. Clamps absent, spores 5-6 × 2.5 -3.5µm On deciduous twigs and branches (in B&K as *Meruliopsis c.*) - see Fig 2. . . . . .***Byssomerulius corium*** (144)

**c** Hymenium smooth (or sometimes fissured when old)

* Spores over 8µm long; clamps present

+ Spores 8-12 × 5-6µm, pip-shaped; cystidia absent. Spores often adhering in fours in slide mounts. Usually developing narrow pilei, but sometimes fully resupinate. Common on recently fallen deciduous logs, esp. sawn ends. Characteristic cracks develop in hymenium with age . . . . . .***Cylindrobasidium evolvens*** (92)

++Spores ellipsoid to cylindric; cystidia present. Basidia and spores with oil drops in protoplasm [Not easy , several species key here.] . . .***Hyphoderma*** species

** Spores under 8µm long
+ Clamps absent; spores 5-7 × 2.5-3.5µm, cystidia narrow and tapered. Basal hyphae thick-walled, forming a distinctive loose mesh branching ± at right-angles . . . . . .***Phanerochaete sordida*** (162)
[Large genus, all species clampless, several not uncommon]
++Clamps present; spores 5-6 × 3.5-4µm, broadly ellipsoid, often with large oil drop. Fruit-body thin, chalk-white, esp. on *Sambucus* but also on many other deciduous hosts (in B&K as *Lyomyces s.*) . . . . .***Hyphodontia sambuci*** (139)
[Small, protruding, capitate cystidia provide confirmation, but are not always plentiful]

## Key 4

All are species of deciduous wood except that the two *Hyphodontia* spp. also occur less commonly on conifers.

**A** Spores over 8µm long. Spines 2-4(-5)mm long. Species developing on dead attached branches

**1** Spores ellipsoid, 8-11 × 5-7µm, esp. on *Quercus* (in B&K as *Cerocorticium m.*) . . . . . .***Radulomyces molaris*** (94)

**2** Spores cylindric, 8.5-10 × 3-3.5µm, esp. on *Prunus* (in B&K as *Hyphoderma r.*) . . . . . .***Basidioradulum radula*** (128)

**B** Spores not over 6µm long. On fallen wood.

**1** Yellow or orange species; spores 2-3µm wide; spines 1-2 mm long

**a** Yellow, but immediately purple in KOH; no cystidia; spores 5-6 × 2-3µm. Very common on rotten wood . . . . . .***Mycoacia uda*** (170)

**b** Orange, often semi-pileate; with large encrusted cystidia; spores 3.5-4 × 2-2.5µm. Esp. on beech debris . . . . . .***Steccherinum ochraceum*** (194)

**2** White to cream species; spores 3.5- 4.5µm wide; spines 0.5-l mm long

**a** With two kinds of cystidia as in *H. alutaria*, which differs little apart from its smooth hymenium (see Key 3 A2a)(in B&K as *Grandinia a.*) . . .***Hyphodontia arguta*** (77)

**b** With long, thick-walled, protruding hyphal ends, making the spines appear hairy . . . under a lens (in B&K as *Grandinia b.*) . . . . . .***Hyphodontia barba-jovis*** (78)

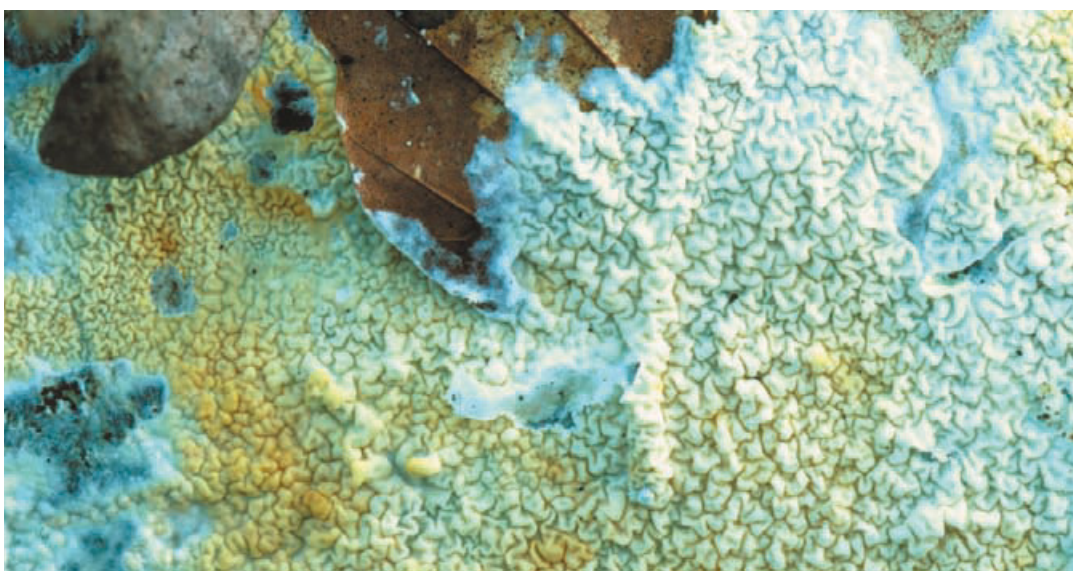

Fig. 3 *Ceraceomyces borealis*: Rare and not keyed above. Confined to northern Scandinavia until the material shown here was found by Nick Legon on a beech log in the New Forest. Now also known from Somerset and Surrey! Photograph: Bolderwood, New Forest, Hampshire, England, 24 September 1993. © N.W. Legon (det. K. Hjortstam).