Abstract

The importance of the Orellani group of mushrooms, of the genus Cortinarius, is linked to several serious human poisoning events, known to have occurred in Europe since the middle of the last century. Grzymala attributed the poisoning to orellanine, a fluorescent pigment contained in the basidiomes of Cortinarius orellanus and Cortinarius orellanoides. In 1985 a similar occurrence happened in Tasmania, so the culprit mushroom was collected and described. The late Prof. Moser found orellanine in the extract of this toadstool. Some years later, having repeatedly visited the original place, the species was found again.

This article covers the description of the mushroom species and the chemical study performed on it. The group of orellanine-containing Cortinarius traditionally considered a section is here elevated to the rank of subgenus based on chemical properties and DNA studies, but also the considerable morphological similarity of the species found in both Hemispheres. A Cortinarius described by Cleland under the name of Cortinarius umbonatus, but different from Dermocybe umbonata Grgurinovic, is here redescribed and given a valid name in subgenus Orellani.

Key words: Cortinarius, Leprocybe, Orellani, orellanine, nephrotoxic.


Introduction

In December 1985, two men consumed a fungus collected at Fortescue Bay on the Tasman Peninsula, south-east of Hobart, in Tasmania, Australia. A week later, one of them was admitted to hospital with symptoms of kidney failure and required a kidney transplant after several weeks of dialysis treatment. The other, who had consumed only a small quantity of the fungus, recovered quickly without apparent consequences. A.K. Mills, University of Tasmania, accompanied the latter patient to the site where the mushrooms were found, and gathered some basidiomes for description and scientific study.

Extracts of the fungus collected by Mr Mills were sent to the Institute of Microbiology of the University of Innsbruck. The late Prof. Moser verified they contained orellanine (pers. comm., in litt.), a substance known to cause renal damage in humans (Feifel et al. 1995, Grzymala 1962, Heufler et al. 1987, Pfalzer et al. 1989, Rapior et al. 1988). The fungus, which was collected in a dry (or intermittently wet) creek bed, has been sought since in other localities, but never found outside the original site. The fungus was found again at the same in 1999 and in the following years (dates in description).

This taxon is described as a new species and its features are discussed in detail. Mr Mill’s description was carefully compared with the specimens collected by Mrs Genevieve Gates and Dr D. Ratkowsky in 1999 and later.

Materials and Methods

Microscopic characters were examined by standard microscopic techniques with a Zenith 2000 optical microscope at 1,000 magnification in oil immersion and phase contrast. An aqueous extract in H_2O was treated with a drop of FeCl_3 to test for the presence of orellanine (Pöder & Feifel 1993). Twenty-five basidiospores were measured, chosen at random from each collection. The minimum, maximum and medium size were taken for
Part of the exsiccatata were sent to Dr M. Clericuzio, together with dried specimens of *C. orellanus* Fr. and *C. orellanoides* R. Hry for thin layer chromatography (TLC). Basidiomatal fragments of *C. umbonatus* Cleland & Harris (coll. AD4353 and AD4354), received from Adelaide Herbarium, were microscopically examined and thereafter sent to Dr Clericuzio for the performance of the TLC. For TLC dried specimens were extracted with aqueous methanol in the dark and the extracts laid on silica gel plates to separate the pigment fractions. The extracts were spotted on precoated Merx 60F 254 silica gel aluminium plates, and developed with a wash-liquid consisting of ethyl-formiate: formic acid : toluene (50:15:35) (Höfland 1980). The chromatograms were air-dried and the chromatogram fractions were thereafter examined in natural light, UV at 254 nm and at 366 nm, to observe absorbance and fluorescence intensity. Orellanine shows a bluish green fluorescence at Rf 0.68.

**Results**

*Cortinarius eartoxicus* Gasparini sp. nov. (Figures 1 & 3)

**Etymology:** from τοξίκον (toxicon in Latin characters) = poison and καπ (car in Latin characters) = spring, indicating the appearance in the very early season and poisonous nature.


**Description**

*Pileus:* (45–) 60–70 mm lato, convexo, late umbonato, the umbo broad, about 18–22 mm, *Cuticle* dry, glabrous, innate fibrillose-matted, rather uniformly coloured deep tawny date brown (colour in range of rusty tawny to dark brick-colour [Henderson *et al.* 1969], encompassing reddish brown hues with brown being dominant). Darker (somewhat more blackish) on disc. *Lamellae:* subdistant, (L = 40–48), slightly ventricose, considerably (13 mm) deep, adnate-emarginate, the margin smooth and homogeneous, cinnamon. *Stipe:* 70–80 × 8–10 mm, cylindrical, fibrillosa, tending to be somewhat sulcate, off-white to tawny brown with pale yellowish hues throughout (having a somewhat orange sheen). Base whitish from mycelial threads, giving it a downy appearance. *Veils:* Cortina present. Universal veil brown, concolorous with the cap or gills, leaving fibrillose threads along the stipe. *Flesh:* solid, ivory white to creamy buff. *Odour:* insignificant. *Solid:* mild. *Chemical tests:* potash hydroxide 30%, and iron chloride aqueous solutions black on pileipellis and context. Aqueous extracts treated with chloride solution (FeCl₃) shows clearly the presence of orellanine (cyclamen-purple ring around dark spot, Figure 2).

*Sporis:* ellipsoidal to broadly ellipsoidal in lateral view (7.8–) 9–10.4 (—11.2) × (5.9–) 6.2–6.9, *Q = 1.36–1.6.* warts medium or fairly small, but prominent, crowded and well distributed. *Hymenium:* margin fertile, basidia cylindrical to clavate, bi- and tetrasporate, 41–50 × 9–9.7 μm with pale granular contents, in palisade with chelioecystidia, cylindrical, clavate, subcapitate, 30–45 × (3–) 7–9 (—11) μm. *Lamellarum trama:* regular, the hyphae broadly elliptical, to 15 μm diam., with yellow plasmatic contents. *Pileipellis epicutis:* thin, about 75 μm deep, consisting of cylindrical hyphae 5–15 μm diam., more or less parallel, with often erect tufts bearing round terminal cells. *Subcute:* subcellular with hyphae shortly elliptic to subspherical 15–30 (—45) μm diam., hyphae often encrusted by a brownish pigment and containing a yellow pigment. *Clamps:* present.

Habitat description
The specimens were found on sandy soil behind sand dunes, in a dried out creek bed. The habitat might be described as a coastal forest, with the two main tall species being *Eucalyptus globulus* Labill. and *E. obliqua* L’Herit., the former being the possible partner. *Banksia marginata* Cav. and *Monotoca glauca* (Labill.) Druce dominated the intermediate shrub layer, with an understorey of the monocotyledons *Lomandra longifolia* Labill., *Dianella tasmanica* Hook. f., *Lepidosperma elatius* Labill. and the bracken fern *Pteridium esculentum* (Forst. f.) Cockayne. *Melaleuca squarrosa* Donn. ex Smith was also present, as was a ground cover of mosses, which included *Ptychomnion aciculare* (Brid.) Mitt.

Chemical investigation (Thin Layer Chromatography)
A comparative TLC analysis was performed on *C. eartoxicus* together with the European species of sect. *Orellani*, viz. *orellanoides* and *orellanus*; also the South Australian specimens 4353 and 4354 were added. The resulting TLC is shown in Figures 4a & b. What is immediately evident is the completely different chromatographic pattern of 4353 compared with the other four (4354, *C. eartoxicus*, *C. orellanoides* and *C. orellanus*). This corroborates its exclusion from *Orellani* and strongly suggests it belonging to *Dermocybe* (presence of red and orange pigments) as proposed by Grgurinovic (1997).

The striking orellanine contents of *C. eartoxicus* leave no doubt to its belonging in subgenus *Orellani* (Figure 2). Presence of orellanine could not be revealed with certainty in 4354; anyway, the orellanine spot was not so clear-cut, probably the result of the age and the state of conservation of dried basidiomes, as noticed in the collections of *C. orellanoides*. The ease of degradation of bipyridyl-N-oxide (orellanine) is well known. Apart from the orellanine spot, it should be remarked that the chromatogram of 4354 is satisfactorily consistent with those of *C. eartoxicus*, *C. orellanus* and *C. orellanoides*, and therefore 4354 can be considered a likely member of *Orellani*. In particular, our chemical analysis shows that major affinities are found between *C. eartoxicus* and *C. orellanus* on one side (see Figure 4a spots a, b, f, and q), and between 4354 and *C. orellanoides* on the other (spots m and p). Notwithstanding the overall similarities, no two species show an identical chromatogram, suggesting that they should be considered as individual species. However, this statement is merely based on TLC analysis of dried specimens. To carry out a definitive chemical investigation, extraction of fresh basidiomes would be needed, followed by isolation and structural determination of the fungal metabolites.

A second TLC analysis was performed, utilising the eluent system proposed by Rapior *et al.* (1988) (where *C. orellanoides* was examined under the name of *C. speciosissimus* Kühn. & Romagnesi) (Figure 4b): the use of hydrochloric acid reduces tailing of orellanine, making spots with low Rf more visible. In this way the spot at Rf 0.0 showed an intense bright yellow fluorescence in *C. speciosissimus* and 4354, while a medium grey-yellowish fluorescence was observed in *C. orellanus* and *C. eartoxicus*. Very polar, probably glycosidic compounds, may be responsible for these spots.
The taxonomic position of *Orellani* is very interesting, being an example of a bi-hemispherical group. The presence in the Northern and Southern Hemispheres (Gasparini 1997) of few, similar but morphologically as well as chemically distinct species, is striking and leads to speculate that the *Orellani* is a possible relict from the end of the Lower Cretaceous or the beginning of the Upper Cretaceous. Before then, it is possible that the group

**Discussion**

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was present throughout the globe with several species, of which now only a few have survived (or have developed).

The macro- and microscopic features of the species of this group are remarkably similar (see Table 1). *Cortinarius orellanus*, in the author's opinion, is possibly a species differentiated during glaciations of the Northern Hemisphere. Among the species found in the Northern Hemisphere it appears to possess more morphologically distinctive traits and it has a distribution in the somewhat thermophilous broadleaved forests.

At the moment the phylogenetic relationships among sections *Leprocybe* (*C. cotoneus* Fr.), *Bolares* (*C. bolearis* (Pers. : Fr.) Fr.), *Zinziberati* (*C. zinziberatus* (Scop. : Fr.) Fr.) and *Raphanoidei* (*C. raphanoides* (Pers. : Fr.) Fr.) have not been tested with the ITS, so that affinity can only be speculated on synapomorphy of morphology and chemical pigmentation. The evidence brought forward by the species tested for DNA based phylogeny (*C. orellanoides*, *C. limonius* (Fr. : Fr.) Fr., *C. gentilis* (Fr.) Fr. and *C. humicola* (Quél.) R. Mre) indicates that fluorescence itself does not justify affinity. These three species, presently placed in *Leprocybe* sect. *Limonei* and sect. *Orellani* appear to be polyphyletic. *Leprocybe* was grouped together mainly by the fluorescence shown under UV light, but this character must have evolved independently in the various species.

In the ITS based phylogeny of Hailand & Holst-Jensen (2000) *Orellani* (*C. orellanoides*, syn. *C. rubellus* Cooke *sensu* Melot) have an individual position within *Cortinarius* s.s. but distant from the subgenera *Cortinarius* (violaceus group), *Dermocybe*, *Phlegmacium*, *Myxacium* and *Telamonia* section *Obnusi* and *Leprocybe* section *Limonei*. They, and before them Liu et al. (1997), showed that *C. gentilis* should be grouped with *Telamonia*. The same conclusion was reached by Peintner et al. (2001) for *C. humicola*.

Fluorescent pigments have been found in species of *Cortinarius* not included in *Leprocybe* e.g. *C. renidens* Fr., *C. varipes* Henry R., *C. helvelloides* (Fr.) Fr., *C. vespertinus* (Fr.) Fr., *C. ochrophyllus* Fr. (Keller-Dillitz 1984), plus in some *Dermocybe* of the Southern Hemisphere (Gill 1995, Keller & Ammirati 1995, Soop 2001). Moreover, the chromatograms are different from section to section and only very few pigments (*leprocyboside, leprophenon, leprolutein, leprovenetin* [sect. *Orellani*]) have been fully elucidated. Apart from the fact that an affinity with pigments does not necessarily imply an affinity among species, the different phylogenetic origin of *Dermocybe* and *Armillati* is in this respect very significant.

Keller-Dillitz (1984) suggested a possible relationship between the groups *Rapahnoidei* and *Orellani* of *Leprocybe* on the ground of a vague similarity of chemical contents at Rf = 0.0. *Cortinarius raphanoides* (Pers. : Fr.) Fr. has never been found to contain orellanine, which is easily detected even in exsiccate (Pöder & Feifel 1993). Apart from this, morphologically *C. raphanoides*, *C. valgus* Fr. and *C. betuletorum* (Moser) Moser, except for the round spores, share very few characters with *Orellani* or, even with sect. *Leprocybe*.

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As one of the issues of this article is to separate *Orellani* from *Leprocybe*, we should consider the characters that described the subgenus *Leprocybe* and its limits, to see if they are exclusive of section *Orellani*. To separate the two sections it is satisfactory to prove no affinity between sect. *Leprocybe* and sect. *Orellani*, as it is irrelevant if all other sections are assigned to one or the other sections. Within *Cortinarius* subgenus *Leprocybe* was described originally for taxa with: 1) dry with no glutinosity of pileus, stipe or veil, 2) with yellow, orange, red-brown, or olivaceous pigmentation, 3) spores usually subglobose or ovoid, 4) flesh containing substances showing yellowish, greenish or bluish fluorescence in ultraviolet radiation. All these characters are shared by other *Cortinarius* s.s. or *Telamonia* s.s. (see examples above) and none of them have proved to be consistently exclusive for the species included in *Leprocybe*. All species of *Leprocybe* give two bright, yellow spots at Rf
Figure 4a. Rf values according to the method of Hoiland: eluent 50% ethyl formiate, 35% toluene and 15% formic acid.
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0.14 and 0.4 respectively (Holland 1980). Yet, provided these spots revealed a common (unknown) pigment the phylogenetical analysis with ITS proved four of the species to be phylogenetically separate and even of different origin at generic level (see above). It cannot therefore be concluded that this character is an indication of phylogenetic affinity.

The only exclusive characters are chemical and they are the presence of compounds of the orellanine complex in section Orellani and xanthones and dermoluteine in section Leprocybe. The anthraquinones contained in section Leprocybe derive from a nonaketide, while the anthraquinonic pigments of Dermocybe of the Northern Hemisphere derive them from an octoketide (Gill & Steglich 1987). However, several Dermocybe from Australia show pigments of nonaketidic origin (Gill 1995, 1997, Gill & Gimenez 1990). Therefore a comparatively close relationship between Dermocybe and section Leprocybe—if based on chemical affinity—cannot be excluded.

Orellanine, being a component of the pigmentary contents of Orellani (Gill & Steglich 1987), is the only pigment of this section to have been successfully analysed with the TLC. Some other secondary metabolites were found by Rapior et al. (1990) in the group C. orellanoides/speciosissimus and by Ballero et al. (1995) in C. bisporus. However, the former (polyols, phenolic acids) as well as the latter (indols) appear to be possessed
by Cortinarius of different taxonomic position and should not be considered useful for the systematic keying of Orellani.

Although the biological synthesis of orellanine has not been clarified, it certainly has not the ketidic origin from the malonate pathway, so common in many fungi of Cortinarius and Dermocybe (Gill & Steglich 1987, Heiland 1980, von Gruber 1969). Furthermore, very many Cortinarius species tested with the iron chloride (Lundsted 2000 [unpublished], Pöder & Feifel 1993) have not shown any presence of orellanine.

This would support the idea of the two sections having different origins. Bearing in mind that, in any case, C. coteaeus is the type of the subgenus, a lack of affinity between section Leprocybe and section Orellani is, in our view, sufficiently proven. Consequently, the latter cannot be included in the same subgenus. Either Orellani must be moved to another subgenus or it must belong to an autonomous subgenus. As no other group of Cortinarius shows affinity with the section Orellani, the latter is the most suitable solution and therefore it is proposed to elevate the original section by Moser (included in subgenus Leprocybe) to subgenus Orellani.

Seven species appear to belong to the new subgenus. Their habit suggests an affinity, their chromatograms are similar and they all contain orellanine and/or the products derived by its degradation. Of the accepted taxa, two species occur in Europe one in North America, one in South America (Chile), one in India and two (C. catarraeticus and C. eartoxicus) in Australia. In the author's opinion C. speciosissimus, C. henrici Remaux and C. rubellus Cooke sensu Melot are synonyms of C. orellanoides.

Subgenus Orellani (Moser 1969) Gasparini, comb. nov.


This subgenus circumscribes species with yellow, brown, or fawn colours to the pileus, gills and/or stipe; universal veil fulvous or brown often well-developed and leaving significant debris on the stipe. Spores subglobose, ovate or ellipsoidal, less frequently amygdaliform, warty. Pileipellis a thin stratum of cylindrical hyphae; hypodermium well-differentiated. Containing several fluorescent pigments, mainly blue-green under UV light and striking amounts of orellanine. Bi-hemispherical. Growing with species of Pinaceae, Fagaceae, Nothofagaceae or Myrtaceae.

Type: Cortinarius orellanus Fr., Epicrisis Fungorum p. 288 (1838).

Chemistry and Toxicity

A lot of work has been carried out over the toxicity of these mushrooms, which appears to be caused by 'orellanine'. This pigment has a very well-known chemical structure and can be synthesized in the laboratory, but neither its natural (i.e. biological) synthesis nor the way it affects the human organism have been fully elucidated (Feifel et al. 1995, Gill & Steglich 1987, Rapior et al. 1989, Sigl-Micheitschs 1990).

The adverse effects are fully known, i.e. a long to very long incubation (from 48 hours to 15 days) after which the symptoms of an acute kidney insufficiency become evident, pain in the back, intense thirst, abundance, or lack of, urination. The poison leads to the necrosis of the kidney canalicle and eventual destruction of the kidney function (see Gasparini 1997). Natural recovery is very precarious; 15% fatalities amongst patients has been recorded, and while treatment may save life the after effects include chronic renal insufficiency and therefore permanently regular dialysis or kidney transplant.

Confusion has arisen from the use of the terms 'orellanine' and cortinarines 'A', 'B', 'C'. The former is a well-known and widely discussed compound (see Gill & Steglich 1987) of bipyridylic structure, whereas the latter are cyclopeptides (Laatsch & Mathies 1991), apparently having a chemical formula similar to amanitins and similar biological adverse effects (Figure 5). Cortinarines, which are phenolic compounds reacting to FeCl₃, although in a different way from orellanine, have been found in some 50 European Cortinarius species. Bjorn Lundstedt (unpublished) worked on the detection of orellanine in 40 species or Cortinariaceae of Tasmania (39 Cortinarius s. lato and one Inocybe). Phenols, which might be cortinarines, were found in 11 different Cortinarius or Dermocybe species, but orellanine was revealed solely in Cortinarius eartoxicus. Phenolic compounds may be specific for Cortinarius and their presence could have a taxonomic relevance.
**Figure 5.** Chemical composition for cyclopeptides (amanitines group + cortinarines) and bipyridyles (orellanine).

**Taxonomic and nomenclatural notes**

**Cortinarius fluorescens** Horak, Beih. Nova Hedwigia 52: 449 (1975)

**Cortinarius graminicola** A.V. Sathe & S. Deshpande, [as 'graminiculus'], *Maharashtra association for the Cultivation of Science, Monograph No. 1 Agaricales (Mushrooms) of South West India* (Pune) 22 (1983)

*Cortinarius graminicola* allegedly belongs to this subgenus, showing blue fluorescence and having macro- and microscopic features similar to *C. fluorescens*, but differing for the different habitat (Gramineae) and continent of occurrence. The type description was ‘Specie haec ab *C. fluorescens* Horak differit graminicola consortio. Typus Locus Purandhara in partes regionis Indicis astros-occidentals. Holotypus: AMH4271.’
A study of the mycorrhizal association is needed to determine the true partner. It is here noted, however, that the differences with *C. fluorescens* in the English description are more consistent than the habitat alone. The size is much larger (over 100 mm across against 50–60), pileal surface dry versus glutinous, lamellae rusty brown versus coffee-and-milk (or argillaceous), basidia (length) 13–26 versus 30–37, epicutis of repent, parallel hyphae (which suggest a scaly/hairy surface) versus presumably an ixocutis.


*Cortinarius brunneofulvus* Fr. 
Basionym: Fr., *Epier.*: 298 n. 154 (1838).
*Cortinarius speciosus* Favre, *Matér. Fl. Crypt. Suisse* 10: 117, 213, Fig. 46, Pl. III (1) (1948), *nom. illegit.*, *non* 

Evidence brought forward by Hoiland (1985) and Pöder & Pipitz (1986) showed that there is no substantial difference between *C. orellanoides* and *C. speciosissimus* and that they should be treated as synonyms. When considering *C. speciosissimus* as a synonym of *C. orellanoides* the latter has the nomenclatorial priority. However, in consideration of *C. speciosissimus* having been widely known and also used as the most popular name not only in mycology but also in medicine, chemistry and toxicology (Gasparini 1997) it should be proposed for conservation. The choice of a unique name cannot but contribute to nomenclatural stability. Bon (1991) suggested *C. speciosissimus* as variety of *C. orellanoides*. The author, as the habitat is different, would rather advise a subspecies. But much more experience is needed to confirm that the variation is constant within the species and not a simple deviation owing to environmental situations.

The microscopic and chemical properties of *C. brunneofulvus* were demonstrated to be identical to those of *C. speciosissimus* (Pöder & Pipitz 1986). Therefore the two are conspecific. *Cortinarius brunneofulvus* has been interpreted by some mycologists as belonging in *Telamonia* (Bresadola 1930) but, in the author’s view, never very convincingly. Therefore *C. brunneofulvus* might well be the earliest name for *C. orellanoides*. As for Cooke’s *C. rubellus*, using a doubtful name is not rendering a good service to mycology.

Gasparini (1997) has examined the type of *C. henrici*. He concluded that the sporadically showing sterile cells and the habitat (cone needles) do not justify the separation of the species, which he considered conspecific with *C. orellanoides* and *C. speciosissimus*. There are many cases in literature where cystidia may be more or less showy and more or less abundant on the margin, this being one of the inconstant characters of a species. In this instance the character is not constant and other morphological, microscopic and chorological aspects of the three species are so close as to be considered elements within the variability of a species. The author believes that the method of distinguishing two species on the constant difference of three characters at least is purely mechanical. However, recent biological studies have demonstrated that some taxonomic characters are simply morphological coincidences and therefore the greatest prudence ought to be used to separate species on small atypical differences and more unambiguous and constant variations could justify such a separation. Even the other distinctive character (chemical) of *C. henrici* does not show a real difference, but only a more rapid discoloration (olive) under the effect of AgNH$_3$. In the author’s view, for instance, *C. violaceus* (L. : Fr.) Fr. and *C. hercynicus* (Pers.) Mos. show more substantial reciprocal differences than *C. orellanoides/C. speciosissimus/C. henrici* and yet they are considered as subspecies or varieties of the same species (e.g. Brandrud 1983). Here they are therefore considered synonymous.


According to the late Prof. M. Moser (pers. comm.) *C. rainierensis* is synonymous of *C. orellanus*. Nonetheless the TLC (Keller-Dillitz 1984) shows a difference at Rf 0,38 particularly evident under UV light. The spore size 9–11 × 6.5–8 μm is similar to *C. orellanus*, while the fibrillose ring, habitat under *Abies*, and chromatography suggests a relationship close to *C. orellanoides*. 

*Some names have been updated.*
**Cortinarius rubellus** Cooke, *Grevillea* 17 (78): 44 (1887)

This species was described by Cooke (1887: 44) as 'a true *Telamonia*, hygrophanous, with a red veil on a yellow background, much smaller than the protologue of each of the taxa comparable therewith'. The spores in his drawing are triangular or siconiform (fig-shape). All this descriptive elements do not conform with the protologue of either *C. orellanoides*, *C. speciosissimus* or *C. henrici*. Furthermore no exsiccata was left and the mycologists of the area never used that name. In the author’s view the contrasting elements are too many and the taxon should be considered doubtful. *Cortinarius rubellus* should be proposed for rejection in accordance with Art. 56.1 (ICBN).

**Cortinarius umbonatus** Cleland & J.R. Harris, *Rec. South Austral. Mus.* 9: 49, Pl. iii, Fig. 1 (1948) 

sensu Moser & Horak (1975)

Grgrurinovic (1997) wrote that type material of *Cortinarius umbonatus* Cleland & J.R. Harris at Adelaide herbarium consisted of a mixed collection of two different species to be considered as two syntypes of the same protologue (Art. 9.4) from two different South Australian collections (National Park and Waterfall Gully, Stirling). One (coll. AD 4353) was chosen by the Australian mycologist as the lectotype of *C. umbonatus* and recombined as *Dermocybe umbonata* Grgrurinovic, while coll. 4354 was recognised as a different species, presumably that cited by Moser & Horak (1975: 448 'Koll. 36 von Cleland unter dem irräumlichen Namen *C. umbonatus* Clel. & Harris, Waterfall Gully 1946.').

For the purpose of investigating Grgrurinovic’s statement, fragments of both collections were obtained from AD and examined. We are in agreement with Grgrurinovic (1997) that AD 4353 is a *Dermocybe*, while coll. AD 4354 has not only different spores, but also it has a TLC compatible with that of *Orellani* (see Figures 4a & b). Orellanine could not be clearly detected, but the other spots are quite similar to those of *C. orellanoides*. There is a green-bluish spot at Rf 0.68, typical for the section, which is very strong for *C. orellanus*, *C. orellanoides* and *C. eartoxicus*, but rather weak for AD 4354. This is indicative for orellanine. Orellanine is unstable and very easily deteriorates. Considering the age of the original collection and the very small quantity of the exsiccata examined, it is quite possible that its detection was problematic. Other spots, like one at Rf 0.60 (light greenish) have equal intensity in all four taxa, while the bright yellow spot at Rf 0.0 is strong in *C. orellanoides* and *C. eartoxicus*, but absent in the other two species. AD 4353 (a *Dermocybe*) shows instead a completely different Rf table, with spots at Rf 0.73 (orange-yellow), at Rf 0.47 (reddish) and [scarce] at Rf 0.0 (tailing, greyish). The compound at Rf 0.73 is 6-methylxanthopurpurin-3-methylether the most abundant compound and at 0.47 austrocoritrubin (Keller et al. 1987), while the other spots were probably not visible owing the age of the exsiccatum and to the scarcity of the material examined.

*Cortinarius umbonatus* (1948) (published as ‘*Cortinarius (Dermocybe) umbonatus’*) is an illegitimate name (ICBN, Art. 53.1) being a later homonym of *Cortinarius umbonatus* (Velen.) Rob. Henry, 1947 [1946]. Grgrurinovic (1997) lectotypified that taxon, based on coll. AD 4353, and recombined it into *Dermocybe*. In accordance with ICBN, Art. 58.1 the correct name in *Dermocybe* must be *Dermocybe umbonata* Grgrurinovic 1997.


The author considers *Dermocybe* as a subgenus of genus *Cortinarius* and therefore Cleland’s species will be renamed elsewhere (Gasparini, subm.).

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1 (from *Larger Fungi of Australia*) (Quote). Neither of the collections of this species at AD had accompanying macroscopic notes, although it is likely that both are syntypes of *D. umbonata*, as their collection dates and localities match those of the protologue of the species. The syntype from Stirling, South Australia, could not be located at AD. The specimen designated as lectotype (AD 4353) has spores which agree more closely with the shape of and measurements cited in the protologue, ellipsoid and 8.8–12.0 × 6.6–8 μm, compared to subglobose, ovoid to ellipsoidal, 6–10 μ × 5–7.5 μ (Clel. & Harris 1948: 49). The other syntype from Waterfall Gully (AD 4354) has larger, elongate ellipsoid to amygdaliform spores 10.8–14.0 [17.4] × 6–7.8 μm ... (unquote).
In accordance with ICBN, Art. 7.7, ‘A name validly published by reference to a previously and effectively published description ... is to be typified by an element selected from the context of the validating description ...’. As explained above that was done by Grgurinovic for *C. umbonatus* Cleland & J.R. Harris (coll. AD 4353), but microscopic and chemical characters proved to be different for coll. AD 4354. A new species is here proposed to provide a name for coll. AD 4354 from Waterfall Gully.

**Cortinarius catarracticus** Gasparini, *sp. nov.* (Figure 6)

**Etymology:** from Greek καταρρακτής (katarraktes in Latin characters) = waterfalls, from the place of provenience Waterfalls Gully.

Holotypus: Australia australis, in loco dicto ‘Waterfall Gully’, 1946, in AD conservatur (AD 4354).


Pileus 50–60 mm, distinctly umbonate at first but spreading to become almost plane, silky smooth, dry, an even tawny brown near Kaiser Brown to Burnt Sienna, finely striate. *Flesh* thick over disk, attenuated rapidly toward periphery. *Gills* in four tiers, sinuato-adrnatae, more or less irregular along the edges, lighter than the pileus, Ochraceous Tawny or clay colour. *Stem* central, smooth, pallid above, browner below with tints of pileus, more or less equal, 60–110 mm × 10–12 mm, slightly swollen at the base. *Sporae* amygdaiform or elliptical. Warts medium or large fairly dense and protruding (10.2–) 11.6–13.4 (–14.6) × (5.9–) 6.3–7.1 (–7.8) μ, Q = 1.7–2.1. *Habitat:* in sclerophyll forests.

Other two species possibly belong to this subgenus, but are insufficiently known, viz. an undescribed species similar to *C. orellanus*, found in Malaysia by Corner in 1941 and studied by Moser & Horak (1975), and *C. bisporus* Ballero *et al.* (1995). *Cortinarius bisporus* was described as follows ‘Context white, pileus 30–60 mm, yellow-brown, stipe and lamellae yellow-brown, veil brownish, spores subglobose 7.5–10 μ, in Sardinia (Italy) under broadleaf’. A collection could not be obtained for examination. However, the overall features cast serious doubts whether this species belongs to *Orellani* and therefore we prefer to omit it from the present key. Also the reported chromatography of the latter was inadequate as no RI chart and no fluorescence was reported.

![Figure 6. Cortinarius catarracticus basidiospores.](image-url)
Key to taxa of *Cortinarius* subgen. *Orellani* in the world

1. Basidiospores (sub) amygdaliform
   1* Basidiospores ellipsoidal to ovoid or subglobose

2. Basidiospores 8.7–11 × 5.7–6.9 μm; pileus not umbonate, rust-coloured; gills pale yellow; stipe typically brass-yellow; veil poorly developed, reddish brown. Thermophilous, under broadleaf. Europe
   2.* Basidiospores 9–11 × 6.5–8 μm; pileus 30–80 mm, conical, umbonate, russet, tawny; gills ochraceous tawny; stipe pale fulvous with submembranous ring; context chamois. Under *Pinaceae*. North America
   2.** Basidiospores 11.6–13.4 × 6.7–7.1 μm; pileus umbonate, brown; lamellae ochraceous tawny or clay colour; stem browner, below with tints of pileus, more or less equal, pallid above. Under *Myrtaceae*, Australia

3. Veil strongly developed, zoning the stipe; pileus 40–60 mm, conical, umbonate, rusty orange; gills rusty orange; stipe yellow-ochre with orange-rust colour; spores 8–10.5 × 6–7.5 μm subglobose. Under *Pinaceae* rarely under broadleaf. Europe
   3* Veil less developed

4. Associated with *Graminaceae* in Western India; pileus 90–110 mm, dry, rusty brown, striate at margin; stipe blackish brown with yellow veil; gills crowded, rusty brown; spores 7.5–11.4 × 5–7.5 μm

4.* Different habitat

5. Pileus 10–50 mm, subumbonate brown-fulvous; gills clay; stipe brownish; context brownish; veil lemon yellow; spores obovate 9–12 × 5.3–6 μm. Under *Nothofagus* in Patagonia

5.* Pileus 45–60 cm, golden date-brown; gills cinnamon; stipe whitish brown; context creamy buff; veil fulvous brown; spores elliptical, 9.3–10.8 × 6.3–7.3 μm. In spring under *Eucalyptus* in Tasmania

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References


Bresadola, G. (1930). *Iconographia Mycologica* 14, Tab.DCIII.


**Table 1. Comparison table for Orellani.**

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>PILEUS Size (cm), Shape</th>
<th>PILEUS colour</th>
<th>STIPE shape</th>
<th>STIPE colour</th>
<th>GILLS Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>orellanus</td>
<td>&lt;8, plane/convex</td>
<td>rusty orange</td>
<td>cylindrical</td>
<td>brassy yellow</td>
<td>pale yellow</td>
</tr>
<tr>
<td>orellanoides</td>
<td>4-6 ± conical-umbonate</td>
<td>rusty orange</td>
<td>clavate to sub-bulbous</td>
<td>yellow-ochre/fulvous</td>
<td>rusty orange</td>
</tr>
<tr>
<td>catarracticus</td>
<td>5 or 6 convex-umbonate</td>
<td>brown; umbo dark</td>
<td>cylindrical</td>
<td>pale at apex-brown at base</td>
<td>ochraceous-tawny or argillaceous</td>
</tr>
<tr>
<td>rainerensis</td>
<td>3-8 conical umbonate</td>
<td>russet/tawny, rusty disc; squamulose</td>
<td>cylindrical</td>
<td>pale fulvous, darkening on touch</td>
<td>ochraceous tawny</td>
</tr>
<tr>
<td>fluorescens</td>
<td>1-5 plane-convex</td>
<td>rusty to brown-fulvous</td>
<td>cylindrical</td>
<td>Brownish</td>
<td>clay</td>
</tr>
<tr>
<td>graminicolus</td>
<td>9-11 umbonate to subumbonate</td>
<td>rusty to brown-fulvous</td>
<td>cylindrical</td>
<td>Blackish brown</td>
<td>Rusty brown</td>
</tr>
<tr>
<td>eartoxicus</td>
<td>1-5 plane-convex (subumbonate)</td>
<td>golden date-brown</td>
<td>cylindrical to sub-clavate</td>
<td>whitish brown</td>
<td>cafe, then brown</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>SPECIES (cont'd)</th>
<th>CONTEXT</th>
<th>VEIL</th>
<th>SPORE Size</th>
<th>SPORE L/B</th>
<th>HABITAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>orellanus</td>
<td>pale yellow</td>
<td>brownish red, fibrillose</td>
<td>8.7—10.8 × 5.7—6.9</td>
<td>1.4—1.6 sub-amygdaliform</td>
<td>Thermophilus broadleaf</td>
</tr>
<tr>
<td>orellanoides</td>
<td>Yellowish</td>
<td>golden yellow, marking zig-zag areas</td>
<td>8—10.5 × 6—7.5</td>
<td>1.2—1.5 sub-globose/broadly ovoidal</td>
<td>Needle (rarely Fagus)</td>
</tr>
<tr>
<td>catarracticus</td>
<td>White</td>
<td>brownish</td>
<td>(10.2—) 11.6—13.4 (—14.6) × (5.9—) 6.3—7</td>
<td>1.7—2.1 sub-globose/broadly ovoidal; warted</td>
<td>Sclerophyll</td>
</tr>
<tr>
<td>rainerensis</td>
<td>chamois/pale buff</td>
<td>fibrilllose ring</td>
<td>9—11 × 6.5—8</td>
<td>broadly ovate</td>
<td>Ombrelliferae-Abies</td>
</tr>
<tr>
<td>fluorescens</td>
<td>Brownish</td>
<td>lemon yellow</td>
<td>7.6—9.5 × 5.8—6.4</td>
<td>elliptoidal; verrucose</td>
<td>Nothofagus</td>
</tr>
<tr>
<td>graminicolus</td>
<td>undescribed</td>
<td>lemon yellow</td>
<td>7.5—11.4 × 5.7—5.5</td>
<td>1.55</td>
<td>Graminaceae</td>
</tr>
<tr>
<td>eartoxicus</td>
<td>yellowish to biscuity</td>
<td>ffulvouish brown</td>
<td>(9.3—) 10.8 (—12.7) × (6.3—) 7.3 (8.2)</td>
<td>1.4—1.56 elliptoidal, verrucose</td>
<td>sandy soil, xerophytic residues, amongst Eucalyptus, Banksia and Monotoca</td>
</tr>
</tbody>
</table>