

# **The study of larger basidiomycetes, especially polypores, in the Malesian region and the role of the Singapore Botanic Gardens**

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**ABSTRACT.** The development of the study of larger basidiomycetes, especially polypores, in the Malesian region is presented. The historical importance of the botanical gardens in Bogor and Singapore is emphasised and an overview of the mycological collection in Singapore is given. This includes several isotypes of taxa described by G.E. Masee, C.G. Lloyd and N. Patouillard, as well as paratypes and holotypes of taxa described by E.J.H. Corner. The problems linked to Corner's material are discussed in the light of studies made in both Singapore and Edinburgh. The polypore collection in Singapore is a valuable resource for studying any geographical variation of fungal floras in the Malesian region and a unique tool for examining any temporal change in this flora, given the continuity of collections in the island since H.N. Ridley in 1892.

**Keywords.** Basidiomycetes, Malesia, polypores, Singapore Botanic Gardens

## **Introduction**

The Malesian region in the sense of *Flora Malesiana* is one of the botanically most interesting tropical regions. Progress in the study of its vascular flora has been important but our knowledge of its mycological flora is still uneven, with some areas and some groups better sampled than others. The most intensively studied area is probably Peninsular Malaysia and Singapore and the best studied group is the larger basidiomycetes. This is linked to the work of E.J.H. Corner, based in Singapore in the thirties and forties. The importance of the mycological collection of the Singapore Botanic Gardens (SING, here and elsewhere, acronyms designating herbaria follow Holmgren et al. 1990) as well as that of E.J.H. Corner is emphasised. My experience is based on several stays in the Singapore Botanic Gardens and a recent one in the Royal Botanic Garden Edinburgh (E), the two institutions that host the majority of Corner's material. I also examined duplicates in the Royal Botanic Gardens Kew (K).

## **Mycology in the Malesian region**

During the nineteenth and early twentieth centuries, mycological prospecting in the Malesian region was, except for some expeditions or cruises, centred on the two

gardens linked to the British and Dutch presence in the region, Singapore and Bogor. However, no well-known specialist in mycology worked there until K.B. Boedijn arrived in Sumatra in 1926, moving in 1928 to the Bogor (then Buitenzorg) garden, and Corner in Singapore in 1929.

In mycological journals one will find biographies of those two scientists by Donk (1965) for Boedijn, and Watling (2001b) and Watling & Ginns (1998) for Corner. A detailed account of Corner's contribution to Malaysian mycology has been published by Watling in 2007.

Before the period of Boedijn and Corner, mycological collections were mostly made by general botanists and referred to overseas specialists. From the time of H.N. Ridley, directors or assistant directors of the Singapore Botanic Gardens have thus sent many collections to Kew, but also to N. Patouillard and especially C.G. Lloyd. The provided identifications form the basis of T.F. Chipp's catalogue of fungi of the Malay Peninsula (1921).

After the disruption of World War II, the situation diversified with more and more research performed in local institutions. This is especially the case at the Bogor herbarium with M. Rifai and the Forest Research Institute of Malaysia with S.S. Lee. In both institutions, young researchers are now active and mycology is really developing locally. This is accompanied by occasional involvement of foreign monographers, for whom the speed of air travel makes short visits to the tropics easier. The publication of nicely illustrated popular books like those of Tan (1990), Pegler (1997) and Zainuddin et al. (2010) will certainly develop the interest of the general public for fungi.

The state of development can be found in publications like the recent book edited by Jones, Hyde & Vikineswary (2007), the paper by Ahmad (1986) and the *Checklist of literature on Malaysian macrofungi* by Lee et al., which is only available on the internet ([www.chm.frim.gov.my/Checklist\\_final.pdf](http://www.chm.frim.gov.my/Checklist_final.pdf)).

The Singapore Botanic Gardens, which has been pivotal in those developments, does not have at the moment a resident mycologist but gives excellent facilities to visitors and curates meticulously a large mycological herbarium. Its importance for the study of fungi in the Malaysian Region should be emphasised and will be the object of the following section.

### **The mycological collection of the Singapore Botanic Gardens (SING)**

The oldest fungal material in the herbarium of the Singapore Botanic Gardens goes back to H.N. Ridley and dates as far back as 1892. After 1900 one sees collections by I.H. Burkill and his wife E.M. Burkill, C.F. Baker and especially T.F. Chipp. Local collectors were Kiah, Nur and Sappan. When he replaced Chipp, R.E. Holttum was also active in mycological collecting. He mostly left this activity to Corner when the latter joined the staff, but kept making collections until the early thirties.

Many of those collectors regularly sent part of their material to Kew and to C.G. Lloyd. Masee, Lloyd and Patouillard have all described new species on the basis of these collections. The holotypes are of course in the herbarium of the describing

author (K for Masee, BPI for Lloyd, FH for Patouillard) but it is usually overlooked that the isotype kept in Singapore can be a large collection from which a relatively small part has been sent. This isotype can thus be precious for estimating the variability of the type collection or in case of loss or damage to the holotype, as one can judge from the illustrations of this paper.

An example of a work by Masee on Singapore fungi is his *Fungi exotici XVII* (1914), entirely devoted to a mailing from Mrs. Burkill, with the description of 17 new species. A paper entirely devoted to Singapore boletes by Patouillard & Baker (1918) describes 16 new species. Some are discussed by Singer (1981), who revised their holotypes and a full discussion with type analysis is done by Watling (2001a). An example of those species is *Boletus spinifer* Pat. & C.F. Baker, whose holotype was also studied in detail by Heinemann & Rammeloo (1982). They noted a difference in pores from the original description and synthesise the numerous discussions of this unusual fungus. None of the authors who discussed this species seem to have thought of revising Baker's isotype in SING (no. 0036203). This could give more insight into the variability of the collection on characters like the pores.

It was only during 1917 that Baker was assistant-director of the Singapore Botanic Gardens, before moving to the Philippines. His collaboration with Patouillard was nonetheless fruitful, for besides the boletes, Patouillard (1922) based two new species of polypores on material sent by Baker. For one, *Phellinus chaetoloma* Pat., the isotype (SFN 5409) is important, for the holotype at FH has been determined as *Phellinus contiguus* (Pers.:Fr.) Pat. by Ryvardeen (1983), while the original description does not fit that species, the setal structures in the hymenium being described as obtuse. This was noted by Corner (1991, p. 119) who examined the Singapore isotype and determined it as a resupinate *Phellinus noxius* (Corner) G.Cunn. I concur with this determination. Corner suggested the specimens have been muddled. It would thus be interesting to compare the two parts of the collection to confirm this. If *Ph. chaetoloma* is really the same as *Ph. noxius*, it will be necessary to conserve this well known, phytopathologically important name against *Ph. chaetoloma*, as well as if necessary against *Ph. sublamaensis* Lloyd, which was considered as a prior name for *Ph. noxius* by Ryvardeen (1989).

The second species was *Phaeolus iobaphus* Pat., the isotype of which is also worth detailed study. Here also there is a discrepancy between the original description, that gives the spores as smooth, and the description by Ryvardeen, that gives them as finely asperulate. My preliminary impression is that the collection could be heterogeneous (at least the SING part) and that in this SING part the asperulate spores could be a contamination.

On the basis of his type examination, Ryvardeen combined the epithet in *Wrightoporia*. It is not clear whether Corner (1989a, p. 121) did look at the type himself, or relied on Ryvardeen's description, but he made a further combination in *Stecchericium*.

Several Singapore botanists, the last being R.E. Holttum, and the most prolific T.F. Chipp, have sent material, especially of polypores to C.G. Lloyd. Lloyd described several species on the basis of those collections, now housed in BPI. The polypore

holotypes have been revised by Ryvar den (1989, 1990, 1992). The isotypes preserved in SING are however worthwhile studying for there can be a large collection of which a small part only was sent to Lloyd. Many collections which are not types are also interesting for understanding Lloyd's concepts and can be quite helpful for comparison when one is working in the Singapore herbarium (Fig. 1).

I did spot 18 isotypes of Lloyd's polypore species, some of which will be the object of separate publications. As an example (see also Fig. 2–4) of the interest of this material, I will discuss the case of *Hexagonia angulata* Lloyd and *H. umbrosa* Lloyd. The two species were published at a short interval in 1920 as follows: *H. umbrosa* Lloyd, Mycol. Writ. VI, Mycol. Not. 63 (May 1920) 957, with no figure; and *H. angulata* Lloyd, Mycol. Writ. VI, Mycol. Not. 64 (Sept. 1920) 1003, fig. 1831.

The type of *H. umbrosa* was not explicitly cited in the original description, but the collection "Blakang Mati, 24 Dec. 1919. On dead mangrove below high tide mark, T.F. Chipp. Singapore Field Number 5460", present number 31697, is accompanied by a note by Lloyd "5460 Hexagona umbrosa. This is the second collection you have sent. The former was referred to Hexagona tenuis but this dark plant should have a name." This is a clear link to the publication, where it is stated: "This is the second collection of this dark umber plant received from Mr Chipp..."



**Fig. 1.** *Echinoporia hydnophora* (Berk. et Broome) Ryvar den sub *Echinodia theobromae* Pat.. Singapore, Botanic Gardens, on *Quercus*, 9 Dec 1919, Ahmad, S.F.N. 5143, new number SING 32631, is an example of an important historical collection in the Singapore herbarium, even if not a type. Parts of this collection were sent by T.F. Chipp to Kew and to Lloyd. Patouillard got a piece through Kew and sent to Singapore the letter reproduced here. Lloyd also reported his comments (not reproduced here), which were published in Mycol. Writ. VI, Mycol. Not. 62 (Jan. 1920) 934–935, fig. 1704, 1705. This is the collection that convinced both Patouillard and Lloyd that *Echinodia theobromae* (a name with a complex nomenclature outside the scope of this paper) was indeed the conidial stage of a polypore.



**Fig. 2.** Isotype of *Daedalea ridleyi* Lloyd, Mycol Writ. VI, Mycol. Not. 62 (Jan. 1920) 930, fig. 1689 at SING. The 10 fruitbodies have been mounted on two sheets. This is a single collection (Singapore, Bukit Timah, 27.8.1900, H.N. Ridley, S.F.N. 4920) but later the two sheets have been given different new numbers (31717 and 32628). One has been placed in the type collection and not the other. They should be reunited in the type collection and worth a detailed study. The holotype was identified “*Lenzites acuta* Berk.” by Ryvardeen (1989), but despite Lloyd’s comment that it is not related, I believe it is *Daedalea sprucei* Berk. or the related (if distinct) *D. langkawiensis* Corner, of which the type is also present in SING.

The isotype of *H. angulata* was annotated “Pulau Penang, Waterfall Gardens, 23 Jan. 1920, M. Noor, coffee brown on dead wood. Singapore Field Number 5604”, present number 31696. It fits well the picture 1831 of Lloyd.

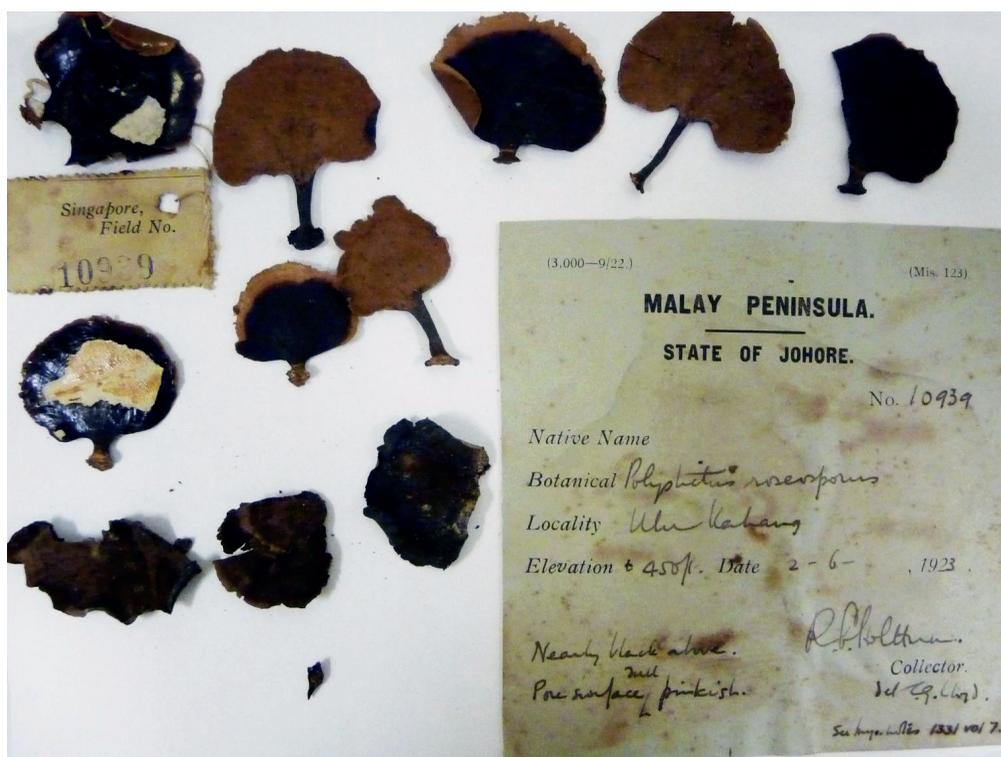
Those two collections were studied by Corner (1989a, pp. 20–21), while Ryvardeen published his revision of the holotypes stored in BPI, in the same year.

Ryvardeen placed the two names in synonymy with *Hexagonia tenuis* (Hook.) Fr., while Corner (1989b) synonymised *H. angulata* with *H. umbrosa*, which he considered distinct from *H. tenuis*, treated in *Trametes* (invalid publication).

I personally agree that the two collections belong to a single species, distinct from *H. tenuis* by being thicker and with bigger (about 1.5 mm) pores. I however do not consider the species as far away from *H. tenuis* as Corner thought. He gave great importance to the dimitic or trimitic nature of the context. There is however a large variation in the abundance of ramifications of thin hyphae, which already appears in Corner’s description and I feel he overemphasised the character.



**Fig. 3.** Isotype of *Fomes oroniger* Lloyd, Mycol. Writ. VII, Mycol. Not. 73 (Oct 1924) 1330, fig. 3048 (with Note 74) at SING. Malay Peninsula, Pahang, Fraser Hill, Elev. about 4000 ft., 12.1.1923, R.E. Holttum, SFN 11346 (later renumbered 71318). Lloyd already relied on Holttum for the observation of the specimens retained in Singapore. The collection made up of three nice big fruitbodies was well annotated by Y. Abe in 1990, but I am not aware of a publication. The holotype was identified by Ryvarden (1989) as *Phellinus pachyphloeus* (Pat.) Pat., but the present isotype was cited as *Ph. melanodermus* (Pat.) Fidalgo by Corner (1991, p. 112), who uses different characters to differentiate the two species.



**Fig. 4.** Isotype of *Polystictus roseoporus* Lloyd, Mycol. Writ. VII, Mycol. Not. 73 (Oct 1924) 1331, fig. 3053 (with Note 74) at SING. Malay Peninsula, State of Johore, Ulu Kahang, Elev. 450 ft., 2.6.1923, R.E. Holttum, SFN 10939. The identity with *Microporus affinis* (Blume & Nees : Fr.) Kuntze proposed by Ryvarden (1992) after examination of the holotype is not problematic, but one can see the abundance and variability of specimens in the isotype.

A problem that however remains, is whether *H. umbrosa* is distinct from *H. umbrinella* Fr. The group of *H. tenuis* is certainly in need of revision and the well preserved isotypes at SING should be part of it.

### Corner's mycological collections

As emphasised by Watling (especially 2007), intensive collecting by E.J.H. Corner has been fundamental in the study of mycological diversity in the Malaysian region, as well as for mycological taxonomy as a whole.

Working with Corner's material is, however, not straightforward, as I have discovered after years of studies, initiated when R. Kiew, then curator of the Singapore herbarium, asked me to assess the significance of numerous collections stored in the Singapore herbarium, collections which had been overlooked for many years.

I concentrated my work on polypores, a group for which I had the necessary expertise, and especially well represented in the Singapore herbarium, which I visited several times from 2004 to 2010. At that time, the aim was to reorganise the polypore collection in an easily accessible way, made possible through two fellowships of the Singapore Botanic Gardens, with the support of the Belgian National Science Foundation (FNRS), as well as the general resources of my laboratory.

I have thus acquired a good idea of what material Corner had left in Singapore and could compare it to the material in his personal herbarium kept at the Royal Botanic Garden Edinburgh (E), as well as to the duplicates in Kew (K). Those visits to Great Britain were made possible by a grant for a sabbatical year made by the FNRS.

Most authors have taken for granted that Corner's types were systematically to be found in his personal herbarium at E, as if when leaving Singapore after the war, he had taken with him every interesting collection he had made. This is not the exact situation, and if it is true that a majority of types are now hosted in E, several paratypes and holotypes are to be found in SING. The great number of types kept in E makes the revision by Hattori, whose publication started in 2000, of foremost interest. My intention is to complement it with the Singapore types, through this paper and some subsequent ones.

That some holotypes of Corner's names should be in SING should be apparent to an attentive reader of his "Ad Polyporaceas" (1983–1991), where the mention "herb. Singapore" occurs beside the mention "herb. Corner".

It also happens that the institution or herbarium where the type is conserved was not indicated, and for types, this makes the new name invalid in the case of the Xanthochroic Polypores, Ad Polyporaceas VII. This last volume of the series was published in 1991, while Art. 37.7 of the ICBN (McNeill et al. 2006) makes such indication of the localisation of the type of a new name mandatory after 1990. An example of such an invalid name is *Phellinus glaucescens* (Petch) Ryvarden var. *minor* Corner (1991, p.93). If anybody wanted to validate that name, which is not my intention, the type is apparently the no. 28266 in SING, without corresponding material in E.

One should note that, despite its title, the publication by Corner in 1993, does not give indications on the status of its collections. It is a synthesis of the points of polypore taxonomy on which he disagreed with contemporary mycologists.

Most of Corner's collections in SING are from the years 1929–1932. This is, however, not exclusively so. There are collections from 1929 in E and from 1941 in SING. There is some difference in the proportion of material in E and SING by genera. I have only seen a single Corner collection of *Amauroderma* in SING (*A. rugosum*, Botanic gardens, 20/4/1932). This is not one of the ten bar-coded collections in E. The same situation occurs with *Trametes*, richly represented in E, but for which I have seen only three collections in SING. Those are of *Tr. persoonii* (Mont.) Pat. (later reduced to synonymy of *Tr. scabrosa* (Pers.) G. Cunn.), from 1929, 1930 and 1941 and are not recorded in E.

In contrast, the Singapore herbarium is rich in *Phellinus*, under that name, or more often *Fomes*. It is in that genus that Corner described his first polypores in 1932. Those were:

- *Fomes levigatus* Corner, Trans. Br. Mycol. Soc. 17 (1932) 52. Later renamed *Phellinus leiomitus* Corner, Beih. Nova Hedwigia 101 (Ad Polyporaceas VII) (1991) 108, by reason of homonymy in the genus *Phellinus*.
- *Fomes senex* (Nees et Mont.) Imazeki var. *bulbosetosus* Corner, *ibid.*: 75.
- *Fomes senex* (Nees et Mont.) Imazeki var. *hamatus* Corner, *ibid.*: 75.
- *Fomes lamaensis* (Murrill) Pat. var. *secedens* Corner. Gard. Bull. Straits Settlem. 5 (1932) 341.
- *Fomes noxius* Corner, *ibid.*: 342.
- *Fomes pachyphloeus* Pat. var. *hispidus* Corner, *ibid.*: 347.

The holotypes of all these taxa are in SING (see, e.g., Fig. 5 and 6) and I have not located any material in E.

It may be that Corner had made enough progress in his study of *Phellinus* (“*Fomes*”) not to consider it necessary to take much material with him when he left Singapore, especially given the fact that these are among the bulkiest polypores.

The type of *Phellinus noxius* (Corner) G.Cunn. is an especially noteworthy collection. It seems to have been split with one part placed in the type collection, receiving, in addition to the no. 25750, a general number 31727 (Fig. 6), while another part of 25750 is in the general herbarium, despite the mention in Corner’s handwriting “*Fomes noxius* Corner. Type”. The two parts should be reunited to better appreciate the variability of the collection. Indeed the type material is more dimidiate than one would guess from the original description. The importance of this collection comes from the possible conflict with previous, less well known names, like *Phellinus chaetoloma* Pat. and *Fomes sublamaensis* Lloyd. *Phellinus noxius* is a pathogen of major economic importance in the tropics, with 741 hits in Google Scholar, against 4 for *Ph. sublamaensis* (Lloyd) Ryvardeen. Even if the synonymy with *Ph. sublamaensis* does not seem to be accepted anymore, *sublamaensis* being apparently a synonym of *Ph. lamaensis* (Murr.) Pat., conservation against *Ph. chaetoloma* might be necessary as stated earlier.

Corner has mostly used the collections he had made as types of his new names; however, he sometimes also used material of the Singapore herbarium collected by other people. For example, the holotype of *Inonotus perchocolatus* Corner, Beih. Nova Hedwigia 101 (Ad Polyporaceas VII) (1991) 123 was collected by Kiah. The holotype “Singapore, Dalvey Road, 14 May 1920, leg. Kiah, Sing. F.N. 5714” has received the new number 32830 and is what most authors would consider a *Phellinus* in need of further examination and not an *Inonotus*. In the same publication, p. 124, is also described a var. *parvisporus* of this species, with type “Malaya, Johore, leg. R.E. Holtum s.n. Jul. 1931; herb. Singapore (ut ‘Poria 11a’)”. This is also present in SING and has received the number 28254, probably later than the study by Corner.



**Fig. 5.** Holotype of *Fomes levigatus* Corner, Trans. Br. Mycol. Soc. 17 (1932) 52 at SING, later renamed *Phellinus leiomitus* Corner, Beih. Nova Hedwigia 101 (1991), by reason of homonymy in the genus *Phellinus*. This taxon is usually ignored in recent treatments of *Phellinus*.



**Fig. 6.** Holotype of *Fomes noxius* Corner, Gard. Bull. Straits Settlements 5 (1932) 341 at SING. *Phellinus noxius* (Corner) G.Cunn., a species of major phytopathological importance in the tropics. This is the part of the collection SFN 25750 which has received the new number 31727 and has been incorporated in the type collection. Another part of this collection is still in the general herbarium.

### Perspectives for the future

Further developments in the study of the fungal flora of the Malesian region will certainly take place in several centres, especially the Bogor Herbarium and the Forest Research Institute Malaysia. For Singapore, interesting results will shortly come from the use of the rich herbarium.

The polypore collection in the Singapore herbarium, when reordered, will be an excellent tool for a model study of the fungal flora of the Malesian region. This is due to the large number of specimens that allow the study of the variability of species, and the presence of reference material, illuminating the concepts of authors like Lloyd and Corner.

It can be the basis of comparisons with distant areas, like Papua New Guinea, for which the Belgian herbaria GENT and LG hold numerous collections (Quanten 1997). This comparison would tell us if the polypore flora varies between the westernmost and easternmost parts of the Flora Malesiana territory.

It also presents a unique opportunity to follow floristic evolution in time. With areas like the Gardens' jungle or Bukit Timah regularly studied since Ridley's time at the end of the 19th century, one may get an indication of any change, linked to man's influence or climate, in the fungal flora of a tropical region. This, I believe, is unique in the world.

ACKNOWLEDGEMENTS. My work in Singapore has been made possible by two fellowships of the Singapore Botanic Gardens in 2005 and 2007 and the support of the Belgian Science Foundation (FNRS, now FRS) for the stay in 2004 (contract 2.4551.99.F) and 2009 and 2010, in the framework of a sabbatical year, that also allowed me to visit the herbaria of Kew and Edinburgh. During my visits in Singapore I always found excellent facilities provided by the curators, R. Kiew, who drew my interest to the Corner collections, and B. Tan, as well as continuous help from J. Leong-Skornickova and the very efficient herbarium manager S. Lee. In Kew (B. Spooner and B. Aguirre-Hudson) and Edinburgh (R. Watling and E. Haston) the hospitality was also excellent and I wish I will keep visiting these three great herbaria.

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