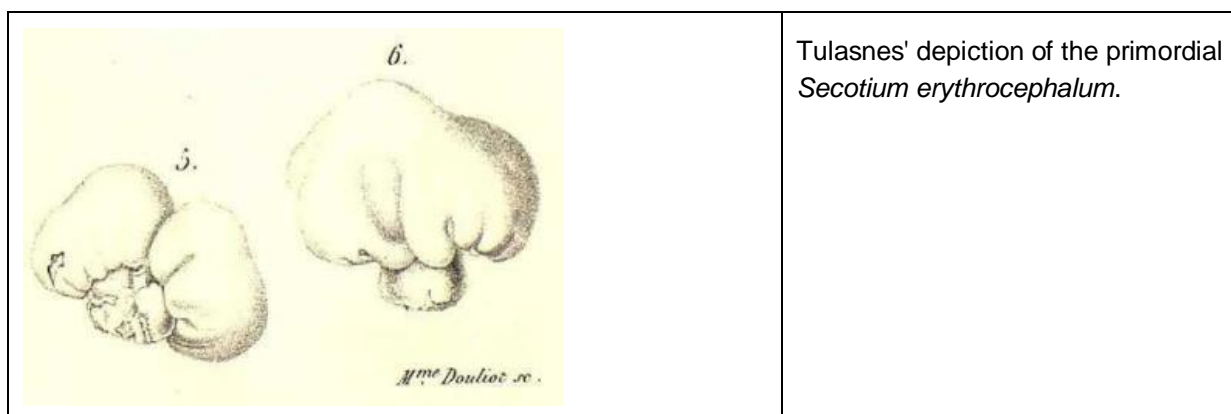


Mycological Notes 16: Growth and variability of *Leratiomyces erythrocephalus*, the Scarlet Pouch Fungus

Jerry Cooper – September 2012

The familiar scarlet pouch fungus can be quite variable in appearance and that has caught out more than one mycologist, including me. Here I describe that variability, and I also predict this fungus will eventually spread around the world on wood chips.

Leratiomyces erythrocephalus is one of our most iconic fungi. It was originally named *Secotium erythrocephalum* from material collected by [Étienne Fiacre Louis Raoul](#) near Akaroa. Raoul was surgeon on the expedition ship L'Aube. In 3 years in New Zealand from 1837 to 1840 he collected many plant specimens, mostly from the Akaroa area (during the episode of the French claim for New Zealand). Our fungus was first described in an article authored by Raoul 1844 ([Annales des sciences naturelles](#)) where the introduction of the name was attributed to Louis Tulasne. In the same article Tulasne describes the equally iconic *Illeodictyon cibarium*, also from Akaroa. Raoul/Tulasne describe *Secotium erythrocephalum* as scarlet capped, with a white stem and 2-spored. Both species were again covered in Raoul's 'Choix De Plantes De La Nouvelle-Zelande' in 1846. Raoul's original description of the fungus is the classical concept of a stalked, secotioid scarlet-capped fungus. Louis Tulasne, along with his brother Charles, described the genus in more detail in 1845 ([Annales des sciences naturelles](#)) and in this article he first depicts the nearly gastroid form of the primordial fruitbody.





In 1891 Lloyd described what we now consider to be the same taxon, sent to him by H.W Laing from Lyttleton under the name *Secotium lutescens*, which as the name suggests was described as pale yellow, and without the stipe extending. Thus Lloyd's material represents a yellow form of the primordial fruitbody.

In 1924 Cunningham published a revision of the genus *Secotium*, and in another 1924 paper he discusses the ontology of the developing fruitbody. In these papers he distinguishes *S. erythrocephalum*, and *S. novaezealandiae* (now *Psilocybe weraroa*) as the only two species growing on wood. For *S. erythrocephalum* he describes the nearly gastroid primordium, which internally forms a solid columella running from top to bottom. The externally visible base of the columella is the base of the stem. The peridium then tears away from the base of the columella. Finally, and after some continued development in this semi-gastroid state, the hollow stem expands downwards as an extension of the columella, and we arrive at the familiar mature state of a scarlet pouch supported by a white hollow stem with bright yellow/orange remnants of surface pigment. This character of a prolonged semi-gastroid form followed by stipe elongation is a common phenomenon. It was noted by Patouillard in his paper introducing the genus *Leratiomyces* for *L. similis*, a dull-red cousin of *L. erythrocephala* from New Caledonia (Patouillard, 1907). In the 1924 paper Cunningham notes that *L.*

erythrocephalus is common in lowland New Zealand forests but is also known from gardens where the rhizoids are always associated with fragments of wood. Cunningham describes the fungus as 4-spored and notes differences in form of collections and spore size, usually 12 x 5um but up to 25um.

Colenso collected material and it is clear from his notes that he was unsure if the gastroid and stalked stages were [different forms of the same fungus](#).

In 2006 on the Westport Foray at Pororari River Gorge I collected material of an [orange gastroid fungus](#) (PDD 87061). I didn't consider *L. erythrocephalus* at the time, because the fungus had no stem and was the wrong colour. After much head-scratching I tentatively decided it was an undescribed *Nivatogastrium*, because the characters fitted the genus. Egon Horak has named a number of *Nivatogastrium* species in New Zealand, but they are high elevation 'snow-bank' fungi. Egon suspected my material was closer to *Leratiomyces similis*. After later seeing the variability within *L. erythrocephalus* I now realise this was perhaps immature material. It has the characteristic bright yellow/orange pigment at the junction of the peridium with the columella. This material is 1, 2, 3 & 4-spored with an average spore size of 16.5x8.8um. Regarding *Nivatogastrium* it will be interesting to see from molecular studies whether they are related to *Nivatogastrium nubigenum*, the type of the genus, known from the US. I suspect they will have closer affinities to our *Clavogaster novozelandicus* (*Weraorua virescens*), or perhaps *Leratiomyces*.

<i>L. erythrocephalum</i> ? JAC9958 (PDD 87061)	Note basal columella
	

In 2006 I collected material of *Leratiomyces erythrocephala* in the grounds of Lincoln University growing on wood chips in a flower bed. The material also showed the immature semi-gastroid form, although at the time I didn't consciously note that, as the mature iconic stalked form was dominant.



L. erythrocephalus, Lincoln University Gardens, 2006. Note accompanying semi-gastroid form

What did register about this collection was the presence of the species on bark chips. I was aware of the work of Ross Beever et al (later published as Bridge et al 2008) which showed that *Weraroa erythrocephala* was congeneric with the similar looking, but duller red, *Leratiomyces similis* from New Caledonia. And they recognised the relation to the fungus mistakenly identified as *Stropharia aurantiaca* which had become well known as a spreading species across the globe on wood chips. *Leratiomyces* is the earliest available name for the group of species, and the real identity of *S. aurantiaca* sensu auct. was confirmed as *Leratiomyces ceres*. Was this Lincoln University observation the start of a similar explosion of *L. erythrocephala* in the same habitat?

In 2008 I collected material identical to Lloyd's *S. lutescens* at Okuti Valley near Little River on the Banks peninsula ([PDD 87670](#)). This was the semi-gastroid form, and this time with a yellow cap. This material had 1-2 spored basidia with an average spore size of 15x8.7um. I decided this must be a phenotypic variant of *L. erythrocephalus*.

L. erythrocephalum (*S. lutescens*) JAC10480, PDD87670

Note entire columella

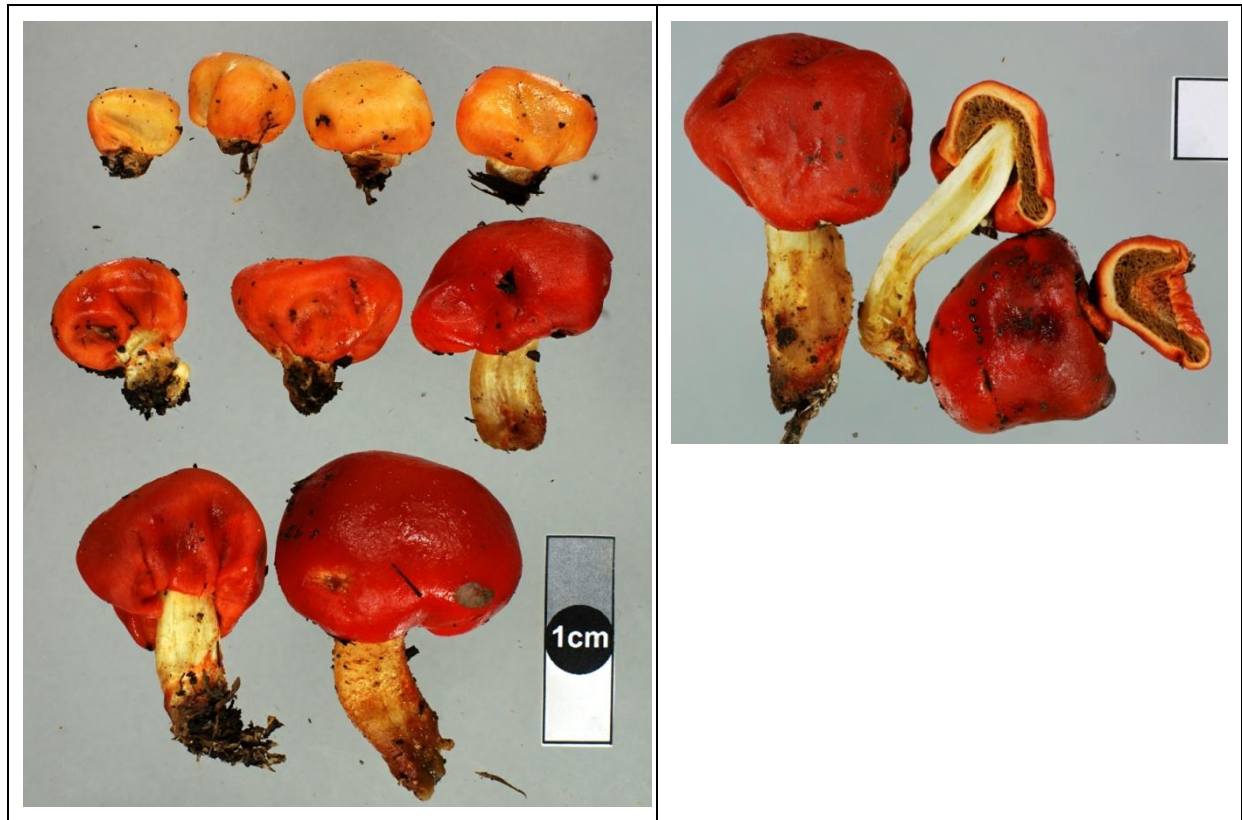


In 2010 I collected material on wood chips (of Oak) in an urban restoration site in Christchurch ([PDD 95952](#), PDD 95955). This material finally showed me the connections and solved the mystery. All of this material was growing together and shows the range in colour form from yellow to scarlet, and the progression from the semi-gastroid form to the final stalked form and with both 2 & 4 spored basidia. PDD95952 15.2 x 7.6um, PDD95952 15.7 x 8.9

JAC11559=PDD95952, JAC11562=PDD95955

Note yellow/scarlet variation and gastroid/secotioid progression

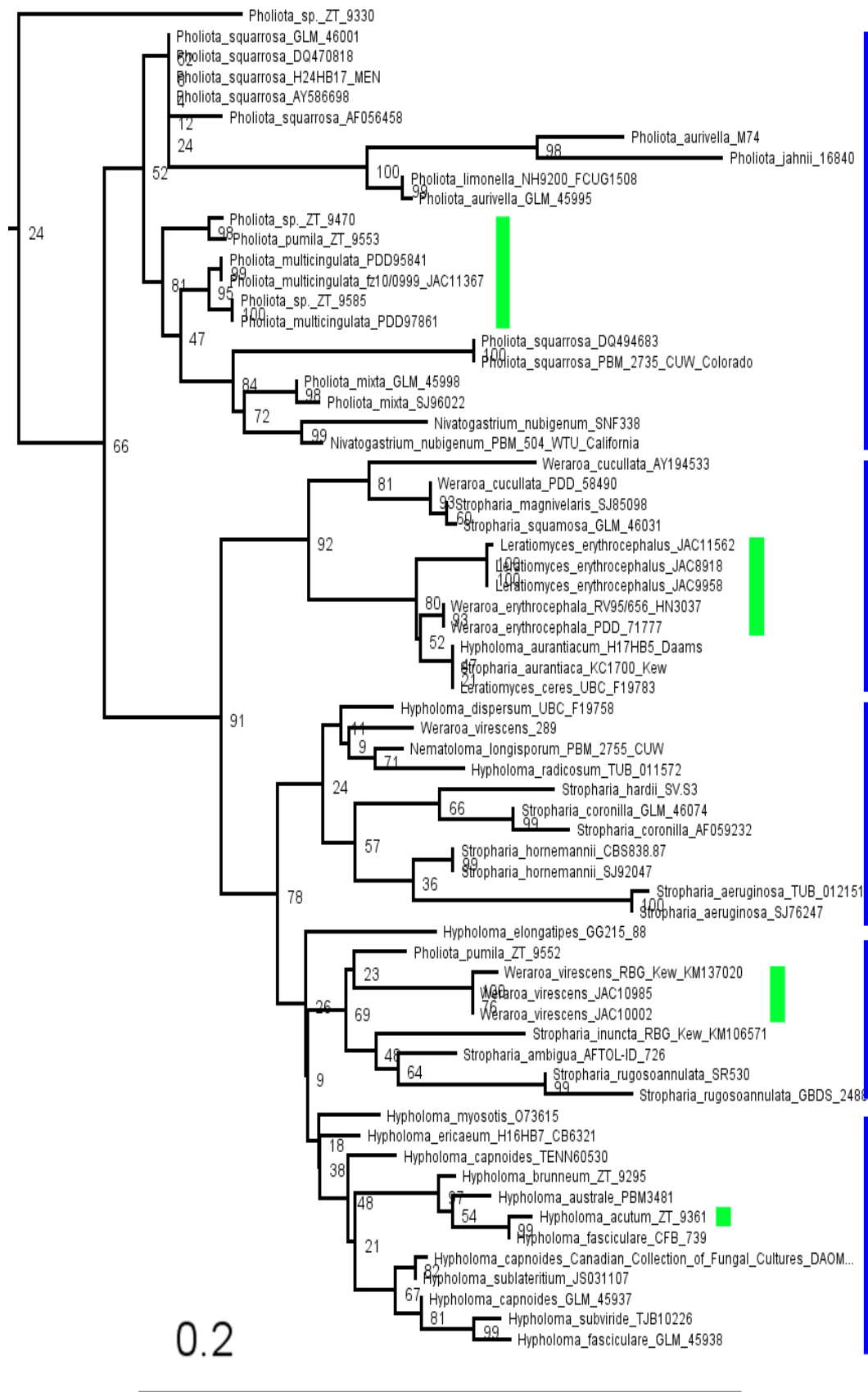




So are these all the same species? I think there is still a chance the Pororari material may be something different [it isn't, see later]. Note the position of the developing columella at the bottom only, whereas in other material it is entire. Patouillard loc. cit. and others have used the character to delimit genera, e.g. in *Clavogaster* the columella is said to be absent. However, it remains to be seen if the character is stable or correlates with phylogeny. One of the characters I noticed, and have taken as being ubiquitous despite other variability is the bright yellow/orange pigment near the columella/peridium junction which becomes spread across the developing stalk. Under ultraviolet light it is intensely yellow fluorescent. That same fluorescent pigment is present on the stems of *Leratiomyces ceres*. On the other hand the same character is present in material of *Weraroa virescens* and that has been shown from molecular work to be separate to *Leratiomyces* and closer to '*Hypholoma*' *disepersum*, although that work requires confirmation with study of more material.

So, don't be caught out by the variability in *Leratiomyces erythrocephalus* which can be both yellow and semi-gastroid as well as stalked secotioid and scarlet. On the other hand the variation in micro and macro morphology suggest a closer look using molecular tools is warranted, and certainly the relationships between *Leratiomyces* and the New Zealand species currently known in *Nivatogastrium* and *Weraroa virescens* needs elucidating.

Update October 2012 – some sequence data



The tree represents a maximum likelihood analysis of ITS + LSU sequences from Genbank and

additional New Zealand material. *Nivatogastrium nubigenum* (the type of the genus) is clearly a *Pholiota*. Unfortunately no material of New Zealand *Nivatogastrium* species has yet been sequenced. The variation in *W. erythrocephala* showing a spectrum of gasteroid and yellow forms, as discussed above, is confirmed. Note however that some existing sequences of *L. erythrocephala* segregate separately. It is likely this separation is a false consequence of this analysis as one set of sequences are just ITS and the other just LSU, there being relatively few ITS+LSU to constrain the tree. *Weraroa virescens* falls into a broad clade containing the type species of *Hypholoma* (*H. fasciculare*). However there is some support for a distinct clade containing material labelled *W. virescens*, *Pholiota pumila*, *Stropharia inuncta*, *S. ambigua*, and *S. rugosoannulata*. I'm not sure if any distinct morphological features link these taxa, and the clustering requires confirmation. If the group is considered worthy of recognition at generic rank then the name *Clavogaster* is available. *Clavogaster novozelandicus* is most likely synonymous with *W. virescens*, although the type is lost. Certainly if not worthy of recognition as a separate genus then *W. virescens* needs placing in *Hypholoma*.

References.

- Bridge, P.D.; Spooner, B.M.; Beever, R.E.; Park, D.-C. 2008: Taxonomy of the fungus commonly known as *Stropharia aurantiaca*, with new combinations in *Leratiomyces*. *Mycotaxon* 103: 109-121
- Cunningham, G.H. 1924: A critical revision of the Australian and New Zealand species of the genus *Secotium*. *Proceedings of the Linnean Society of New South Wales* 49(2): 97-119
- Cunningham, G.H. 1924: The Structure and Development of two New Zealand Species of *Secotium*, *Transactions of the British Mycological Society*, v10, 216-224
- Lloyd, C.G. 1908: *Mycological Writings Vol.2*, *Mycological Letter* No 19, p6
- Patouillard, N.T. 1907: Le *Ratia*, nouveau genre de la série des *Cauloglossum*. *Bulletin Trimestriel de la Société Mycologique de France* 23(1): 50-52
- Raoul, É.F.L. 1844: Choix de plantes de la Nouvelle-Zélande. *Annales des Sciences Naturelles, Botanique*, 3e Série 2: 113-123
- Raoul, É.F.L. ed. 1846: Choix de plantes de la Nouvelle-Zélande. Fortin Masson
- Tulasne, L.-R.; Tulasne, C. 1845: Description d'une espèce nouvelle du genre *Secotium* Kze., appartenant à la flore française. *Annales des Sciences Naturelles, Botanique*, 3e Série 4: 169-177