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History of the Study of Australian Agaricales

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Abstract

Three periods in the naming of Australian agarics can be distinguished. Initially, during the era of discovery, exploration and early settlement (1788–1838), few agarics were collected and no new species were described. Subsequently (1839-), local collectors were mobilized and a large number of collections were sent to Europe for identification. From 1899 resident taxonomists, notably J. B. Cleland and E. Cheel, began to describe new species, but the pattern of the previous period continued. Important factors affecting the progress of Australian agaricology have been (1) the seasonal, sporadic and ephemeral fruiting of agarics, (2) the difficulty of preservation, (3) the need for detailed notes on fresh material, (4) the importance of microstructure in taxonomy, and (5) the reliance on overseas expertise. The activities of H. T. Tisdall are discussed in relation to such problems.

The Agaricales (agarics) include the fungi commonly known as mushrooms, toadstools and boletes. Agarics may be present in large numbers in suitable habitats in season and they exhibit a variety of form and colour which makes them a conspicuous component of the mycoflora, especially in comparison to many of the microfungi.

A little over 1,000 species of agarics have been reported from Australia to date. Of these, about half are species described from Australian type localities with the remainder being records of species originally described from elsewhere (May & Wood, unpubl.). It is difficult to provide an estimate of the number of Australian agarics but, based on comparison with the mycofloras of other regions and extrapolation from current revisions of particular genera, there are likely to be well over 3,000 species.

Little is known of the naming and use of Australian agarics by the aborigines. Ethnographic data on fungi are scarce and there are virtually no references to specific species of agarics. The following account concerns the naming of Australian agarics since European colonization, with the focus being on those factors which stimulated or hindered the advance of Australian agaricology.

The progress of the naming of Australian agarics is summarized in Fig. 1, which shows the number of new taxa of Agaricales described, by decade, since 1788. The circumscription of the Agaricales is that of Singer (1986) with the exception of the Polyporeae. The information is derived from a census of Australian agarics (May & Wood, unpubl.). In general, the records of species described from elsewhere which were newly recorded from Australia follow a similar pattern.

Discovery, exploration and early settlement (1788–1838)

In comparison to the rich harvest of new and often strange species of plants and animals described during the first fifty years after the European settlement of Australia collections of fungi are rarely recorded. The only new species of fungus to be described was the especially bizarre gasteromycete *Aseroe rubra* Labill.

Soon after British settlement White noted that 'a toadstool was picked up by one of our company, which, some of the natives perceiving, they made signs for us to throw it away, as not being good to eat' (White 1790, p. 166).[1] Later reports are similarly cursory and there are incidental references to agarics in the diaries and accounts of A. Cunningham (Lee 1925), Backhouse (1843) and Leichardt (1847).

The paucity of references to agarics in the narratives of voyages of discovery and exploring expeditions can be attributed primarily to the seasonal and sporadic occurrence of agarics. Fruiting bodies appear predominantly in autumn and winter in temperate regions and then only if suitable rain has fallen. In the arid areas, in which much of the land exploration was concentrated, fruiting of agarics is rare.

Fungi were not recorded at all by some of the exploring parties. Leschenault (1816), in the account of the voyage of *Le Géographe* and *Le Naturaliste* (1800–1804) under Baudin, attributed the lack of fungi and other cryptogams to the aridity of the soil and the dryness of the climate. Gaudichaud, discussing the results of the voyage of *L'Uranie* and *La Physicienne* (1817–1820) under Freycinet, commented that, although fungi were collected elsewhere, 'New Holland, at the two extremities eastern and western did not offer to me a single species' (Gaudichaud 1826, p. 165). However, fungi were encountered by those who were in the right place at the right time. Peron, also a member of the Baudin expedition, found that on King Island 'the fern-families, the mosses and the fungi have a great number of species as beautiful as they are vigourous; this seems to me to result from the constant humidity of the atmosphere and of the ground' (quoted by Micco 1971, p. 11). Grey, in the journal of his expedition to north-west and western Australia (1837–1839) noted that 'the different kinds of fungus

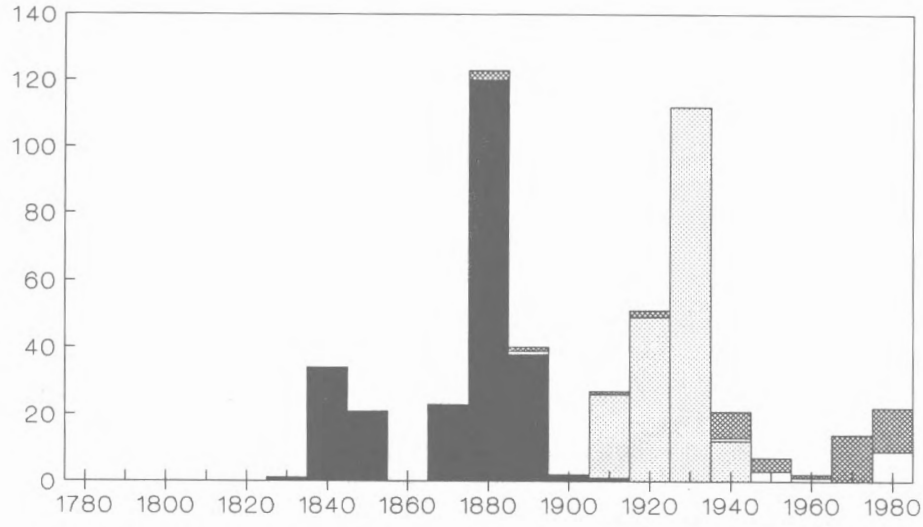

Fig. 1. Number of new taxa of Australian Agaricales described per decade from 1780–1789 to present. Authors are indicated as follows: ■ – Berkeley, Broome, Cooke, Fries, Kalchbrenner, Massee; ▨ – Cleland, Cheel; ▩ – other overseas authors; □ – other Australian authors.

are very good. In certain seasons of the year they are very abundant, and the natives eat them greedily' (Grey 1841, p. 294).

The only named species of agarics recorded during this period were the three species included by Brown (1814) in a list of fungi common to Australia and Europe which had been collected during the voyage of the *Investigator* (1801–1803) under Flinders. Interestingly, amongst Brown's notes on Australian plants[2] there are some descriptions of fungi including an agaric collected from the Kent Group, Bass Strait, in 1804. The collection is noted as emitting a bluish-white phosphorescence and there is also a detailed description, in Latin, of the fruiting bodies. The description clearly refers to *Pleurotus nidiformis* (Berk.) Sacc., not formally described until 1844. This common luminescent agaric, known as the 'ghost fungus', appears to have been named at least four more times since under the appropriate epithets *P. lampas* (Berk.) Sacc, *P. illuminans* (F. Muell.) Sacc., *P. candescens* (F. Muell.) Sacc. and *P. phosphorus* (Berk.) Sacc. Although there are many references to the ghost fungus in both popular and scientific literature (Willis 1967) the correct generic placement and synonymy has yet to be established and there is still no description available which includes the information on macro- and micro-characters necessary in the modern taxonomy of the Agaricales. Brown's notes, in fact, contain more information than some of the type descriptions of the above-mentioned species. Brown's interest and expertise were certainly not restricted to 'higher' plants and he was also well acquainted with the cryptogamists of the day (Mabberley 1985). However, there are no published references to any of his manuscript descriptions of Australian fungi, although specimens may not have been preserved.

The absence of taxonomic publications on agarics during this period was probably due, apart from lack of material, to the scarcity of specialists who were competent to name exotic fungi and who also might have encouraged their collection. The major taxonomic mycologists at the time were C. H. Persoon (France) and E. M. Fries (Sweden) who did publish on extra-European material, but generally that provided by non-British collectors. Significantly, the first comprehensive account of British fungi was that of Berkeley (1836), and it was the Rev. M. J. Berkeley who began the taxonomic study of Australian agarics.

Resident collectors and overseas taxonomists

Berkeley (1839) described *Favolus pusillus* Fr. var. *pallidus* Berk. [= *Dictyopanus pusillus* (Pers.) Singer] and recorded a collection of *Lentinus villosus* Klotzsch, which he subsequently (Berkeley 1840) named *Lentinus fasciatus* Berk. [= *Panus fasciatus* (Berk.) Pegler]. The two species were based on material collected by R. C. Gunn and R. W. Lawrence in Tasmania and were the first new species of agarics to be described from Australia.

The rapid increase in the number of new species described from 1839 (Fig. 1) is attributable to the mobilization of resident collectors who, in contrast to the random activities of preceding collectors, were able to gather agarics wherever and whenever they occurred. The collections were forwarded to European mycologists by correspondents who played an important role in recruiting and supporting the collectors and also in making contact with mycologists. At first, William Hooker (Royal Botanic Gardens, Kew) acted as an intermediary between Berkeley and the collectors J. Drummond, Gunn, Lawrence and W. Archer. The new species forming the initial peak between 1839 and 1860 (Fig. 1) are based mainly on the collections of William Hooker's recruits, with some collections being contributed by J. D. Hooker as a result of the voyage of HMS *Erebus* and HMS *Terror* (1839–1843). During this period Berkeley, with the exception of agarics collected by L. Preiss and named by Fries (see Parbery & Sheather, this volume), described all new species.

William Hooker encouraged the collectors to send fungi, noting in a letter to Berkeley that 'there has arrived today for me a parcel of fungi from Swan River . . . if you could find time to draw out a list of the present ones . . . it would encourage him [Drummond] to persevere in collecting these things more than any-

thing else' (quoted by Galloway 1977, p. 501). Drummond wrote to William Hooker 'You observe . . . that the *Fungi* of this land must be worth picking up. They do exist, indeed in great variety, and some are highly curious' (Drummond 1842, p. 215).

However, European taxonomists had some difficulties with naming Australian agarics. Berkeley, in reference to some collections sent by Drummond, stated that 'the list of agarics would have been much longer had not the notes belonging to many species been lost and the specimens much corroded by insects' (Berkeley 1845, p. 42). In a letter to William Hooker, Drummond noted that 'some sort of mould got amongst my collection . . . and destroyed many of them' (quoted by Galloway 1977, p. 501). Following collection the putrescent fruiting bodies of most agarics must be thoroughly dried — even then they are very susceptible to attack by insects and other fungi.

In the second half of the 19th century the role of intermediary shifted to correspondents resident in Australia, the most important of whom were Ferdinand Mueller (Melbourne) and F. M. Bailey (Brisbane) and this made communication with local collectors much easier. Both Mueller and Bailey passed on a large number of agarics from a wide circle of collectors and they also contributed many new species themselves. The collections they forwarded to Europe form the basis for the second peak of activity between 1870 and 1910 (Fig. 1). Most new species (98%) were named by Berkeley, C. Broome, M. C. Cooke and G. Massee, all of whom were based in England, and by C. Kalchbrenner in Hungary.

Cooke published the comprehensive *Handbook of Australian fungi* in 1892, a work that can best be regarded as 'somewhat unsatisfactory' (Ainsworth 1976, p. 230). Cooke did have to contend with material that was 'very wretchedly preserved' and named only 10% of the material which was sent to him from overseas (English 1987, p. 231). But the major problem with his compilation, and the previous works on which it is based, is that all the species had only been seen in the dried condition. In agarics especially, many characters necessary for classification are lost after drying. In introductory remarks to the first decade of his series on exotic fungi 'Decades of fungi' Berkeley had stressed that 'it is much to be wished that collectors of Fungi would take notes of the colour and substance of their species when gathered . . . The value of such annotations can best be appreciated by those who have to contend with all the difficulties which arise in the examination of exotic forms; difficulties which are multiplied ten times in the genus *Agaricus* [s.l. = Agaricales]' (Berkeley 1844, p. 185). In the introduction to his *Handbook*, Cooke was still emphasizing these points: 'The difficulties in the way of determination or description from dried specimens, especially of Agaricini, badly preserved, with no information, and destitute of figures, are almost insurmountable. Errors are almost inevitable in such cases, and there is never so much certainty or satisfaction as when the specimens can be seen living, or in a fresh state . . . Rarely have the specimens been carefully dried, and much more rarely have they been accompanied by any notes or figures' (Cooke 1892, p. vi).

Some of the field notes were excellent (Fig. 2) but in other instances it is obvious that a good deal of imagination had to go into the reconstruction of the appearance of the fruiting bodies as can be seen from a comparison of Bailey's 'rough' sketch (Cooke 1892, p. vi) of *Agaricus avellanus* Cooke & Massee (Fig. 3) and a painting by Cooke of that species (Fig. 4).

In contrast to the 'higher' plants, Australian agarics collected during the 19th century were easily accommodated into existing genera. Berkeley, discussing some of the collections contributed by Mueller, noted that 'The collection on the whole, can scarcely be said

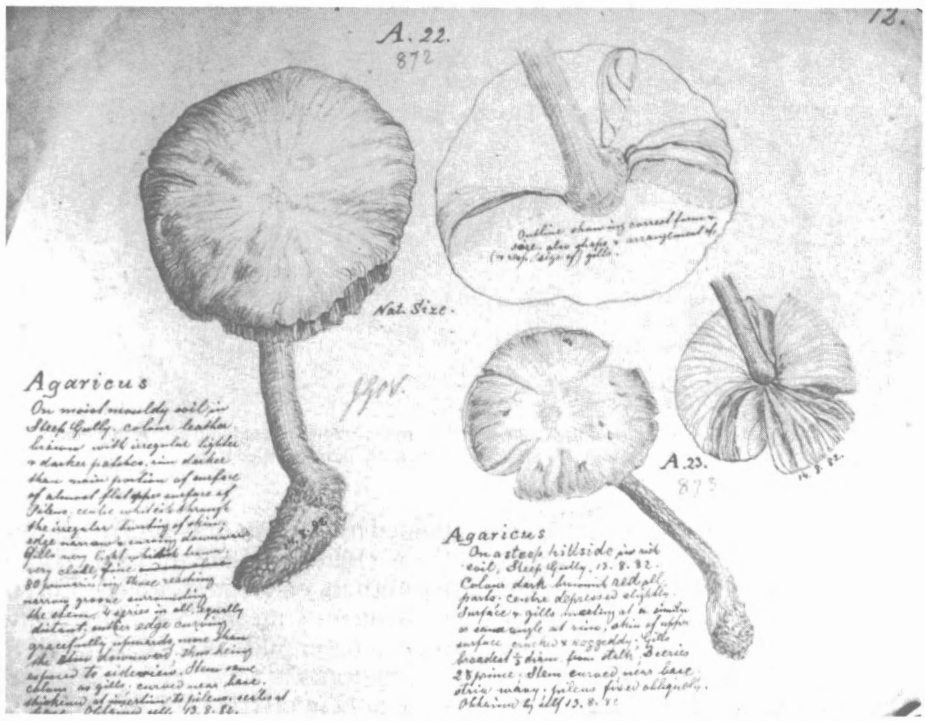

Fig. 2. Notes on agarics by J. G. O. Tepper sent to M. C. Cooke for identification (now in the library, National Herbarium of Victoria).

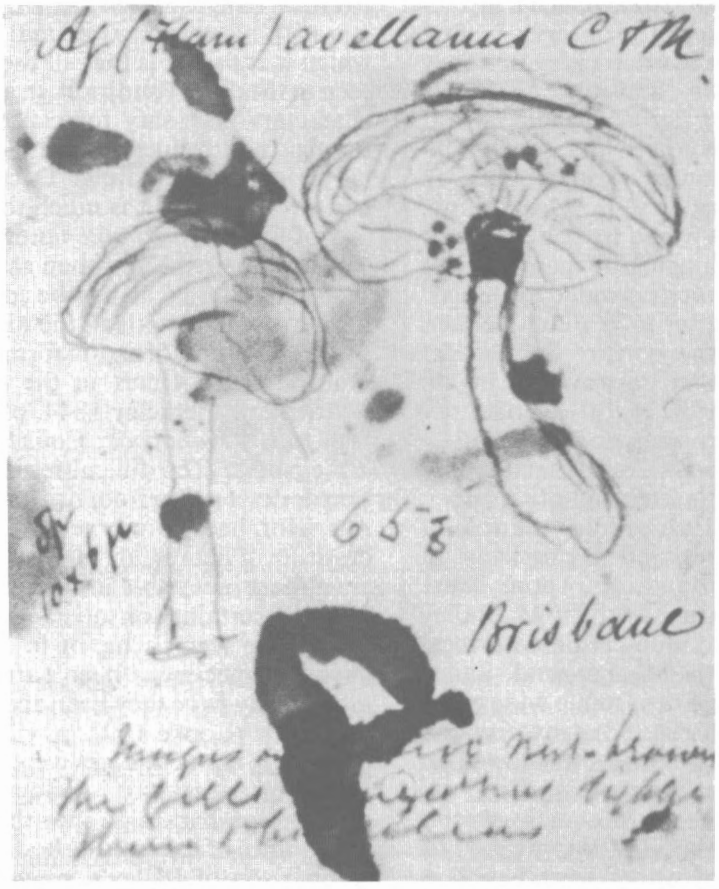

Fig. 3. F. M. Bailey's notes on the type of *Agaricus avellanus* (accompanying the specimen at the Herbarium, Royal Botanic Gardens, Kew).

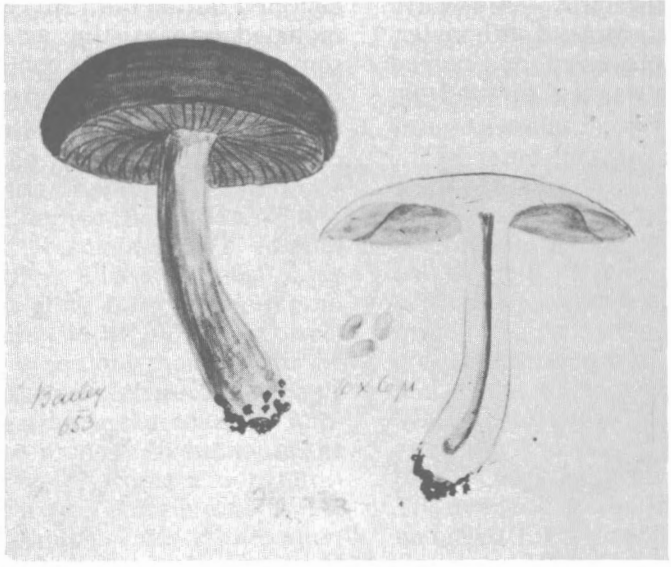

Fig. 4. Watercolour illustration of *Agaricus avellanus*, based on Bailey's notes (bound into a copy of Cooke's *Handbook of Australian fungi* in the library, Plant Research Institute, Burnley, Victoria).

to be of any great interest . . . as the aberrant forms are few' (Berkeley 1873, p. 155). The only novel genus from Australia, *Metraria* Cooke & Masse was apparently based on the mixture of a watercolour of an *Amanita* Pers. and the spore print of a *Hebeloma* Kummer (Reid 1980; Holland & Pegler 1983).

Berkeley also found that many of the collections were 'either identical with European species or so nearly allied that with dried specimens only, unaccompanied by notes or drawings it is impossible to separate them' (Berkeley 1873, p. 155). This tendency to place Australian collections under European species has consequently meant that a large number of European species (over 500) have been recorded from Australia. The majority of these records are likely to be incorrect, especially in mycorrhizal genera such as *Russula* Pers. and *Cortinarius* Fr. for which surveys of the comparable mycofloras of New Zealand (McNabb 1973;

Horak 1988b) and South America (Moser & Horak 1975) have found no European species in native forests.

It is not surprising that the dried specimens of agarics, lacking the form and beauty of fresh collections, failed to excite attention. It is only now being realized that the agarics of the Southern Hemisphere, especially those associated with *Nothofagus* Blume, are key elements in understanding the evolution of many genera and generic limits established on Northern Hemisphere species must be altered (Horak 1988a; 1988b).

Apart from a few species whose authorship had been attributed to Mueller by Berkeley and by Kalchbrenner, not one of the agarics included by Cooke (1892) was described by a taxonomist resident in Australia. In contrast, by the end of the 19th century the study of Australian plants by resident taxonomists, such as Mueller, had begun in earnest. A consideration of the activities of H. T. Tisdall illustrates some of the difficulties involved in the establishment of mycological taxonomy in Australia.

Henry Thomas Tisdall

Tisdall was a schoolteacher who spent a number of years at Walhalla in East Gippsland and later resided in Melbourne. He was an active member of the Victorian Field Naturalists Club and was encouraged by Mueller to specialize in collecting fungi (Tisdall 1961). Tisdall made many collections of agarics and other fungi which were forwarded by Mueller to Cooke for description. Tisdall also made the important discovery of the fruiting body of *Polyporus mylittae* Cooke & Massee, for over 40 years only known from its sclerotium, the 'native bread', *Mylitta australis* Berk. (Tisdall 1886).

Many of Tisdall's notes, often accompanied by excellent watercolours (Fig. 5), are now in the library of the National Herbarium of Victoria (MEL). On some of the sheets there are thin slices of the fruiting bodies. Importantly, some of these specimens are holotypes or isotypes of names published by Cooke and Massee, the types of which are usually only sought from the Herbarium, Royal Botanic Gardens, Kew (K). Tisdall's notes are often detailed as can be seen from an extract from those on a collection of *Amanita vaginata* (Bull.: Fr.) Vittad. from Stringer's Creek: 'Volva, thick white, it had evidently enveloped the whole plant which had burst through upwards. Pileus forming a rounded cone, dark brown at apex gradually to pale yellow at the edge, from the edge upwards parallel lines formed by depressions in the testa extend about two thirds of the pileus . . .'. Such information would have been of great value to Cooke, who singled out Tisdall's material, along with that of Miss [presumably Louisa] Wehl and Flora Martin (nee Campbell) as being exceptional amongst the collections he had examined from Australia (Cooke 1892).

The separation between collector and taxonomist meant that some misinterpretation on the part of both parties was inevitable. Tisdall submitted an excellent watercolour of what is obviously *Mycena interrupta* (Berk.) Sacc. (Fig. 6) to Cooke, who did not recognize it despite the existence of a coloured illustration of the type of this distinctive blue agaric in Berkeley (1859). Cooke enquired on the sheet if the colour of the spores were white or pink, and assuming they were pink, identified the collection as a species of *Agaricus* tribus *Leptonia* Fr.. Tisdall (1885) evidently mistook Cooke's enquiry to refer to the colour of the spores under the microscope rather than that of the spore print which would have been the intent of Cooke's query and followed Cooke's identification in later listing *Leptonia lampropus* (Fr.) Quél., noting, however, that 'this fungus is mentioned by Cooke [*Handbook*] as being only found in pastures . . . but I have never noticed them except on trunks of trees' (Tisdall 1896, p. 96). Tisdall's collection of *M. interrupta* predates, by almost fifty years, the first published record of the species from Victoria (Stewart & Hooke 1934: as 'pixie's parasol').

In 'Notes on the genus *Calocera*' Tisdall provided

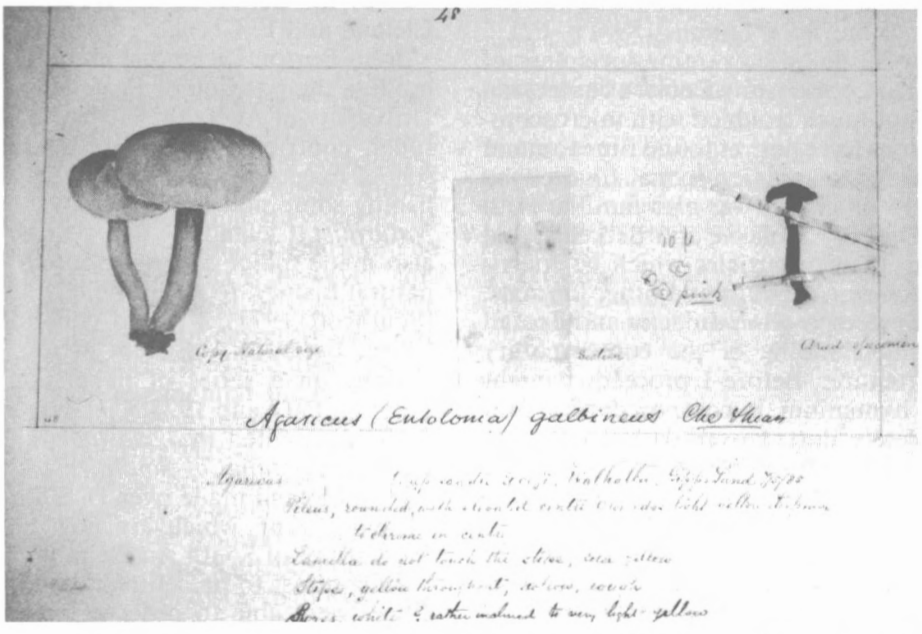

Fig. 5. Isotype of *Agaricus galbineus*, with notes by the collector, H. T. Tisdall (library, National Herbarium of Victoria).

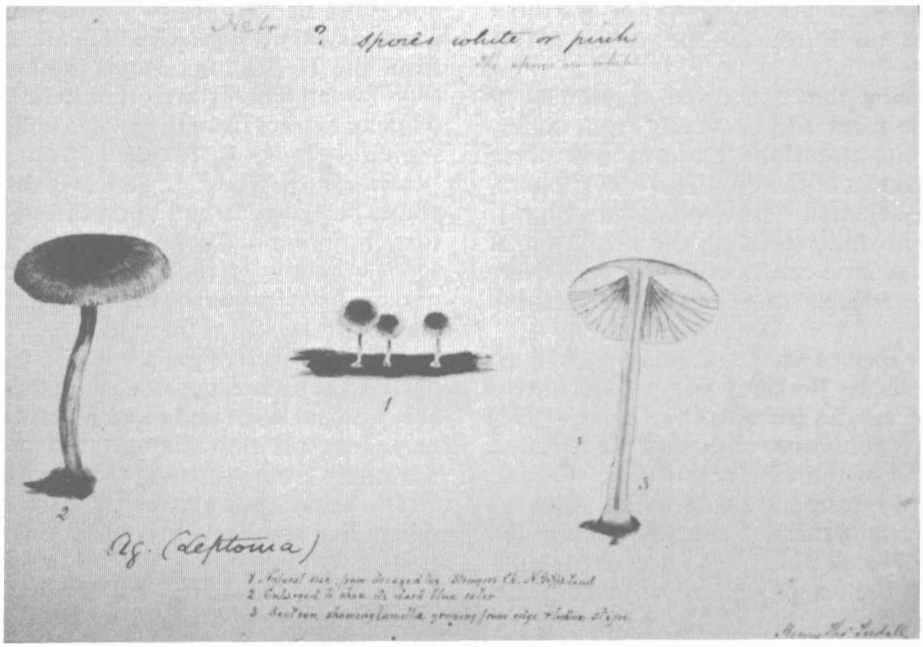

Fig. 6. Notes on an agaric by H. T. Tisdall with annotation by M. C. Cooke (library, National Herbarium of Victoria).

an exhaustive discussion of the macro- and micro-characters of what he considered to be a new species in the genus but concluded that 'still I am uncertain, and would wish to obtain more specimens before asking Baron von Mueller to submit the whole question to Dr. Cooke' (Tisdall 1894, p. 131). He had earlier stated that he was 'content to state such characters concerning fungi which I am in a position to describe, leaving the responsibilities of classification to such veterans in Science as Dr. Cooke and Professor Berkeley'(Tisdall 1887, p. 47). The struggle to transcend deference to overseas experts and establish taxonomy in Australia had already begun for the 'higher' plants, notably by Mueller, but mycology lagged far behind. In discussions after the reading of Tisdall's paper on *Calocera*, Daniel McAlpine, no doubt realizing Tisdall's competence to do so, urged 'the local working out and naming of such additions to our flora' (Anon. 1894, p. 62).

It is notable that Tisdall did examine specimens of fungi with the microscope despite Cooke's contention that 'Australia is not much troubled with microscopical students. Her sons have not yet found time to stand for hours at one end of a microscope' (quoted by English 1987, p. 169). Tisdall was also familiar with the textbooks of De Bary, Tulasne and Berkeley, and often quoted from them in articles which he contributed to *The Victorian Naturalist* and other journals. The tone of these pieces is often didactic and Tisdall shows a good understanding of the contemporary ideas on microstructure: 'Before I proceed, I might explain that the hymenium is composed of a thin membrane completely dotted over with quaternary groups of spores, each spore is borne on the end of a slender stalk or sterigma, and four of these sterigma spring from a . . . basidium . . .' (Tisdall 1885, p. 169). The reliance on microstructures in the taxonomy of the Agaricales has discouraged many subsequent amateur mycologists and it is unfortunate that Tisdall's interest in fungi was not directed towards the publishing of new species and that he did not have the opportunity of more intimate contact with specialists in the field. Lack of ready access to type material and literature would have also been factors discouraging local efforts in taxonomy.

Resident taxonomists

The first new species of agaric to be described by a resident mycologist independently of European specialists was *Hebeloma frenchii* McAlpine (McAlpine 1899). This was the only agaric described by McAlpine who, however, founded Plant Pathology in Australia (Pascoe, this volume). Around the turn of the century Tasmanian botanist, Leonard Rodway, co-authored a number of new species of agarics with Englishman G. Massee, but the peak of new species between 1910 and 1940 (Fig. 1) was almost entirely due to the activities of resident mycologists, J. B. Cleland and E. Cheel.

John Burton Cleland studied medicine, eventually holding the position of Professor of Pathology at the University of Adelaide. He had a life-long interest in fungi, contributing his first article on fungi to his school magazine in 1893 (Southcott 1971) and publishing some notes on fungi in the *South Australian Naturalist* (Cleland 1970) a year before his death. He also made major contributions to other branches of natural history, to anthropology and to conservation (Southcott 1971). Cleland collaborated with Edwin Cheel, Botanical Assistant at the Botanic Gardens, Sydney on a series of papers on Australian fungi between 1914 and 1923. Cleland's continuing interest in fungi resulted in *Toadstools and mushrooms and other larger fungi of South Australia* (Cleland 1934–1935). Cleland made over 16,000 collections of fungi (Talbot 1976), which are now housed at the State Herbarium of South Australia (AD).

In contrast to preceding taxonomists, Cleland and Cheel were able to observe in the field the species which they described, and also had the opportunity to assess the range of variation of fresh material. They

were also careful not to assume that all the species they collected were new. In the introduction to their series 'Australian fungi: notes and descriptions' they stated that 'we have adopted the plan of referring Australian plants to European species if there seems reasonable grounds for considering them the same ... We, however, also add to such identifications our own descriptions of the Australian plants' (Cleland & Cheel 1918, p. 88). Their work is also distinguished by the inclusion of copious notes on the colour of fresh material and some details of spores and other micro-characters as well as discussions of intra-specific variation.

Current research on agarics

Rolf Singer and others have revolutionized the classification of the agarics, producing a system in which the emphasis is on the micro-structure of the fruiting body. Information on cultural morphology, sexuality, interfertility and chemical characters is also of great importance. Cleland's species, and indeed all those of his predecessors, need to be revised according to modern concepts of genera and species but his *Toadstools and Mushrooms* will remain 'outdated and yet timeless' (Talbot 1976, p. 3).

Some of the types of species of agarics described during the 19th century have been re-examined, notably by D. Pegler (K), E. Horak (ZT) and Singer (FH). Such species as *Anthracophyllum archeri* (Berk.) Singer and *Melanotus hepatochrous* (Berk.) Singer, amongst the first to be described, can be considered well known today. However, the majority of named species are known only from the type and there are many dubious records of European species. There is also a large number of undescribed species.

Forty nine agaric species have been described since 1950 (Fig. 1), mostly by overseas taxonomists. At present, in Australian Universities and research institutions there are only four mycologists who have published on agarics. There are also a number of amateur, student or retired agaricologists. Collaboration with, or visits by overseas experts has resulted in significant contributions to the taxonomy of *Amanita* (Reid 1980), *Armillaria* (Kile & Watling 1983) and the gasteroid agarics.

Gasteroid agarics

The gasteroid agarics comprise genera which have long been placed in the Gasteromycetes but which are now recognized as being closely related to the Agaricales. Most gasteroid agarics grow partly or wholly buried and therefore one would expect that they would be even less well known than the epigeal agarics. The knowledge of such fungi in Australia is, however, surprisingly complete. A small number of species were described in the 19th century but currently over one hundred species have been described and these species are for the most part well documented and have often been revised several times. The initial impetus for studies on this group came from Massee who described collections from Rodway. At first Massee published new taxa himself, then Rodway co-authored a number of new species and eventually Rodway himself described more new species. This collaboration was important in shifting the focus of research to Australia. Subsequently, the majority of species in this group have been described by Australasian mycologists, notably G. H. Cunningham, J. Cribb and G. Beaton. Beaton was not a professional mycologist but had a wide interest in the taxonomy of fungi and set up a microscope and library and, with the advice and collaboration of overseas mycologists, described many new species of fungi, especially in the Ascomycetes (Weste 1988). The revision of the Victorian species of gasteroid agarics, commencing with Beaton et al. (1984), is the first comprehensive modern treatment of any group of Australian agarics.

Conclusion

The above account has been concerned with the history of the *naming* of new species of Australian agarics. Naming is by no means knowing and there is much to be learnt about the biology of the species. Agarics are important in forestry (many species are mycorrhizal), in plant pathology (*Armillaria*), and as sources of biologically active compounds. The group also includes choice edible species as well as extremely poisonous ones. Research in these areas is being severely retarded by the lack of taxonomists. Many of the factors which have hindered progress in the past still operate today, the most important being the continual reliance on overseas expertise.

If agarics, and fungi in general, are ever to be given the coverage accorded to the 'higher' plants in the *Flora of Australia*, mycology in Australia must be strengthened considerably. Pascoe (this volume) provides further strong evidence of the neglect of taxonomic mycology in Australia and his call for the appointment of mycologists to State herbaria is strongly endorsed and echoes the plea of McAlpine, almost a century ago: 'There can be no doubt that the necessity for sending specimens, often difficult to preserve, to distant countries for identification has greatly retarded our knowledge of these important organisms [fungi], and I think the time has now arrived when we ought to make an effort to study and develop our own resources' (McAlpine 1895, p. 752).

Acknowledgements

I thank Katrina Geering, Andrew May, David Albrecht, Alec Wood and the librarians at the University of Melbourne, the National Herbarium of Victoria and the Plant Research Institute, Burnley for assistance in locating references and other material. Ian Pascoe kindly provided photographs.

Notes

1. The *Coprinus*-like fruiting bodies depicted in plate 33 of White's *Journal*, in the foreground of the illustration of the 'blue frog', are presumably an addition by the engraver, perhaps 'toadstools' for the frogs!
2. These notes are part of Brown's extensive 'manuscript slip catalogue' contained in Solander boxes at the Department of Botany, British Museum (Natural History). There is a microfilm copy at the Australian National Herbarium (CANB).

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