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Elmar E. Leppik and Estonian mycology

Erast Parmasto
Institute of Zoology and Botany, Estonian Agricultural University, 181 Riia St., EE 51014 Tartu, Estonia. E-mail: e.parmasto@zbi.ee

Abstract: Elmar Emil Leppik (1898-1978) was the most prominent Estonian mycologist and plant pathologist. His influence on mycological studies was established beginning in 1923 when he worked in Estonia, and continued long after he had to leave Estonia as a refugee in 1944. The mycological herbarium and library established by him at Tartu University has served as a firm foundation upon which to base studies that are going on today. Continuity of mycological research in a small country like Estonia is passed on not only from teacher to student, but more often it is a written continuity of ideas and aims.

INTRODUCTION

In a small country like Estonia (about 45,000 sq km; 1.5 mln inhabitants in 1997) mycological studies usually are sporadic and discontinuous. The first scanty data on Estonian fungi were published in 1777 (Parmasto, 1989). Although Johannes Anton Weinmann, the author of the first survey of Russian fungal biota (1836), was actually the Learned Gardener of the Botanical Garden of Tartu University (1805-1813), his interests had not turned to fungi at that time. Thus, it was not until the middle of the Nineteenth Century, that the first specialized studies on the fungal biodiversity of the country were carried out.

From 1850-1859 Heinrich August Dietrich studied fungi while he was employed as Chief Gardener at the Haimre Manor in northern Estonia. As a result of his extensive studies, two research papers (1856, 1859) and nine fascicles of exsiccata (*Plantarum florae Balticae cryptogamarum*, Cent. I-IX, 1852-1857) were issued. These activities mark the beginning of scientific mycology in Estonia.

After moving to Tallinn, Dietrich lost his interest in, or time to devote to mycology. For the next sixty years Estonian fungi were studied only by botanists or mycologists working outside of Estonia. These include C. Gobi, V. Tranzschel, T. Westergren, and F. Bucholtz, who individually published several valuable papers. Although Fedor Bucholtz went to Estonia at the end of his life, he had no time for fungi, because he devoted himself (1919-1923) to the reorganization of the newly reopened Institute of Botany, Tartu University, after the War of Independence. Bucholtz published only four short papers while he was in Tartu, all in 1922; these were one 2-page paper with mycological notes, and three in Estonian that were two popular articles on plant protection and one on sexuality in fungi.

ELMAR LEPIK, THE FIRST ESTONIAN MYCOLOGIST

Elmar Lepik was born in the Jõgeva Commune north of Tartu; he was the son of a farmer. His birth date has been given in the Estonian Encyclopedia (1972, 2nd ed. 1990) as 4 October 1898; however, according to the Census Book of the Laiuse Parish for 1898, the date was 3

Elmar E. Leppik (1950)

December 1898 (Annuk, 1998). It seems that not even the year of his birth was recorded correctly, because in a personal letter to me, dated 11 November 1967 he wrote to me (in Estonian): "My true jubilee is not next year, but some years later. This is a mistake difficult to correct now. I shall send you more exact data later". He never did.

As a student, although Lepik was interested in mycology, he was even more interested in algology, and his first (unpublished) paper was entitled "Estonian algae" (Tartu, 1922. 76 pp., in Estonian). After graduating he was told: if you want to get a stipend from the Rockefeller Foundation and be employed at Tartu University, you must take phytopathology and mycology (S. Talts, pers. comm.).

Lepik followed this advice because from 1926 to 1929 he was a fellow of the Rockefeller Foundation and (later) Tartu University in Bern, Genf and Zürich. Among his tutors were the well known mycologists E. Fischer and E. Gäumann. He received his Dr. Sc. Nat. degree 1928 in Zürich; the dissertation was entitled "Untersuchungen über den Biochemismus der Kartoffelfäulen. Der Einfluss der Phytophthora-Fäule auf die chemische Zusammensetzung der Kartoffelknolle."

After returning to Estonia, Elmar Lepik worked at Tartu University beginning as Acting Assistant Professor (1929-1931), and progressing to Assistant Professor (1931-1938), Professor Extraordinary (1938-1942), and Professor (1942-1944). From 1929 on he was also the Head of the Phytopathological Station of Tartu University (Annuk, 1998). Through his efforts, the station became the center of phytopathological and mycological studies in Estonia. He aquired monographs and key books and all the important mycological journals of the day for the library: including almost complete sets of Annales Mycologici, Bulletin de la Société Mycologique de France, Mycologia, Mycology, Rabenhorst's "Flora", volumes of Saccardo's Sylloge fungorum. In addition several series of fungal exsiccata were obtained comprising altogether more than 10,000 specimens. Lepik compiled and issued six fascicles of the "Fungi Estonici exsiccati"; this was the basis for exchange of fungal specimens. He and his co-workers collected fungi extensively; there are about 10,000 Estonian specimens of this time included in the herbarium. Another important contribution was the addition of a biochemical laboratory to the Phytopathological Station in 1931.

During his activities in Estonia (1923-1944), Lepik published more than 150 papers, including studies on distribution of microfungi in Estonia, revisions of Dietrich's exsiccata, checklists of fungi found in some interesting regions of Estonia, and on edible and poisonous fungi as well as on wood rotting fungi of Estonia. There were also many popular phytopathological articles published for farmers in Estonian. One of Lepik´s most interesting theoretical papers dealt with the historical development of the fungal biota of Estonia (1941). He published a full bibliography of his papers (1976), and his papers on Estonian fungi also are available in the List of Estonian Fungi (L. Järva & E. Parmasto, 1980). Besides his scientific research, Lepik organized a wide network of farmer-correspondents who reported on the occurrence and damage caused by phytopathogenic fungi. He helped farmers in other ways, because at the Phytopathological Station, new fungicides were manufactured; the Station was also the official plant quarantine center in Estonia.

Lepik was helpful in faciliating the research of others. He served as editor of the transactions (Annales) (1937-1943) of the Estonian Naturalists' Society. He also participated in the compilation and editing of handbooks on gardening, and the agricultural encyclopedia. Of his students and colleagues, several phytopathologists were interested in mycology and published articles on Estonian phytopathogenic fungi (E. Kaarep, A. Kivilaan, A. Kustasson, A. Käspre, A. Luhakooder, R. Toomre, and others). Because of his support, even an amateur mycologist, N. Witkowski, was allowed the opportunity to study mushrooms, and this work resulted in several valuable papers.

ELMAR LEPPIK, AN AMERICAN MYCOLOGIST AND EVOLUTIONIST

As a refugee, Elmar Lepik (since 1947 spelled Leppik) worked as a lecturer and professor in botany and plant pathology in German universities. Later he served as an instructor at the US Army Agriculture and Technical School. In 1950 he moved to the United States; for the

first seven years he taught at Augustana College in South Dacota and worked as a research scientist at the Hormel Institute of the University of Minnesota and as a guest investigator at the University of El Salvador. In 1957 he was employed at the research institutes of the US Department of Agriculture at Iowa State University and until 1964 when he moved to Beltsville, Maryland, a centre for agricultural studies (Cook, 1967).

Leppik's interests changed during this period toward the problems of the origin and phylogeny of flowering plants and fungi, evolutionary classification of flower types, co-evolution of plants, insect-pollination, and biology of bees. Six papers on the phylogeny of rust fungi were published in "Mycologia" (1953-1962). He became more and more interested in theoretical biology and general questions of evolution, and he published several important papers on this subject in the "Acta Biotheoretica", "Evolution" and "Evolutionary Biology." A series of papers was devoted to the problems of evolution of homologous and analogous characters; he was really the first biologist to acquaint American biologists with the theories of N. I. Vavilov's.

Elmar Emil Leppik died 4 November 1978 in Maryland, only 20 years ago.

CONTINUITY OF MYCOLOGICAL STUDIES IN ESTONIA

When some young students of Tartu University became interested in mycology in 1950, there were no longer any mycologists in USSR-occupied Estonia. The Phytopathological Station had been destroyed in battles at Tartu in 1944, but the excellent mycological library and a good fungal herbarium fortunately survived. The head of the Institute, Prof. A. Marland was a Lyssenkist; but, nevertheless, he dared to permit some students to use the library in years (about 1946-1954) when the use of any foreign literature was rigorously forbidden by the Soviet authorities. The head of the Botanical Institute, Prof. August Vaga gave moral support to the mycological studies. As a botanist interested in theoretical problems, he was one of the first biologists in world who recognized Fungi as independent kingdom of living organisms (Vaga, 1952). In 1952 contacts with the mycologists of the Botanical Institute of the Academy of Sciences of the USSR in Leningrad were established.

The aims and research projects of this generation of young mycologists were predetermined by Leppik's actions; he was a paragon for them. Short papers on occurrence of fungal species, surveys of fungal biota of some of the regions of Estonia similar to those studied by Leppik were published. Leppik had been interested in wood-rotting polypores; a survey of these fungi in Estonia was the first theme of studies of young E. Parmasto.

Leppik had been able to develop mycological and phytopathological studies equally in Estonia, not subordinating one to the other. The new mycologists managed to follow his example despite external pressure. His exsiccata "Fungi Estonici exsiccati" were followed by the exsiccata "Mycotheca Estonica" (3 fascicles, 1957-1961). Leppik was a master at compiling popular books, articles, and short notes in journals and newspapers, and the same trend was shown in the work of the young mycologists in Estonia.

In 1963, correspondence between E. Leppik and me began. In reply to a New Year greetings, on 11 April 1964 he sent me a message in English headed "Official letter," but with a line with thanks handwritten in Estonian. In the following correspondence (1964-1975) he wrote in Estonian, but we both used a half-official style: we both knew well that all correspondence with foreigners was monitored by KGB officers; letters were sometimes detained for checks for up to two months. In preparation for a scientific publication by Estonian mycologists to mark his jubilee, Leppik was notified of the intention; however, on 11 November 1967 he wrote, "As a precaution, I ask you and others not to do this. Refugees are on a black list [in Estonia] as before, and it may cause unforeseen political trouble to the authors of such publications. I do not like to think that somebody may suffer on my account." (Translated by E. P.)

Leppik sent us his reprints (including a full collection of his papers bound into four volumes produced by him in six copies) and several mycological books printed in the USA, otherwise unavailable then in Soviet Estonia. Through our letters we told each other of the news of mycological life in both countries. We

sent Estonian biological publications which he later passed on to the library of the National Fungus Collections in Beltsville. In 1971 and several times later he asked me to send him Vol. 47 of the "Annales" of the Estonian Naturalists' Society published in 1943 for the US Library of Congress. Although it was a crime in the Soviet Union to send something published in that year abroad, it was impossible to tell Leppik of the law. We managed to send the publication to him, but it did take two years to find the way.

Leppik's papers published in the USA on the phylogeny of fungi inspired us in Estonia to pay more attention to evolutionary studies. Phylogenetic taxonomy of fungi based on world data became one of the main trends in Estonian mycology.

MYCOLOGICAL RESEARCH: CONTINUITY OF AIMS AND IDEAS

Except for the last few decades, the continuity of mycological studies in Estonia has not been based on teacher-student relationships. Much more important has been the influence of ideas from writings and the wish to continue these studies originated by predecessors, on a new, contemporary level. Possibly, the same is true in other small countries, too. In the light of this approach, Elmar Emil Leppik's influence on the present day mycological studies is very significant in Estonia, as it has been during the last seventy years.

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Erasmus Mycophilus

Hans Trass
Institute of Botany and Ecology, University of Tartu, 38 Lai St, EE 2400, Tartu, Estonia.

Abstract: The services work of the Academician, Professor Erast Parmasto in the fields of mycology and general biology are described in connection with his reaching 70 years of age on the 23. October 1998. The personal characteristics, which have made him a leading contemporary mycologist, are analysed.

Erasmus Mycophilus - is the way I have named Erast Parmasto. I believe he has had nothing against this (he has published some of his popular works under the pseudonym Erasmus Mats).

In 1988 I wrote (Trass, 1988) "To the graduates of Nõmme High school in 1947 it was already clear then that there was at least one future biology professor amongst them - Erast Parmasto. Several signs alluding to this had already come to our attention: a passionate love of nature from an early age, great intellectuality, jerky movements and an inexplicable absent mindedness. And indeed they were not wrong."

We both lived in the garden town of Pääsküla, 12 km from Tallinn. We went to Kivimäe primary school together (1936 - 1942) then to Nõmme High School (1942 - 1947) and Tartu University (1947 - 1952). Then our ways parted, Erast began his postgraduate studies in the Institute of Zoology and Botany (ZBI) of the Estonian Academy of Sciences, now a part of the Estonian Agricultural University, and I entered the department of Plant Systematics and Geobotany of Tartu University (TU).

On one spring day in 1943, Erast took me by the hand and led me to Pääsküla sand quarry to gather lichens. The first of our collected species which I identified happened to be quite interesting - *Cladonia carneola*. Erast had been introduced to lichenology by Endel Alas, a pupil of the Gustav Adolf High School. Erast's active lichenological interest continued until 1948. Then he fell in love with fungi, or mycology. He writes (Parmasto, 1998: 31-32) "It is only worth studying that which is still unknown, that which others are not researching. However, the opposite philosophy is gaining ground nowadays: this states that we should study, that which is currently, the most important. A scientist's greatest achievement is considered to be the publishing of a new piece of research in an authoritative journal such as "Nature", two weeks before another competing scientist studying the same matter elsewhere does so. Understandably, such a race ensures the fast development of the most relevant topics in science and is therefore, generally very sensible. But a little too sensible for me. Anyway, I have always been a poor competitor.

I have always got on well with mushrooms even as a child when my mother took me mushroom picking in the autumn to the forests near our home and towards Harku bog. Later my course-

Erast Parmasto (1998)

mate and friend Väino Lasting, who was a passionate fungi collector, repeatedly asked me to join him on his mushrooming expeditions. For a handbook we used the antiquated German language Central European fungi identification handbooks found in the department library. On their basis, I compiled / translated a new handbook for the identification of genera of *Agaricales* of which I think we made some five copies. The work of the typist was financed by Professor Vaga".

This was the beginning of the fungal period in Erast Parmasto's life. A rapid career and recognition, initially among the mycologists of the former Soviet Union and later among western ones, followed. His career can be summarized as follows: 1950 - 1952 senior laboratory assistant in the Institute of Zoology and Botany, 1952 - 1955 postgraduate in the same Institute, 1955 - 1957 acting head of botany section, 1973 and 1979 - 1991 section head, 1956 - 1961 and 1964 - 1973 senior researcher, 1961 - 1964 scientific secretary, 1957 - 1960 editor of the "Estonian Nature" magazine, 1969 defended his Doctoral thesis, 1980 was elected Professor, 1985 - 1990 director of the Institute, 1972 was elected corresponding member of the Estonian Academy of Sciences and in 1986 was elected to the position of Fellow, 1973 - 1981 was the academician-secretary of the geology, biology and chemistry division of the Academy, 1982 - 1987 was a member of the presidium of the Academy, 1988 - 1995 past-time Professor at Tartu University, 1991 onwards senior researcher of ZBI. Other activities and posts characterising his many faceted achievements: 1971 - 1977 member of the executive commitee of the International Mycological Association and 1977 - 1983 vice-president, 1973 - 1976 President of the Estonian Naturalists' Society and honorary member (1988), Estonian merited scientist (1985), Estonian national award (1982), honorary member of the American Mycological Society (1994), honorary member of the Polish Botanical Society (1995). He has been honoured with the Estonian great nature protection award (1978), the Medal of the Estonian Academy of Sciences (1988), with the Estonian White Cross order (1998).

Parmasto has described a surprisingly large number of new taxa, in 1988 they included 2 classes, 2 families, 1 tribe, 23 genera, 77 species, 195 new combinations. In the last 10 years, many more have been added but even their author is not able to list them all! Parmasto's name has, in his honour, been used to distinguish several taxa - the genus of fungi *Parmastomyces*, the subgenus *Parmastinella*, the species *Amylodontia parmastii, Vararia parmastoi* and others. This is an indication of the high regard conferred on him by mycologists.

Erast had great difficulty in answering my question as to which of his works he considers the most important and most cited. His answer was evasive and unclear. Therefore, I must base my selection on the information presented in "Members of the Estonian Academy of Sciences" (1998): "Conspectus systematis Corticiacearum" (1968), "Variation of basidiospores in the Hymenomycetes and its significance to their taxonomy" (1987; together with Ilmi Parmasto), "Limits of splitting (on schizotaxia)" (1994), "CORTBASE. A nomenclatural database of corticoid fungi" (1997). I would add, here, the major article "The genus Dictyonema ('Thelephorolichenes')" (1978) in which he explains that instead of the 60 species of basidiolichens described only 5 really exist. Here EP comes to the fore as a "species destroyer"!, rather than as a describer of new taxa. I would characterise this article as a good example of harsh taxonomical realism.

Erast's unique personality is happily endowed with a number of distinctive and mostly positive traits. I will outline just a few of them.

- He can be damned sarcastic in his criticisms and discussions, bordering, in some peoples' opinion, on the rude; I know that this witty sarcasm mixed with irony and humour is not ill meant, it is just EP's style not unfriendliness or maliciousness.
- The highly gifted EP is, to use a worn phrase, a committed work-a-holic, fanatically devoted to his science and research, who does not know the meaning of the word holiday. When he was on Ruhnu Island with his wife Ilmi Parmasto, supposedly on holiday, EP every day worked on his research and collected Aphyllophorous fungi. Ilmi is used to such a way of life; she is, after all, a successful mycologist herself.
- EP has a very poor memory for faces and names, I suspect that on occasions he has

not even recognised me. Once we saw the physicist Harry Õiglane, who EP knew well, on the street and EP cheerfully commented "Look, there comes Eilart!". And there is nothing wrong with his vision. It is a strange quirk of character that Erast knows and recognises hundreds of plants and fungi at a glance, but people with difficulty. Is it perhaps that other characteristic of his, absent mindedness.

In Erast as a scientist, the aptitude for both analysis and synthesis are well married. He is exceptionally strong in both. His analytical abilities stand out in his taxanomical works, revealed as the systematicians sharp eyed and instinctive ability to separate species and taxa (EP himself calls this a "systematical sense of smell", in Russian "sistematitsheski njuhh"). Occasionally, Erast has even seemed annoyingly pedantic. Once, he admonished me severely for abbreviating the name of the famous Italian scientist A. B.Massalongo (following the example of other lichenologists) to Mass.; it must be Massal., or the name in full, explained EP and went on to expound at length. When I protested, EP replied brusquely that a true systematician must be a pedant! He is, I think, right. EP's aptitude for synthesis is manifested in his interest and multitude of works concerning fundamental questions in the general theory of systematics (the position of fungi in the phyla of organic nature, the phylogenesis of the macro-groups of fungi, etc.).

Parmasto has a great love of everything new in science. In the last ten years he has become an eminent specialist in the use of computers in biology. His special interest is the use of cladistic methods in systematics.

- I have always been impressed by EP's way with words, his remarkably expressive language and style in his many articles in newspapers, magazines and collected works. These are wittily written in a popular / belletristic style. I was amazed, when I read the "Lexicon of Estonian men of letters" compiled by O. Kruus (1995), not to find Erast Parmasto's name there, although the names of many less expressive current affairs commentators were included.
- And finally EP's many expeditions, trips and field works. He is undoubtedly one of the most travelled Estonian biologists, especially within Estonia, Siberia and the Far East. Erast cannot live without field work which he has at times also carried out in late autumn, winter and early spring. Into the forest!, is his habitual cry.

Erasmus, you are *a capite ad calcem* in you beloved science. Continue to be so, and proceed with the same enthusiasm and success. You will, after all, only be 70!

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Identification of groups within *Laetiporus sulphureus* in the United States based on RFLP analysis of the nuclear ribosomal DNA

Mark T. Banik[1], Harold H. Burdsall, Jr.[1], and Thomas J. Volk[2]
[1]Center for Forest Mycology Research, Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin
[2]Department of Biology and Microbiology, University of Wisconsin-La Crosse, La Crosse Wisconsin

Abstract: One hundred sixteen collections of *Laetiporus sulphureus* from throughout the United States were analyzed for variation in the internal transcribed spacer (ITS) region of the nuclear ribosomal DNA. The region was amplified using primers ITS 4 and ITS 5 in a polymerase chain reaction (PCR) and was the same size for all collections. The PCR products were digested with six restriction endonucleases and analysis of the resulting restriction fragment length polymorphisms (RFLP) identified seven *Laetiporus* restriction groups (LRG I-VII). Fruiting bodies within each LRG usually had the same color pore layer and occurred on similar host types (conifers vs. hardwoods) in similar positions on the host. Distinctive differences in morphological and ecological characteristics occurred between many of the LRGs. The RFLP pattern of LRG VII is suggestive of a heterozygous condition, composed of the pattern types occurring in LRGs I and VI. These three LRGs appear to be identical for the other characters examined and probably represent the true *L. sulphureus*. The apparent lack of individuals representing heterozygous combinations between the other four LRGs may indicate that these LRGs are reproductively isolated. One of these, LRG IV appears to be the white pored, ground-fruiting species described as *Polyporus cincinnatus,* by Morgan in 1885. The combination *Laetiporus cincinnatus* is proposed for this species.

INTRODUCTION

Laetiporus sulphureus (Fr.) Murr. is a common, easily identified member of the Polyporaceae that occurs in most areas of the United States. It is pathogenic, causing a brown cubicle rot of roots, butts, and heartwood of living trees. In the eastern, central, and southwestern United States it occurs almost exclusively on hardwoods, especially *Quercus* spp., but is commonly found on conifers in the Rocky Mountains and Pacific Northwest (Gilbertson & Ryvarden, 1986). It is also a persistant saprophyte and can survive and fruit for many years from a colonized substrate (Hepting & Roth, 1950).

Although *L. sulphureus* is easily identified via its bright orange color, morphological diversity within the species has lead to the description of a number of varieties. *Laetiporus sulphureus* var. *sulphureus* is the type of the genus and has basidiocarps with a lemon yellow pore layer and occurs on standing trunks, stumps or downed logs. *Polyporus* sulphureus variety *semialbinus* Peck was described to accommodate specimens with white pore layers (Peck, 1906). This same form was more thoroughly described as variety *overholtsii* by Rosen (1927), who included white pored collections, with pink pelei fruiting from the ground in association with *Quercus* species. It also appears this form was described as *Polyporus cincinnatus* Morgan (1885), but this elevation to the species level has not been widley accepted (Overholts, 1953). Specimens occurring on conifers have also been considered as a distinct form and in Europe collections from *Picea* sp. were used to describe the species *L. montanus* Cerny (1989).

Relative uniformity of microscopic traits among varieties of *L. sulphureus* has hampered studies on their taxonomy. In addition, compatibility information is unavailable due to erratic basidiospore germination and the absence of clamp connections. However, with the advent of molecular biological techniques such as polymerase chain reaction (PCR) and restriction fragment length polymorphism (RFLP) analysis, studies of closely related taxa have become feasible. We intend to use these techniques in evaluating the relationships between populations of *L. sulphureus*. This paper represents the first step in this evaluation.

MATERIALS AND METHODS

Collections of *L. sulphureus* were obtained from many different hosts and locations in the United States and information on host, fruiting position and pore layer color were recorded. Complete collection information is available from the authors upon request. Tissue isolates were obtained from most of the collections by excising small pieces from the pileus context using aseptic technique, and placing them on 1.5 % malt extract (Difco, Detroit, Mich.) and 2% agar medium (MEA) in Petri plates. All isolates are on deposit in the Center for Forest Mycology Research (CFMR) culture collection maintained at the USDA Forest Products Laboratory in Madison, WI.

Template DNA for PCR was obtained via several different methods. Primarily, tissue isolates were grown on cellophane overlaying MEA, ground and diluted 1:100 for use in PCR using previously described techniques (Volk et al., 1996). In addition, scrapings of aerial mycelium from MEA cultures or small pieces of fruiting body pore layer and trama were treated in the same manner as mycelium from cellophane. Finally, for some collections DNA was extracted from mycelium grown in 10 ml of 2% malt extract 0.2% yeast extract (Difco) broth in 90mm Petri plates. The mycelium was filter harvested, freeze dried, ground in a sterile mortar and pestle with dry ice and then extracted for DNA using CTAB (Rogers et al., 1989). The DNA obtained was diluted 1:1000 for use in PCR.

Amplification of the internal transcribed spacer (ITS) region of the nuclear ribosomal DNA was accomplished using primers ITS-4 (5'-TCCTCCGCTTATTGATATGC-3') and ITS-5 (5'-GGAAGTAAAAGTCGTAACAAGG-3') in PCR. The reaction mixture and amplification conditions used were those described by Volk et al. (1996). Following amplification the products were digested with the following restriction endonucleases: *Hae* III, *Hind* III, *Hinf* I, *Msp* I, *Rsa* I, and *Hha* I (Promega, Madison, Wis.). Digests were run using the reaction buffer supplied with each enzyme, 5 µL of amplification product, 5 units of each enzyme and water to bring the final volume to 20 µL. The reactions were incubated overnight at 37°C and the resulting digestion products were separated on a 4% agarose gel. Fragment sizes were determined using the method of Volk et al. (1996).

RESULTS

Amplification products of the ITS region were obtained from 116 *L. sulphureus* collections. Five of these were amplified directly from the basidiocarps and the remainder from tissue culture mycelium. There appeared to be no difference in amplification product from the different sources of template DNA, so the data were combined for analysis. The size of the PCR product was about 650 bp for each of the samples. Digestion of the PCR products of the 116 samples with *Hae* III, *Hind* III, *Hinf* I, *Msp* I, *Rsa* I, and *Hha* I, yielded two, two, three, three, four and two different RFLP banding patterns, respectively (Fig. 1, Table 1). For each of the collections tested, collating the pattern types obtained from each enzyme resulted in one of seven unique combinations. Groups of collections exhibiting the same combinations of patterns were referred to as *Laetiporus* restriction groups (LRG) and were designated LRG I - LRGVII (Table 2). Twenty nine collections belonged to LRG I, 14 to LRG II, 11 to LRG III, 33 to LRG IV, 5 to LRG V, 1 to LRG VI and 23 to LRG VII. The relation of the LRGs to host, fruiting position, pore layer color, and geographic location are shown in Table 3.

DISCUSSION

All of the isolates in each LRG possessed the same pattern types for each of the six enzymes. Collections within each LRG had many other characters in common. All collections of LRGs I, III, VI and VII had a yellow pore layer and fruited from stumps, living and dead trunks, or logs. All collections of LRGs IV and V had white pore layers. LRGs II and V fruited from stumps, living and dead trunks, and logs. LRG II was the only group to show variation in pore color with collections from Louisiana having white pores and those from California having yellow. LRG IV was the only LRG to fruit on the soil from roots and was found in this position in 30 of 33 collections. The specimens of LRG IV appear to correspond to the description of *L. sulphureus* var. *semialbinus* (Overholts, 1953).

LRG III was the only group collected from conifers, and it appears to be restricted to these hosts. The other LRGs were collected most often on oak except for LRG II from California,

where it occurs most often on *Eucalyptus*. LRG IV occurs almost exclusively on oak, which is also the most frequently reported host for *L. sulphureus* var. *semialbinus*. LRGs I, V, VI and VII do not seem to be as closely associated with oak.

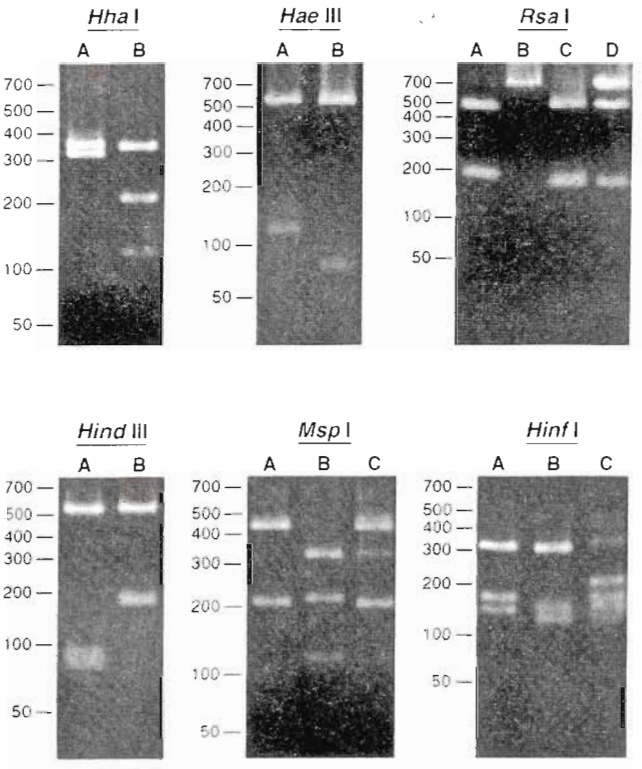

Fig. 1. Representative banding patterns obtained from the PCR amplified ITS region of 116 collections of *Laetiporus sulphureus* when digested with six restriction endonucleases.

Table 1. Approximate size in base pairs (bp) of the fragments obtained from the ITS region of the nuclear ribosomal DNA of 107 L. sulphureus isolates when digested with six restriction endonucleases.

	Pattern Type Designation			
enzyme	A	B	C	D
Hha I	375, 335	360, 210, 115	-	-
Hae III	550, 115	550, 60, 50	-	-
Rsa I	440, 180	660	460, 150	660, 460, 150
Hind III	530, 90, 80	560, 180	-	-
Msp I	450, 195	335, 210, 115	500, 450, 335, 195, 115	-
Hinf I	335, 170, 145	315, 140, 120	200, 170, 140, 120	-

Table 2. Designation of seven *Laetiporus* restriction groups (LRG) based on the RFLP pattern obtained from the ITS region of the nuclear rDNA when digested with six restriction endonucleases.

	Restriction Endonuclease					
LRG	*Hha* I	*Hae* III	*Rsa* I	*Hind* III	*Msp* I	*Hinf* I
I	B	B	B	A	A	A
II	A	A	B	A	B	B
III	A	A	A	A	B	C
IV	A	A	A	B	B	A
V	B	B	B	A	B	A
VI	B	B	C	A	B	A
VII	B	B	D	A	C	A

Table 3. Number of collections of each *Laetiporus* restriction group (LRG) thatexhibit a specific morphological, distributional, or ecological characteristic.

		LRG						
		I	II	III	IV	V	VI	VII
pore layer color	white	0	4	0	29	5	0	0
	yellow	24	7	5	0	0	1	19
host	*Quercus* sp.	20	3	0	26	4	0	11
	other hardwood	9	10	0	4	1	1	7
	conifer	0	0	8	0	0	0	0
fruiting position	soil from roots	0	0	0	26	0	0	0
	trunks, logs and stumps	27	12	9	3	5	1	16
geographical location	northeastern	5	0	0	0	0	0	1
	southeastern	2	5	0	2	0	0	2
	midwestern	22	0	1	31	5	1	20
	northwestern	0	0	8	0	0	0	0
	southwestern	0	9	2	0	0	0	0

Complete distributions of the LRGs can not be determined definitely from this study. Due to the extensive sampling in the midwest more can be said about the LRGs occurring there than other areas. The absence of LRG II from this area may indicate that its range is restricted to warmer climates like those of Louisiana and California from which our collections originated. LRG III was originally believed to be found only in the west and northwest, until its collection in Michigan in 1997. This distribution may be closely tied to host preference, in this case old growth or mature conifers which are rare in east of the Rocky Mountains. LRG IV is one of the most common groups in the midwest, although it was collected rarely in other regions. This LRG was collected as far south as Louisaina and as far west as South Dakota. If this LRG is indeed the same as *L. sulphureus* var. *semialbinus* it is likely that it should also be common in the northeast, where it has been reported to be more common than the yellow pored form (Overholts, 1953). LRGs I and VII seem to be present throughout the eastern United States and LRG VI was only collected in Wisconsin.

While the RFLP patterns for most of the LRGs are distinctive, LRG VII may result from the combination of the patterns present in LRGs I and VI. These three groups have the same pattern when digested with enzymes *Hae* III, *Hha* I, *Hind* III, and *Hinf* I. Pattern D for *Rsa* I, present in LRG VII, has fragment sizes that could result from the combinations of patterns B and C which are found in LRG I and VI respectively. Pattern C for *Msp* I, present in LRG VII, likewise appears to be a combination of pattern A found in LRG I and pattern B found in LRG VI. Combined patterns such as these have been shown to be indicative of compatibilty between isolates with differing RFLP patterns in the intergenic spacer region of the rDNA for several species of *Armillaria* (Volk et al., 1996; Banik & Burdsall, 1998). The combined patterns found in LRG VII suggest a similar situation.

Reproductive isolation of the other LRGs may be inferred from the absence of RFLP patterns indicative of genetic exchange between them. This appears especially likely for LRG's I, IV and V which were collected extensively in Dane County, Wisconsin. Thirty four collections were made in Dane County but none possessed RFLP patterns suggesting they were interbreeding. In several instances two or three of the LRG's were collected in the same 1 hectare woods, with no evidence of combined patterns. Combined patterns involving LRG's II and III were also not detected, but the areas in which they occur were not extensively sampled.

The morphological and ecological data strongly associate LRG IV with the form described as *L. sulphureus* var. *semialbinus*. In addition the reproductive isolation indicated by the RFLP data strongly support this form as a distinct species. The oldest validly published name for the white-pored form occurring on roots or soil was described by Morgan (1885) as *Polyporus cincinnatus*. Therefore, for this species, we propose the new combination ***Laetiporus cincinnatus* (Morgan) Burdsall, Banik & Volk (comb. nov.)**, (Basionym: *Polyporus cincinnatus* Morgan; J. Cincinnati Soc. of Nat. Hist. 8: 97, 1885). Also, we believe that LRGs I, VI, and VII probably all represent true *L. sulphureus*.

The taxonomic status of the LRGs II, III and V remain in question. The lack of RFLP patterns indicative of genetic combination between these groups coupled with consistent differences in pore color, host, and fruiting habit, suggests possible species status for several of these LRGs as well. Mating studies to determine the compatibility of these LRGs are currently underway in our laboratory. The results of those studies couple with further molecular biological and morphological data will lead to a clearer understanding of the relationships among the LRGs.

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Ceriporia sulphuricolor, a new polypore species from Italy

Annarosa Bernicchia[1] & Tuomo Niemelä[2]

[1] Università degli Studi, Istituto di Patologia Vegetale, Via Filippo Re, 8, I-40126 Bologna, Italy

[2] Botanical Museum, P.O.Box 47, FIN-00014 University of Helsinki, Finland

Abstract: A new polypore species (Basidiomycetes), *Ceriporia sulphuricolor* Bernicchia & Niemelä, is described from northern Italy. The species inhabits old and strongly decayed stumps of *Pinus pinea*. It is bright yellow-coloured when fresh, and the colour retains fairly well on drying. Hyphal structure is monomitic with simple-septate hyphae which are strongly encrusted in the subiculum. Spores are ellipsoid, about 3.1-4x2-2.4 µm. The closest relative may be *C. alachuana* (Murr.) Hallenberg, which is not yellow and which has narrower spores. We consider *Ceriporia* to be the right genus for the species, rather than *Wolfiporia*, whose subicular hyphae are very thick-walled.

INTRODUCTION

The fungal flora of Europe is very well known, if compared with most other continents. There are anyhow areas, for instance the extreme Northeast and the Mediterranean, from where new species of Aphyllophorales are still to be found. In the southern countries the great number of woody plant species enhances the possibility of finding previously unknown, specialized wood-inhabiting species.

During the last few years many geographical regions of Italy have been closely studied from the mycological point of view. Most of the newly described Italian polypore species originated from Sardinia, Emilia-Romagna and Tuscany. Examples are *Antrodia macrospora* Bernicchia & De Dominicis, *A. squamosella* Bernicchia & Ryv., *Fomitopsis labyrinthica* Bernicchia & Ryv., *Phellinus juniperinus* Bernicchia & Curreli and *P. rosmarini* Bernicchia.

In this paper we describe a new species from the Mesola Forest in Ferrara District. It is a reserve of about 1 100 hectares, lying along the Adriatic coast between Po di Goro and Po di Volano. The area is in the southern section of the fan-shaped delta of Po River. Woody vegetation is predominated by the oak species *Quercus ilex*, found in three floristic associations.

MATERIALS AND METHODS

The specimens of the new species were collected by the author AB. TN made most of the microscopical analysis and prepared the drawing. Drawings were made with the aid of a drawing tube, attached to Leiz Diaplan microscope (phase contrast illumination). The text has been prepared jointly.

Measurements and drawings were made from microscopic slides mounted in Cotton Blue (CB); in addition the specimens were studied in Melzer's reagent (IKI) and 5% KOH. 30 spores were measured from each specimen; in presenting the size variation, 5% of the measurements from each end of the range are given in parentheses. L = mean spore length (arithmetical mean of all spores), W = mean spore width (arithmetical mean of all spores), Q = quotient of the mean spore length and mean spore width (L/W ratio); (n=x/y) means x measurements of spores from y specimens.

Specimens are preserved in the herbarium of the Plant Pathology Institute of the University of Bologna (HUBO). Duplicates are deposited in the Botanical Museum of the University of Helsinki (H).

CERIPORIA SULPHURICOLOR BERNICCHIA & NIEMELÄ, SPEC. NOVA

Carposomata annua, resupinata, effusa, flavo colore vel flavo citrino. Pori rotundi vel sinuosi saepe oblongi et incisi, 4-7(-9) per mm, dissepimentis tenuibus. Systema hypharum monomiticum: hyphae generativae ramosae, afibulatae, tunicis plus minusve tenuibus, incrustatis in superiore parte subiculi. Nulla cystidia sunt, sed hyphidia, aliquando frequentes, adsunt. Basidiosporae hyalinae, leves, ellipsoideae, nonamyloideae, 3.1-4x2-2.4 µm. Ad ligna arborum coniferarum.

Typus: Italy, Ferrara, Bosco della Mesola, on *Pinus pinea*, 28.XI.1995 A. Bernicchia 6591 (HUBO, holotypus and isotypus; H, isotypus). Other specimens examined: locality and host as in the holotypus; 28.XI.1995 Bernicchia 6592, 6685; 21.III.1996 Bernicchia 6684; 10.IX.1996 Bernicchia 6696 (HUBO, H).

Basidiocarps annual, resupinate or nodulose on vertical substrate, adnate and widely effused, soft when fresh, brittle upon drying. Margin thin, yellowish white when fresh, yellow when dry. Pore surface colour ranging from citric to sulphurous yellow or bright yellow; colours keep well upon drying. Pores round to angular in horizontal parts of basidiocarp, slightly sinuous on sloping subtrates, 5-7(-9) per mm, old pores 4 per mm; dissepiments thin, lacerate and incised. Section: subiculum very thin (ca. 0.2-0.3 mm), pale yellow; tubes concolorous, brittle when dry. The consistency is soft and fleshy when fresh, and fragile, chalky in dry specimens. Fresh basidiocarps have a strong but pleasant scent.

Hyphal system monomitic, all hyphae simple-septate, IKI-, CB-. The structure is rather messy in IKI but quite clear in CB.

Subiculum: upper layer next to wood with intermixed hyphae, sparsely branched, thin-walled but heavily encrusted, up to 8-10 µm in diam; lower subiculum with thin-walled, sometimes inflated hyphae, (2.7-)3-4.5(-6) µm in diam, increasingly (sub)parallel downwards when approaching the tube trama. Tramal structure dense, with parallel hyphae (2.2-)2.8-4(-4.5) µm in diam; hyphal tips at the dissepiment edge with no special structures. No cystidia seen, but hyphoid cystidioles (hyphidia) found in well-preserved hymenium, 19-29 µm long.

Basidia cylindric-clavate, 8-13x(3.8-)4-4.5 (-5.5) µm with 4 short and thin sterigmata; most basidia collapsed and difficult to observe. Basidioles similar in shape but slightly smaller. Basidiospores very numerous, ellipsoid, very thin-walled, IKI-, CB-, (3-)3.1-4(-4.1)x(1.9-) 2-2.4(-2.7) µm, L=3.49 µm, W=2.17 µm, Q=1.56-1.71 (n=150/5).

REMARKS TO CERIPORIA SULPHURICOLOR

Ceriporia sulphuricolor was growing on very decayed and wet wood, inside an old, hollow stump at a depth of 5-15 cm below the ground. Both the basidiocarps and wood beneath were soaked through. The locality, called "Le Cave", is a restricted area, very dry and arid where, besides old *Pinus pinea* and *P. pinaster*, also *Quercus ilex* and *Juniperus communis* are growing. It is a pioneer stage on dry sands located in a dunal holm-oak woodland with a xerothermophilous vegetation. The site is about 300-400 metres from the Adriatic coastline. Later *Protomerulius caryae* (Schwein.) Ryv. appeared on the same stump.

A thorough study on *Ceriporia* was published recently by Pieri and Rivoire (1997). Together with adjoining, excellent colour plates it is the most complete, up-to-date account of the genus in Europe. If the key in that paper is followed, our new species will result in the species *C. alachuana* (Murr.) Hallenberg, and the drawing by Pieri and Rivoire (1997, fig. 1) is strikingly similar to our species. Both Lowe (1966), Ryvarden & Gilbertson (1993) and Pieri & Rivoire (1997) mention tan, rose or pinkish hues in the basically cream colour of *C. alachuana*, which do not fit with our new species. The carneous tint in fragile, resinous tubes is also evident in an American specimen preserved in Helsinki (herb. H), collection Lowe 11510.

Spores of *C. alachuana* are somewhat longer. The collection of Lowe 11510 should represent the species in the strict sense, since it was described from North America. The spores in that specimen are ellipsoid, (3.6-)3.8-4.5(-4.9)x2-2.3(-2.4) µm, L=4.07 µm, W=2.18 µm, Q=1.87 (n=60/1). Gilbertson and Ryvarden (1986) and Ryvarden and Gilbertson (1993) report the spores to be somewhat longer (4-5 µm), cylindrical-ellipsoid, while Pieri and Rivoire (1997) accept both the ellipsoid and almost cylindrical spore shapes. The concept of *C. alachuana* seems to be collective.

Ceriporia sulphuricolor has hyphoid cystidioles or hyphidia in its hymenium. They have slightly swollen base and a long, slender neck, or they taper gradually towards the sharp tip. In well-developed, young hymenial layer they are common and distinct, but in partly collapsed structure they cannot be seen anymore. Similar structures were found rarely also in *C. alachuana*.

Lowe (1966), Hallenberg (1979), Gilbertson & Ryvarden (1986) and Ryvarden & Gilbertson

(1993) consider *Ceriporia alachuana* to grow on angiosperms. Pieri & Rivoire (1997) mention predominantly angiosperms, too, but also a single find from *Pinus halepensis*.

All in all, *Ceriporia sulphuricolor* is characterized by simple-septate generative hyphae which are heavily encrusted in the subiculum, and by ellipsoid spores which are slightly shorter than in *C. alachuana*. Both these species have hyphoid cystidioles, but they are much more abundant in the new species. Growing on *Pinus*, *C. sulphuricolor* has host characteristics different from most other species of the genus. The other species, commonly or occasionally growing on gymnosperms have allantoid spores: *Ceriporia reticulata* (Pers.: Fr.) Domański, *C. spissa* (Schwein.: Fr.) Rajchenberg, *C. purpurea* (Fr.) Donk and *C. viridans* (Berk. & Broome) Donk. The pure and bright yellow colour is a striking field character of the new species.

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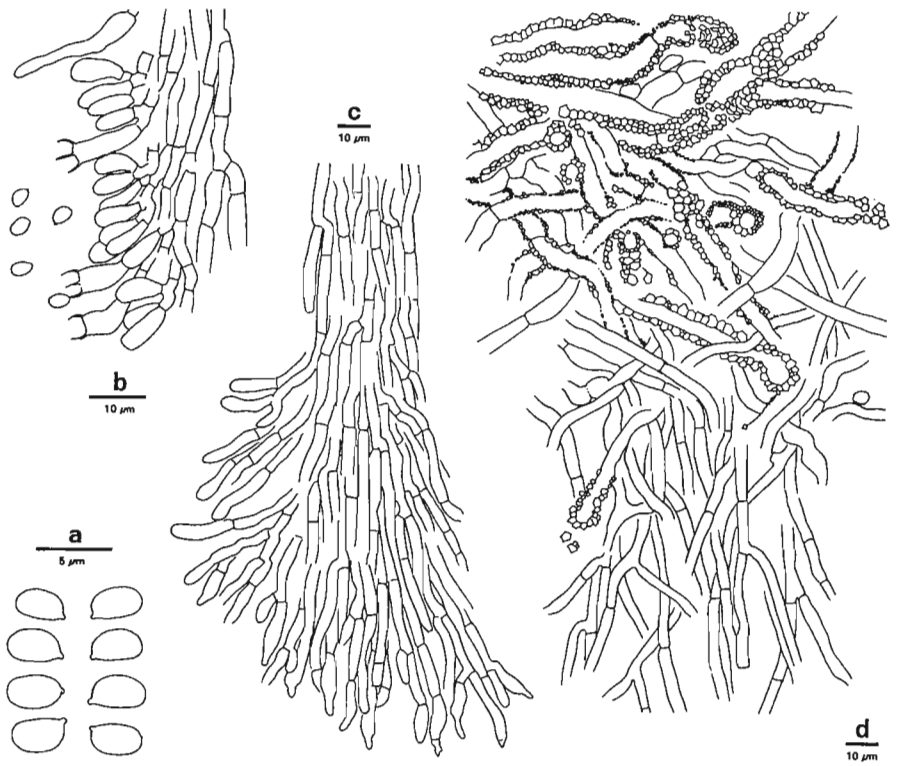

Fig. 1. *Ceriporia sulphuricolor*, holotype. - a) spores, b) hymenium and tramal hyphae, c) dissepiment edge, d) vertical section through subiculum, showing heavily encrusted upper subiculum and transition towards tube trama. Drawn in Cotton Blue.

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Aphyllophoroid fungi of old and primeval forests in the Kotavaara site of North Karelian biosphere reserve

M. A. Bondartseva, V. M. Lositskaya and I. V. Zmitrovich
V.L. Komarov Botanical Institute, RAS, 2 Prof. Popov st., St-Petersburg, 197376, Russia

Abstract: Aphyllophoroid fungi in Kotavaara site of the North Karelian biosphere reserve (Finland) were studied during the seasons of 1995—1997. The study is a part of the program according to which biodiversity of the different groups of organisms in old and primeval forests is investigated. The total number of 126 species related to 18 orders, 37 families, 72 genera were registered, being collected both in the whole investigated forest area (1995—1996) and on sample plots (1997). Among those some threatened and indicator species were found: *Amylocystis lapponica*, *Antrodia albobrunnea*, *Diplomitoporus crustulinus* etc., 18 species in total. It means that this forest site being bordered by cutted area and mires conserved some features of the natural ecosystem and may be restored. The employment of two methods of collecting (rout and on sample plots) shows the best results. A total of 32 species were found out of the sample plots only. At the same time observations on the sample plots may be effective for the study of abundance of any widespread species, as well as for monitoring programs.

INTRODUCTION

The results of a part of joint Finnish-Russian project dedicated to the study of old forest fragments conserved inside the cutted area at the territory of the North Karelian biosphere reserve are presented. Project includes investigations on biodiversity of the different groups of organisms (higher plants, mosses, insects, wood-inhabiting fungi etc.). Kotavaara forest site (Fig. 1) is one of studied areas of the North Karelian biosphere reserve. The area includes pine stands (*Pinus sylvestris*) with spruce (*Picea abies*) and with some deciduous trees (*Betula* spp., *Populus tremula*, *Alnus incana*, *Salix caprea* etc.) at the second level. The soil is covered with *Vaccinium myrtillus*, partly *V. vitis-idaea* and mosses. The forest tract is surrounded by cutted area and mires being of elongated form approximately of 0,7 km long and not more than 0,4 km at the widest part. Wood-inhabiting fungi were investigasted by route collecting in 1995—1996 and on sample plots in 1997. A total of 13 sample plots were disposed inside the forest (NN 4, 6, 7, 9, 12—14, 19—22, 24, 25) and two ones on clearings (NN 17, 23). The plots were situated as two transects that cross each other being 25 x 25 m (Fig. 2). Collections and observations were made during August—September 1995, 1996, 1997.

RESULTS AND DISCUSSION

Identified species are arranged according to the new collective key-book "Nordic Macromycetes" (Hansen & Knudsen, 1997), with few exclusions, because it is the most full edition where all the groups of aphyllophoroid fungi of the North Europe are presented. A total of 126 species belonging to 72 genera, 37 families, 18 orders have been identified for the area, among which 93 species were found in 1995—1996 on the whole territory, and 94 species were registered in 1997 on sample plots. The total number of 66 species were common for the plots and the whole forest tract, 28 species were found only on plots, 32 species — only outside the plots (see the list of species).

List of species

The following list of aphyllophoroid fungi is presented in alphabetic order. All the taxa are given as in Nordic Macromycetes, 3 (Hansen & Knudsen, 1997) with few exclusions. For each species are mentioned substrate and number of sample plot(s) where the species was found. Area out of plots indicated as "K". Indicator and threatened species are marked with asterisk.

ALBATRELLUS CONFLUENS (Alb. & Schwein.: Fr.) Kotl. & Pouzar — on soil (K).

AMPHINEMA BYSSOIDES (Pers.: Fr.) J. Erikss. — on fallen *Pinus sylvestris*, *Picea abies* and *Populus tremula* (K, 19, 20, 25).

*AMYLOCYSTIS LAPPONICA (Romell) Singer — on fallen *Picea abies* (K).

AMYLOSTEREUM CHAILLETII (Pers.: Fr.) Boidin — on

fallen *Picea abies* (4).

*Antrodia albobrunnea (Romell) Ryvarden — on fallen *Picea abies* (K, 6).

A. serialis (Fr.) Donk — on fallen *Pinus sylvestris* and *Picea abies* (K, 4, 6, 7, 12, 20, 22, 24, 25).

A. sinuosa (Fr.) P. Karst. — on fallen *Pinus sylvestris* and *Picea abies* (K, 14, 23).

A. xantha (Fr.: Fr.) Ryvarden — on fallen *Pinus sylvestris* and *Picea abies* (K, 7, 21—25).

Antrodiella romellii (Donk) Niemelä — on fallen *Pinus sylvestris* (K).

A. semisupina (Berk. & M. A. Curtis) Ryvarden — on fallen *Betula* sp. (K, 7, 25).

*Asterodon ferruginosus Pat. — on fallen *Betula* sp., *Picea abies* (K, 14).

Athelia acrospora Jülich — on fallen *Betula* sp. (13).

A. bombacina (Pers.) Jülich — on debris of *Pinus sylvestris* (K, 6).

A. epiphylla Pers.: Fr. — on plant debris (K, 9).

Bjerkandera adusta (Willd.: Fr.) P. Karst. — on dead *Populus tremula* (K, 9, 14, 21).

B. fumosa (Pers.: Fr.) P. Karst. — on stump of *Populus tremula* (K).

Botryobasidium botryosum (Bres.) J. Erikss. — on fallen *Populus tremula* and *Picea abies* (K, 4, 6, 7, 13, 22, 25).

B. candicans J. Erikss. — on woody debris (K).

B. laeve (J. Erikss.) Parmasto — on debris of *Populus tremula* (K).

B. subcoronatum (Höhn. & Litsch.) Donk — on fallen *Picea abies* and *Pinus sylvestris* (19, 21, 23, 25).

Botryohypochnus isabellinus (Schleich.: Fr.) J. Erikss. — on fallen *Picea abies* (K).

Cantharellus cibarius (Fr.: Fr.) Fr. — on soil (K, 21).

Ceraceomyces borealis (Romell) J. Erikss. & Ryvarden — on fallen *Betula* sp. (K).

C. serpens (Tode: Fr.) Ginns— on fallen *Betula* sp., *Pinus sylvestris* and *Picea abies* (K, 7).

C. sublaevis (Bres.) Jülich — on fallen *Betula* sp., *Populus tremula*, *Picea abies* (K, 9, 21).

Ceriporia viridans (Berk. & Broome) Donk — on fallen *Populus tremula* (K, 22).

*Ceriporiopsis pannocincta (Romell) Gilb. & Ryvarden— on fallen *Betula* sp., *Picea abies* (K, 25).

Cerrena unicolor (Bull.: Fr.) Murrill — on fallen *Betula* sp. (K, 25).

Chaetodermella luna (Romell ex D. P. Rogers & H. S. Jacks.) Rauschert — on fallen *Pinus sylvestris* (12).

Chaetoporellus latitans (Bourdot & Galzin) Singer — on fallen *Pinus sylvestris* (6).

Clavicorona pyxidata (Pers.: Fr.) Doty — on fallen *Picea abies* (K, 7).

Coltricia perennis (L.: Fr.) Murrill — on sandy soil (K).

Coniophora arida (Fr.) P. Karst. — on fallen *Populus tremula* and *Picea abies* (K, 4, 7, 13, 19, 22, 25).

C. olivacea (Pers.: Fr.) P. Karst. — on fallen *Populus tremula* (K, 6, 17).

Corticium roseum Pers.: Fr.— on fallen *Populus tremula* (K, 9, 25).

Creolophus cirrhatus (Pers.: Fr.) P. Karst. — on fallen *Populus tremula* (K, 9).

Cylindrobasidium laeve (Pers. non Fr.) Chamuris — on fallen *Betula* sp. (21).

Dacryobolus karstenii (Bres.) Oberw. ex Parmasto — on fallen *Pinus sylvestris* and *Picea abies* (6, 13).

Datronia mollis (Sommerf.: Fr.) Donk — on fallen *Populus tremula* (K, 13, 14).

*Diplomitoporus crustulinus (Bres.) Domański — on fallen *Picea abies* (K).

*D. lenis (P. Karst.) Gilb. & Ryvarden— on fallen *Pinus sylvestris*, *Picea abies* (K, 24).

Fomes fomentarius (L.: Fr.) Fr. — on dead and fallen trunks and stumps of *Betula* spp. (K, 4, 6, 7, 9, 12—14, 19, 20, 22—25).

Fomitopsis pinicola (Sw.: Fr.) P. Karst. — on dead and fallen trunks and stumps of *Pinus sylvestris*, *Picea abies*, *Betula* spp. (4, 6, 7, 9, 14, 19, 21, 24, 25).

*F. rosea (Alb. & Schwein.: Fr.) P. Karst. — on fallen *Picea abies* (K).

Ganoderma lipsiense (Batsch) G. F. Atk. — on fallen *Populus tremula* (K).

Gloeophyllum sepiarium (Wulfen: Fr.) P. Karst. — on fallen *Pinus sylvestris*, *Picea abies* (K, 17).

Gloeoporus dichrous (Fr.: Fr.) Bres. — on fallen *Betula* sp. (K).

Hapalopilus rutilans (Pers.: Fr.) P. Karst. — on fallen branch of *Betula* sp. (K).

Hericium coralloides (Scop.: Fr.) Pers. — on fallen *Populus tremula* (K).

Hydnellum ferrugineum (Fr.: Fr.) P. Karst. — on soil (K, 24).

H. suaveolens (Scop.: Fr.) P. Karst. — on soil (K).

Hyphoderma radula (Fr.: Fr.) Donk — on fallen *Betula* sp. (22, 23).

H. SETIGERUM (Fr.: Fr.) Donk — on fallen *Betula* sp. (12).

HYPHODONTIA ABIETICOLA (Bourdot & Galzin) J. Erikss. — on fallen *Picea abies* (24).

H. ALUTACEA (Fr.) J. Erikss. — on fallen *Pinus sylvestris* (23).

H. ASPERA (Fr.) J. Erikss. — on fallen *Populus tremula* (K, 4, 12, 17).

H. BREVISETA (P. Karst.) J. Erikss. — on fallen *Picea abies* (K, 4).

H. HASTATA (Litsch.) J. Erikss. — on fallen *Picea abies* (25).

H. SUBALUTACEA (P. Karst.) J. Erikss. — on fallen *Betula* sp. (12).

HYPOCHNICIUM EICHLERI (Bres.) J. Erikss. & Ryvarden — on fallen *Populus tremula* (K, 20, 23).

H. GEOGENIUM (Bres.) J. Erikss. — on fallen *Picea abies* (24).

INONOTUS OBLIQUUS (Pers.: Fr.) Pilát — on living, rarely dead and fallen trunks of *Betula* spp. (4, 6, 7, 20, 25).

I. RADIATUS (Sowerby: Fr.) P. Karst. — on dead *Alnus incana* and fallen *Populus tremula* (K).

I. RHEADES (Pers.: Fr.) P. Karst. — on fallen *Populus tremula* (K, 13).

*JUNGHUHNIA COLLABENS (Fr.) Ryvarden — on fallen *Picea abies* (K).

LAXITEXTUM BICOLOR (Pers.: Fr.) Lentz — on fallen *Betula* sp. (K).

*LENTARIA AFFLATA (Lagger) Corner — on fallen *Populus tremula* (4, 7, 9, 14, 22).

MERULIOPSIS CORIUM (Pers.: Fr.) Ginns — on fallen *Populus tremula* (K, 9).

MERULIUS TREMELLOSUS Schrad.: Fr. — on dead *Betula* sp. (K, 17).

OXYPORUS CORTICOLA (Fr.) Parmasto — on fallen *Populus tremula* (K, 9, 14, 21, 23, 24).

O. POPULINUS (Schumach.: Fr.) Donk — on living and dead *Betula* sp., *Populus tremula* (K).

PARMASTOMYCES MOLLISSIMUS (Maire) Pouzar — on fallen *Picea abies* (K, 19).

PENIOPHORA CINEREA (Pers.: Fr.) Cooke — on fallen *Populus tremula* (25).

P. NUDA (Fr.) Bres. — on fallen *Populus tremula* (K, 25).

*PHAEOLUS SCHWEINITZII (Fr.) Pat. — on living *Picea abies* (9).

PHANEROCHAETE LAEVIS (Pers.: Fr.) J. Erikss. & Ryvarden — on fallen *Betula* sp., *Populus tremula, Picea abies* (K, 13, 14, 21, 22).

PH. SANGUINEA (Fr.: Fr.) Pouzar — on fallen *Pinus sylvestris* and *Picea abies* (K, 12, 20, 25).

PH. SORDIDA (P. Karst.) J. Erikss. — on fallen *Betula* sp., *Populus tremula* (K, 4, 7, 20, 21, 23).

PHELLINUS ALNI (Bondartsev) Parmasto — on dead *Alnus incana* (K, 25).

*PH. CHRYSOLOMA (Fr.) Donk — on fallen *Picea abies* (K, 4, 9, 13, 20, 21).

PH. CONCHATUS (Pers.: Fr.) Pat. — on fallen *Salix caprea* (K, 19).

*PH. FERRUGINEOFUSCUS (P. Karst.) Bourdot — on fallen *Picea abies* (K).

PH. IGNIARIUS (L.: Fr.) Quél. — on living and dead *Betula* sp. (K, 7, 9, 14, 19, 24).

PH. LAEVIGATUS (Fr.) Bourdot & Galzin — on dead *Betula* sp. (K, 6, 20, 23).

*PH. LUNDELLII Niemelä — on dead *Betula* sp. (K, 7).

PH. PINI (Brot.: Fr.) A. Ames — on living *Pinus sylvestris* (K, 6, 7, 14, 19, 20, 21, 22, 24).

PH. POPULICOLA Niemelä — on living and dead *Populus tremula* (K, 4).

PH. TREMULAE (Bondartsev) Bondartsev & Borissov — on living, rarely fallen *Populus tremula* (K, 6, 9, 12, 13, 14, 21, 22, 24, 25).

*PH. VITICOLA (Schwein.: Fr.) Donk — on fallen *Picea abies* (K).

PHLEBIA RADIATA Fr.: Fr. — on fallen *Betula* sp. (13).

PHLEBIELLA SULPHUREA (Pers.: Fr.) Ginns & Lefebvre — on fallen wood and small debris of *Betula* spp., *Populus tremula, Picea abies* (K, 4, 6, 9, 13, 14, 19—22, 25).

PHLEBIOPSIS GIGANTEA (Fr.: Fr.) Jülich — on fallen *Pinus sylvestris* (K, 13).

PILODERMA BYSSINUM (P. Karst.) Jülich — on fallen *Picea abies* (20).

P. FALLAX (Liberta) Stalpers — on fallen *Pinus sylvestris, Picea abies, Populus tremula, Betula* sp. as well as small plant debris, mosses, rootlets of *Vaccinium myrtillus*, etc. (K, 4, 6, 7, 9, 12, 13, 14, 19—21, 23, 25).

PIPTOPORUS BETULINUS (Bull.: Fr.) P. Karst. — on fallen trunks and branches of *Betula* sp. (K, 4, 6, 13, 19, 20, 22, 23, 25).

POLYPORUS VARIUS Fr. — on fallen *Populus tremula* (K, 9, 14, 22).

POSTIA CAESIA (Schrad.: Fr.) P. Karst. — on fallen *Picea abies* (K).

*P. LATERITIA Renvall — on fallen *Pinus sylvestris* (K).

P. STIPTICA (Pers.: Fr.) Jülich — on fallen *Picea abies* (K, 13).

P. SUBCAESIA (A. David) Jülich — on fallen *Populus*

tremula (7, 9, 22).

PYCNOPORUS CINNABARINUS (Jacq.: Fr.) P. Karst. — on fallen *Betula* sp. (K, 17).

RESINICIUM BICOLOR (Alb. & Schwein.: Fr.) Parmasto — on fallen *Picea abies* (19).

R. FURFURACEUM (Bres.) Parmasto — on fallen *Pinus sylvestris*, *Picea abies* (4, 12, 13, 19, 21, 22).

SCHIZOPORA FLAVIPORA (Cooke) Ryvarden — on fallen *Populus tremula* (23).

S. PARADOXA (Schrad.: Fr.) Donk — on fallen branch of *Betula* sp. (K).

SCYTINOSTROMA ODORATUM (Fr.: Fr.) Donk — on fallen *Picea abies* (K, 7).

SERPULA HIMANTIOIDES (Fr.: Fr.) P. Karst. — on stump and fallen log of *Picea abies* (K, 25).

*SISTOTREMA RADULOIDES (P. Karst.) Donk — on fallen *Populus tremula* (K, 6).

SISTOTREMASTRUM SUECICUM Litsch. ex J. Erikss. — on fallen *Picea abies* (K, 21).

*SKELETOCUTIS ODORA (Sacc.) Ginns — on fallen *Picea abies* (K, 24).

S. SUBINCARNATA (Peck) Jean Keller — on fallen *Picea abies* (K, 23).

STEREUM GAUSAPATUM (Fr.) Fr. — on fallen *Populus tremula* (K).

S. HIRSUTUM (Willd.: Fr.) Gray — on fallen *Betula* spp. (K, 9, 23).

S. RUGOSUM (Pers.: Fr.) Fr. — on dead *Alnus incana* (K, 22, 24).

S. SANGUINOLENTUM (Alb. & Schwein.: Fr.) Fr. — on fallen *Picea abies* (K, 9).

THELEPHORA TERRESTRIS Ehrh.: Fr. — on soil and coniferous debris (19).

TOMENTELLA ATRAMENTARIA Rostr. — on small coniferous debris (K).

T. RADIOSA (P. Karst.) Rick — on plant debris (K).

T. TERRESTRIS (Berk. & Broome) M. J. Larsen — on soil and plant debris (K).

TRAMETES HIRSUTA (Wulfen: Fr.) Pilát — on stumps and fallen branches of *Betula* sp. (K, 17, 19).

T. OCHRACEA (Pers.) Gilb. & Ryvarden — on fallen *Betula* sp., *Populus tremula* (K, 9, 14, 19, 21, 24, 25).

TRECHISPORA FARINACEA (Pers.: Fr.) Liberta — on deciduous debris (K).

T. MOLLUSCA (Pers.: Fr.) Liberta — on debris of *Salix* sp. (K, 9).

TRICHAPTUM ABIETINUM (Pers.: Fr.) Ryvarden — on fallen *Pinus sylvestris* and *Picea abies* (4, 6, 7, 12—14, 17, 19, 20, 24, 25).

*T. PARGAMENUM (Fr.) G. Cunn. — on fallen *Betula* sp. (K).

TUBULICRINIS SUBULATUS (Bourdot & Galzin) Donk — on fallen *Picea abies* (13, 25).

As it is seen from the list of species, corticioid (52 spp.), porioid (35 spp.) and hymenochaetoid (16 spp.) fungi prevailed in every site among the other groups. The most multispecific genus is *Phellinus*. A total of 11 species of the genus were found in different sites of the area, the most widespread being *Phellinus pini*, *Ph. tremulae*, *Ph. chrysoloma*, more rare were met *Ph. igniarius*, *Ph. lundellii*. Another genera were presented by six (*Hyphodontia*)—four (*Antrodia*, *Botryobasidium*, *Postia*, *Stereum*), or not more than 1—3 species each.

The sample plots were situated in transects for study the linear distribution of different species in dependence of the distance from the border of forest core (Fig. 2). Numerical diversity of wood-inhabiting fungi on sample plots inside the forest varied from 7 to 26 species, the most common species number hesitate from 15 to 19. At the old clearing (plot N 17) there were found only 7 species, at the new one (plot N 23) 15 species, because some forest fungi were still not eliminated there. The greatest species number was observed on the plot N 25 (26 spp.), neighbour plots were also rich with wood-inhabiting fungi. It may be explained by the fact that these plots are located in more wide part of the forest tract, where the core is surrounded by more wide buffer zone.

One of good characteristics of the forest state is the presence of threatened and indicator species. The lists of such species were proposed by different specialists for their countries. Thus for Finland the lists were published by Kotiranta & Niemelä (1993, 1996), for Estonia preliminary list of indicator species was proposed by Parmasto & Parmasto (1997). Only seven of eighteenth threatened and indicator species found in Kotavaara were named by Parmasto & Parmasto as important indicators for Estonian forests: *Amylocystis lapponica*, *Diplomitoporus crustulinus*, *Fomitopsis rosea*, *Phaeolus schweinitzii*, *Phellinus ferrugineofuscus*, *Sistotrema raduloides*, *Skeletocutis odora*. Such species as *Hericium coralloides* and *Serpula himantioides* from Estonian list were found in Kotavaara area but were not recognized of in-

dicator importance for Finland. Both species are very rare in investigated area. As it was shown in our study the most number of indicator species were concentrated in more wide part of the forest tract: *Antrodia albobrunnea* (plot N 6), *Neriporiopsis pannocincta* (plot N 25), *Diplomitoporus lenis* (plot N 24), *Lentaria afflata* (plots NN 5, 7, 9, 14, 22), *Phaeolus schweinitzii* (plot N 9), *Phellinus chrysoloma* (plots NN 4, 9, 13, 20, 21), *Ph. lundellii* (plot N 7), *Sistotrema raduloides* (plot N 6), *Skeletocutis odora* (plot N 24). *Asterodon ferruginosus* (plot N 14) was the only indicator species that was found on plot N 14 in the narrow part of the forest. Some of the indicator species were registered in the area outside the sample plots: *Amylocystis lapponica, Antrodia albobrunnea, Asterodon ferruginosus, Ceriporiopsis pannocincta, Diplomitoporus crustulinus, D. lenis, Fomitopsis rosea, Junghuhnia collabens, Phellinus chrysoloma, Ph. ferrugineofuscus, Ph. lundellii, Ph. viticola, Postia lateritia, Sistotrema raduloides, Skeletocutis odora, Trichaptum pargamenum.*

The common species (found at the whole area and at least on 6 plots) were presented on plots very poorely. Even the most distributed fungi, as *Fomes fomentarius, Fomitopsis pinicola, Piloderma fallax, Trichaptum abietinum*, were found not everywhere, being absent at some plots. Practically all these species were registered at the plot N 25 — the richest one among the others. Some of these fungi were found neither at the clearings nor inside the forest. The presence or absence of some species depends on forest type and its state, and partly on the distance from the border of forest tract, because independently of the level of management inside the forest itself, the microclimatic changes take place when forest core becomes smaller of any critical size.

One of the important indicators of natural ecosystem destruction is species composition of fungi on clearings as a result of management influence on nature. In our study there were two sample plots on clearings — an old plot N 17 and new one N 23. At the old one there were found few species that are characteristic for the open space — at clearings, near the roads, villages etc. (*Coniophora olivacea, Gloeophyllum sepiarium, Merulius tremellosus, Trametes hirsuta*). *Hyphoderma setigerum, Pycnoporus cinnabarinus, Trichaptum abietinum* need the neighbour of forest, but these species also grow in somewhat antropogenic conditions. At the new clearing there were found twice more species — 15, among which not only anthropogenic ones as *Antrodia xantha, A. sinuosa, Fomes fomentarius, Piptoporus betulinus, Stereum hirsutum* were found, but also *Botryobasidium botryosum, B. subcoronatum, Hyphoderma radula, Hyphodontia alutacea, Hypochnicium eichleri, Phanerochaete sordida, Piloderma fallax, Schizopora flavipora, Skeletocutis subincarnata*, that are characteristic for the forest habitats.

CONCLUSION

Preliminary results show the importance of conservation of more great territories of natural old forests with any buffer zone around them for keeping full biological diversity of the ecosystem. Our investigations show, that some of examined sites are in good condition and may be reserved as the rests of old forests at the area, for example the site where the sample plots are situated. Another sites at Pieni Kotavaara are somewhat destroyed but may be reconstructed, and some of them need more attentive study for making any conclusion.

ACKNOWLEDGEMENTS

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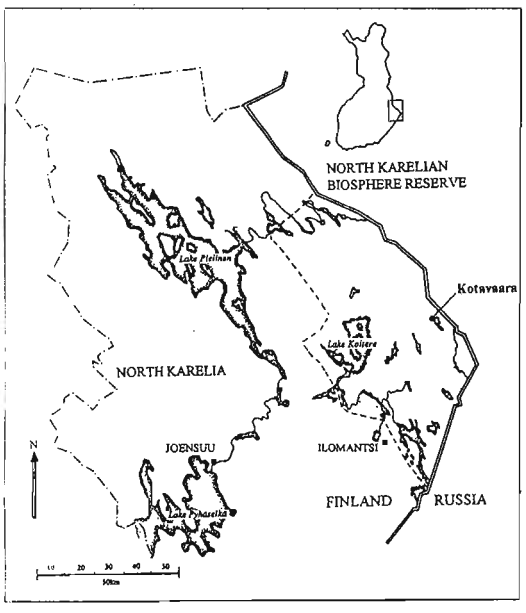

Fig. 1. Location of the North Karelian biosphere reserve.

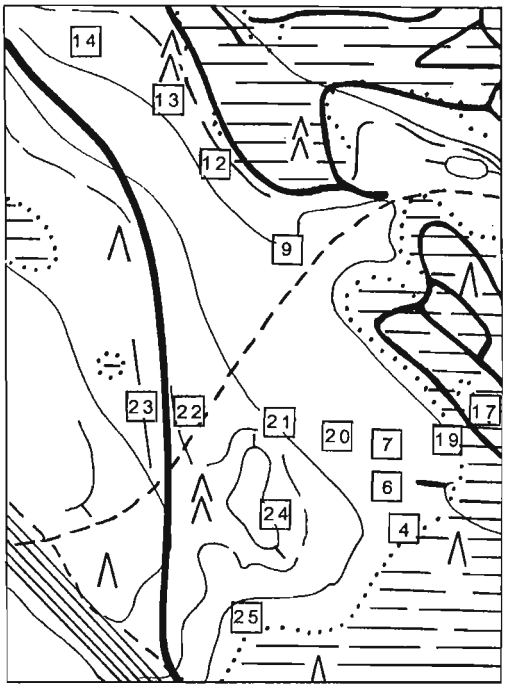

Fig. 2. Scheme of sample plots situation at the Kotavaara forest site.

Folia Cryptog. Estonica, Fasc. 33: 25–28 (1998)

Changbai wood-rotting fungi 10. A new species of *Dentipellis* (Basidiomycota, Aphyllophorales, Hericiaceae)

Yu-Cheng Dai
Botanical Museum, P.O. Box 47, FIN–00014 University of Helsinki, Finland

Abstract: A new hydnaceous species, *Dentipellis microspora* Y. C. Dai, is described and illustrated based on recent collections from northeastern China. It differs from the other species of the genus by having extremely small spores, distinctly clavate cystidia, inflated subicular hyphae. Its hymenium is dominated by strongly branched dendrohyphidia; unlike in the other species of the genus, its hyphae dissolve in KOH, and it lives on gymnosperms. The species is evidently a saprotrophic fungus on rotten wood of *Abies*, and causes a white rot. Other species of the genus were studied, and spores and cystidia of these species are illustrated.

INTRODUCTION

The knowledge of the genus *Dentipellis* Donk in China is very fragmentary, and only *D. fragilis* (Pers.:Fr.) Donk has been reported from northeastern China (Hjortstam and Ryvarden, 1988). While identifying wood-rotting fungi from the Changbai Mts., Northeast China, two specimens collected on rotten wood of *Abies* were found, clearly belonging to *Dentipellis*. All the reported species in the genus were checked, but no known taxon fits with the Chinese material. For this reason this hydnaceous resupinate fungus is described here as a new species.

The genus *Dentipellis* was described by Donk (1962), and *D. fragilis* was designated as the type species. Niemelä and Saarenoksa (1985) published a modern illustrated description of *D. fragilis*. Ginns (1986) made a comprehensive study on the genus, and accepted three species and emended the generic diagnosis. I have studied some specimens of the three species, and spores and cystidia of these species are illustrated for comparison.

METHODS

The measurements and drawings (except cystidia) were made from slide preparations stained with Cotton Blue (CB). Spores were measured from sections cut from the spines. IKI stands for Melzer's reagent and KOH for 5% potassium hydroxide; CB+ means cyanophilous and CB– acyanophilous. In presenting the variation in the size of the spores (hyphae, dendrohyphidia, basidia, cystidia), 5% of the measurements were excluded from each end of the range, and are given in parentheses. In the text the following abbreviations are used: L= mean spore length (arithmetical mean of all spores), W= mean spore width (arithmetical mean of all spores), Q= quotient of the mean spore length and the mean spore width (L/W ratio), (n=x/y) x measurements of spores (hyphae, dendrohyphidia, basidia, cystidia) from y specimens. The width of a basidium (cystidium) was measured at the thickest part, the length of a basidium was measured from the apex (sterigmata excluded) to the basal septum. Sections were studied at magnification up to x1250 by using a Leitz Diaplan microscope and phase contrast illumination. Drawings were made with the aid of a drawing tube, and cystidia were drawn from the slide stained with KOH.

DESCRIPTION

Dentipellis microspora Y. C. Dai, spec. nova (Fig. 1)

Carpophorum annuum, resupinatum, contextum cremeum. Spinae cremea vel luteola. Systema hypharum monomiticum, hyphae fibulatae; cystidia pallida, clavata. Sporae pallidae, oblongae vel ellipsoideae, amyloideae, 2.5–3.2 1.7–2.2 µm.

Holotype: **China**. Jilin Prov., Antu County, Changbaishan Nat. Res., on rotten wood of

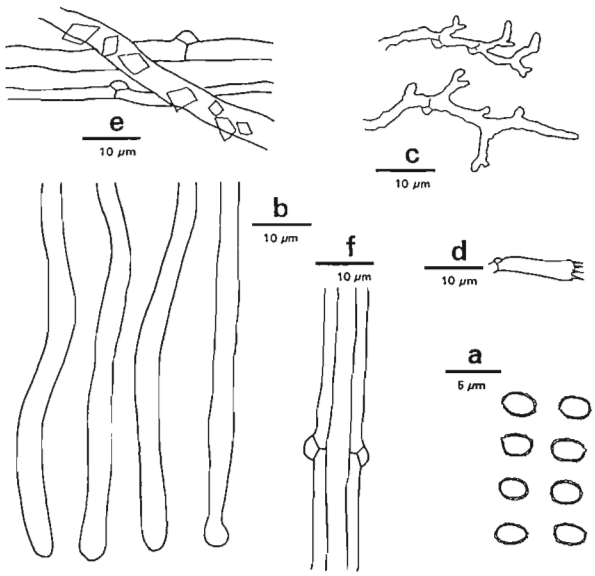

Fig. 1. Anatomical details of *Dentipellis microspora* Y.C. Dai (drawn from the type). —a: Basidiospores. —b: Cystidia. —c: Dendrohyphidia. —d: Basidium.—e: Subicular hyphae. —f: Tramal hyphae.

Abies, mixed coniferous forest, alt. 1000 m, 13.VIII.1997 *Dai 2432* (H; isotype, Y. C. Dai).

Basidiocarps annual, resupinate, inseparable, 15 cm or more in longest dimension, up to 5 cm wide, without odour or taste. Fresh spines soft, white to cream, becoming yellowish to pale brown when bruised, cream to pale buff and fragile upon drying, 3–7 mm long, 0.1–0.15 mm in diam at their bases. Margin very narrow, less than 1 mm wide, white to cream. Subiculum cream, soft corky, 0.3–1.5 mm thick, without ochraceous layer next to the substrate.

Hyphal system monomitic; all septa with clamp connections; hyphae dissolved in KOH.

Subiculum. — Generative hyphae thin-walled, hyaline, occasionally branched typically at right angles, interwoven, some inflated, IKI–, CB+, 3–7(–8) µm in diam (n=63/2), some covered with coarse or more or less rhomboid crystals; gloeoplerous hyphae absent.

Spines. — Hyphae in trama thin-walled, hyaline, occasionally branched at very narrow angle, IKI–, weakly CB+, parallel along the spines, commonly covered with rhomboid crystals. Cystidia frequent, hyaline, thin to slightly thick-walled, clavate, contents oily and yellowish in KOH, rooting deep from the trama, the cystidium-like apical part (17–)18–27(–31) 3–5 µm (n=40/2); basidia clavate, with four sterigmata, 12–15 3–4 µm (n=5/2); dendrohyphidia dominant in the hymenium, hyaline, thin-walled, strongly branched and winding, 1.2–2.8 µm in diam (n=30/1).

Spores. — Basidiospores oblong-ellipsoid, thin-walled, hyaline, minutely rough, strongly amyloid, CB–, (2.4–)2.5–3.2(–3.3) x (1.6–)1.7–2.2(–2.3) µm, L = 2.90 µm, W = 1.95 µm, Q = 1.49–1.50 (n=61/2).

Additional specimen examined (paratype): **China**. Jilin Prov., Antu County, Changbaishan Nat. Res., on rotten wood of *Abies*, mixed forest, alt. 1100 m, 4.IX.1993 *Dai 1045* (H).

Etymology. — *Microspora* (Lat., adj.), referring to the small spores.

DISCUSSION

Identification

Dentipellis microspora is characterized by its extremely small spores (2.5–3.2 x 1.7–2.2 µm), dendrohyphidia which dominate in hymenium, distinctly clavate cystidia, inflated subicular hyphae, and by the tendency of the hyphae to swell in KOH. There are other three species in the genus: *D. fragilis*, *D. dissita* (Berk. & Cooke) Maas Geest., and *D. leptodon* (Mont.) Maas Geest. All these three have large or fairly large spores (5–5.6 x 4–4.8 µm, 4.4–4.8 x 3.4–4 µm and 3.2–4 x 2.4–3 µm respectively, Ginns, 1986). Cystidia are distinctly moniliform in *D. fragilis* and *D. dissita*, and irregularly moniliform in *D. leptodon*. They have no dendrohyphidia, and they all live on angiosperms. Hence the new species seems to be the only one in the genus living on gymnosperms. Specimens of the three previously known species were studied, and the spores and cystidia are illustrated in Figs. 2–4.

Of the above-mentioned species, *Dentipellis microspora* is more closely related to *D. leptodon*,

especially because the hyphae of the latter species in one Canadian specimen (DAOM 158439) more or less dissolve in KOH. Some differences between the two species are discussed above. In addition, *D. leptodon* has gloeoplerous hyphae in the subiculum, abundant yellowish oily drops in the slides mounted in CB, no crystals or only fine crystals on the hyphae (similar to those in *Trechispora mollusca* (Pers.:Fr.) Liberta), and its spines are thicker and more crowded (0.2–0.4 mm in diam at their bases; 0.2–0.5 mm in diam, Ginns, 1986). In contrast, *D. microspora* has no gloeoplerous hyphae and no oily drops in the CB slide; it has coarse or more or less rhomboid crystals on the hyphae (similar to those in *T. hymenocystis* (Berk. & Broome) K.H. Larss.), and thinner and more spaced spines (basally 0.1–0.15 mm in diam). The new species was collected only twice, growing on the rotten wood of *Abies* in the virgin forest of the Changbaishan Nat. Res., NE China, and it causes a white rot. It is most probably a rare species.

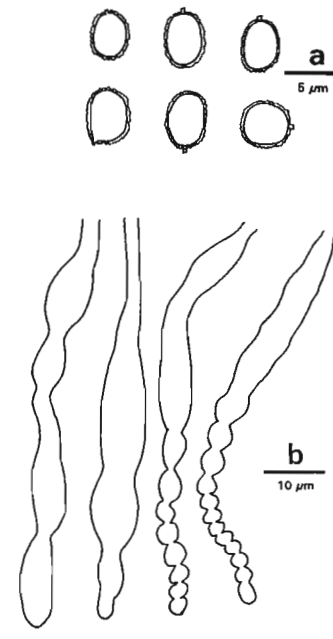

Fig. 3. Basidiospores (a) and cystidia (b) of *Dentipellis dissita* (Berk. & Cooke) Maas Geest. (drawn from DAOM 190988).

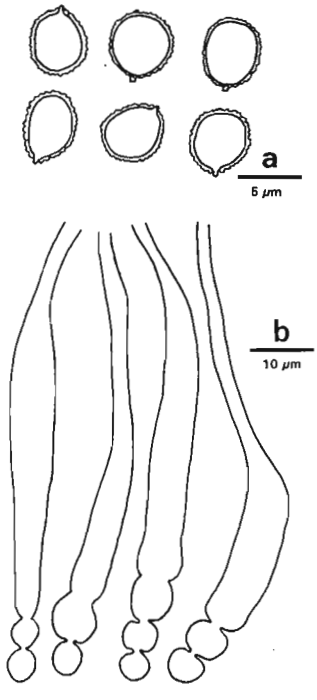

Fig. 2. Basidiospores (a) and cystidia (b) of *Dentipellis fragilis* (Pers.:Fr.) Donk (drawn from Dai 2060).

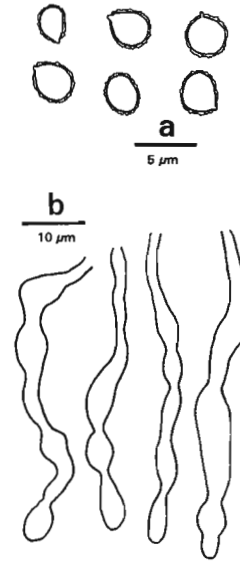

Fig. 4. Basidiospores (a) and cystidia (b) of *Dentipellis leptodon* (Mont.) Maas Geest. (drawn from DAOM 15849).

Other species of *Dentipellis* in China

Teng (1996) mentioned *Oxydontia macrodon* (Pers.) Miller in China. I did not study the material of the above name, and according to the description, especially the spore dimensions (6–7 x 5–6.5 µm, Teng, 1996), the report seems to refer to *D. fragilis*.

Dentipellis fragilis is fairly common in NE China, and lives on fallen trunks and rotten wood of several genera of angiosperms. The spines in the Chinese material of *D. fragilis* are shorter and less dense than in the European material. Hjortstam and Ryvarden (1988) also mentioned the above differences. However, I have studied the material from Europe and North America, and in the microscope the Chinese collections fit very well with the specimens from the other continents.

For comparison the following specimens were examined. — *Dentipellis dissita*. **Canada**. Ontario, Dorset, 22.IX.1984 Ginns 8613 (DAOM 190893). Québec, Gatineau, Cantley, on *Quercus*, 14.XI.1981 Ginns 6412 (DAOM 182849). **U.S.A.** New York, Alleghany State Park, on wood of angiosperm, 15.IX.1984 Ginns 8610 & Lowe (DAOM 190988). — *D. fragilis*. **China**. Jilin Prov., Antu County, Baihe, on rotten wood of *Populus*, 13.IX.1995 Dai 2137a (H); Changbaishan Nat. Res., on fallen trunk of *Acer*, 13.IX.1995 Dai 2060 (H), on fallen trunk of *Betula*, 3.IX.1993 Dai 1005 (H); on fallen wood of *Populus*, 1.IX.1993 Dai 943 (H). Wangqing County, Lanjia, on fallen trunk of angiosperm, 13.IX.1993 Dai 1309 (H). **Finland**. Uusimaa, Helsinki, Botanical Garden, on dead branch of *Acer*, 10.X.1981 Niemelä 2330 (H); Kumpula, on *Populus*, 17.IX.1991 Saarenoksa 35891 (H). **U.S.A.** Washington, Olympic Peninsula, Hoh River, on *Populus*, 27.VIII.1957 Lowe 8081 (DAOM 94597). — *D. leptodon*. **Canada**. Ontario, Algonquin Nat. Park, on *Betula*, 22.X.1966 Cain (DAOM 158439). **India**. Himachal Pradesh, Mahasu, Narkanda, on fallen log, 17.VIII.1965 Khara 4029 (DAOM 149199, isotype of *D. subseparans* Khara & Rattan).

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How many species are there?

James Ginns
1970 Sutherland Road, Penticton, British Columbia, V2A 8T8, Canada
Email: ginnsj@em.agr.ca

Abstract: A survey of the Corticioid fungi of North America lists 919 species. This is more than a 100% increase since the 1926 monograph by E. A. Burt. The species are distributed among 165 genera with 126 (76%) genera containing fewer than 6 species. The need for baseline data is noted and the hazards in compiling data from the literature are illustrated and discussed. The numbers of species in various regions of the World are compared.

INTRODUCTION

Some systematists are concerned with numbers of specimens, because they are necessary to evaluate, for example, habitat preferences, geographic distribution, or variation of characters within a species. Other systematists measure numbers of, if one is a mycologist, spores, cystidia or basidia to accumulate statistically significant data. And a few systematists are interested in numbers of species.

When the topics of rare species, species conservation, and biodiversity (see synopses by Hawksworth, 1991, 1992) became popular, I became more interested in the numbers of species of the Corticiaceae s.l. in North America. There were several reasons for my interest. First, a critical review of the species was needed, primarily because the past 65 years of literature was widely scattered. Second, there was no current, coherent body of baseline data for North America. And, most mycologists had a 'casual ignorance' of the size of the group and of its relevance in the functioning of the ecosystems where the species occur.

The importance of baseline data cannot be overemphasized. Before species can be labelled 'rare' there has to be data on their distribution and occurrence in the past and at present. Such information is available for very few of the species in North America. Before fungal species can be proposed for conservation we need data on their habitats. And before the fungal biodiversity of an area, whether a country, a park, or an ecosystem, can be assessed, it is necessary to have data on the numbers of individual species in the area being studied.

Baseline data for a park or country can be accumulated in two ways. First, by collecting within the area, see, for example, Parmasto & Parmasto (1997). Second, by searching the scientific literature for reports of species from the area. The current emphasis on biodiversity studies should promote the accumulation of baseline data. Therefore, it seems appropriate to briefly review the status of the numbers of the Corticioid fungi in North America.

DEFINITIONS

The term 'North America' includes just Canada and the United States, excluding Hawaii. These countries cover 7,466,913 square miles (1,933,855,800 hectares) and include a variety of habitats from subtropical to arctic tundra.

The term 'Corticioid fungi,' proposed by Parmasto (1995), is convenient because it is general, has no taxonomic status, thus can encompass species in several orders and families. It is used to refer to the Aphyllophorales with effuse, sometimes reflexed, primarily nonporoid basidiomes.

NUMBERS OF SPECIES

The only monograph of the Corticioid fungi of North America is E. A. Burt's "Thelephoraceae of North America," and ancillary papers (1914-1926). He had a much broader concept of the Corticioid fungi and of North America than defined above. Thus, to accurately compare Burt's data with current data only species of Corticioid fungi are included from his broad concept of the "Thelephoraceae," and only species from Canada or the United States are included. On

this basis, Burt treated 441 species of Corticioid fungi, which were distributed in 18 genera.
In studying some species treated by Burt, I found that his detailed citation of collection data for each specimen examined to be extremely valuable, because they made it possible to confirm species concepts, geographic distributions, and morphological features. However, problems became evident. The following two examples illustrate the problem of species concepts. First, Burt (1926) proposed a new species, *Corticium ravum* Burt (now *Conferticium ravum* (Burt) Ginns & Freeman). The five collections Burt cited from the United States were studied and only one specimen was judged conspecific with the holotype. Two specimens were two different species of *Gloeocystidiellum* and one specimen was neither *Gloeocystidiellum* s.l. nor *Conferticium*. The second example is Burt's treatment of *Corticium auberianum* Mont., a species originally described from Cuba. He cited 10 specimens from the United States. Ginns (1992) studied the ten and reassigned them to eight species in six genera (Table 1). Was Burt's species concept extremely broad or did he misidentify specimens?
Recently, Ginns & Lefebvre (1993), and Ginns (1998), following a survey of over 600 references, a critical evaluation of the synonymy, and study of some poorly known species (see Ginns 1992), recognized 919 species in North America. One hundred thirty species are known only from the type specimens (holotype and often paratype specimens). Some of these, as well as some other species, lack detailed descriptions and illustrations. And only 33% of the species have been described in culture (Ginns, unpubl.). Nevertheless, in the 67 years since Burt's monograph our knowledge of the Corticioid fungi has increased by more than 100%.

Table 1. *Corticium auberianum* Mont., specimens from the United States cited by Burt (1926).

Locality	Redetermination
Arkansas	Peniophora sp. nov. (2 specimens)
Florida	Phanerochaete sp.
Georgia	Scytinostroma sp. 1
Louisiana	Scytinostroma sp. 2 (2 specimens)
North Carolina	Hyphoderma sp.
South Carolina	Corticium sp.
Vermont	Hyphodontia sp. 1 & sp. 2

GENERA COMPRISING THE MYCOFLORA

The 919 species are distributed in 165 genera (Ginns 1998). Most genera are small (Table 2); 126 genera have fewer than six species. The 15 largest genera are listed in Table 3, and they account for 44% of the species.

Table 2. Size of the genera of Corticioid fungi in North America.

Number of species	Number of genera[1]
1	45
2	36
3	21
4	17
5	7
6 to 9	7
10 to 19	14
20 to 54	12

[1] Data from Ginns (1998).

COMPARISON WITH OTHER GEOGRAPHIC AREAS

The number of species of Corticioid fungi in the World and in several major regions are shown in Table 4. Unfortunately there is no readily available number for all of Europe. The figure of 1845 species in the World was calculated by adding the species numbers given by Hawksworth et al. (1995) for the families or orders of Corticioid fungi.

Table 3. The fifteen largest genera of Corticioid fungi in North America.

Name	Number of species[1]
Athelia	21
Botryobasidium	22
Dendrothele	17
Hymenochaete	22
Hyphoderma	40
Hyphodontia	30
Peniophora	36
Phanerochaete	28
Phlebia	29
Sistotrema	21
Stereum	22
Thelephora	17
Tomentella	54
Tubulicrinis	20
Tulasnella	23
Total	402

[1]Numbers from Ginns & Lefebvre (1993), except *Botryobasidium* from G. Langer (1994) and *Hyphodontia* from E. Langer (1994).

Table 4. Corticioid fungi - Worldwide distribution.

Area	Number	Source
Canada & United States	919	Ginns (1998)
North America	1320	Ginns unpubl.
South America	363[1]	Hjortstam & Larsson (1994)
North Europe	463[1]	Eriksson & Ryvarden (1973-1976), Eriksson et al. (1978-1984), Hjortstam et al. (1988a & b)
Africa	488[1]	Hjortstam & Larsson (1994)
Asia	343[1]	Hjortstam & Larsson (1994)
Australasia	210[1]	Hjortstam & Larsson (1994)
World	1845	Hawksworth et al. (1995)

[1]Cyphellaceae and Thelephoraceae not included.

DISCUSSION

The question 'How many species of Corticiaceae are there?' will not be answered in the near future or, perhaps not, in the next few decades. The principal reason is that there are many geographic regions and ecological niches in the World that have not been sampled. And there are problems of synonymy and species concepts to be resolved.

When collating numbers of species reported in published studies some hazards became obvious. The examples from Burt's work illustrate the need for caution when compiling data from earlier authors. The question of species concepts has to be resolved before early and current studies can be accurately compared. And before the number of species treated by Burt can be compared with recent counts, it is necessary to have an understanding of the synonymy to prevent one fungus from being counted several times simply because it has appeared under different names in the past. Thus, 441 species of Corticioid fungi in Burt's monograph and the 919 in Ginns (1998) must be interpreted as approximately correct.

The large number of small genera in the Corticioid fungi is primarily a result of splitting of the large Friesian genera to remove discordant elements and improve the homogeneity of the parent genus. Parmasto (1991) presented

an erudite discussion of the phenomenon/problem of the relatively new, small genera of the Corticioid fungi. His general conclusion was that many of the small genera are not justified. Although the Corticioid fungi in various regions of the World (Table 4) were compared, the data is weak. The tally of 1845 known species in the World seems conservative because over 1600 species are known in just North America and some tropical areas (Ginns, unpubl.). The relatively few species reported for Africa, Asia, Australasia, and South America are an indication of our lack of knowledge of the fungi in these areas. Although this discussion dealt with the known species, the totals have little relevance to the actual number of species, because there may be hundreds of still undescribed species in the World.

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Evolutionary processes on species level in wood-inhabiting Basidiomycetes

Nils Hallenberg
Department of Botany, Evolutionary Botany, Box 461, SE 40530 Göteborg, Sweden

Abstract: A model of a life cycle is presented which explains the scattered and many times unpredictable occurrence of numerous wood-fungi. Important ingredients in this model are: 1) a high genetical variability among spores produced from basidiomata, 2) possibilities for ecological specialization, 3) a prolonged period for haploid mycelia before mating, 4) a latent period prior to mycelial extension. Species structure is discussed on bases of morphology, incompatibility studies, and intraspecific genetical variation.

INTRODUCTION

Fungi are fascinating organisms, making up a considerable part of the biosphere. Still, only minute fractions of their activities are visible to human eyes. Terms such as an "individual" has another meaning among fungi than we are used to from their application in other organisms. Concepts on population, dispersal, species delimitation, or even speciation, are based on our knowledge from plants and animals but have been applied to the fungal world without further considerations. There are reasons why fungal organisms may be difficult to understand, as they differ in fundamental areas from other organisms. Two subjects will be discussed here where there is an incongruity: principles behind species delimitation and distribution. Both are intimately connected with evolutionary processes at species level. A model for a life cycle is presented in order to explain their unpredictable occurrence. The model is based on wood-inhabiting Basidiomycetes and examples presented are mainly taken from my own experiences on research with biosystematics in Corticiaceae.

BACKGROUND AND BASIC ASSUMPTIONS

As a background to this discussion it is necessary to consider some different methods applied in the delimitation of corticioid species:

A) The basic object for species delimitation is, by tradition, basidiome morphology. There is no indication that this tradition will change, but how to evaluate individual morphological characters will get increased attention.

B) Intercompatibility between haploid mycelia has been particularly used by people working with wood-inhabiting Basidiomycetes, as these fungi often are easy to cultivate. The distinct results obtained from the tests have been very helpful in species delimitation studies and the biological species concept has therefore become well established (Boidin, 1986).

C) Species delimitation and intraspecific genetic variation have also been studied, using protein electrophoresis (Hallenberg, Larsson & Larsson, 1994), DNA fragment analysis (Smith & Anderson, 1989), and DNA sequencing.

To a significant part these studies are mutually supportive but contradictory results are common enough to create conflict. Mostly, these conflicts seem to be related to the application of species names.

A mycologist using the morphological concept wants a description which facilitates a rapid and safe determination. In principle, it should be possible to determine all collected specimens to species or describe as new, using this method.

The biological species concept relies upon a pure and attractive theory, which unfortunately is not universally applicable (Heywood, 1963). When used in combination with comparative morphology, intercompatibility tests may be very useful in finding out species boundaries and which of the characters that are useful for separation of taxa. A conflict arises when distinguishing morphological characters are insignificant or absent and the principal bases for separation is interincompatibility. Good surveys over various results from intercompatibility

studies are given by Boidin (1977) and Petersen (1995). The application of the biological species concept and its relation to speciation is further discussed by Burnett (1983) and Brasier (1997). Finally, DNA-related data offer new information and a new set of characters which can be used in species delimitation and studies of intraspecific variation. Fragment analysis (RAPD and related methods) has been applied in some cases, which indicate that a high gene flow is prevailing in local populations (Stenlid, Karlsson, and Högberg, 1994, Nordén, 1997). DNA sequences have also been compared in studies of intraspecific variation. ITS region (nuclear rDNA) has been found ta have suitable degree of divergence in some species (Hibbett et al., 1995; Hallenberg, Larsson & Mahlapuu, 1996; Larsson, Larsson & Hallenberg, 1998). Still, the number of investigated species are few.

CONFLICTS

The combination of the above mentioned methods for delimitation of species has demonstrated several conflicting situations:

A morpho-species may be subdivided into more narrowly defined morpho-species. A good example is the splitting of *Sistotrema brinkmannii* (Bres.) J. Erikss. into several taxa (Hallenberg, 1984). In earlier studies (Lemke, 1969; Ulrich, 1973) *S. brinkmanni* was characterized as one species which included several intercompatibility groups. Any further delimitation of these groups into species was obviously not deserving of belief at that time. A most probable reason was that microcharacters were over-estimated. Different species inside this complex are separated by observation in x10 - x20 magnification. Of course, here is no conflict but there is a risk over a narrow delimitation of a taxon. It must be reasonably possible for other mycologists to follow the instructions on how to keep the different species separate.

The taxonomic splitting of *Armillaria mellea* complex was based on intercompatibility tests and the new species recognized were associated with diagnostic characters for identification. Nevertheless, Termorshuizen & Arnolds (1997) found that morphological criteria for separation of *A. lutea* Gillet from *A. cepistipes* Velen. were too uncertain and proposed a unification of these two taxa, despite the already shown incompatibility between them.

The next step comes when there exist several intercompatibility groups within a morpho-species that are impossible to distinguish from each other by normal means (microscope, substrate preferences, etc). There are cases when species have been described as new and distinguished only on the basis of incompatibility, despite that morphology or ecology could not be used as separating characters (David & Déquatre, 1984). An "ultra-species" should then be the corresponding morpho-species (Boidin, 1986).

During the last 20 years, a substantial amount of crossing tests have been performed at the mycology laboratory, University of Göteborg. In pace with the development of the culture collection for corticioid fungi (FCUG), new material was added from various parts of northern hemisphere and continously growing groups of intercompatible specimens were indicated. Summarizing this period of research shows that crossing test data from about 130 species have been obtained so far. Among these, sibling complexes were found in 65 species. To sibling species are here referred inter-incompatible populations which are morphologically indistinguishable from each other. Two siblings were never collected on the same resource unit (branch, log, etc.). For complete and updated information, see "FCUG" under my institutes homepage (www.systbot.gu.se).

This means that half of the investigated species included two or more incompatibility groups, which could not be separated from each other on the basis of morphology. In some species complexes, like *Hyphodontia aspera* (Fr.) J. Erikss. - *H. breviseta* (P. Karst.) J. Erikss., or in *H. sambuci* (Fr.) J. Erikss., as many as nine incompatibility groups have been identified. It may be argued that an investigation of a species complex must be very thoroughly performed and include a great number of samples from various regions, to give useful results. For corticioid fungi, however, this is not realistic. Corticioids are in most cases impossible to determine in the field, why every collecting day should ideally end with the determination of all collected specimens by microscopy. Consequently, much effort is needed to assemble even a moderate number of cultures from each species. On the other hand, contemporary studies of all corticioid species found in an area is a

much more productive way of working. Even if this does not solve the complex situation for individual species in any statistical sense, these studies help us to understand species complexes in a more general view. A relatively small number of representatives in many incompatibility groups is, in this way, compensated for by the study of a great number of different species. Altogether, there are now convincing indications that different incompatibility groups within many species complexes are ecologically isolated from each other. This makes it reasonable to believe that ecological specialization with accompanying genetical isolation, is a normal behaviour among corticioids. Numerous examples are given in Hallenberg (1988, 1991a, 1991b). It is most likely that other groups of Basidiomycetes are similar in this respect.

From the statements above it could be easily concluded that corticioids have a conservative basidiome morphology which is often insufficient for the recognition of the real species. This is, however, not the whole truth as similarity in basidiome morphology sometimes may be referred to parallellisms, not close relationship. In *Ceraceomerulius serpens* (Fr.) J. Erikss. & Ryvarden three siblings were detected (Hallenberg, 1988) and one of them is obviously phylogenetically distant from the other two. A contrary case is found in *Peniophora cinerea* (Fr.) Cooke (Hallenberg, 1986; Hallenberg & Larsson, 1992). Here, there are two incompatibility groups within Europe; one is ecologically specialized to a certain substrate (decorticated branches of *Fagus*), while the other seems to be non-specialized but avoids the former kind of substrate. During the sampling of additional representatives, I came across two specimens which did not discriminate between the incompatibility groups but could mate with both. A further indication of very close relationship between the two siblings is the result that both readily mate with representatives from N. America. The story becomes even more complicated as representatives from NE America are different in micromorphology from their European partners, and have therefore frequently been reported under a wrong species name (*P. nuda* (Fr.) Bres.). This kind of extended mating ability in intercontinental crossing experiments has earlier been reported as "triangular intercompatibility" (Boidin, 1986; Mounce & Macrae, 1938). From this it follows that speciation events have occurred on one continent yet have not affected a theoretical mating relationship with representatives from a geographically distant area, even though a morphological differentiation had occurred. Vilgalys (1991) found that populations of *Collybia dryophila* (Fr.) P. Kumm. on both sides of the Atlantic, differed in their morphology, despite being intercompatible. Mating ability on a global scale can at least be said to indicate a close relationship, but does not necessarily imply a proof for conspecificity.

As mentioned above, there are still only a few studies directed to intraspecific variation using molecular techniques. Both DNA sequencing from a variable region (ITS) and fragment analysis have demonstrated that sibling species generally are closely related but distinctly separated from each other. In *P. cinerea*, however, any obvious differences have hitherto not been detected between the two incompatibility groups in Europe. This could be interpreted as the first steps on the evolution of a new species. On the other hand, within a biological species ITS sequences are often strikingly similar, despite a wide geographical distribution. More sensitive DNA based methods will certainly reveal an obvious variation as a result of allopatric differentiation.

All the studies summarized above were intended to reveal the true nature of a corticioid species, to be helpful in its delimitation, and in revealing inconsistencies in a supposed uniform species. There is a fundamental connection between the concept of a species and its Latin name. These names are superior as means of communication between people and are particularly so in groups of organisms with a wide distribution. A small number of fungal species are known in great detail, mostly owing to their importance as pathogens or usefulness in some respect. Even if such a species initially was looked upon as a species complex, we could gradually learn how to keep incompatible and genetically divergent populations apart. There is no doubt that species will be much more narrowly defined under such circumstances. Other species may be less known but still possible to identify by morphological characters. For purely practical reasons it is desirable to give Latin names to specimens which we can

identify to species, without going into too complicated analyses. In theory, it would be possible to find a species concept which could be generally applicable but in practice the concept varies, depending on species. This way to look upon a species concept comes very close to what Parmasto (1985) called "the practical standard of a species".

ON SPECIES DISTRIBUTION

It is common knowledge that wood-inhabiting Basidiomycetes have a wide geographical distribution within a climatic zone. This has been documented by numerous field reports from the northern hemisphere and the correctness of determinations has been verified by crossing experiments. Possible reasons for the wide distribution of species are:

1. Efficient long-distance spore dispersal. Even though most spores from a basidiome will fall within a distance of few metres, and even if an unoccupied niche in nature will most probably get a spore-establishment from a nearby basidiome, there is convincing evidence of long distance dispersal.
2. The species are very old, have remained unchanged for long periods of time, and have been distributed along with coherent forest vegetation during the biohistory (Hallenberg, 1991a). A basis for this hypothesis is the very stabile micro-environment created (dead wood) where these fungi live.

The two possible factors could be looked upon as alternatives but the most probable explanation is that both factors are of great importance. We know from the dispersal of fungal pests, that the Atlantic is too large a barrier for spore dispersal, without being guided by man or possibly other vectors. A great majority of corticioids from broad-leaved, nemoral areas in Europe have been collected in similar forests in N. America, despite these forests being geographically well separated. An explanation is that the common wood-fungus flora remained unchanged since before last glaciation periods, when the broad-leaved zone was encircling the northern hemisphere.

We also have good examples of rapid dispersal in wood-fungi, when a new niche has appeared and with a little help from man. The worldwide distribution of *Serpula lacrymans* (Fr.) P. Karst. seems to be a result of the increased trade during the 15th century and onwards (Bech-Andersen, 1995).

Several speculations have mentioned that the enormous amount of basidiospores produced in some species, is an important factor in promoting their distribution. This is probably true, but far more interesting is the fact that small corticioids, seeming to produce only small amounts of spores from tiny specialized basidiomes, are just as widely distributed as the large polypores. It seems more likely to look upon a high spore production as an adaptation to overcome difficulties in establishment in the near environment than to long distance dispersal.

THE MODEL

Production of basidiospores in a heterothallic species implies that spores with a certain degree of genetical variation will be equally dispersed in the environment. Nothing of this variation is aborted in the basidiome, but only a fraction of all existing genotypes will ever be established on a suitable niche. Consequently, the realized niche for a species is only using a part of the available genetic variation (Brasier, 1987). Thanks to this variation, scattered establishments may take place in an environment which is unusual or new to the species. As an example we can find that wood-fungi which are typical for deciduous trees may occasionally be found on conifers. The special genetic prerequisite which is present in such an unusual, but succesfully established, haploid mycelium will, in most cases, be later dispersed in the common gene pool after only a few generations. On the other hand, if this new establishment is found in an environment where the original population is absent, stabilizing and isolation processes will take place during future generations. A new, ecologically specialized sibling which is incompatible with its close relative from which it originated, has been created.

There is good evidence for the existence of incompatibility genes in normal populations (Chase & Ulrich, 1990; Hallenberg, 1988, 1991b). Once a haploid mycelium has been established it can probably survive for a long time before becoming paired with a spore or with

another compatible establishment nearby. Free living haploid mycelia during an extended period on a natural substrate, was found in infection experiments with *Heterobasidion annosum* Bref. (Stenlid, 1994). For most species it is not possible to investigate the potential existence of haploid germlings on natural substrates but it is rather likely that this is a normal process in the establishment of wood-fungi. A prolonged pre-mating period will promote the existence of scattered and isolated occurrences as well as long-distance dispersal, but most of all it will promote heterogeneity in populations which is necessary for the survival of scattered occurrences (Hallenberg, 1995; Nordén, 1997).

Even a paired mycelium may continue its life as a latent infection until conditions favour development of a vegetative mycelium (Rayner & Boddy, 1988). It is easy to realize that latent infections from several species may be present at a suitable infection site. Such sites are only establishment niches, the starting points from where a mycelial expansion make take place. The key to which species or individual that may be favoured, could be related to many external factors. For primary invaders, the causes for death of a tree (branch) could be decisive, while some of the secondary invaders could be looked upon as followers to the species responsible for primary decay (Niemelä, Renvall & Penttilä, 1995). Once established, a mycelium has an advantage over less successful competitors, unless the conditions do not favour a particular species. There may be a long series of events preceeding the appearance of a certain species and the climate comes as a superimposed determinator.

Species which are restricted to dead and decaying wood and established there via air-borne spores, will all have a rather limited life span for the active mycelium and its basidiome. This means that continuously new substrates must be occupied and this is also supplied under natural conditions. Efficient spore-dispersal is therefore a precondition for all wood-fungi also in the local perspective. With this model it is reasonable to explain why some occurrences of wood-fungi seem to be unpredictable and that a scattered occurrence of a species could be an effect of a life strategy.

The original question addressed in this paper concerned evolutionary processes at species level. It follows that such changes are linked to their energy sources (dead wood) and these seem to have a very conservative structure. Vegetation in northern Europe has drastically changed due to human impact but the kind of substrates which are available for wood-fungi has not changed. Rearrangements of species composition is taking place when the fungus flora becomes adapted to the structure in modern forests. There is also an obvious risk that increased travelling and transportation will have dispersal effects. The functional aspects of wood-decay will most probably not change. This is, however, not in opposition to our desire for a rich and variable biodiversity or to avoid negative effects caused of uniformity in modern forestry. More drastic effects where wood-fungi could play an important role, would be attained if new niches were introduced by accident or ignorance. We should keep the story of *Serpula lacrymans* in our minds.

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Parmastomyces mollissimus in North Europe

Heikki Kotiranta
Finnish Environment Institute, Nature and Land use Division, P.O. Box 140, FIN-00251 Helsinki, Finland. email: heikki.kotiranta@vyh.fi

Abstarct: The distribution and biology of *Parmastomyces mollissimus* (Maire) Pouzar in North Europe is presented. The macroscopical and microscopical features of *P. mollissimus* are described and its systematic position is briefly discussed.

MATERIALS AND METHODS

The study is based on material preserved in the herbaria of Copenhagen (C), Helsinki (H), Finnish Forest Research Institute (HFR), Oulu (OULU), Stockholm (S), Tartu (TAA), Uppsala (UPS) and the reference herbarium of Heikki Kotiranta (H.K.).

Microscopy was studied in Cotton blue (CB), Melzer´s regent (IKI) and 5% potassium hydroxide (KOH). For every collection 30 spores were measured. The abbreviations used are: L* = mean spore length, W* = mean spore width, Q = range of the variation in L/W ratio, Q* = quotient of the mean spore length and mean spore width (L/W ratio).

The nomenclature of polypores follow Niemelä (1997) and for the authors the reader is referred to that publication.

Parmastomyces mollissimus (Maire) Pouzar, Česká Mykol. 38:203, 1984

Basionym: *Tyromyces mollissimus* Maire, Bull. Soc. Hist. Nat. Afrique Nord 36(3):37, 1945. Syn. *Polyporus subcartilagineus* Overh., Mycologia 33:90, 1941 (illegitime name - no Latin diagnosis) - *Polyporus transmutans* Overh., Mycologia 44:226, 1952. - *Tyromyces kravtzevianus* Bondartsev & Parmasto, Mycotheca Estonica 1(25), 1957.

Fruit body annual, resupinate to effused-reflexed. Taste bitter to sourish, smell licorice-like, resembling that of *Antrodia sinuosa*. When fresh white, soft, fragile and subcartilagineous. When touched turns slowly brown. Brittle when dry. Upper surface of the pileus at first white, rough, because of agglutinated hairs, rusty brown when touched or dried, sometimes inconspiciously striated, mostly thin and narrow, expanding less than 20 mm, uneven, up to 10 cm broad along the wood. Edge of the pileus thin, sharp, rolling inwards when dry. Pore surface at first white, when touched dark honey brown to rusty brown, when fully resupinate sometimes with guttation depressions. Tubes up to 3.5 mm long. Pores close to the margin roundish to isodiametric, elsewhere seldom also labyrinthiform, variable in size, (2-) 3-4 (-6) per mm. When dry, dissepiment edge thin, entire to lacerate. Context two layered: upper layer thin, white, soft; lower layer, just above the tubes, hyaline, gelatinous, at first translucent creamish, turning into a black line in old fruit bodies when dry. The gelatinized, dark hyphae ("black line"), which continue in old fruit bodies into the upper parts of the pore trama, is very hard, corneous.

Hyphal system monomitic, hyphae clamped, walls acyanophilous, indextrinoid. The hyphal structure of the upper layer of the context (in resupinate specimens subiculum, which is against the wood) consists of three (looks like four) types of hyphae: a) the dominating "normal" hyphae are subparallel, sparsely clamped, thin-walled or with slightly thickened walls, up to 5 µm wide and give rise to, narrow thin-walled, about 1.5 µm wide hyphae, which are normally without septa or simple septate. These hyphae are actually side branches of the dominating hyphae, but they are characteristically collapsed, and look like fibre-hyphae, b) fairly many thick-walled (walls up to 2 µm thick), up to 15 µm, but normally 8-10 µm wide hyphae, with conspicious clamps, often of the shape seen in the genera *Kavinia* Pilát and *Ramaricium* J. Erikss. The walls swell remarkable or even dissappear in KOH, c) gloeoplerous hyphae rare to abundant, with slighthly thickened walls, (3-) 5-8 µm wide, in IKI and KOH yellowish or yellowish brown, in CB blue, with oily or granular contents. Between the hyphae are yellowish oily bodies. The dark line consist of same type of

hyphae as above, but they are gelatinized, tightly packed, and individual hyphae are difficult to discerne. Tramal hyphae subparallel, flexuose, at first thin-walled, later with thickened, up to 0.5 µm thick walls, 3-4 µm wide. Subhymenial hyphae thin-walled, richly branched, 3-3.5 µm wide. Cystidia none, but a few thin-walled, 28-30 x 4-5 µm cystidioles rarely present in young fruit bodies. Basidia subclavate or subcylindrical, often constricted in the middle part, basally clamped, very thin-walled, (17-) 20-25 (-28.5) x (5-) 5-6 (-7) µm, with normally

Table 1

	Specimens examined	L	L*	W	W*	Q	Q*
Finland	Askola 2428	**4.5-5.1** (-5.6)	4.87	**2.5-2.9**	2.63	1.66-2.04	1.84
	Askola 2496	(4.6-) **4.8-5.4** (-5.7)	5.05	**2.5-3.0**	2.78	1.6-2.0	1.81
	Kotiranta 1540	(4.2-) **4.5-5.1**	4.82	(2.3-) **2.5-3.0**	2.71	1.5-1.95	1.81
	Kotiranta 1643	(4.0-)**4.5-5.0** (-5.6)	4.91	(2.3-) **2.5-2.7** (-3.1)	2.62	1.66-2.13	1.87
	Kotiranta 1848	(4.5-) **4.8-5.8** (-6.0)	5.21	**2.3-3.0** (-3.5)	2.88	1.5-2.1	1.80
	Laineet al.	(4.7-) **5.0-5.3** (-5.5)	5.04	(2.4-) **2.6-3.0**	2.74	1.62-2.25	1.84
	Lindgren 753b	(4.4-) **4.7-5.7** (-6.2)	4.96	(2.7-) **2.9-3.2** (-3.7	2.99	1.4-1.93	1.65
	Lindgren 8069	(4.7-) **5.0-5.8** (-6.2)	5.41	(2.6-) **2.9-3.5** (-3.9)	3.10	1.35-2.0	1.74
	Penttilä 1044	(4.3-) **4.6-5.2** (-5.7)	4.97	**2.4-2.9** (-3.2)	2.72	1.56-2.08	1.82
	Penttilä 1832	(4.8-) **5.3-6.1** (-6.4)	5.65	(2.7-) **2.9-3.2** (-3.4)	2.97	1.75-2.06	1.90
	Penttilä1952	(4.2-) **5.0-6.0**	5.34	(2.2-) **2.7-3.0**	2.81	1.7-2.1	1.89
Estonia	Kalmeti	(4.4-) **4.6-5.3** (-5.6)	4.94	(2.4-) **2.6-3.0**	2.77	1.67-2.04	1.78
Poland	Domański	(4.6-) **4.8-5.3** (-6.0)	5.07	(2.3-) **2.5-3.0**	2.69	1.64-2.21	1.88
Russia	Parmasto 7848	(4.0-) **4.2-4.8** (-5.0)	4.40	(2.2-) **2.4-2.8** (-3.0)	2.58	1.42-2.0	1.70
	Parmasto 8947	(4.0-) **4.4-5.0** (-5.3)	4.63	(2.3-) **2.5-3.0**	2.68	1.42-1.85	1.72
	Parmasto 8948	(4.1-) **4.3-5.0** (-5.2)	4.68	(2.3-) **2.5-3.0**	2.68	1.41-1.96	1.74
	Parmasto 9078	(4.3-) **4.5-5.0** (-5.3)	4.83	**2.2-2.7** (-2.9)	2.59	1.59-2.21	1.86
	Parmasto 9081	(4.3-) **4.5-5.0**	4.92	(2.3-) **2.5-3.0**	2.73	1.58-2.0	1.78
	Parmasto 103712	(4.1-) **4.3-5.0** (-5.2)	4.58	(2.2-) **2.4-2.9** (-3.1)	2.63	1.5-2.09	1.73
	Järva	(4.2-) **4.5-5.1** (-5.6)	4.80	(2.2-) **2.5-2.9** (-3.1)	2.68	1.59-2.08	1.78
Canada	Ginns 2358	(5.0-) **5.2-5.9** (-6.1)	5.45	(2.2-) **2.4-2.8**	2.57	1.88-2.45	2.11
United States	Holmquist 783	(5.0-) **5.4-6.0** (-6.8)	5.72	(2.2-) **2.5-3.0**	2.73	1.82-2.31	2.09
	Stein	**5.0-5.5**	5.16	**2.6-3.0**	2.83	1.72-2.03	1.82

four, very thin (needle-like), straight to slightly curved, 2-3 µm, in a few cases even up to 5 µm long sterigmata. Spores ellipsoid to short cylindrical, ventrally slightly concave, staight or convex, about 4.5-5.5 x 2.6-3.0 µm (see Table 1.), with a inconspicuous apiculus, with up to 0.1 µm thick wall, strongly cyanopilous, dextrinoid, hyaline or very slightly yellowish green in KOH.

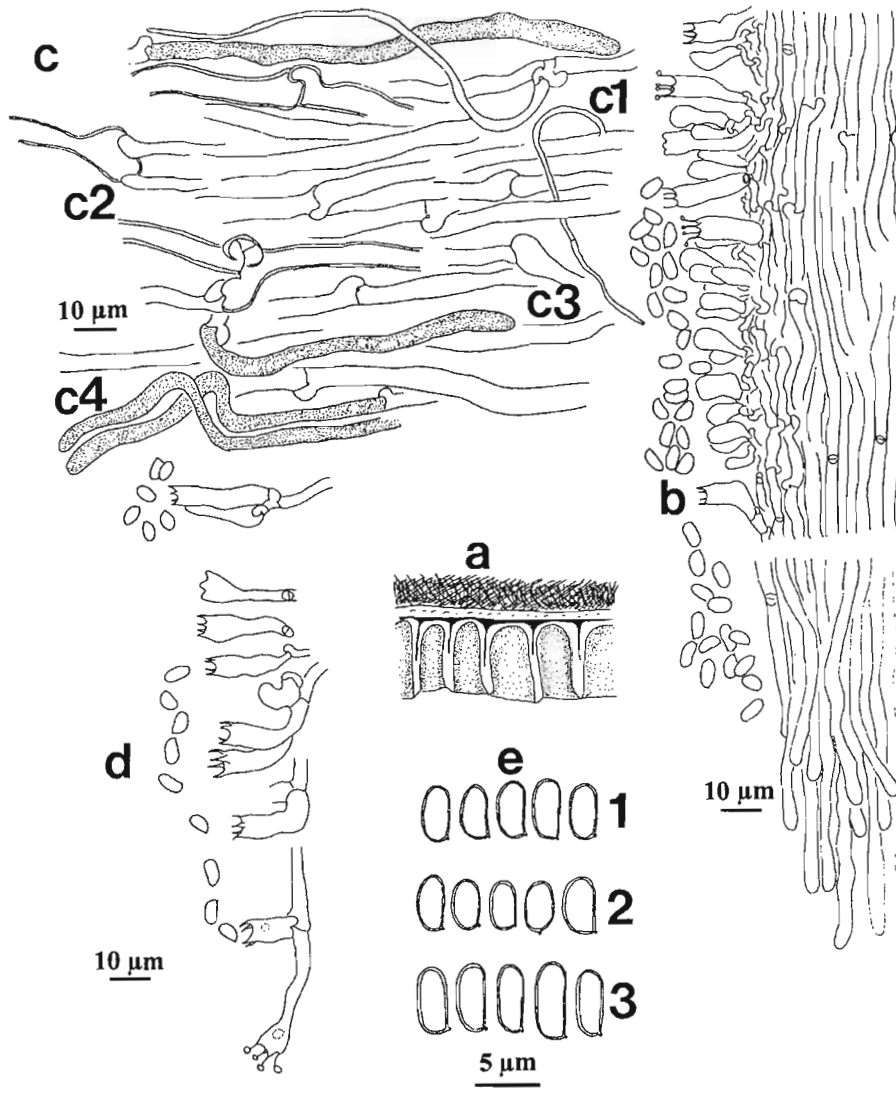

Fig. 1. *Parmastomyces mollissimus* (Maire) Pouzar. - a: section through fruit body, showing the dark line above the tubes and upper trama. - b: a vertical section through young trama and dissepiment edge. - c: a section through context, showing c1. the general hyphae with narrow side branches, c2. thick-walled clamped hyphae, c3. hyphae with ampullaceous clamps, c4. gloeoplereous hyphae. - d: basidia and spores. - e: spores. (*Askola 2429, b, c, Penttilä 1832 d, Kotiranta 1848 e1, Parmasto 8948 e2, Stein e3*).

SPECIMENS EXAMINED

Finland. Uusimaa: Nurmijärvi, Ojakkala, brook-side grass-herb forest, fallen *Picea abies*, Grid 27°E:670:380, 3.IX.1988 Toivonen & Askola 2429 (H); same locality, grass-herb forest, fallen *Picea abies*, 3.IX.1988 Askola 2496 (H); Ruotsinpyhtää, Tesjoki, Holma, on log of *Pinus sylvestris* on the ground together with *Skeletocutis subincarnata* coll. and *Oligoporus sericeomollis*, dryish pine dominated heath forest, Grid 27°E:6709:462, 25.IX.1979 Kotiranta 1848 (H.K.). Etelä-Häme: Jämsä, Edessalo, Kolvonlahti W, on about 250 years old, partly strongly decayed, partly burned *Pinus sylvestris* on the ground together with *O. sericeomollis*, dryish pine dominated heath forest, Grid 27°E:6848:413, 18.VIII.1979, Kotiranta 1540 (H); Korpilahti, Vaarunvuori, on fairly decayed, decorticate *Pinus sylvestris* on the ground, dryish pine dominated heath forest, Grid 27°E:6871:433, 1.IX.1979 Kotiranta 1643 (H). Etelä-Savo: Savitaipale, Peltoinlahti, Vaartaja, on decayed *Pinus sylvestris* on the ground, Grid 27°E:678:53, Laine, Wickström & Niemelä (HFR 7495a). Pohjois-Karjala: Lieksa, Patvinsuo National Park, Lahnasuo, on fairly thin, fallen *Pinus sylvestris*, old forest, Grid 27°E:7007:682, 25.IX.1988, Penttilä 1044 (H), same National Park, Suomunjärvi W, Hietavaara, on fairly large, moss-covered fallen, growing partly on dead *Amyloporia xantha*, together with *S. subincarnata* coll., old pine dominated heath forest (*Vaccinium vitis-idaea* site type), open place, Grid 27°E:7010:687, 3.IX.1990 Penttilä 1952 (H). Kainuu: Hyrynsalmi, Tuli-Varpusuo Nature Reserve, Tuohimaa, on *Pinus sylvestris* on the ground, old forest, Grid 27°E:716:61, 20.IX.1990 Penttilä 1832 (H); Kuhmo, Matovaara, Välilampi S side, on trunk of sawed *Pinus sylvestris* (40 cm in diam.), together with *Skeletocutis lenis*, Grid 27°E:70868:6110, 12.VII.1997 Lindgren 753b (H); Kuhmo, Puntari, on crown of a fairly strongly decayed, decorticate fallen *Pinus sylvestris*, Grid 27°E:7094:6165, 22.VIII.1997 Lindgren 8069 (H). **Estonia**. Räpina: Järvselja, on corticate *Picea abies* in spruce dominated, fairly luxuriant forest, 5.IX.1956 Kalmeti (H, S, TAA, UPS). **Poland.** Białowieza National Park, on fallen *Picea abies* in humid mixed virgin forest, IX.1960 Domański (S). **Russia.** Altay Territory: Regio Montano-Altaica, Altay Nature Reserve, Telezkoje lake, Köga, on rotten unidentified trunk, IX.1959 Parmasto 7848 (TAA), Telezkoje lake, Karatš, on corticate trunk of *Larix sibirica* in mixed deciduous forest, 23.VIII.1959 Parmasto 8947 (TAA), same place, on corticate trunk of *Larix sibirica* in larch forest, 23.VIII.1959 Parmasto 8948 (TAA). Krasnoyarsk Territory: Tšornöi, Tanzöbei, on decorticate *Pinus cembra* ssp. *sibirica*, in cembra forest, 27.VIII.1958 Parmasto 9078, 9081 (TAA). Primor'ye Territory: Chugujevski district, Bulyga-Fadejevo, Kljuch, Pravaja Sokolovka, on decorticate coniferous wood, 4.VIII.1981 Parmasto 103712 (TAA). Khabarovsk Territory: Sorgavan, Nel'ma, on trunk of *Abies nephrolepis*, 1.IX.1976 Järva (TAA 92107). **Canada**. Ontario: Black Sturgeon Lake, on decorticate log of *Picea*, 6.IX.1973 Ginns 2358, (OULU 010061). **USA**. New York: Warrensburg, on stump of coniferous tree, 9.IX.1961 Lowe 12013 (C); same place, on wood of a gymnosperm, 25.IX.1971 Holmquist 783 (UPS), Westchester, in a cavity of a living *Quercus* sp., 30.X.1980 Stein (UPS).

DISTRIBUTION AND BIOLOGY

Parmastomyces mollissimus has a circumpolar, mainly temperate-boreal, distribution. It is described from North Africa, Algeria (Maire, 1945). In Europe it is rare, and the southernmost localities there are in Portugal, France and Italy (Ryvarden & Gilbertson, 1994). In Northern Europe it is found only in Estonia and Finland. In Russia it seems to be more common in the southern and eastern parts, and according to Gilbertson and Ryvarden (1987) it is very common in western mountains of the United States. In Eurasia all the records are south of Arctic circle, and the northernmost known site is in Finland (64°40'N). Mukhin (1993) suggests, that *P. mollissimus* is a thermophilic species, which zonal distribution is determined by climatical factors and the distribution is restricted to southern and middle taiga. This opinion is supported by extensive studies in Northern Finland (Renvall et al., 1991; Renvall, 1995) and northern parts of West Siberian plain, where *P. mollissimus* is absent (Mukhin, 1993; Kotiranta, 1995). In Canada and the United States the view is very similar (Overholts, 1977; Gilbertson & Ryvarden, 1987; Jung, 1987). One collection

there derives from Mackenzie district in North West Territories (Ginns, 1986). The accurate locality is not known by the author, and it can be from the southern parts of the district.

In literature very little is said about the habitats of the species. However, many of the specimens collected are from National Parks, or otherwise protected areas. This is natural, because keen polyporologists focus their interest on old-growth forests, which contain the most diverse polypore assemblages. However, fairly many of the collections derive also from managed forests, which gives the impression, that *P. mollissimus* does not belong to the old forest, or virgin forest (old-growth forest) species (see Kotiranta & Niemelä, 1996, pp. 19-21). In North Europe it grows both, in fairly luxuriant *Picea abies* dominated forests, and in dry, *Pinus sylvestris* dominated heath forests.

The substrate in Eurasia is a dead coniferous tree. The following host species are mentioned: *Picea abies, Pinus sylvestris, Pinus cembra* subsp. *sibirica* (Parmasto, 1959; Ryvarden, 1978; Mukhin, 1993), *Abies nephrolepis* and *Larix sibirica*. The African specimen was collected from *Pinus halepensis* (Maire, 1945). In North America the hosts are: *Abies lasiocarpa, Picea glauca, Picea mariana, Pinus banksiana, Pinus ponderosa, Populus tremuloides, Prunus serotinus* (Overholts, 1977; Ginns, 1986; Gilbertson & Ryvarden, 1987) and *Quercus* sp. In Western parts of North America it grows mainly on dead conifers and in Eastern parts on hardwoods, which may be still living.

DISCUSSION

Pouzar's (1984) opinion, that *Tyromyces mollissimus* Maire (Maire, 1945), is the same species as earlier was well known as *Parmastomyces kravtzevianus* is sound, even if it is not accepted by, e.g. Gilbertson and Ryvarden (1987, 1994). However, Maire's description from the year 1945 is unusual good and clear, if we also remember when it was made. According to a fairly free translation of the original, Latin description of Maire, *T. mollissimus* is "resupinate, rarely dimidiate ... soft, white, but turns into reddish or brownish red ... pores small, irregular. Cystidia none; basidia clavate 13-16 x 6.5-7 µm with four sterigmata. Spores hyaline, smooth ... turning reddish in iodine ...oblong-ellipsoid... 5-7 x 3-3.5 µm. Hyphae ... clamped." According to Maire *T. mollissimus* resembles *Polyporus* (*Postia*) *fragilis, P. erubescens* (*Leptoporus mollis*) and *P.* (*Oligoporus*) *sericeomollis*, but the spores are dextrinoid. In my opinion this is a very good description, and does not cast doubts on the identity of the species.

Parmastomyces was long known as a monotypic genus, untill Corner (1989) described four new tropical species in it. However, he is not satisfied with the solution and is in the opinion, that even three new genera could be made for the new species. Recently Dai and Niemelä (1995) combined *Polyporus taxi* Bondartsev into *Parmastomyces*. Their main arguments were, that *P. taxi* is monomitic, has fairly thick-walled, oblong spores, which are distinctly dextrinoid and strongly cyanophilous. Dai and Niemelä exlude the genus *Hapalopilus* P. Karst., because the spores of that genus are negative in both CB and IKI, and because the fruit body of *P. taxi* turns gray in KOH, not pinkish red as the species of *Hapalopilus*. The genus *Tyromyces* P. Karst. is rejected, because the spores in that genus are thin-walled, CB-, IKI-, the colour of the fruit body is not changing upon drying or bruising, and do not show colour reaction when treated by KOH. Moreover, they discuss about the possible relationship to the genus *Oligoporus* Bref., because both have the same kind of hyphal system, similar spores and also cause a white rot.

According to the specimens examined, *P. mollissimus* is clearly a brown rot fungus like, e.g. *Oligoporus rennyi* and *O. sericeomollis* (see also Jülich, 1984; Gilbertson & Ryvarden, 1987; Ryvarden & Gilbertson, 1994; Hjortstam, 1998). The fruit body of *P. taxi* is very light, the context is safran yellow, soft, turns immediately black when treated with KOH, has no black, corneous layer above the tubes and the spores are indextrinoid (not distictly dextrinoid). Moreover, the hyphae are very thin-walled, quite different from those seen in *P. mollissimus*. The only clear similarities between *P. mollissimus* and *P. taxi* are the type of rot (brown), and the cyanophility of the spores. In my opinion that is not enough to keep the congeneric. The type of rot rules out the genera *Tyromyces* and *Hapalopilus* and so far I do not know any suitable genus for *P. taxi*. (Specimen examined:

Polyporus taxi Bondartsev. China. Jilin Prov., Antu County, Changbaishan For. Res., on living tree of *Larix*, coniferous forest, alt. 1100 m, 16.VIII.1997 Y.C. Dai 2524 (H)).

The systematic position of *Parmastomyces* is a little bit unclear. Like Dai and Niemelä (1995) prove, *Parmastomyces* is fairly similar to some species of *Oligoporus*, which, however have indextrinoid spores, and do not have any kind of gloeoplereous hyphae. The hyphal system, the reactions of the spores to CB and IKI, and the type of rot point very strongly towards Coniophoraceae (see also Ryvarden & Gilbertson, 1994; Harmsen & Vesterholt, 1997) and the genus *Leucogyrophana* Pouzar. Especially *L. pinastri* (Fr.) Ginns & Weresub has amazingly similar hyphal system in rhizomorphs as young specimens of *P. mollissimus* in subiculum. The hyphal polymorphism of *P.mollissimus* is not so striking as in *L. pinastri*, but most often easily observable, if carefully searched. These two species are, however, easily distinguished, because the hyphae in tramal teeth (sometimes look like pores) of *L. pinastri* are strictly parallel, the shape of the spores is more roundish and they are as a rule not strongly dextrinoid. Young specimens of *P. mollissimus* may also resemble *Leucogyrophana mollusca* (Fr.) Pouzar (syn. *L. pseudomollusca* (Parm.) Parm.). The hyphal system and spores are very alike, but the spores of *L. mollusca* are larger, about 6-7.5 x 4-4.5 µm (Eriksson & Ryvarden, 1976).

I have studied one specimen, collected from a cavity of a living oak, and it differs from the general outer appearance of *P. mollissimus*. The fruit body is robust, effused-reflexed, the surface of the cap is dark cigar brown, matted, like in *Gloeophyllum odoratum*, but harder. The subiculum is soft, creamish white, up to 20 mm thick. The tubes are up to 40 mm long, and there is no black line above the pores. Microscopically, however, it is a "normal" *P. mollissimus*. Another exceptional specimen (Domañski IX.1960) had at first only a few dextrinoid spores. However, after two days in Melzer´s reagent, all turned dextrinoid. This specimen was otherwise "normal".

If summarized: *P. mollissimus* belongs to the Coniophoracea, but has affinities to the Phaeolaceae. However, it still seems to be the only species of the exceptional genus *Parmastomyces*.

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Notes on the division of the genus *Fomitopsis* (Polyporales)

F. Kotlaba[1] & Z. Pouzar[2]

[1]Institute of Botany, Academy of Sciences of the Czech Republic, 252 43 Průhonice near Praha, Czech Republic
[2]Mycological Department of the National Museum, Václavské nám. 68, 115 70 Praha 1, Czech Republic

Abstract: The authors discuss the generic taxonomy of the genus *Fomitopsis* sensu stricto and the related or similar genera *Fomes, Laricifomes, Pilatoporus* and *Rhodofomes*. A key to the genera discussed is appended.

INTRODUCTION

In our opinion, the problem of the delimitation of the genus *Fomitopsis* P. Karst. is still open and remains not sufficiently resolved. It must be admitted that the majority of polypore specialists conceive the genus in a broader sense and do not feel the necessity to split it into narrower separate genera. Nevertheless, already Donk (1974, p. 215) voiced the opinion that the broader concept of the genus *Fomitopsis* is heterogeneous, and still artificial ("As it appears on the Check list, *Fomitopsis* is much reduced but it is still heterogeneous").

A rather broad concept of the genus *Fomitopsis* was proposed by Bondarcev & Singer (1941), including also species with cyanophilous or dextrinoid spores (now *Haploporus* Sing., *Heterobasidion* Bref. and *Perenniporia* Murrill), as well as those without clamps on generative hyphae (*Rigidoporus* Murrill). Both groups are in contemporary taxonomy excluded from *Fomitopsis*.

Corner (1989) included the genus *Fomitopsis* in his very broadly defined genus *Trametes* Fr. He, however, simultaneously expressed a suspicion that such a wide concept of *Trametes* may eventually appear unnatural in future (p. 27).

As a result of our recent study of the microstructure of *Fomitopsis* sensu lato, we still prefer the narrower concept of genera in this group of polypores.

When studying, about nine years ago, Pilát's types of polypores, we proposed a new delimitation of some genera in the *Fomitopsis* group. We segregated two satellite genera, viz. *Pilatoporus* and *Rhodofomes*, from *Fomitopsis* in the broader sense (Kotlaba & Pouzar, 1990). Recently, incited by criticism of our concept by some specialists (e.g. Ryvarden, 1991; Ryvarden & Gilbertson, 1993), we returned to the problem on the grounds of our study of some freshly collected specimens as well as rich herbarium material.

RESULTS

The genus Fomitopsis sensu stricto

The type species of this generic name is *Fomitopsis pinicola* (Sw.: Fr.) P. Karst. This polypore has moderately thick-walled spores, which is never the case in other species of *Fomitopsis* sensu lato. The study of this character, however, is connected with the problem that *F. pinicola* produces spores only in short periods during spring and summer (see e.g. Orłoś, 1958), remaining sterile for the rest of the year; some carpophores bear a heavy spore print on the pileal surface up to the autumn.

The majority of spores, especially those from the spore deposit, are provided with a distinctly thickened wall (see e.g. Keller, 1974, tab. 14, fig. 10; Keller, 1977, tab. 201). Among these thick-walled spores, spores with a definitely thin wall (especially in the hymenium) can also be found. We are unable to explain the cause of the presence of these thin-walled spores, often intermixed with the thick-walled ones, especially in the hymenium (not fully developed spores?). Nevertheless, we think that this small amount of thin-walled spores should not be considered as important for the delimitation of genera in polypores. We consider the thickness of the spore wall in the majority of spores to be a taxonomic character of high generic value.

This character, in combination with other characters, plays an important role e. g. in the

delimition of the genus *Spongipellis* Pat. as is generally accepted. For the above reasons, we delimit the genus *Fomitopsis* P. Karst. on the basis of the thick-walled spores (together with other characters).

In our system of polypores proposed forty one years ago (Kotlaba & Pouzar, 1957), we did not take into acount the thickness of spore walls in this group of polypores. Furthermore, one of us (Pouzar, 1966) erroneously defined the genus *Fomitopsis* as having thin-walled spores. Later, when we studied this problem again (Kotlaba & Pouzar, 1990), we could definitely confirm the presence of thick-walled spores in *Fomitopsis pinicola*. We therefore re-considered their importance in the generic classification.

In 1957, we also considered the hyphal system of *Fomitopsis* to be dimitic on the basis of Teston's (1953) findings. Studying later the hyphal system of *F. pinicola*, we definitely found that it is in fact trimitic (see already Pouzar, 1966) but the binding hyphae should be looked for in the oldest part of the context, close to the wood.

An additional character besides the thick-walled spores of *Fomitopsis* in a narrow sense is the presence of a resinous substance on the pileal surface and presence of clamp connections on thin-walled generative hyphae (no clamps on hyphae with a thickened wall).

The genera Rhodofomes and Pilatoporus

The genus *Rhodofomes* Kotl. & Pouzar is characterized by thin-walled spores, presence of clamps on thin-walled generative hyphae, the rose colour of the carpophore context and absence of a resinous crust on the pileal surface. The type species of the generic name *Rhodofomes* is *Rhodofomes roseus* (Alb. et Schwein.: Fr.) Kotl. & Pouzar. We do not include *Fomitopsis cajanderi* (P. Karst.) Kotl. et Pouzar in *Rhodofomes* because of the different biological activity of this species - a problem, already discussed by Donk (1974).

On the other hand, the genus *Pilatoporus* Kotl. & Pouzar is somewhat more distant from the genera of this group of polypores. It has a trimitic hyphal system and hyaline hyphae in common with the genera *Fomitopsis* sensu stricto and *Rhodofomes*. Otherwise it is substantially different. As recently pointed out by Vampola (1996), a highly characteristic feature of *Pilatoporus* is the presence of pseudoskeletal hyphae provided with conspicuous clamp connections. This feature has also been confirmed by our present study. The type species of the generic name *Pilatoporus* is *Pilatoporus palustris* (Berk. & Curt.) Kotl. & Pouzar.

Five years ago (Kotlaba & Pouzar, 1993), we described *Pilatoporus maroccanus* Kotl. & Pouzar from Morocco. This polypore was identified by Vampola (1996) and then by Bernicchia & Ryvarden (1996) as *Trametes suaveolens* (Fr.) Fr. On the other hand, Blanco, Checa & Moreno (1997) compare *Pilatoporus maroccanus* with *Trametes junipericola* Manjón, Moreno & Ryvarden growing on *Juniperus thurifera*. These authors found *Pilatoporus maroccanus* to have some characters (size of spores, colour of pores etc.) in common with *Trametes junipericola*. It therefore remains e.g. to be studied thoroughly whether *Trametes junipericola* has pseudoskeletal hyphae or not.

We re-studied the type material of *Pilatoporus maroccanus* and can confirm that this polypore is really very distant from other species of the genus *Pilatoporus* but is truly close to *Trametes suaveolens*, and belongs in fact to the genus *Trametes*. *Pilatoporus maroccanus* grows, however, on living cypress (*Cupressus sempervirens*) and has somewhat smaller spores: 7,0-9, 3 x 2,5-3,5 µm, contrary to 8,5-11,7 x 3,5-4,5 µm in *Trametes suaveolens* (according to our present measurements). The identity of *Pilatoporus maroccanus* can be resolved by a more detailed study of the spore size variability of this species as well as of *Trametes suaveolens*.

The genus Laricifomes

This polypore genus was described forty one years ago (Kotlaba & Pouzar, 1957) but the main character recently observed (see Gilbertson & Ryvarden, 1986), i.e. inflated, strongly thick-walled hyphal segments ("sclerids"), was not mentioned by us at that time. Further important characters of *Laricifomes* Kotl. & Pouzar are a trimitic hyphal system with hyaline hyphae, presence of clamp connections solely on thin-walled generative hyphae, white chalky context, crumbly consistency, styptic properties and pileal surface without a resinose substance. All these characters, especially the pres-

ence of "sclerids", fully justify the separation of *Laricifomes* from *Fomitopsis*. It is interesting to note that Teixeira (1958) fully accepted the genus *Laricifomes* but later (Teixeira, 1994) rejected it.

Donk (1974) supported the transfer of *Fomitopsis officinalis* (Vill.: Fr.) Bondartsev & Singer to a genus of its own but under another generic name, viz. *Agaricum* "/Mich./ Maratti". However, as correctly pointed out by Ryvarden (1991), the present Code does not allow the application of this name - now *Agaricon* Adams. 1763 - as it is, in fact, an orthographic variant of the conserved name *Agaricus* L. 1753 (Agaricaceae) so that *Agaricon* is really a homonym of *Agaricus*.

From the biological point of view, it is interesting that *Laricifomes*, *Pilatoporus* and *Rhodofomes* species produce spores during the whole vegetation period, not periodically as in the species of the genera *Fomitopsis* and *Heterobasidion* (the latter formerly referred by some authors to the genus *Fomitopsis*, although it is dimitic and has verruculose spores).

The genus *Fomes* Fr. (in a strongly restricted sense) shows perhaps certain similarities with genera from the *Fomitopsis* group but differs in having amyloid hyphal elements in the younger parts of the pileal surface - a character which is completely missing in all the above-mentioned genera of the *Fomitopsis* group; another important character of *Fomes* is that it has strongly thick-walled spores.

Key to the genera of the group of polypores discussed

1a Hyphal elements with a strongly amyloid wall present in younger parts of the pileal surface ..... *Fomes*
1b No amyloid elements present in the pileal surface 2
2a Pseudoskeletal generative thick-walled hyphae with remarkable clamps present in the context ..... *Pilatoporus*
2b Clamps present only on thin-walled generative hyphae 3
3a Inflated, strongly thick-walled hyphal segments present in context ..... *Laricifomes*
3b No inflated thick-walled hyphal segments present in context 4
4a All spores thin-walled, context of carpophore rosaceous ..... *Rhodofomes*
4b The majority of spores apparently thick-walled, context cream to pale woody coloured ..... *Fomitopsis*

We are fully aware that tropical and subtropical species of polypores are not considered in our application of the narrower genera of the *Fomitopsis* group but, as pointed out by J. Eriksson (1950, p. 7), in the taxonomy of a difficult group we should start with a more simplified situation, correcting later the system by confronting it with a more complex set, both on species and generic level.

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Pseudotomentella ochracea sp. nov., based on morphological and molecular data

Urmas Kõljalg[1] and Ellen Larsson[2]
[1]Institute of Zoology and Botany, Estonian Agricultural University, 181 Riia St., EE-51014 Tartu, Estonia.
[2]Botanical Institute, University of Göteborg, Box 461, S-40530 Göteborg, Sweden.

Abstract. *Pseudotomentella ochracea sp. nov.* is described and illustrated. The phylogenetic placement of *P. ochracea* within the Thelephorales is shown and its relationships with other taxa discussed.

INTRODUCTION

In 1908 Patouillard described *Tomentella aurantiaca* Pat. from Guadeloupe and the holotype is still the only known specimen of that taxon. In the autumn 1997 one of us (E. Larsson) collected in Eno River State Park (North Carolina, USA) a tomentelloid specimen which is strikingly similar to *T. aurantiaca* in its morphology. The spores, however, are distinctly different: *T. aurantiaca* has lobed spores, whilst our new taxon, *Pseudotomentella ochracea*, has slightly globose spores. According to the phylogenetic and distance analyses of molecular data our specimen should be included in *Pseudotomentella*. This is also supported by the colour and ornamentation of its spores as well as by its pelliculose fruitbody.

MATERIAL AND METHODS

For light microscopic studies, samples were mounted in 3% potassium hydroxide (KOH). For all measurements, pictures of the samples were transferred to the computer using Sony CCD Video Camera attached to a Nikon Labophot 2 microscope and analysed by Global Lab Image (Data Translation Inc.) software. Drawings were made using a Nikon drawing tube attached to the Nikon Labophot 2 microscope at magnifications x1250 and x750. The colour name follows Rayner (1970), and colour indices follow the Munsell (1976) colour system. For the protocol of a taxon description compilation in DELTA format see Kõljalg (1996).

DNA was extracted with a modified 2% CTAB method (Savolainen et al., 1995) and after isolation purified with GeneClean kit (Bio 101 Inc.). PCR amplification was performed for 5' end of nuclear large subunit (nucLSU) rDNA, using primers LR0R and LR7 (http://www.botany.duke.edu/fungi/mycolab/primers.htm). PCR conditions followed Gardes and Bruns (1993). Presence of fragments was checked on a 0.6% SeaGem agarose gel (FMC) and amplified products were purified with QIAquick kit (Qiagen Inc.) according to the manufacturer's instructions. Direct DNA sequencing was performed on an ALFexpress (Pharmacia Biotech) automated sequencher. Thermo Sequenase fluorescent labelled primer cycle sequencing kit (Amersham Int.) and primers LR3R, LR5, LR21, (http://www.botany.duke.edu/fungi/mycolab/primers.htm) and CTB6 (http://plantbio.berkeley.edu/'bruns/primers.html) for 5' end of nucLSU rDNA were used for cycle sequencing. Sequences were edited with Sequencher (GeneCodes Inc.) for the Macintosh OS and aligned by hand. Phylogenetic and distance analyses were performed using test version 4.0d64 of PAUP*, written by David L. Swofford. The calculations were conducted as follows: 1) 39 species of Thelephorales were included into parsimony analysis (heuristic search, addition sequence random, 1000 replications, tree bisection-reconnection (TBR) swapping and MULPARS ON option) and distance analysis (neighbour joining, Jukes-Cantor substitution model) analyses; 2) 16 species from previous analyses representing major monophyletic groups (including all sequenced *Pseudotomentella* species) were selected to run maximum likelihood (estimating nucleotide frequencies and transition/transversion ratio, molecular clock not enforced) analysis.

RESULTS: PHYLOGENETIC AND DISTANCE ANALYSES

Parsimony analysis gave two most parsimonious trees. Strict consensus (not shown here) is well resolved and all *Pseudotomentella* species except *P. tristis* (P. Karst.) M. J. Larsen form a good monophyletic group. The same group is also supported by neighbour joining and maximum likelihood analyses (Fig. 2.).

TAXONOMY

Pseudotomentella ochracea Kõljalg & E. Larsson, sp. nov. (Fig. 1.)

Carposomata effusa, separabilia. Hymenophorum ochraceum, laevis. Rhizomorphae adsens. Hyphae subiculi septato-nodosae, 3-5.5 µm latae, tenuiter tunicatae, hyalinae in solutione KOH. Hyphae subhymenii septato-nodosae, 3-5.5 µm latae, tenuiter tunicatae, hyalinae in solutione KOH. Cystidia nulla. Basidia 30-45 x 5-7 µm, utriformia, flexuosa, hyalina in solutione KOH, 4 sterigmatibus. Sporae 4.6-5.6 µm, globosae, echinulatae, hyalinae vel luteo-fuscae in solutione KOH.

Holotype: U.S.A., North Carolina, Orange Co, Eno River State Park, on dead wood. 2 November 1997. Leg. E. Larsson, EL99-97 (GB).

GeneBank Accession No: AF092847

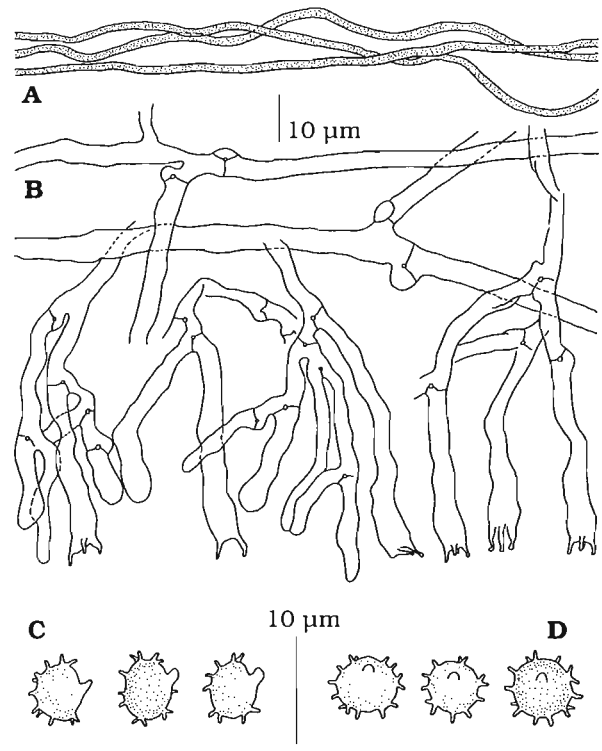

Fig. 1. *Pseudotomentella ochracea* (holotype in GB). – A: Skeletal hyphae from a dimitic hyphal cord. – B: Section through basidiocarp. – C: Basidiospores in lateral face. – D: Basidiospores in frontal face.

Basidiocarp resupinate, separable from the substratum, pelliculose, continuous. *Hymenophore* near Ochreous (7.5 YR 6/8) when dry, smooth, concolorous with subiculum. Sterile margin indeterminate.
Hyphal cords present in subiculum and margins, dimitic, pale to dark brown in 3% KOH, individual hyphae simple-septate, clamped and skeletal, simple-septate and clamped hyphae 3-10 µm diam, hyaline in 3% KOH, skeletal hyphae 1.5-2.5 µm diam, thick-walled, hyaline to yellowish in 3% KOH. *Subicular hyphae* clamped, 3-5.5 µm diam, thin-walled, without encrustation, hyaline or yellowish in 3% KOH. *Subhymenial hyphae* clamped, 3-5.5 µm diam, thin-walled, hyaline or yellowish in 3% KOH. *Cystidia* absent.
Basidia 30-45 µm long and 5-7 µm diam at apex, clamped at base, utriform or slightly clavate, not stalked, mainly sinuous, without transverse septa, hyaline in 3% KOH, 4 sterigmata.
Basidiospores 4.6-5.6 µm long in frontal and lateral face (mean value 5.10 µm, n=30), slightly globose frontal and ellipsoid lateral face, bi- or trifurcate, hyaline or sometimes yellowish in 3% KOH. *Chlamydospores* absent.

DISCUSSION

According to the morphology, the closest species to *Pseudotomentella ochracea* is probably *Tomentella aurantiaca*. As noted before, *T. aurantiaca* has strongly lobed bi- and trifurcate spores, while the spores of *P. ochracea* are globose with bi- and trifurcate ornamentation.

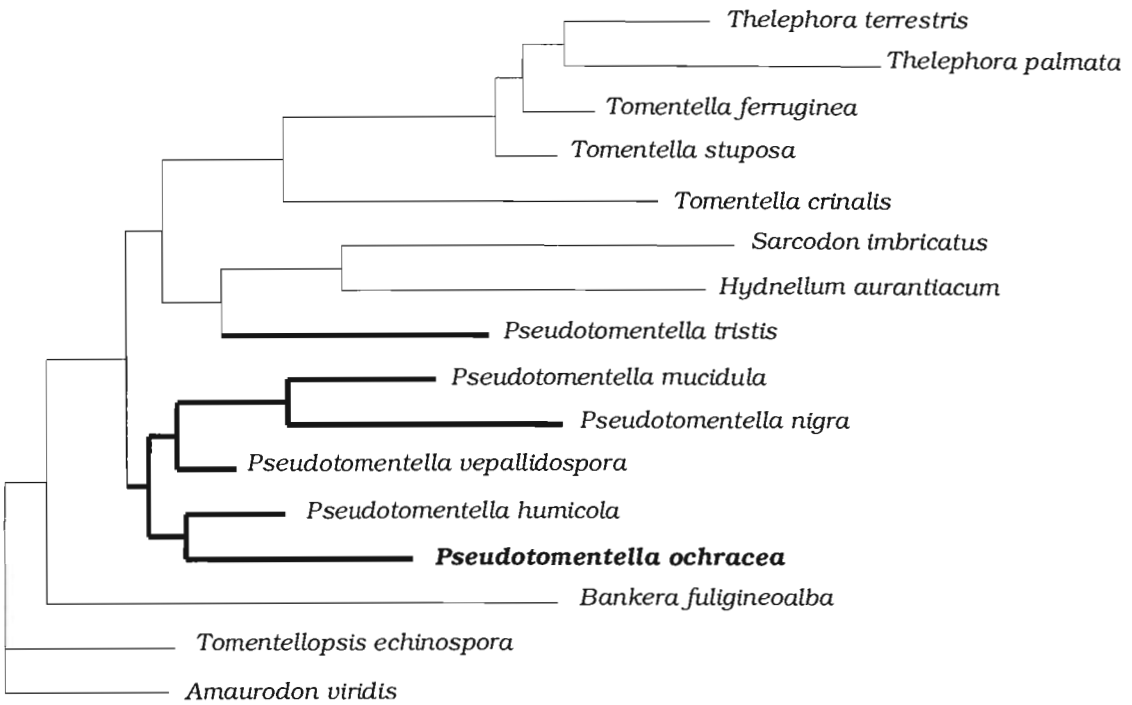

Fig. 2. Maximum likelihoood tree demonstrating placement of *Pseudotomentella ochracea* among Thelephorales (–Ln likelihood = 4650.43705)

Otherwise these two species are almost entirely similar: hyphae as well as basidia are similar in size, colour and shape; the hymenophore is ferruginous brown. Larsen (1974) hypothesized that *T. aurantiaca*, together with *Tomentella atrocyanea* Wakef. (=*Amaurodon atrocyaneus*), might be closely related to *Pseudotomentella* species. The pelliculose fruitbody and spore ornamentation of *T. aurantiaca* support this idea as well as its similarity with *P. ochracea*. Stalpers (1993) argued that *Tylospora* should be placed in the Thelephorales and mentioned that "... *Tomentella aurantiaca* seems to be a coloured equivalent of *Tylospora fibrillosa* ...". Preliminary molecular analyses show that *Tylospora* is not closely related to the Thelephorales (unpublished data) and the morphology of *Tomentella aurantiaca* is in fact different from *Tylospora* species. It is remaining unclear if *T. aurantiaca* should be placed in *Pseudotomentella*. More specimens and molecular data are needed to solve this question.

Phylogenetic and distance trees derived from molecular data (nucLSU rDNA) support the placement of our specimen in *Pseudotomentella*. The clade with five *Pseudotomentella* species (Fig. 2.) was monophyletic in all analyses. *P. tristis* was only species which in most cases was placed in the clade containing *Sarcodon*, *Hydnellum* and *Boletopsis* species. *Pseudotomentella tristis* could be closely related with *Sarcodon* and *Hydnellum* species since they all have brown spores. In contrast, other *Pseudotomentella* species shown on Fig. 2. have hyaline to slightly yellowish spores.

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Evolution of *Hyphodontia* (Corticiaceae, Basidiomycetes) and related Aphyllophorales inferred from ribosomal DNA sequences

Ewald Langer
Eberhard-Karls Universität Tübingen, Lehrstuhl Spezielle Botanik/Mykologie, Auf der Morgenstelle 1, D-72076 Tübingen, Germany. E-mail: ewald.langer@uni-tuebingen.de

Abstract: The genus concept of *Hyphodontia* and *Schizopora* was reevaluated combining ribosomal DNA sequences and morphological characters. The position of the genera *Hyphodontia* and *Schizopora* within the system of Basidiomycetes has been assessed by sequence data obtained from mitochondrial small subunit rDNA (mtSSU). A parsimony analysis of molecular data of the mtSSU region did not confirm monophyly of *Hyphodontia*, but clearly supports that *Schizopora* species are within a clade together with other *Hyphodontia* species. There is strong evidence that *Trichaptum*, *Basidioradulum* and species of the Hymenochaetales form a evolutionary lineage together with *Hyphodontia* and *Schizopora*.

INTRODUCTION

The corticioid genus *Hyphodontia* was described by John Eriksson in 1958 from a group of species previously referred to *Corticium* Fr., *Peniophora* Cooke, *Odontia* Fr. and *Radulum* Fr. (J. Eriksson, 1958). *Hyphodontia* was delimited in the original description from *Hyphoderma* Wallr. em. Donk by having smaller basidia, fibrous basidiocarps and more narrow hyphae. Together with cellular illustrations of the entire micromorphology of the basidiocarps this description was very convincing for a delimitation against *Hyphoderma*.

The generic concept founded by the selection of species by J. Eriksson (1958) was a wide one right from the beginning. It comprised resupinate species with smooth to odontioid basidiocarps. Micromorphological characteres with the typical suburniform basidia, fibrous hyphae with a characteristic pattern of hyphal branching, a variety of cystidial types, different spore shapes with thin-walled and thick-walled spores. Parmasto (1968) enlarged this concept by combining *H. spathulata* (Schrad.: Fr.) Parmasto with odontioid to irpicoid basidiocarps showing the typical features of hyphodontioid micromorphology. Hjortstam and Ryvarden (1986) introduced the first poroid species in the genus by combining *H. apacheriensis* (Gilb. & Canf.) Hjortstam & Ryvarden. Consecutively the list of irpicoid or poroid species in the genus *Hyphodontia* grew considerably by introducing *H. niemelaei* Wu (Wu, 1990), *H. latitans* (Bourd. & Galz.) E. Langer and *H. nothofagi* (G.H. Cunn.) E. Langer (E. Langer 1994).

Many authors accepted *Hyphodontia*, e.g. E. Parmasto (1968), Eriksson & Ryvarden (1976), Telleria (1980), Hassan (1981), Boidin (1988), Gilbertson & Blackwell (1988), Wu (1990), Boidin (1991), E. Langer (1994) or Telleria (1995). As a consequence of the wide use of *Hyphodontia* it was conserved against the older names *Grandinia* Fr., *Lyomyces* P. Karst., *Kneiffiella* P. Karst. and *Chaetoporellus* Bondartsev & Singer (Gams, 1993). Another clearly delimiting character against *Hyphoderma* was found by E. Langer & Oberwinkler (1993). *Hyphodontia* species have dolipores with continuous parenthesomes whereas *Hyphoderma* species have dolipores with perforated parenthesomes. E. Langer (1994) monographed all hitherto validly described species on worldwide scope including the genera *Schizopora* Velen. and *Echinoporia* Ryvarden comprizing species with resupinate, effused-reflexed and pileate basidiocarps. *Schizopora* and *Echinoporia* have been found to be closely related to *Hyphodontia*. Drepanocysts and malocysts (Hassan & David, 1983) are unique characters occuring on hyphae in pure culture of all hitherto investigated species of *Hyphodontia* and *Schizopora* (Nakasone, 1990; E. Langer, 1994).

The number of Hymenomycetes showing dolipores with continuous parenthesomes included in analyses using mtSSU and nucSSU rDNA data was not very high hitherto (Hibbett

& Donoghue,1995; Swann & Taylor, 1995; Hibbett et al., 1997). Results of those analyses were non-uniform in the way that clades had weak bootstrap values or tree topologies were different. The general phylogeny of major clades within the Hymenomycetes remained unclear.

MATERIAL AND METHODS

DNA was extracted from small patches of mycelium grown on malt yeast peptone agar medium in petri dishes after Bandoni (1972), modified by G. Langer (1994). DNA was extracted using the method of Singer-Sam et al. (1989). The mycelium was incubated in a mixture of 500 µl ultrapure water with 5% Chelex® 100 (BIO-RAD) at 65 °C for 1 hour followed by an additional incubation at 90 °C for 1 min. After centrifugation at 13.000 rpm an aliquot of 25 µl was used for PCR.

Standard PCR used primers as described by White et al. (1990). Indentity of PCR products was controlled using 1.5% agarose gels. PCR products were cleaned from the PCR mix using QIAquick spin collumns (QIAGen) following the producers manual. DNA was precipitated with 3 volumes of ethanol for 1-24 hours at -20°C followed by 15 min. centrifugation at 4°C. The pellet was washed with 70% ethanol and dryed for about 30 min at room temperature. Then resolved in 30 µl of ultrapure water. Cycle sequencing was carried out with primers MS1/2 for mtSSU DNA. Cycle sequencing followed protocols published by T. M. Pohl & E. Maier (1995) when using a Direct Blotting Electrophoresis device with a 4% PAA gel. Blotted DNA on nylon membrane was visualized following a protocol given in Kessler (1992). Moreover a ABI 377 automatic sequencer was used following the protocols given by the manufacturer.

11 mtSSU rDNA sequences have been deposited in GenBank accession numbers AF069630 (*Tulasnella eichleriana*), AF069631 (*Botryobasidium subcoronatum*), AF069632 (*Basidioradulum radula*), AF069640 (*Hyphodontia alutaria*), AF069633 (*Hyphodontia barba-jovis*), AF069634 (*Hyphodontia aff. sambuci*), AF069635 (*Hyphodontia sambuci*), AF069636 (*Schizopora radula*), AF069637 (*Daedaleopsis confragosa*), AF069638 (*Schizophyllum commune*) and AF069639 (*Phanerochaete sp.*),.

16 mtSSU rDNA sequences have been retrieved from GenBank, accessions numbers AF026642 (*Dacrymyces chrysosporus*), AF026649 (*Phebia radiata*), AF026652 (*Botryobasidium isabellinum*), AF026654 (*Schizopora paradoxa*), AF026656 (*Agaricus bisporus*), AF026670 (*Thelephora* sp.), AF026673 (*Amanita muscaria*), M91009 (*Boletus satanas*), U27022 (*Auricularia auricula-judae*), (*Fomitopsis pinicola*), U27044 (*Inonotus hispidus*), U27061 (*Phellinus igniarius*), U27063 (*Peniophora nuda*), U27074 (*Russula compacta*), U27076 (*Stereum hirsutum*), U27078 (*Trichaptum abietinum*).

Sequences were aligned using CLUSTAL V (Higgins et al., 1992) with manual adjustment. PAUP 3.1.1. (Swofford, 1991) was used to calculate parsimony analysis for a data matrix containing 1307 characters with 399 informative sites. Settings described by Hibbett et al. (1997) have been used to calculate trees. Additionally a bootstrapping with 100 replicates was used to test robustness of trees.

Micromorphology was studied with a ZEISS Standard Lab 16 and Axioplan 2 light microscope using phase optics. For analizing hyphal texture Phloxin b (3%) was used as stain after application of potassium hydroxide (5 %).

RESULTS AND DISCUSSION

Species of *Hyphodontia* are divided in 5 groups according to the morphology of their cystidial types. 2 main groups within the genus are distinguishable by two totally different types of cystidia. One group having only thin- or thick-walled tramal cystidia never produced within the hymenium (e.g. *H. barba-jovis* (Bull.: Fr.) J. Erikss., *H. curvispora* J. Erikss. & Ryvarden). The other group is characterized by the general ability to produce hymenial cystidia of different kinds (e.g. *H. crustosa* (Pers.: Fr.) J. Erikss., *H. alutaria* (Burt) J. Erikss., *H. halonata* J. Erikss. & Hjortstam, *H. sambuci* (Pers.) J. Erikss.). Species with tramal cystidia never produce hymenial cystidia and the other way round. Within the species-group producing only hymenial cystidia, three subgroups are separable by cystidial type.

Grouping according to cystidial types within the genus *Hyphodontia*:

1. tramacystidia (e.g. *H. barba-jovis*)

2. hymenial cystidia and capitate cystidia (e.g. *H. sambuci*)
   a. subulate cystdia (e.g. *H. crustosa*)
   b. lagenocystidia (e.g. *H. alutaria*)
   c. moniliform cystidia (e.g. *H. halonata*).

The delimitation of *Hyphodontia* and *Schizopora* is well founded when considering the hymenial surface: smooth to odontioid in *Hyphodontia* versus irpicoid to poroid in *Schizopora*. But micromorphology of those genera, with the same types of basidia, cystidia, spores and hyphal branching, makes a sound delimitation impossible. Even the hymenial surface is not a good character for delimitation: *Sch. paradoxa* (Fr.) Donk and *Sch. radula* (Pers.: Fr.) Hallenb. have resupinate and odontioid, irpicoid or poroid basidiocarps whereas *Sch. cystidiata* David & Rajchenberg and *Sch. flavipora* (Cke.) Ryvarden have effused-reflexed to pileate and poroid basidiocarps. Species of the tropical genus *Echinoporia* have also effused-reflexed to pileate basidiocarps but are distinguished clearly by their conidia producing denticles.

A parsimony analysis using morphological characters (Langer, 1994) resulted in monophyly of a group uniting species of *Hyphodontia*, *Schizopora* and *Echinoporia*. An analysis of molecular data of the mtSSU rDNA region (Fig. 1) did not confirm monophyly of *Hyphodontia*, but clearly supported that *Schizopora* species are within a common clade with other *Hyphodontia* species. The results also give strong evidence (100% bootstrap) that members of the Hymenochaetales, together with *Basidioradulum* radula (Fr.) Nobles and *Trichaptum abietinum* (Pers.: Fr.) Ryvarden, evolved as sistergroup to the *Hyphodontia* lineage. Nevertheless *H. alutaria*, as a sistergroup of the Hymenochaetales/*Hyphodontia* clade, is not reliably supportet by bootstrap (55%). In earlier analyses (Hibbett & Donoghue, 1995; Hibbett et al., 1997; Ko et al., 1997) corresponding tree topologies have been found for Hymenochaetales, but not supported by bootstrap. When considering ultrastructural data of the dolipore parenthesomes, it is obvious that all members of the Hymenochaetales/*Hyphodontia* clade have dolipores with continuous parenthesomes (Traquair & McKeen, 1978; Oberwinkler, 1985; E. Langer & Oberwinkler, 1993).

The evolution of *Hyphodontia* species with different cystidial types corresponds to the interpretation of E. Langer (1994) in that species with tramal cystidia (*H. barba-jovis*) are a sister group to species with hymenial cystidia (*H. sambuci, Sch. paradoxa, Sch. radula*). The doubtful position of *H. alutaria* as sistergroup of the Hymenochaetales/*Hyphodontia* clade could be understood when considering its unique cystidial type, called lagenocystidium (see E. Langer, 1994; Fig. 20).

A *Tulasnella* species has been involved for the first time into a DNA analysis of Basidiomycetes this time. The question if *Botryobasidium* species have been evolved cosely to heterobasidioid Basidiomycetes as suggested by G. Langer (1994) has been confirmed with high bootstrap (95%). *Botryobasidium subcoronatum* (v. Höhn. & Litsch) Donk with smooth spores and *B. isabellinum* (Fr.) Rogers with spiny spores are a sistergroup (100% bootstrap) to *Tulasnella eichleriana* Bres., a Heterobasidiomycete with special basidial morphology and capacity of producing secondary spores.

A basal position in evolution of Hymenomycetes play *Auricularia* Bull. and *Dacrymyces* Nees as confirmed also by other analyses (Hibbett & Donoghue, 1995; Swann & Taylor, 1995; Hibbett et al., 1997).

For the reason of comparability a representative number of different corticioid, polyporoid and agaricoid Hymenomycetes was included in the present analysis. The resulted topology coresponds to that found by Hibbett et al. (1997) uniting an euagarics clade with 85% bootstrap as sister group to a clade containing *Thelephora* sp. and *Boletus satanas* Lenz. Other lineages comprising Polypores and russuloid Basidiomycetes are not supported by this bootstrap. Although not supported by bootstrap, all additionally included taxa of different corticioid, polyporoid and agaricoid Hymenomycetes come out as sister group of the Hymenocheatales/*Hyphodontia* clade. The dolipore parenthesomes of that group are not known completely but many of them show dolipores with perforated parenthesomes, e.g. *Amanita muscaria* (L.: Fr.) Hooker, *Schizophyllum commune* Fr.: Fr., *Agaricus bisporus* (Lge.) Singer, *Thelephora* ssp., *Phanerochaete* ssp., *Russula* ssp. (Thielke, 1972; Jersild et al., 1967; G. Langer, 1994; pers. comm.)

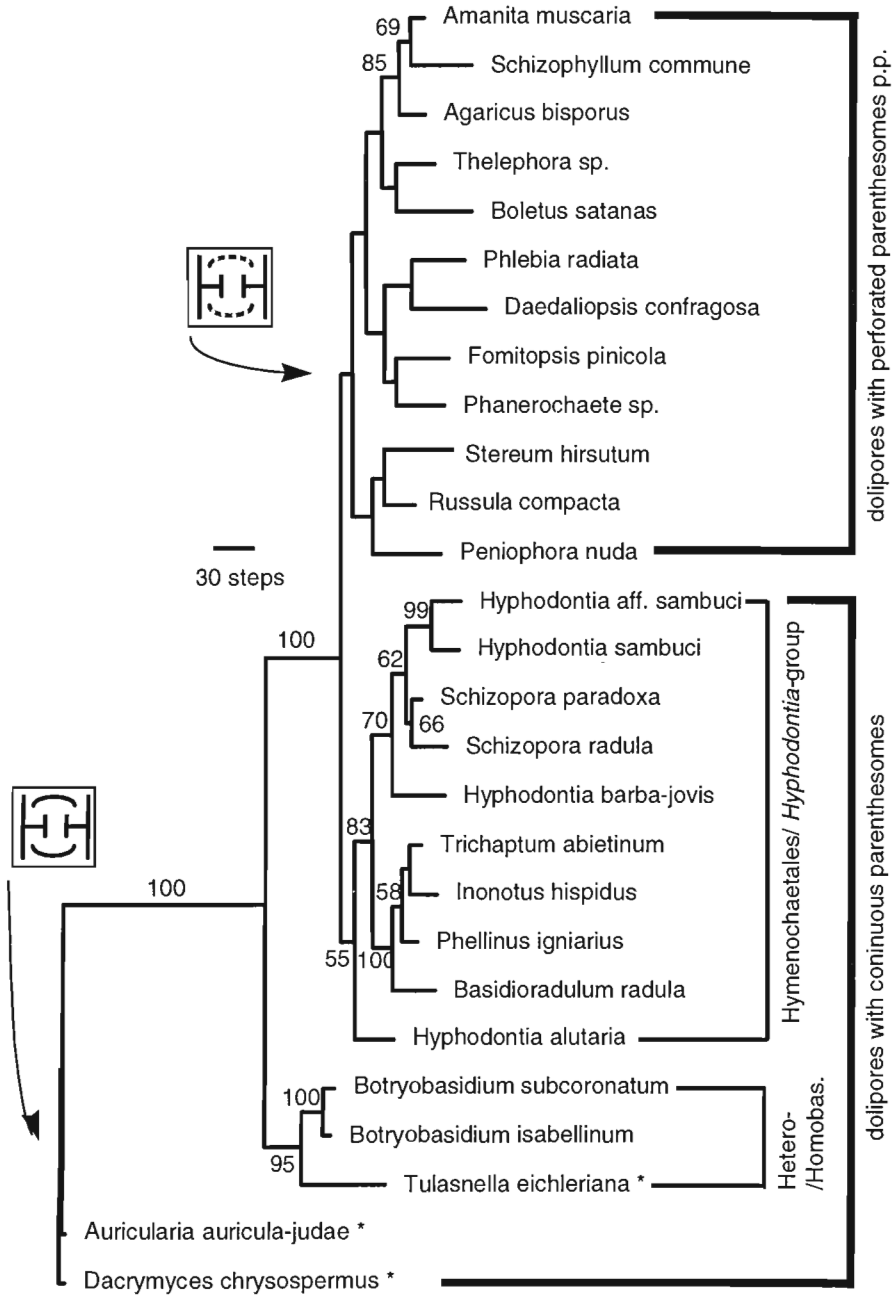

Fig. 1. Phylogeny of *Hyphodontia*, relied Aphyllophorales and other Homobasidiomycetes inferred from mtSSU data. Bootstrap tree calculated from 100 replicates using simple taxon addition sequence with MULPARS on. Tree length 1344, CI 0.557, RI 0.576, 399 informative characters. Only bootstrap frequencies > 50% shown. Species with asterisk are Heterobasidiomycetes. Status of dolipore types shown by symbols.

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Haplotrichum parmastii sp. nov. collected in Costa Rica

Gitta Langer and Ewald Langer
Universität Tübingen, Spezielle Botanik u. Mykologie, Auf der Morgenstelle 1, D-72076 Tübingen, Germany, E-mail: ewald.langer@uni-tuebingen.de

Abstract: The morphology of *Haplotrichum parmastii* sp. nov., an anamorph of a probably unknown *Botryobasidium* species collected in Costa Rica, is illustrated, described, and discussed. Keys for selected *Haplotrichum* species are provided, detected as anamorphs of *Botryobasidium*, as well as for *Haplotrichum* subsection *Ramosa*.

INTRODUCTION

The deuteromycete genus *Haplotrichum* Link (lignicolous Hyphomycetes) comprises several species which are known as anamorphs of *Botryobasidium* Donk emend. G. Langer (Corticiaceae, Basidiomycetes). These conidial stages were formerly placed in *Oidium* Link by Linder (1942), but since the 12th International Botanical Congress the latter taxon is conserved for Erysiphales and their anamorphs (Weresub, 1973). The taxonomy of *Haplotrichum* (lignicolous Hyphomycetes) was interpreted and subdivided by Holubová-Jechová (1980) using micromorphological characters. A detailed morhological study of *Haplotrichum* species detected as *Botryobasidium* anamorphs was done by G. Langer (1994). The anamorph stages of *Botryobasidium* are often appearing independently from their teleomorphs. The conidial stages may be adapted to different weather conditions and are in some cases more common than the basidiocarps. Therefore, some anamorphs had been described long before their teleomorphs were known, e.g. *Botryobasidium candicans* John Eriksson 1958 with its anamorph first described in 1809 as *Acladium capitatum* Link. *Haplotrichum capitatum* ([Link] Pers.) Link is the type species of *Haplotrichum* Link 1924 usually abbreviated as *H. capitatum* (Pers.) Link. The latter taxon has priority over the earlier name *Acladium* [Link] Pers. 1822 (Holubová-Jechová, 1975).

MATERIAL AND METHODS

Specimens were examined from fresh and herbarium material with a ZEISS Standard Lab 16 light microscope using phase optics. For analizing hyphal texture Phloxin b or Cotton blue was used as stain after application of potassium hydroxide (5 %).

For transmission electron microscopy samples were prefixed in 2% glutaraldehyde in 0,1 M sodium cacodylate buffer (pH 7,2) during several days; following six transfers in 0,1 M sodium cacodylate buffer (pH 7,2); fixation with 1% OsO_4 in 0,1 M sodium cacodylate buffer (pH 7,2) for 2 hours in the dark; six transfers in distilled water 10 min. each; staining in 1% uranyl acetate solution for 1 hour in the dark; dehydration in 10%, 25%, 50%, 75%, 85%, 95% and 3 times in 100% acetone 10 min. each. The material was flat embedded in Spurr's plastic (Spurr, 1969). Series of sections (75-100 nm) were cut on a Reichert ultramicrotome using a diamond knife. The sections were mounted on Formvar coated single slot copper grids and stained with lead citrate after Reynolds (1963). The ultrathin sections were examined with a Zeiss EM 109 electron microscope at 80 kV.

DESCRIPTION

Haplotrichum parmastii G. Langer sp. nov.

Coloniae albidae ad griseae, hyphae rectangulae ramosae, sine fibulis, hyalinae, tenuitunicatae vel leviter crassitunicatae. Conidiophora 5-6 µm in diametro, erecta et ramosa, leviter crassitunicata, saepe anastomosans, hyalina. Conidia singularia vel in catenae dentibus condiogenes efferentes. Cellae conidiogenes ex parte vesiculatae. Conidia ellipsoidea, 11-13 x 7.5-9 µm, leviter crassitunicata, minutissime ornata, hyalina vel leviter lutea, inamyloidea. Septa hypharum doliporis parentisomatibus continuis perforata. Holotypus in ligno putrido

crescit, Costa Rica, prope San Jeronimo, Bajola Hondura. Holotypus in herbario K.

Holotypus: GEL 1577, Costa Rica, San Jeronimo, street North of San Jeronimo ca. 2 km in direction to Bajola Hondura, ca. 1440-1500 m alt., leg. G. & E. Langer, 10.II.1989, deposited in K.

Isotypi: GEL 1577 in Herbarium G. & E. Langer, deposited in GB and CR.

Paratypus: GEL 1608, Costa Rica, Orosi, Orosi-valley, Rio macho, secondary forest at a bridge spanning the Rio Macho, ca. 1140 m alt., leg. G. & E. Langer, 10.II.1989, deposited in K, CR and Herbarium G. & E. Langer.

Etymology: "parmastii" in honor to Erast Parmasto, dedicated for his 70th birthday on 23.X.1998.

Colonies: first single, downy white to pale gray, confluent when old, 500-1000 µm thick; growing on heavily decayed and white-rotted wood. There are no basidia, basidiospores nor cystidia found in the examined specimens. Hyphae and conidia staining very deep in cotton blue.

Conidiophores: 5-6 µm in diam., without clamps, erect, branched, slightly thick-walled, cell walls up to 0.5 µm, hyaline smooth in light microscopy (Figs. 1-2), slightly rough ornamented in TEM and REM (Figs. 4-5). Up to three apical cells are conidiogenous.

Conidiogenous cells: with prominent conidiogenous teeth, slightly thick-walled, some vesiculate, producing single conidia or conidia in acropetal chains (Figs. 1-4).

Conidiogenous teeth: cone-like, 1 x 2 µm.

Conidia: ellipsoid, 11-13 x 7.5-9 µm, slightly thick-walled, cell walls up to 0.5 µm, rough ornamented, hyaline to slightly yellowish, inamyloid, with 1 or a few distinct papilla (Figs. 3-5).

Septal pores: dolipores with continuous parenthesomes (Fig. 5)

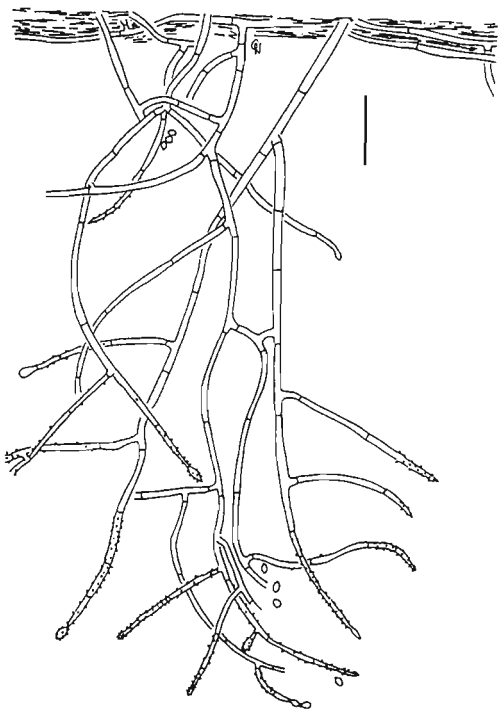

Fig. 1. *Haplotrichum parmastii*, GEL 1577, Holotype, conidiophores, bar = 60 µm.

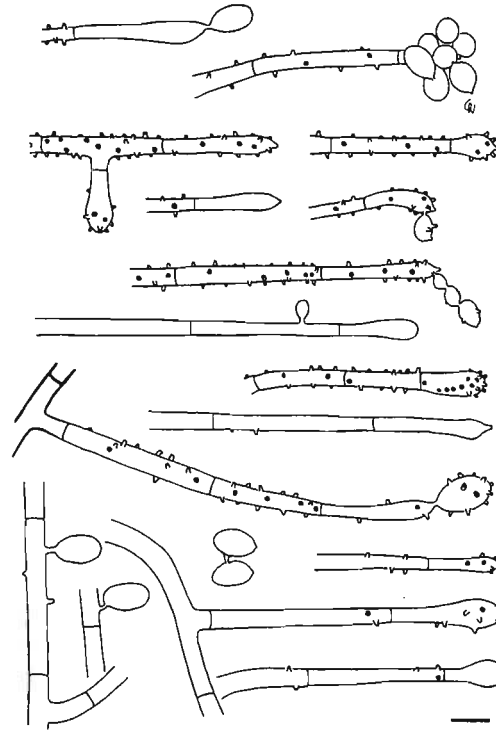

Fig. 2. *Haplotrichum parmastii*, GEL 1577, Holotype, conidiogenous cells, bar = 10 µm.

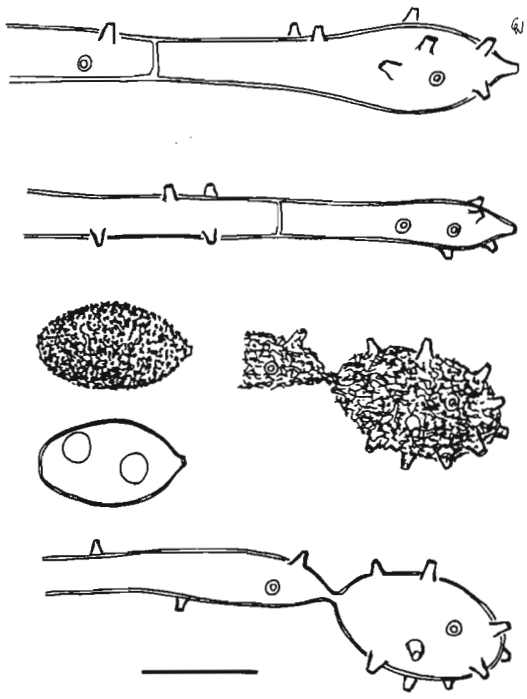

Fig. 3. *Haplotrichum parmastii*, GEL 1577, Holotype, conidiogenous cells and conidia in detail, one cell drawn with ornamentation, bar = 10 µm.

DISCUSSION

The micromorphological characters of the here described Central American specimens fit the genus concept of *Haplotrichum*, but can be distinguished from all other hitherto known species. Because no basidia are found in the specimens, the description under the anamorph name was compelling. After the classification from Holubová-Jechová (1980) *H. parmastii* could be placed in the subsection *Ramosa* Hol.-Jech., due to the absence of clamps, presence of vesiculate conidiogenous cells with conidiogenous teeth, and ramified conidiophores. In our opinion Holubová-Jechová's subdivision of *Haplotrichum* is useful for determination, but do not reflect natural relationships. Her intrageneric classification is based only on micromorphological similarities of the conidial stages. For phylogenetic systematics as many characters as possible should be used of the holomorph sensu Henning (1982).

Nevertheless, two of the 8 hitherto known species attached to the *Ramosa*-group by Holubová-Jechová are anamorphs of *Botryobasidium*. These are *H. rubiginosum* (Fr.) Hol.-Jech. connected with *B. robustior* Pouzar & Jechová and *H. curtisii* (Berk.) Hol.-Jech. connected with *B. curtisii* Hallenb. Both species form brownish colonies and can be distinguished from *H. parmastii* by globose conidia. Both *H. curtisii* and *H. parmastii* are characterized by rough ornamented conidia. The additional 6 species of the *Ramosa*-group (*H. gracile* (Linder) Hol.-Jech., *H. linderi* Hol.-Jech., *H. ovalisporum* (Linder) Hol.-Jech., *H. pulchrum* (Berk.) Hol.-Jech., *H. ramosissimum* (Berk. & Curt.) Hol.-Jech., *H. vesiculosum* (Linder) Hol.-Jech.), all have smooth conidia and conidiophores (Linder, 1942). Additional separating characters are given in the keys, below. Three species of the *Ramosa*-group are known from Central or South American regions: *H. curtisii*, *H. gracile* and *H. vesiculosum*. From this region (Cuba) the similar species *H. caribense* Hol.-Jech. is described, differing, however, from all other known *Haplotrichum* species by very the large, branched conidiogenous teeth. *H. chilense* (Linder) Hol.-Jech., with ornamented conidia but indistinct conidiogenuous teeth, has probably a so-called Gondwana distribution (G. Langer, 1994; Ryvarden, 1991). Beside the type locality in Chile, this species has also been collected in Grenada, Brasil and New Zealand (G. Langer, 1994).

Botryobasidium species and their anamorphs like *H. conspersum* are characterized by a septal pore type with continuous parenthesomes (G. Langer, 1994). Therefore the continuous dolipore parenthesomes of *H. parmastii* found in the type material (Fig. 5) give strong evidence that its unknown teleomorph is a *Botryobasidium* species.

KEYS

Key for *Haplotrichum* subsection *Ramosa* Hol. Jech.

The following key is constructed by data compiled of Linder (1942), Hallenberg (1978), Pouzar & Holubová-Jechová (1969) and own studies.

1. Conidia and conidiophors rough ornamented 2
– Conidia and conidiophors smooth 3
2. Conidia globose, (8)-10-16 µm in diam., pale brown to yellowish; colonies orange to cinnamon coloured; hyphae rarely anastomosing ..... *H. curtisii*
– Conidia ellipsoid, 11-13 x 7.5-9 µm hyalin to slightly yellowish; colonies white to greyish; hyphae often anastomosing ..... *H. parmastii*
3. Cell wall of conidia with an internal ornamention 4
– Cell wall of conidia without an internal ornamention 5
4. Conidia dark, rusty brown, broadly ellipsoid to globose, 13-17.5 x 13-15 µm; Conidiophores and hyphae often anastomosing ..... *H. rubiginosum*
– Conidia pale brown, ovoid to subglobose, 11.5-14.5 x 12.5-6.5 µm; Conidiophores and hyphae usally not anastomosing ..... *H. ovalisporum*
5. Conidia lemon-shaped 6
– Conidia ellipsoid to ovoid 7
6. Conidia reddish brown, 22-12.5 x 12.5-14.5 µm; Conidiophores up to 1100 µm long ..... *H. linderi*
– Conidia nearly hyaline, 14.5-18x 7-11 µm; Conidiophores up to 425 µm long ..... *H. ramossisimum*
7. Conidia in short chains, hyaline, 14.5-20 x 10.5-11.5 µm; Conidiogenous teeth prominent 2-3.5 x 2.5-7.5 µm ..... *H. vesiculosum*
– Conidia single; Colonies yellowish 8
8. Conidiophores up to 1000 µm long; Conidia hyaline, 12.5-16.5 x 9-12.5 µm; Conidiogenous teeth 0.5 x 1.5-3.5 µm ..... *H. gracile*
– Conidiophores up to 255 µm long; Conidia yellowish, 12.5-20 x 9-12.5 µm; Conidiogenous teeth 1.5-2.5 x 1.5-5.5 µm ..... *H. pulchrum*

Key for *Botryobasidium* anamorphs with *Haplotrichum* morphology, including *H. parmastii* and *H. caribense*

Further information and illustration of the following species are published in G. Langer (1994).

1. Conidia elongate to fusoid 2
– Conidia globose, ellipsoid to limoniform 4
2. Basal hyphae with inconstant clamps; conidia 15-25 x 6-8 µm ..... *H. medium*
– All hyphae without clamps
3. Conidia 23-45-(70) x (5)-7-10-(13) µm ..... *B. latisporum*
3. Conidia 23-40 x 7-10 µm ..... *B. longisporum*
4. Conidiophores only basally branched, without vesiculate conidiogenous cells; conidia not in acropetal chains 5
– Conidiophores often also apical branched, with vesiculate conidiogenous cells 6
5. Conidiophores bearing numerous conidiogenous cells, located at the last 3-4 apical cells; conidia 13-19-(20) x 9-13 µm ..... *H. conspersum*
– Conidiophores bearing few conidiogenous cells, located at the last 1-2 apical cells; conidia (18)-20-25 x 10-13 µm ..... *H. ellipsosporum*
6. Conidia globose, subglobose to boad ellipsoid 7
– Conidia ellipsoid to limoniform 10
7. Conidia globose, (8)-10-16 µm in diam., surface rough ornamented, pale brown to yellowish;

colonies orange to cinnamon coloured; hyphae rarely anastomosing ..... *H. curtisii*
- Conidia globose broad ellipsoid, surface smooth *8*
8. Conidia in acropetal chains 9
- Conidia not in acropetal chains, dark, rusty brown, 13-17.5 x 13-15 µm with 1 distinct papilla ..... *H. rubiginosum*
9. Conidia globose, yellow, with 1 - 2 indistict papilla, 11-16 x 12.5-14 ..... *H. tomentosum*
- Conidia globose to broad ellipsoid, rusty brown, 17-25 x 14-22 µm with 1-2 distinct papilla ... . *H. simile*
10. Conidia surface rough ornamented 11
- Conidia surface smooth 12
11. Conidiogenous teeth numerous and distinct, conidia 11-13 x 7.5-9 µm; Colonies white to greyish ..... *H. parmastii*
11. Conidiogenous teeth few and indistinct, conidia 11-18 x 9-12 µm; Colonies white to pale yellowish to creme coloured ..... *H. chilense*
12. Conidia 20-30 x 10-14.5 µm; Colonies yellow to ochreaceous to pale rusty ..... *H. aureum*
- Conidia 13-16 (19) x 8-10 µm; Colonies white to pale yellowish to creme coloured .... *H. capitatum*

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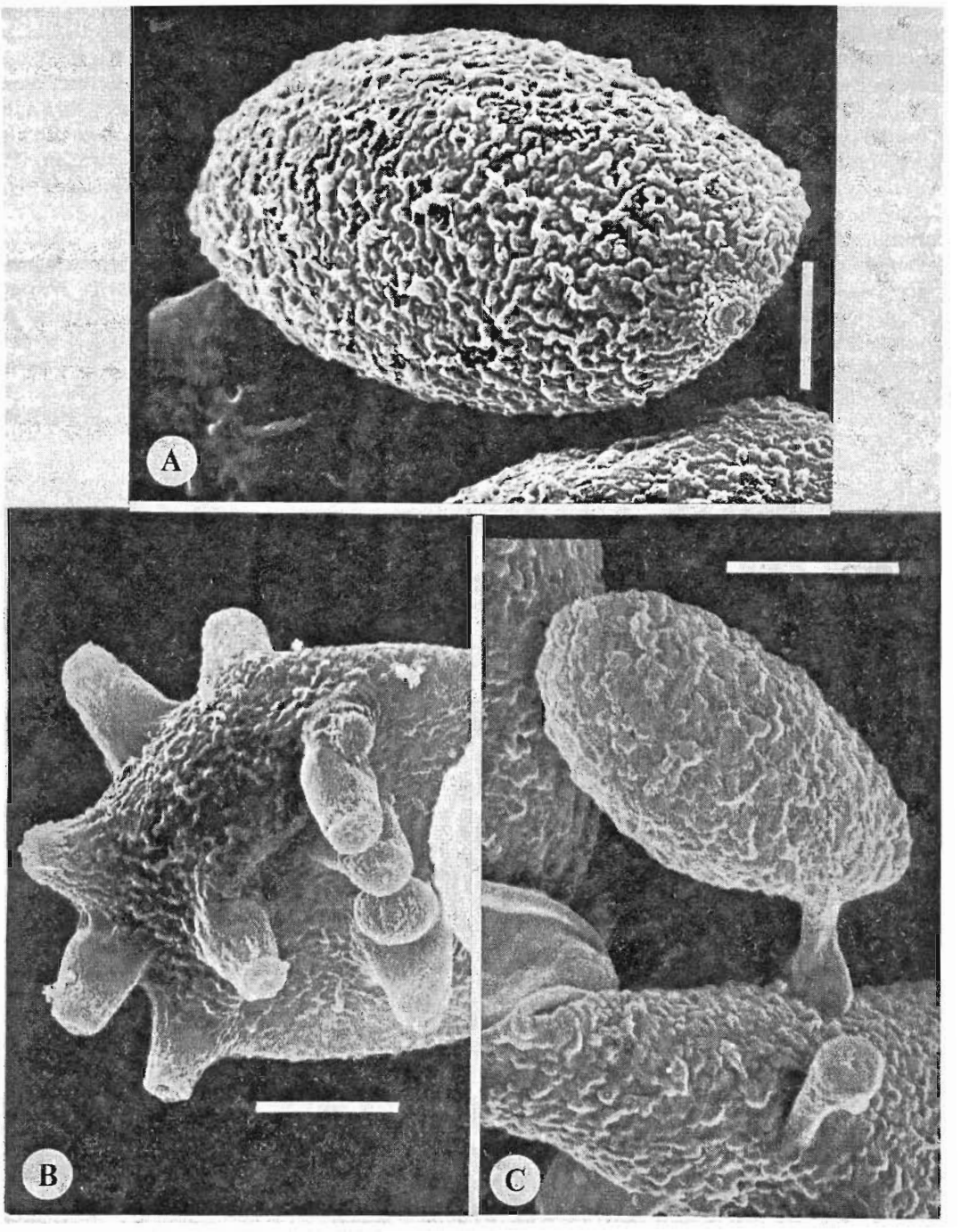

Fig. 4. *Haplotrichum parmastii* , GEL 1577, Holotype, ultrastructure of conidiogenous cells and conidia. A, B, C) REM micrographs, bars = 2 μm. A) conidium; B) conidiogeneous teeth at the top of a condiophore; C) conidium attached to a conidiogeneous tooth.

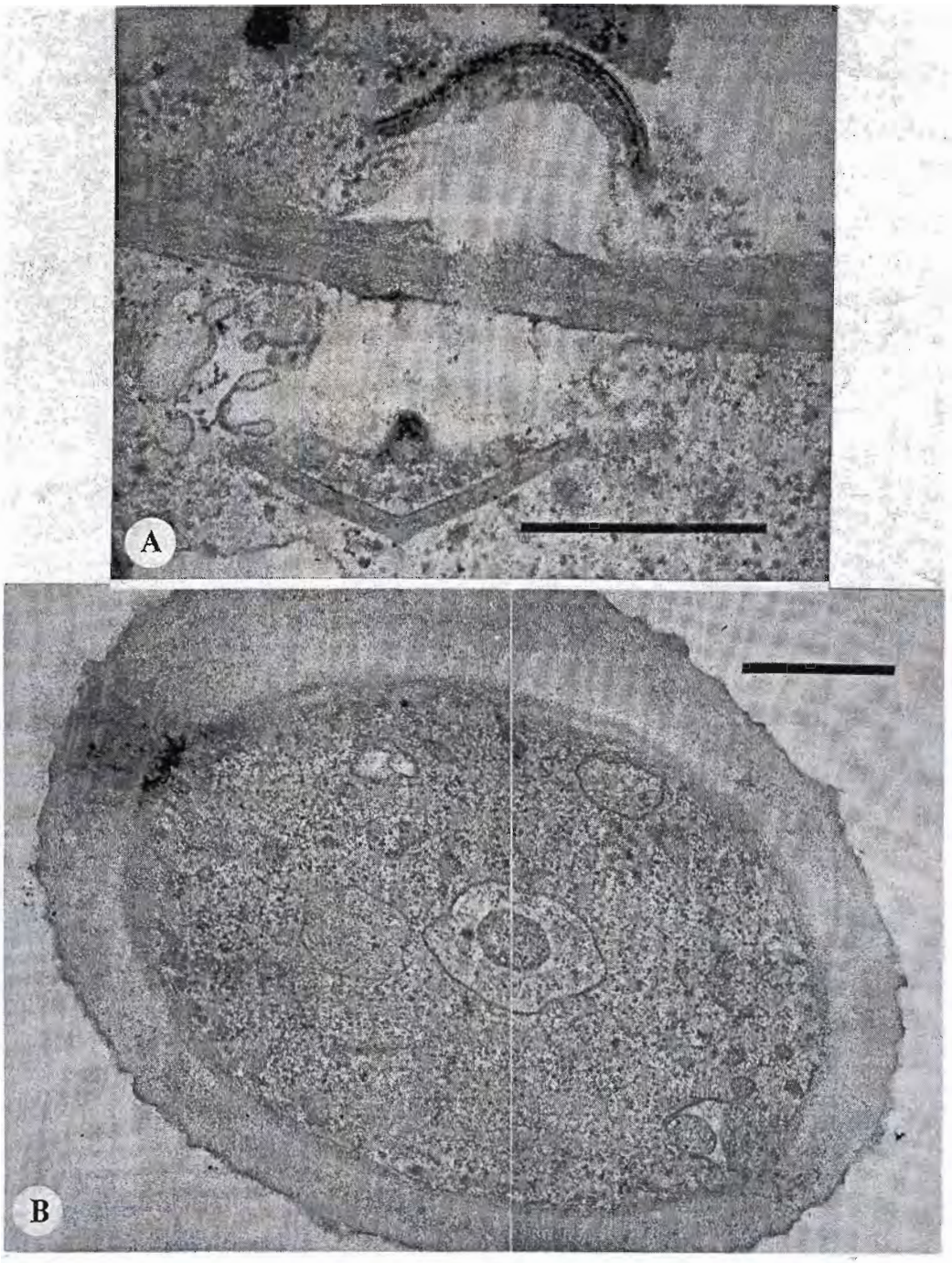

Fig. 5. *Haplotrichum parmastii* , GEL 1577, Holotype, ultrastructure of conidiogenous cells and conidia. A, B) TEM micrographs, bars = 0.5 µm. A) doliporus with continuous parenthesomes; B) section through a conidium.

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A molecular perspective on *Ceraceomyces sublaevis*

Karl-Henrik Larsson and Ellen Larsson
Botanical Institute, Göteborg University, Box 461, SE-405 30 Göteborg. Sweden

Abstract. The intraspecific variation in *Ceraceomyces sublaevis* (Basidiomycotina, Stereales) was studied by sequencing the internal transcribed spacer region and a portion of the adjacent large subunit region of the nuclear ribosomal DNA. Sequences were analyzed using parsimony as optimality criterion. Samples are divided into two well-separated clades supported by high bootstrap values. The two clades correspond to two species: one with, and one without cystidia. *Ceraceomyces sublaevis* is a misapplied name and a younger synonym of *Metulodontia nivea*. Both species must be described, the cystidiate one as *Ceraceomyces eludens*, the other as *Ceraceomyces microsporus*.

INTRODUCTION

Jülich (1972) introduced the genus *Ceraceomyces* (Basidiomycotina, Stereales) as a segregate from *Athelia* Pers. and included three species with *Corticium tessulatum* M. C. Cooke as type. Later additions have raised the number of species to 14 (Hjortstam, 1998). *Ceraceomyces sublaevis* (Bres.) Jülich is a common species on woody debris in conifer and mixed conifer/deciduous forests in North Europe. It is a characteristic species and easily recognizable through the combination of a white, pellicular (athelioid) basidioma, very small, subglobose spores, and undifferentiated, septate cystidia.

Bourdot and Galzin (1911) suggested that a species they called *Corticium microsporum* (P. Karst.) Bourdot & Galzin was similar to *Ceraceomyces sublaevis* but always devoid of cystidia. This idea was again discussed and accepted by Litschauer (1927). Eriksson (1958) studied several specimens determined as *Corticium microsporum* by Litschauer and others and found that cystidia were usually present, albeit sometimes very difficult to find. He concluded that *Corticium microsporum* could not be kept separate from *Ceraceomyces sublaevis*. Jülich (1972) and subsequent authors have accepted Eriksson's opinion.

Specimens lacking cystidia are frequently encountered in the Nordic countries. A closer study of a large number of specimens collected in Norway and Sweden revealed that non-cystidiate species differed from cystidiate ones also in other respects. Therefore, it seemed necessary to restudy the problem and to use molecular methods to test the hypothesis that *Ceraceomyces sublaevis* (Bres.) Jülich can be divided into one species with, and one without, cystidia.

This study forms part of a larger phylogenetic investigation of the athelioid fungi within the family Corticiaceae. Earlier work has shown that the ITS and the adjacent 5' end of the large subunit (LSU; 28S) nuclear rDNA are potentially informative regions for systematic studies on species and genus level within the Corticiaceae (Hallenberg et al., 1995; Larsson et al., 1998). Since we needed to analyze both the relationship between morphologically similar species and the higher level relationships within a portion of the polyphyletic family Corticiaceae we sequenced a 1.200-1.300 bp contiguous region covering the whole ITS and approx. 900 bp of the 5' end of LSU.

MATERIALS AND METHODS

Taxon sampling

Specimens used for sequencing are listed in Table 1. Preliminary analyses on a larger dataset indicated that *Ceraceomyces serpens* (Tode: Fr.) Jülich is the sister taxon of *C. sublaevis*. In this study only one specimen of *C. serpens*, collected on deciduous wood, was included. Since it seems to be a heterogeneous taxon (Hallenberg, 1988), it is possible that a phylogenetic study including other specimens of *C. serpens* would give deviating results.

All sequences were obtained from dried herbarium material. Dr. J. N. Stokland, Oslo, and

Table 1. Collection data and GenBank accession numbers for the fungi studied.

	Country/Comm.	Herb.	Substrate	Coll.	Collector	GenBank no.
C. microsporus	Swe/Alingsås	GB	Picea	8473	K.H. Larsson	AF090875
C. microsporus	Nor/Larvik	O	Quercus	22310	J.N. Stokland	AF090876
C. microsporus	Nor/Brunlanes	O	Pinus	22748	J.N. Stokland	AF090874
C. microsporus	Nor/Halden	O	Pinus	27153	J.N. Stokland	AF090873
C. eludens	Nor/Modum	O	Pinus	20378	J.N. Stokland	AF090881
C. eludens	Nor/Brunlanes	O	Pinus	22780	J.N. Stokland	AF090877
C. eludens	Nor/Frogn	O	Betula	24145	J.N. Stokland	AF090880
C. eludens	Nor/Halden	O	Pinus	27108	J.N. Stokland	AF090879
C. eludens	Nor/Halden	O	Pinus	27202	J.N. Stokland	AF090878
C. serpens	Swe/Alingsås	GB	angiosperm	8478	K.H. Larsson	AF090882

a group of students working for him contributed most of the specimens. The material was generated through an ecological study of the influence of forest stand parameters and management on biodiversity (Stokland et al., 1997). Vouchers are kept in GB and O.

Molecular techniques

DNA extractions was carried out using a modified 2% CTAB method (Savolainen et al., 1995). DNA from herbarium specimens was further purified with GENECLEAN (BIO 101 Inc.).
The ITS region and approx.1.200 bp of the 5′ end of large subunit rDNA were amplified using primers ITS1F, ITS4B (Gardes & Bruns, 1993), LR0R, and LR7 (http://www.botany.duke.edu/fungi/mycolab/primers.htm). One 25-100 µl reaction per template was run using a Biometra thermal cycler (Biometra). Generally we used Taq polymerase (Advanced Biotechnologies) and reaction buffer IV supplied by the manufacturer but in some cases Ready To Go PCR Beads (Pharmacia Biotech) were used. PCR conditions followed Gardes and Bruns (1993). The presence of fragments was checked on a 1% SeaKem (FMC) agarose gel, and amplified products were purified with Quiaquick (Qiagen) spin columns.
Primers used for sequencing were ITS3, ITS4 (White et al., 1990), LR5, LR21, LR3R (http://www.botany.duke.edu/fungi/mycolab/primers.htm), and CTB6 (http://mendel.berkeley.edu/boletus.html). Cycle sequencing was carried out using Thermosequenase (Amersham) fluorescent labelled primer cycle sequencing kit with 7-deaza-dGTP following the manufacturer's recommendations. 25-100 ng of template DNA and 5 pmol Cy5-labelled primer were used per reaction. Sequences were obtained using ALFExpress (Pharmacia Biotech) automated sequencer and edited using computer software ALF manager (Pharmacia Biotech) for Microsoft Windows 95 and Sequencher (GeneCodes Inc.) for the Macintosh OS. Sequence alignment was done manually.

Phylogenetic analyses

Parsimony analyses of manually aligned sequences were performed using PAUP* 4.0d64 (test version provided by D.L. Swofford, Smithsonian Institution, Washington, D.C.). All transformations were considered unordered and equally weighted. Gaps were treated as missing data. One hundred replicate heuristic searches were performed, using random taxon addition and TBR bransch swapping. Bootstrap analyses used 100 replicates with simple taxon

addition sequence, with TBR bransch swapping, and with MULPARS on.

RESULTS AND DISCUSSION

Using maximum parsimony as optimality criterion, a heuristic search, including all nine sequences of *Ceraceomyces sublaevis* and with *Ceraceomyces serpens* as outgroup, yielded one most parsimonious tree, 123 steps long (Consistency index 1.0) (Fig. 1). *C. sublaevis* is distributed over two clades, both with 100 % bootstrap support. The two groups are consistent also in runs incorporating a larger and phylogenetically much more variable data-set. Molecular data strongly support the hypothesis that *Ceraceomyces sublaevis*, as it is presently understood, consists of two, closely related species. Variation within clades was low. A specimen (24145) growing on *Betula* differed by a few bases, which may represent a real genetical difference owing to adaptation to a deviating substrate. On the other hand, one specimen on *Quercus* (22310) did not differ markedly. KHL 8473 also differed by a few bases and in this case the deviation could be explained by geographical distance. However, sampling was not intended to reveal intraspecific variation why no definite conclusion can be drawn from these anomalies. Morphological differences and nomenclature are discussed below.

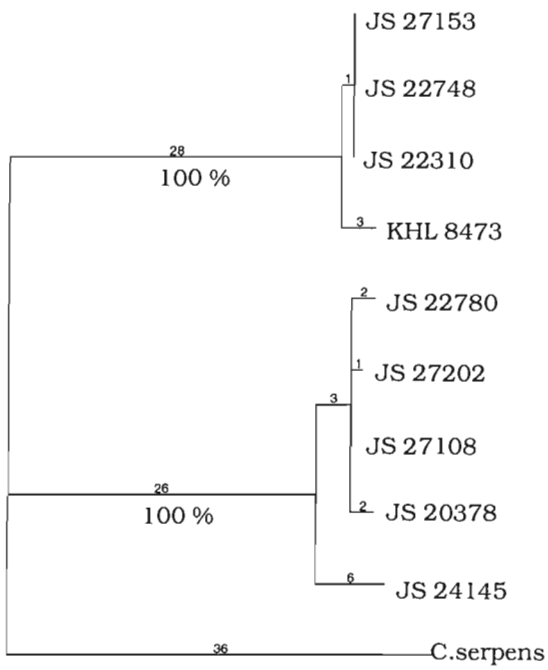

Fig. 1. Phylogram showing branch lengths in proportion to the number of inferred changes. Bootstrap values are followed by '%'.

TAXONOMY

Corticium sublaeve was described by Bresadola (1903) based on a Polish specimen contributed by Eichler. Höhnel and Litschauer (1908) studied a part of the original collection and found cystidia, why they moved the species to *Peniophora*. They described and depicted the cystidia as 'lang keulenförmig ..... der hervorragende Teil ..... etwas gelb gefärbt und infolge zarter Inkrustierung etwas rauh', a rather surprising description of the septate cystidia present in *Ceraceomyces sublaevis*. Jülich (1972) claimed that no type material could be found in Stockholm, where many of Bresadola's collections are housed. Contrary to Jülich's statement original material was found in herb S. The envelope has notations in Bresadola's handwriting and is named *Corticium sublaeve* Bres. n. sp. There are measurements of spores, basidia, and hyphae and the collecting data is given as 'ad truncos Alni oktobri'. The material is in fairly good condition but few spores can be found. The material does not correspond to our present opinion of *Ceraceomyces sublaevis*. The basidiome is athelioid, ochraceous to light rosy-brownish. The subiculum is well developed and slightly darker. Hyphal system is monomitic. Hyphae are clamped and in the subiculum of variable width. Hymenial gloeocystidia occur frequently. They are 20-35 x 4-5 µm, cylindrical, slightly sinuous, tapering towards the apex, and frequently with a schizopapille. Contents are oily. Besides gloeocystidia a few cylindrical to clavate cystidia with a slight yellowish incrustation were observed emerging above the basidial layer. Spores are broadly ellipsoid, smooth, 5-6(-7) x 3.5-4(-5) µm (12 spores seen), not amyloid. Taken in combination with the description by Höhnel and Litschauer (1908) these characteristics fit *Metulodontia nivea* (P. Karst.) Parmasto. This species is monomitic, has schizopapillate, sulphopositive gloeocystidia and ellipsoid,

nonamyloid spores. More important, it has encrusted cystidia exactly as those described and illustrated by Höhnel and Litschauer (1908). Such cystidia are often rare and occur irregularly in the basidioma, which explains why Bresadola and Höhnel and Litschauer, when looking at the same material, came to different conclusions concerning presence of cystidia. The blackening of the cystidia in sulphovanilline is a character that often disappears with age.

The acystidiate species was described by Bourdot and Galzin (1911) and called *Corticium microsporum* (P. Karst.) Bourdot & Galzin. They based the name on a collection sent by Karsten to Bresadola, which was provided with the provisional name *Tomentella microspora*. However, Karsten never published a *Tomentella microspora* and hence the aforementioned combination by Bourdot and Galzin must instead be taken as publication of a new species. Unfortunately, a *Corticium microsporum* (Bres.) Herter was published as early as in 1910 (Herter, 1910) based on *Corticium byssinum* P. Karst var. *microsporum* Bres. (Bresadola, 1903). To make things even more complicated Bourdot and Galzin (1911, 1928) state that the latter variety is the same as their *Corticium microsporum*.

Litschauer (1927) studied several collections named *Corticium microsporum* and concluded that what Bresadola had described was something very close to *Corticium* (*Piloderma*) *byssinum*, a species totally lacking clamps on the hyphae. From the Stockholm herbarium we have seen two collections determined by Bresadola. One is the cystidiate *Ceraceomyces sublaevis*, the other is *Trechispora cohaerens* (Schwein.) Jülich & Stalpers. Thus there are three possible interpretations of Bresadola's name, none of them corresponding to the opinion given by Bourdot and Galzin. Our conclusion is that *Corticium microsporum* is not available as a name for the acystidiate species discussed here. It is possible to typify *Corticium microsporum* so that it becomes available for the cystidiate species but this would make a confused situation even messier. Herter (1910) cites a collection by Jaap under his new name *Corticium microsporum*: "Bei Triglitz auf faulenden Zweigen und Laub in einem Gehölz von *Betula* im oktober (Jaap)". This is probably the same collection from Jaap's Fungi sel. exs. that Litschauer (1927) cited in connection with his new species *Corticium submicrosporum* ("Ad ramos et folia putrida Betulae ..... Prov. Brandenburg: Triglitz in der Prignitz"). *C. submicrosporum* is a later synonym of *Sporotrichum cohaerens* Schw. = *Trechispora cohaerens*. Therefore it seems reasonable to use the collection in S representing *T. cohaerens* to typify *Corticium byssinum* var. *microsporum*. Lectotype of *Corticium byssinum* P. Karst var. *microsporum* Bres. selected here: Ad *Popul. tremulam* Oktobri. Leg. Eichler no. 61 (S).

Ceraceomyces eludens K. H. Larss. nov. sp.

= *Ceraceomyces sublaevis* (Bres.) Jülich sensu Jülich, not *Corticium sublaeve* Bres. = *Metulodontia nivea* (P. Karst.) Parmasto.

Basidioma effusum, resupinatum, separabile; margine indeterminato, interdum filis hyphale instructo; hymenophoro in vivo rugoso, in sicco laevi, albido vel cremeo-alutaceo. Systema hyphale monomiticum, septis omnino fibulatis. Subiculum tenue, hyphis 3-5 µm latis, tenuitunicatis, rectis. Hyphae subhymeniales tenuitunicata, 2.5-3.5 µm latis. Cystidia rara vel abunda, cylindrica, septiis fibulatis, 60-100(-120) x 5-6(-7.5) µm. Basidia anguste clavata, 18-25(-30) x 4.5-5.5 µm, 4 sterigmatibus. Sporae leves, subglobosae vel late ellipsoideae, (3-)3.5-4(-4.5) x (2.5-)2.7-3.5 µm.

Holotype. Sweden. Dalsland, Dalskog parish, south-west of lake Bergatjärn. On decayed *Pinus sylvestris*. 23 Sep. 1972. Leg. K. H. Larsson & K. Hjortstam, Hjm 5844 (GB).

Basidioma resupinate, effused, when fresh and well developed ceraceous and wrinkled (meruloid), when dried almost smooth, cracked. Hymenium closed, pellicular and easily peeled off, leaving the subiculum on the substrate, white but in the herbarium changing to creamy-yellowish or even reddish. Margin usually not differentiated but sometimes minutely fibrillose or with cordons. Hyphal system monomitic, all septa with clamps. Subiculum thin, with thin-walled, 3-5 µm wide, rather straight hyphae with sparse ramifications and anastomoses, some-

times grouped into cordons. Occassionally inflated hyphae up to 10 µm wide can be found. Subhymenium thickening, rather dense, with thin-walled 2.5-3.5 µm wide hyphae, sometimes with a grainy encrustation. Cystidia few to abundant, sometimes very difficult to find, especially in younger tissue, emerging from subicular hyphae, cylindrical, first non-septate, by age regularly septate with clamps, often encrusted, 60-100(-120) x 5-6(-7.5) µm, basally 3 µm wide, projecting considerably above the hymenium. Basidia narrowly clavate, 18-25(-30) x 4.5-5.5 µm, with (2-)4, 4 µm long sterigmata. Spores subglobose to broadly ellipsoid, smooth, with one oildrop, (3-)3.5-4(-4.5)x(2.5-)2.7-3.5 µm.

Habitat. On decayed wood of both conifers and angiosperms.

Distribution. Common in North Europe. Distribution outside that area can not be mapped before material determined as *Ceraceomyces sublaevis* is revised.

Ceraceomyces microsporus K.H. Larss. nov. sp.

= *Corticium microsporum* (P. Karst.) Bourdot & Galzin, Bull. Soc. mycol. France 27:241, 1911, nom. illeg., non *Corticium microsporum* (Bres.) Herter, Krypt.-Fl. Mark-Brand. 6(1):88-89, 1910.

?= *Tomentella microspora* P. Karst. nom. prov. in litt. ad Bres.

Differt a Ceraceomyces eludens cystidia desunt, hyphae subhymeniales ca 2 µm latae, hyphae basales 2-3(-4) µm latae.

Holotype. Sweden. Västergötland, Alingsås, South-west side of lake Lille-Trän. On well decayed stem of *Pinus sylvestris*. 1 Oct. 1971. Leg. K. H. Larsson, KHL 507 (GB).

Basidioma resupinate, effused, when fresh and well developed more or less ceraceous and wrinkled (meruloid), when dried smooth, cracked. Hymenium closed, pellicular and easily peeled of, leaving the subiculum on the substrate, white but in the herbarium changing to a creamy-yellowish tint, often with a light rosy tone. Margin not differentiated, sometimes slightly byssoid, cordons not seen. Hyphal system monomitic, all septa with clamps. Subiculum thin, with thin-walled, 2-3(-4) µm wide, rather straight hyphae with sparse ramifications and anastomoses. Subhymenium thickening, rather dense, with thin-walled, mainly 2 µm wide hyphae, often with a grainy encrustation. Cystidia lacking. Basidia narrowly clavate, 20-25(-30) x (3.5-)4-4.5 µm, with (2-)4, ca 5 µm long sterigmata. Spores globose to broadly ellipsoid, smooth, with one oildrop, (2.5-)3-3.5 x (2.3-)2.5-3 µm.

Habitat. On decayed wood of both conifers and angiosperms but more common in coniferous forests.

Distribution. Not uncommon in North Europe. Distribution outside this area not known until all material determined as *Ceraceomyces sublaevis* has been revised.

Remarks. When cystidia are present there is no problem to distinguish between the two species. However, when cystidia are few the best distinguishing character is the width of the hyphae. The average subhymenial hypha is 3 µm wide in *C. eludens* and 2 µm wide in *C. microsporus*. Most subicular hyphae are 3-5 µm wide in *C. eludens* but only 2-3 µm wide in *C. microsporus*. These differences may seem slight and unreliable but, seen in the microscope, they are very obvious. Spore measures overlap considerably and there is also a large variation between and within specimens. Two- or three-spored basidia are not uncommon and they are likely to produce spores larger than normal.

For an illustration of *C. eludens* the reader is referred to Eriksson and Ryvarden (1973: 208). With their small, subglobose spores both species could be mistaken for *Trechispora cohaerens* or *Trechispora confinis* (Bourdot & Galzin) Liberta. However, in the latter species basidia does not exceed 15 µm and in the subiculum it is easy to find hyphae with ampullate septa.

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Contribution to the knowledge of Tomentelloid Fungi in the Iberian Peninsula

I. Melo[1], I. Salcedo[2] & M. T. Tellería[3]

[1] Museu e Jardim Botânico, Universidade de Lisboa, Rua da Escola Politécnica 58, 1250 Lisboa. Portugal.
[2] Dpto. de Biología Vegetal y Ecología (Botánica). Universidad del País Vasco. Aptdo. 644. 48080 Bilbao. Spain.
[3] Real Jardín Botánico, CSIC. Plaza de Murillo 2. 28014 Madrid. Spain.

Abstract: Descriptions and original iconography are given of nine species of *Tomentella*, *T. botryoides* (Schwein.) Bourdot & Galzin, *T. crinalis* (Fr.) M. J. Larsen, *T. ferruginea* (Pers.: Fr.) Pat., *T. fibrosa* (Berk. & M. A. Curtis) Kõljalg, *T. galzinii* Bourdot, *T. pilosa* (Burt) Bourdot & Galzin, *T. subclavigera* Litsch., *T. umbrinospora* M. J. Larsen and *T. viridula* Bourdot & Galzin, occurring in the Iberian Peninsula. Their distribution in the area is reviewed. *T. umbrinospora* is a new record. *T. galzinii* and *T. viridula* are new to Portugal.

INTRODUCTION

This work aims to be the first of a series on the genus *Tomentella* and related fungi occurring in the Iberian Peninsula. So far now 33 species of *Tomentella*, 5 of *Tomentellastrum*, 3 of *Tomentellopsis* and 5 of *Pseudotomentella* were reported from this area (Melo & Cardoso, 1985; Tellería, 1990). In spite of the relatively high number of taxa known, the voucher specimens kept in herbaria are very scanty.

Although it is not difficult to differentiate the genera, at the specific level the problems are considerable. Some characteristics such as the colour and texture of basidiomes, as well as the spore shape and ornamentation, depend on the different authors (Bourdot & Galzin, 1928; Jülich & Stalpers, 1980; Larsen, 1971, 1974, 1981; Kõljalg, 1996; Svrcek, 1960; Stalpers, 1993). Our aim is to add some data, including original iconography, in order to clarify the knowledge of this group for the Iberian Peninsula. This first contribution deals mainly with cystidioid and/or dimitic species.

MATERIAL AND METHODS

The descriptions are based on the specimens deposited in BIO-Fungi, LISU and MA-Fungi. Measurements and drawings were made from microscopical sections mounted in 3% KOH and Congo Red. The colour terms are from the Munsell Soil Color Charts (1990).

DESCRIPTIONS OF SPECIES

Tomentella botryoides (Schwein.) Bourdot & Galzin, Bull. Soc. Mycol. France 40: 159. 1924

°*Thelephora botryoides* Schwein., Schriften Naturf. Ges. Leipzig 1: 109. 1822
Fig. 1

Basidiome resupinate, separable from the substrate, continuous, more or less membranaceous. Hymenophore smooth or colliculose, dark brown (7.5YR 3/2, 4/2) to very dark grayish brown (10YR 3/2). Subiculum arachnoid, rusty brown (2YR 7/12; 3YR 7/12); cordons present in the subiculum and margins. Margin byssoid, rusty brown.

Hyphal system monomitic; cordons with generative hyphae, 2.5-5 µm diam.; basal hyphae with clamps, 3-5 µm diam., thin to slightly thick-walled, often minutely encrusted, pale to dark golden brown; subhymenial hyphae with clamps, 3-4 µm diam., thin-walled, hyaline, pale yellowish brown. Subhymenium and hymenium often with dark bluish green exudates in 3% KOH. *Basidia* clavate, sinuous, 35-45 x 7-9 µm, sterigmata 4, up to 6 µm long. *Basidiospores* irregular-shaped to lobed, 6-8 (9) x (5) 6-8 µm, echinulate, pale brown.

Remarks: Macroscopically, *T. botryoides* resembles *T. ferruginea* (Pers.: Fr.) Pat. Both species feature dark hymenophores contrasting with the rusty brown subicula. However, in *T. ferruginea* the hymenophore is olivaceous (dark yellowish brown) and the hyphal system is dimitic. Previ-

ously reported from the South (Cádiz) and Nothwest of the Iberian Peninsula by Tellería (1980) and López-Prada & Castro (1995) respectively.

Material studied: Spain: Álava, San Millán, Aspuru, 30TWN4552, 600 m, on *Quercus pyrenaica*, 17/VII/1985, I. Salcedo et al., 1450IS, BIO-Fungi 594. Guipúzcoa, Oiartzun, Arizabalo, 30TVN9295, 100 m, on *Quercus* sp., 26/IX/1992, I. Salcedo, 5896IS, BIO-Fungi 3827. Vizcaya, road from Urkiola to Ochandiano, 30TWN2870, 600 m, on *Pseudotsuga menziesii*, 09/X/1983, I. Salcedo, 4211S, BIO-Fungi 8416.

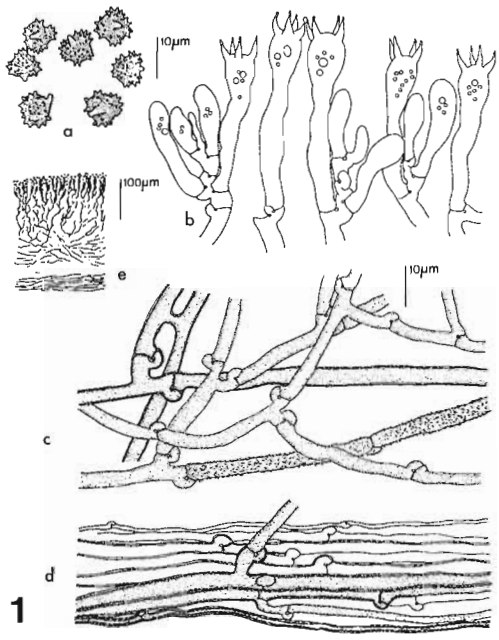


Fig. 1. *Tomentella botryoides* [1450I. Salcedo, BIO-Fungi 594]: a) basidiospores; b) basidia; c) basal hyphae; d) hyphae from cordons; e) section through basidiome.

Tomentella crinalis (Fr.) M. J. Larsen, Taxon 16: 511. 1967

°*Hydnum crinale* Fr., Epicr. Syst. Mycol.: 516. 1838

Fig. 2

Basidiome resupinate, separable from the substrate, continuous, submembranaceous. Hymenophore odontoid to hydnoid, teeth conic with sterile apices, dark brown (7.5YR 3/4) to dark yellowish brown (10YR 3/4). Subiculum more or less arachnoid, concolorous with the hymenophore; cordons present, abundant at the margins. Margin indeterminate.

Hyphal system dimitic; cordons with two kinds of hyphae, skeletal hyphae very narrow, 1.5-2 µm diam., thick-walled, pale yellowish and generative hyphae with clamps, 3-5.5 µm diam., thin to slightly thick-walled, yellowish; basal hyphae with clamps, 3-5 µm diam., thin to slightly thick-walled, yellowish to pale brown; subhymenial hyphae with clamps, 2.5-4 µm diam., thin-walled, yellowish. *Basidia* clavate, stalked, sinuous, 65-75 (85) x 9-11 (12) µm, sterigmata 4, up to 8 mm long. *Basidiospores* irregularly globose, 7-9 µm diam., warted, warts bi to trifurcate, dark brown.

Remarks: This species is easily recognized by its hydnoid hymenophore and warted spores.

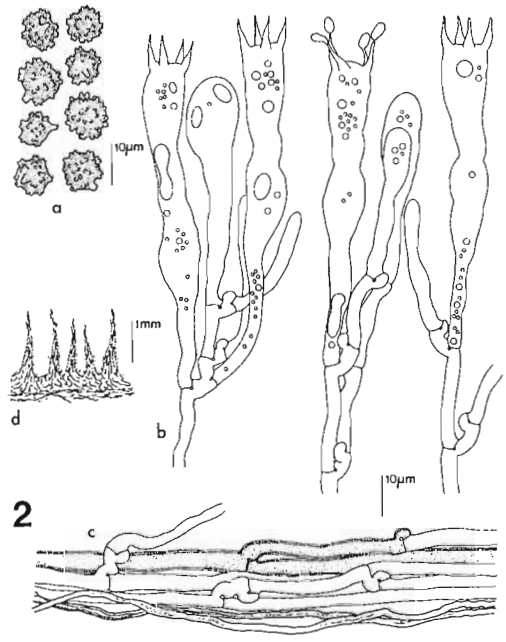


Fig. 2. *Tomentella crinalis* [6070I. Salcedo, BIO-Fungi 4179]: a) basidiospores; b) basidia and subhymenial hyphae; c) hyphae from cordons; d) section through basidiome.

Known so far from East Spain: Albacete (Malençon & Llimona, 1983), Barcelona (Codina & Font-Quer, 1930) and Mallorca (Tellería, 1991).

Material studied: Spain: Álava, Zuya, Guillerna, 30TWN1155, 600 m, on *Salix* sp., 27/I/1990, I. Salcedo et al., 4992IS, BIO-Fungi 6836. León, Puebla de Lillo, beech wood Illarga, 30TUN0965, 1300 m, on *Fagus sylvatica*, 21/X/1992, I. Salcedo, 6070IS, BIO-Fungi 4179.

Tomentella ferruginea (Pers.: Fr.) Pat., Hyménomyc. Eur.: 154. 1887

°*Thelephora ferruginea* Pers.: Fr., Elench. Fung. 1: 198. 1828

Fig. 3

Basidiome resupinate, separable from the substrate, continuous, membranaceous. Hymenophore granulose, dark yellowish brown (10YR 3/4). Subiculum arachnoid, reddish yellow (5YR 6/8) to strong brown (7.5YR 5/8); cordons present under the subiculum and margins. Margin byssoid, lighter than the subiculum.

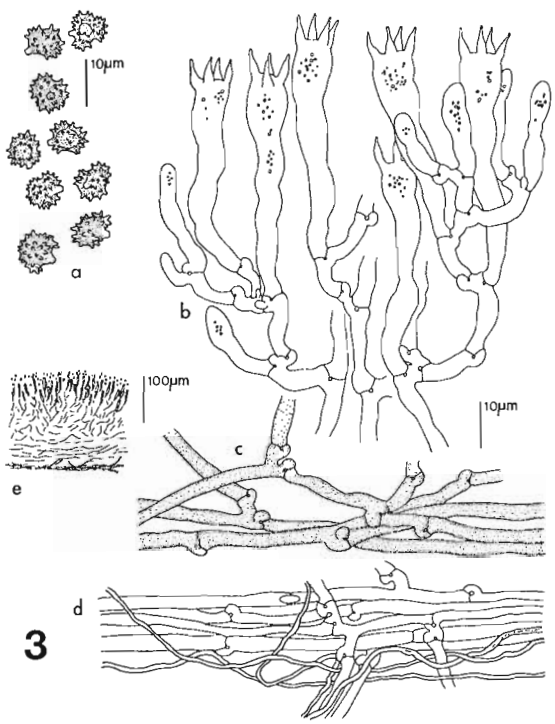


Fig. 3. *Tomentella ferruginea* [6654I. Melo, LISU]: a) basidiospores; b) basidia and subhymenial hyphae; c) basal hyphae; d) hyphae from cordons; e) section through basidiome.

Hyphal system dimitic; cordons with two kinds of hyphae, narrow skeletal hyphae, 1.5-2 µm diam., thick-walled, pale yellowish to brownish and generative hyphae with clamps, 2.5-4 µm diam., thin to slightly thick-walled, pale yellowish; basal hyphae with clamps, 2.5-4 µm diam., regular in outline, thin to slightly thick-walled, pale yellowish; subhymenial hyphae with clamps, 2.5-4 µm diam., thin-walled, hyaline, pale yellowish. *Basidia* narrowly clavate, with green exudates in 3% KOH, 45-60 x 7-9 µm, sterigmata 4, up to 6 µm long. *Basidiospores* lobed to irregularly globose, 7-8 x 6-6.5 µm diam., echinulate, brown.

Remarks: See under *T. botryoides*. Widespread in the Iberian Peninsula: Barcelona (Pearson, 1931; Heim, 1934; Maublanc, 1936; Maire, 1937; Malençon & Bertault, 1971), Lérida (Heim, 1934), Vizcaya (Hjortstam et al., 1981), Cáceres (Blanco et al., 1989), Beira Baixa and Estremadura (Torrend, 1913).

Material studied: Spain: Gerona, Parque Natural del' Albera, next to Castillo de Requesens, 31TDG9599, 460 m, on *Quercus rotundifolia*, 07/XI/1995, I. Melo & J. Cardoso, 6654I. Melo, LISU.

Tomentella fibrosa (Berk. & M. A. Curtis) Kõljalg, Synopsis Fungorum 9: 122. 1996

°*Zygodesmus fibrosus* Berk. & M. A. Curtis, Grevillea 3: 145. 1875 °*Tomentellina fibrosa* (Berk. & M. A. Curtis) M. J. Larsen, Mycol. Mem. 4: 115. 1974

Fig. 4

Basidiome resupinate, separable from the substrate, continuous, arachnoid. Hymenophore provided with tufts of sterile cystidial hyphae, dark reddish brown (5YR 3/4) to dark brown (7.5YR 3/4). Subiculum arachnoid, lighter than the hymenophore; cordons present, abundant and concolorous with the subiculum. Margin byssoid, concolorous with the subiculum.

Hyphal system dimitic; cordons with two kinds of hyphae, skeletal hyphae very narrow, 1-2 µm

diam., thick-walled, pale yellowish and generative hyphae without clamps, 2.5-5 µm diam., thin-walled, yellowish; basal hyphae without clamps, 4-5 µm diam., thin-walled, regular in outline, yellowish; subhymenial hyphae similar to the basal ones. Cystidial hyphae assembled in tufts, originating in the subiculum and projecting above the hymenium, 6-7 µm diam., irregularly thick-walled, dark brown, with several septa unclamped. *Basidia* clavate, sometimes long pedunculate, sinuous, often with transverse septa, 40-60 x 8.5-10 µm, sterigmata 4, up to 8 µm long. *Basidiospores* subglobose, 7-9 µm diam., warted, warts bifurcate, brownish.

Remarks: The hymenial tufts, clampless hyphae and warted spores are characteristics that make this species easily recognized. Widely distributed in Peninsular Spain and the Balearic Islands: Mallorca (Tellería, 1991), Menorca (Tellería et al., 1997), Tarragona (Bertault, 1982), Lérida (Tellería, 1986), Huesca (Hjortstam et al., 1981), Teruel (Tellería, 1980) and Murcia (Honrubia & Llimona, 1982; Malençon & Llimona, 1983).

Material studied: Spain: Álava, Zuya, Zárate, 30TWN1657, 700 m, on *Quercus pyrenaica*, 19/IX/1992, I. Salcedo et al., 5723IS, BIO-Fungi 7366; Valdegovía, Barrio, 30TVN9340, 700 m, on *Pinus sylvestris*, 15/XI/1986, I. Salcedo et al., 2592IS, BIO-Fungi 780. Asturias, Pto. Ventana, 29TQH4872, on *Fagus sylvatica*, 21/XI/1981, 356Tell., MA-Fungi 14628.

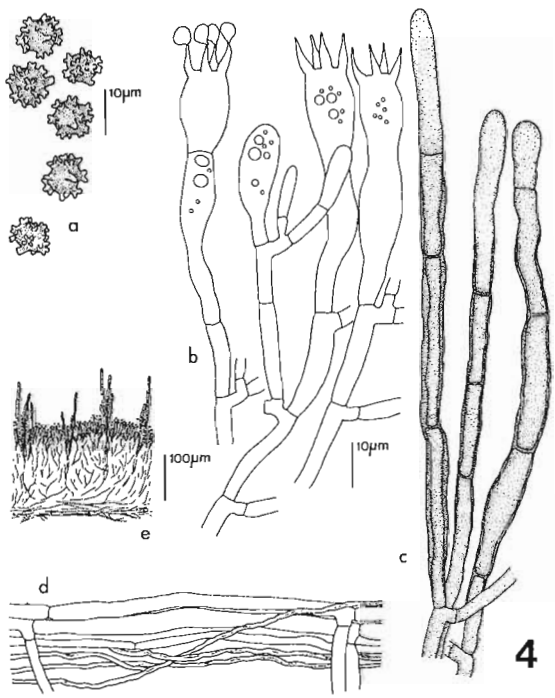


Fig. 4. *Tomentella fibrosa* [5723I. Salcedo, BIO-Fungi 7366]: a) basidiospores; b) basidia and subhymenial hyphae; c) cystidial hyphae; d) hyphae from cordons; e) section through basidiome.

Tomentella galzinii Bourdot in Bourdot & Galzin, Bull. Soc. Mycol. France 40: 143, 1924

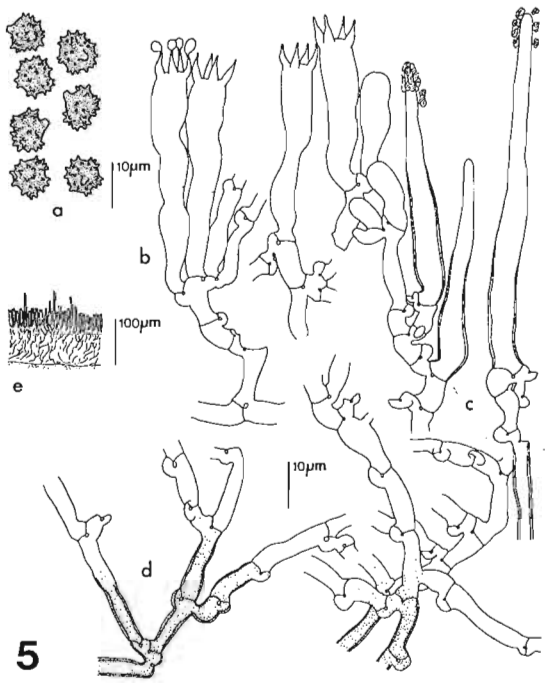
Fig. 5

Basidiome resupinate, adherent to the substrate, discontinuous, mucedinoid. Hymenophore granulose, reddish brown (2.5YR 5/4) to light olive brown (2.5Y 5/4). Subiculum very thin, concolorous with the hymenophore; cordons absent. Margin indeterminate.

Hyphal system monomitic; basal hyphae with clamps, 3.5-4.5 µm diam., thin to slightly thick-walled, pale brownish; subhymenial hyphae with clamps, 3-6 µm diam., thin-walled, hyaline. *Cystidia* acuminate, 50-70 x 4-8 µm, thick-walled towards the base, projecting above the hymenium, sometimes with brownish deposits on the apex. *Basidia* cylindric to clavate, sinuous, 30-50 x 7-8 µm, sterigmata 4, up to 5.5 µm long. *Basidiospores* irregular to lobed, 8-9 x 7-8 µm, echinulate, pale brown.

Remarks: According to Kõljalg (1996) this species is close to *T. subtestacea* Bourdot & Galzin, which differs mainly in that basidiospores turn reddish brown in 3% KOH. So far, only known from two areas in Peninsular Spain: Navarra and Soria (Hjortstam et al., 1981), its distribution is now extended to Portugal

Material studied: Portugal: Algarve, S. Brás de Alportel, E. N. 2, km 713, 29SNB9418, on *Quercus suber*, 23/I/1990, 4583I. Melo, LISU; S. Brás do Alportel, Alportel, 29SNB9418, on *Erica* sp., 23/I/1990, 4535I. Melo, LISU.



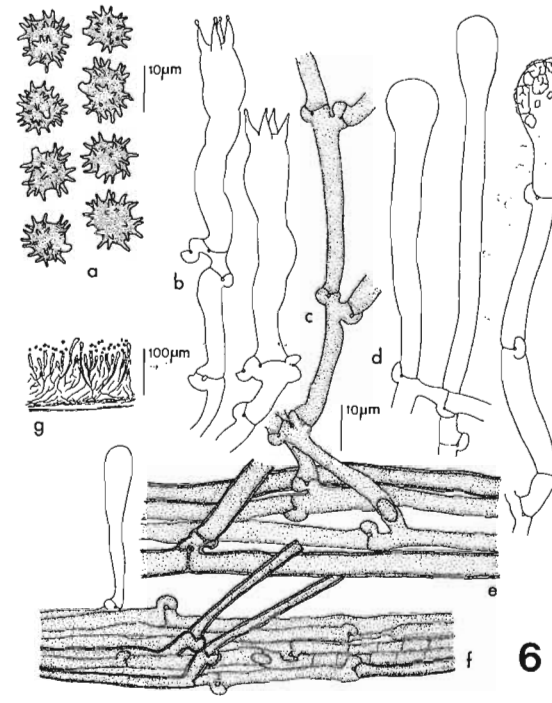


Fig. 5. *Tomentella galzinii* [4583I. Melo, LISU]: a) basidiospores; b) basidia and subhymenial hyphae; c) cystidia; d) basal hyphae; e) section through basidiome.

Fig. 6. *Tomentella pilosa* [4593I. Salcedo, BIO-Fungi 2465]: a) basidiospores; b) basidia and subhymenial hyphae; c) subicular hyphae; d) cystidia; e) basal hyphae; f) hyphae from cordons with cystidium; g) section through basidiome.

Tomentella pilosa (Burt) Bourdot & Galzin, Bull. Soc. Mycol. France 40: 151. 1924

°*Hypochnus pilosus* Burt, Ann. Missouri Bot. Gard. 3: 221. 1916
Fig. 6
Basidiome resupinate, separable from the substrate, byssoid to arachnoid. Hymenophore smooth, yellowish brown (10YR 5/4, 5/6) to dark brown (7.5YR 3/4). Subiculum loosely interwoven, concolorous with the hymenophore; cordons present in the subiculum and margins. Margin indeterminate.
Hyphal system monomitic; cordons with clamped hyphae, 2.5-4 µm diam., thin to slightly thick-walled, pale brown, occasionally bearing cystidia; basal hyphae with clamps, 5-6 µm diam., more or less thick-walled, yellowish to pale brownish; subhymenial hyphae with clamps, 3-4 µm diam., thin-walled, hyaline, pale yellowish. *Cystidia* clavate, very long: up to 130 µm, 8-14 µm diam. at the apex and 3-5 µm at the base, projecting above the hymenium, sometimes encrusted at the apex. *Basidia* cylindric to clavate, sinuous, 40-50 x 8-10 µm, sterigmata 4, up to 6 µm long. *Basidiospores* irregular shaped, 8-9 x 7-8.5 µm, aculeate, spines up to 2.5 µm long, golden brown.
Remarks: This species can be distinguished by its widely capitate cystidia and aculeate spores with long spines (see *T. viridula*). *T. pilosa* has been previously reported from two localities in Peninsular Spain: Vizcaya (Telleria, 1980, Hjortstam et al., 1981) and Segovia (Telleria, 1980).
Material studied: Spain: Álava, Ayala, Beotegui, 30TVN9371, 380m, on burnt wood, 05/XI/1988, I. Salcedo et al., 4593IS, BIO-Fungi 2465.

Tomentella subclavigera Litsch. in Pilát, Bull. Soc. Mycol. France 49: 57. 1933

Fig. 7
Basidiome resupinate, adherent to the substrate, arachnoid. Hymenophore discontinuous, reddish brown (5YR 5/4, 4/4). Subiculum thin, concolorous with the hymenophore; cordons absent. Margin indeterminate.
Hyphal system monomitic; basal hyphae with clamps, short celled, 3.5-5 µm diam., thin-walled, hyaline; subhymenial hyphae similar to the basal ones. *Cystidia* clavate, 112-145 x 6-11 µm, projecting above the hymenium, often with septa unclamped. *Basidia* cylindric, sinuous, 30-35 x 8-9 µm, sterigmata 4, up to 8 µm long. *Basidiospores* globose to subglobose, 7-8.5 µm, echinulate, pale brown.
Remarks: The long, clavate cystidia, short-celled hyphae and globose to subglobose spores enable the identification of this species. Besides the specimens reported by Tellería & Pou (1986), this species is also known from Lérida (Tellería, 1991) and Soria (Hjortstam et al., 1981).
Material studied: Spain: Ávila, Piedalaves, 630m, on burnt wood of *Pinus pinea*, 12/XII/1983, 4787Tell., MA-Fungi 7349.

Tomentella umbrinospora M. J. Larsen, Tech. Publ. State Univ. N. Y. Coll. Forest. Syracuse Univ. 93: 61. 1968

Fig. 8
Basidiome resupinate, separable from the substrate, continuous, arachnoid. Hymenophore smooth, reddish brown (5YR 5/4, 4/4). Subiculum arachnoid, concolorous or lighter than the hymenophore; cordons abun-

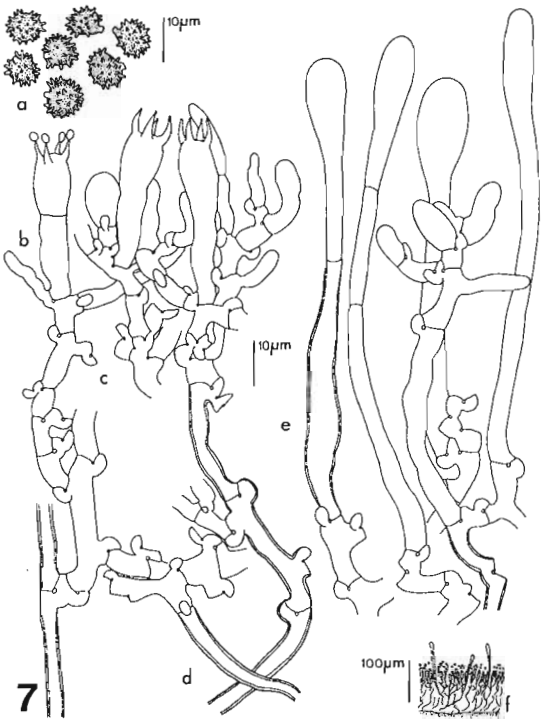


Fig. 7. *Tomentella subclavigera* [4787Tellería, MA-Fungi 7349]: a) basidiospores; b) basidia; c) subhymenial hyphae; d) basal hyphae; e) cystidia; f) section through basidiome.

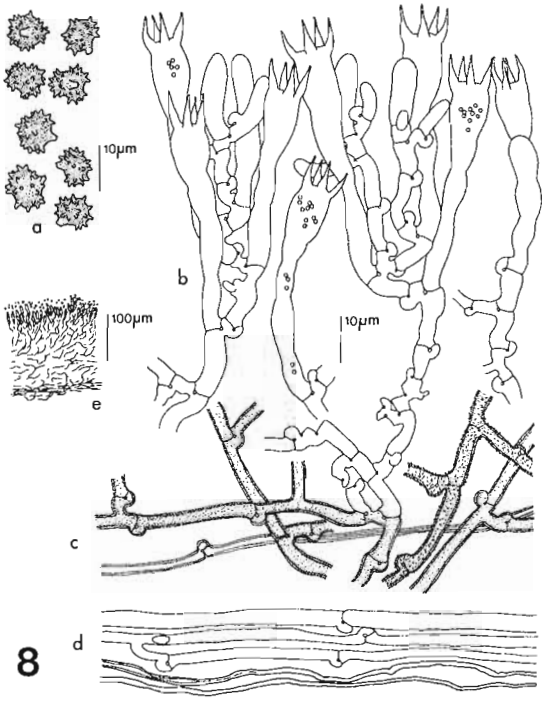


Fig. 8. *Tomentella umbrinospora* [3563I. Salcedo, BIO-Fungi 595]: a) basidiospores; b) basidia and subhymenial hyphae; c) basal hyphae; d) hyphae from cordons; e) section through basidiome.

dant and concolorous with the subiculum. Margin indeterminate.
Hyphal system dimitic; cordons with two kinds of hyphae, skeletal hyphae very narrow, up to 2 µm diam., thick-walled to occluded, pale yellowish and generative hyphae with clamps, 2.5-4 µm diam., thin-walled, yellowish; basal hyphae with clamps, 2.5-4 µm diam., thin to slightly thick-walled, pale brown, sometimes showing spinulose incrustations in Congo Red; subhymenial hyphae with clamps, 3-4.5 µm diam., thin-walled, hyaline, yellowish. *Basidia* clavate, sinuous, sometimes with transverse septa, 40-55 x 7-9.5 µm, sterigmata 4, up to 6 µm long. *Basidiospores* irregular to lobed, 7-8 x 6.5-7.5 µm, echinulate, pale brown.
Remarks: Microscopically, *T. umbrinospora* reminds *T. ferruginea* (Pers.:Fr.) Pat. and *T. crinalis* (Fr.) M. J. Larsen. These species present dimitic hyphal system and some similarities in size and shape of the spores. However, *T. ferruginea* can be distinguished by its olivaceous (dark yellowish brown) hymenophore contrasting with the rusty brown subiculum, and *T. crinalis* by its hydnoid hymenophore. Not known to date for the Iberian mycoflora.
Material studied: Portugal: Baixo Alentejo, Vidigueira, Mendro, 29SPC0636, on *Quercus suber*, 07/V/1997, 7181I. Melo, LISU.
Spain: Álava, Ribera Alta, 2 km from Subijana, 30TWN0942, 750 m, on *Pinus sylvestris*, 17/V/1987, 3563IS, BIO-Fungi 595.

Tomentella viridula H. Bourdot & Galzin, Bull. Soc. Mycol. France 40: 144. 1924

Fig. 9
Basidiome resupinate, adherent to the substrate, mucedinoid. Hymenophore finely granulose, dark yellowish brown (10YR 4/4) to light olive brown (2.5Y 4/4, 5/4). Subiculum very thin, concolorous with the hymenophore; cordons absent. Margin indeterminate.
Hyphal system monomitic; basal hyphae with clamps, 2.5-4 µm diam., some wall thickening apparent, pale yellowish; subhymenial hyphae with clamps, 4-6 µm diam., thin-walled, hyaline. *Cystidia* capitate, thick-walled towards the base, 45-90 x 5-6 µm, apex 7-9 µm diam., sometimes with deposits. *Basidia* cylindric to clavate, sinuous, 45-50 x 9-10 µm, sterigmata 4, up to 6 µm long. *Basidiospores* irregularly shaped, 8-9 x 6-8.5 µm, echinulate, pale brown.
Remarks: The capitate cystidia remind *T. pilosa* but in this species the cystidia are longer with a wider apex. Furthermore in *T. pilosa* spores present long spines. Reported previously from one locality in Spain: Vizcaya (Salcedo & Tellería, 1986), its distribution is now extended to Portugal.
Studied material: Portugal: Algarve, S. Brás de Alportel, Alportel, 29SNB9418, on unidentified wood, 23/I/1990, 4520I. Melo, LISU; Algarve, Faro, Monte Negro, 29SNA9099, 20 m, on *Pinus pinea*, 23/I/1990, 4601I. Melo, LISU.

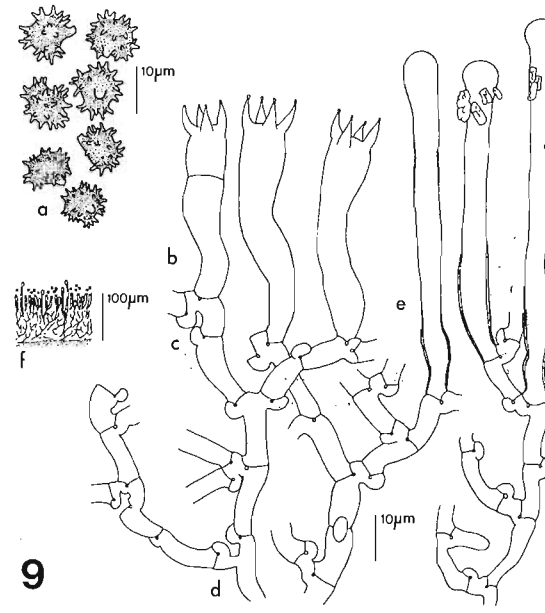


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Fig. 9. *Tomentella viridula* [4520I. Melo, LISU]: a) basidiospores; b) basidia; c) subhymenial hyphae; d) basal hyphae; e) cystidia; f) section through basidiome.

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Three Resupinate Hydnaceous Basidiomycetes From Hawai'i

Karen K. Nakasone and Robert L. Gilbertson
Center for Forest Mycology Research, USDA Forest Service, Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI 53705-2398 and Department of Plant Pathology, University of Arizona, Tucson, AZ 85721

Abstract: Three resupinate basidiomycetes from Hawai'i with toothed hymenophores are described and illustrated. *Phlebia acanthocystis* is a newly described taxon that has cystidia with apical pegs or spines. The new combination *Phlebia subfascicularis* is proposed for *Acia subfascicularis*, originally described from Australia. *Mycoacia kurilensis*, described from the Kuril Islands, is reported from Hawai'i for the first time. In addition, *Mycoacia brunneofusca* from Ethiopia is compared with *P. subfascicularis*, and the new combination, *Phlebia brunneofusca* is proposed.

INTRODUCTION

The mycota of Hawai'i has been described in a number of recent papers (Gilbertson & Hemmes, 1997a, 1997b; Gilbertson & Adaskaveg, 1993; Horak et al., 1996). In this paper, we describe and illustrate three resupinate, wood-inhabiting basidiomycetes with hydnaceous hymenophores from the Hawaiian Islands.

Freehand microscopic sections were mounted in Melzer's reagent (Hawksworth et al., 1995) and 2% (w/v) aqueous KOH and 1% (w/v) aqueous phloxine. Microscopic features were drawn with a camera lucida attachment on an Olympus BH-2 microscope (Olympus Optical Co., Ltd., Tokyo, Japan). Color names are from Kornerup and Wanscher (1978), and herbarium abbreviations follow Holmgren et al. (1990). Collections by R. L. Gilbertson are abbreviated RLG. All collections from the Hawaiian Islands are at ARIZ. Occasionally, a portion of some of these collections is also kept at other herbaria and is indicated in the text.

DESCRIPTION OF TAXA

Phlebia acanthocystis Gilb. & Nakasone, sp. nov. (Figs. 1, 2, 5)

Basidioma effusum, subceraceum, spiniferum; aculei teretes, usque ad 2 mm x 250 µm, singulares, 3–5 per µm, pallidi lutei vel brunnei; hyphae septatae, fibulatae; cystidia inconspicua, obclavata vel ventricosa-rostrata, 22–45 x 4–6 µm, apicibus laevibus, nodosis vel echinulatis; basidia anguste clavata, 4-sterigmatibus, basalibus fibulatis; basidiosporae ellipsoidae vel brevicylindraceae, 3.0–4.5(–5) x (1.8–)2–2.5 µm, parietibus hyalinis laevibus. Holotypus: Hawaiian Islands, Hawai'i, Hamakua District, Kalapa State Park, ad lignam Psidium cattleianum Sabine, 22 Oct. 1991, legit Robert L. Gilbertson 18637 (BPI, isotypus ARIZ, CFMR).

From *acantha* (Greek, noun) = spine, + *cystis* (Greek, noun) = bladder, referring to the spiny cystidia.

Basidiomata, widely effused, up to 8 × 6 cm, thin, up to 180 µm thick, subceraceous, spinose, area between aculei smooth, sometimes cracked when dried, light-colored areas of hymenium turning brown in 2% KOH; context bilayered, composed of a thin, subceraceous upper layer concolorous with the hymenium and a slightly thicker, white, lower layer next to substrate; aculei slender, terete, occasionally compressed, acuminate, occasionally annulate from aggregations of crystals in aculeus trama or translucent with the inner core of encrusted tramal hyphae visible under a dissecting microscope, up to 2 mm long × 250 µm diam, mostly single, occasionally becoming laterally fused or clumping together, 3–5 aculei per millimeter, fragile, brittle, apices entire, smooth, acute to rounded, pale yellow (4A3), light yellow (4A4), greyish orange [5B(4–5)], brownish orange [5C(5–6)], or light brown (6D4), sometimes brownish yellow (5C7) then darkening to brown [6E6, 6F(4–5)], aculei usually evenly colored but occasionally becoming lighter toward apex, often hymenium between aculei lighter in color, sometimes with a mottled appearance resulting from the exposed, white context contrasting with the darker colored aculei; margins gradually thinning out, indistinct, indeterminate, with aculei becoming smaller, warty, and less dense, pale yellow (4A3) to greyish yellow (5B5), with edges abrupt, closely

appressed, cream-colored, porose to felty, or margins up to 2 mm wide, gradually thinning, appressed, smooth, woolly to silky, white to pale cream with bayed or even, fimbriate edges.

Hyphal system monomitic aculei composed of a core of compact, dense, parallel, rarely branched subicular hyphae, these smooth, lightly or heavily encrusted with small, crystalline material, then enclosed by thin subhymenial and hymenial layers; apices sterile, composed of slightly tapered hyphal end cells or sometimes covered by an immature hymenial layer. Subiculum thin, up to 100 µm thick, composed of two layers — a dense lower layer next to substrate 20–40 µm thick, consisting of closely agglutinated subicular hyphae arranged parallel to substrate, and an upper layer up to 60 µm thick, with an open, loose texture; subicular hyphae 2–5 µm diam, nodose septate, moderately branched, sometimes forming H-connections and branching from clamps; walls hyaline, thin to slightly thickened, smooth or occasionally encrusted with fine granular materials. Subhymenium thickening, up to 40 µm thick, a compact tissue of often indistinct subhymenial hyphae and pale yellow mucilaginous materials; subhymenial hyphae 2–3.5 µm diam, nodose septate, short-celled, frequently branched; walls hyaline, thin, smooth. Hymenium composed of a dense palisade of basidia and occasional cystidia. *Cystidia* cylindrical, obclavate to ventricose-rostrate, 22–45 × 4–6 µm, with a short stalk tapering to 2–2.5 µm diam at base, with a basal clamp, tapering gradually toward apex, apex rounded and smooth, knobby, or with short, narrow, hyaline pegs or spines, protruding up to 25 µm beyond hymenium, arising from hymenium, occasional to rare on aculei; walls hyaline, thin, smooth. *Basidia* slender clavate, (10–) 14–26 × 3.5–5.5 µm, tapering to 1.5–3 µm at base, with a basal clamp connection, 4-sterigmate; walls hyaline, thin, smooth. *Basidiospores* ellipsoid to short cylindrical, 3–4.5 (–5) × (1.8–) 2–2.5 µm; walls hyaline, thin, smooth, negative in Melzer's reagent.

Habitat. On wood and bark of angiospermous branches and slash.

Distribution. Hawaiian Islands (Hawai'i, O'ahu).

Representative Specimens Examined

United States: Hawaiian Islands, Hawai'i, Puna District, Pohoiki Road, on (decorticate) *Mangifera indica* L. (mango), 15 Aug. 1991, RLG 17347 (CFMR), Cape Kumukahi, on (decorticate) mango, 26 July 1991, RLG 17088. South Hilo District, Honua Hawai'i, on (corticate) *Pandanus tectorius* Parkins (hala), 3 Sept. 1991, RLG 17658; Hilo Baptist Church, on (decorticate) *Trema orientalis* (L.) Blume (gunpowder-tree), 4 Oct. 1991, RLG 18285 (CFMR) and on (corticate) gunpowder-tree, 4 Oct. 1991, RLG 18286. Hamakua District, Honokaia Boy Scout Camp, on (corticate and decorticate) *Casuarina equisetifolia* L. ex J.R. & G. Forst. (horsetail casuarina), 5 Nov. 1991, RLG 18952 and 27 Aug. 1991, RLG 17531 (CFMR), on (decorticate) *P. cattleianum* (strawberry guava), 10 Oct. 1991, RLG 18243. Ka'u District, Kipuka Puaulu, Hawai'i Volcanoes National Park (HVNP) on (corticate) *Acacia koa* A. Gray (koa), 18 July 1991, RLG 17046. O'ahu, Honolulu District, Manoa Falls, on (decorticate) mango, 7 Oct. 1991, RLG 18419. Maui, West Maui District, Maluhia, on (decorticate) strawberry guava (?), 30 Nov. 1991, RLG 19183.

Remarks. The diagnostic features of this species are the spiny, light-colored basidiomata,

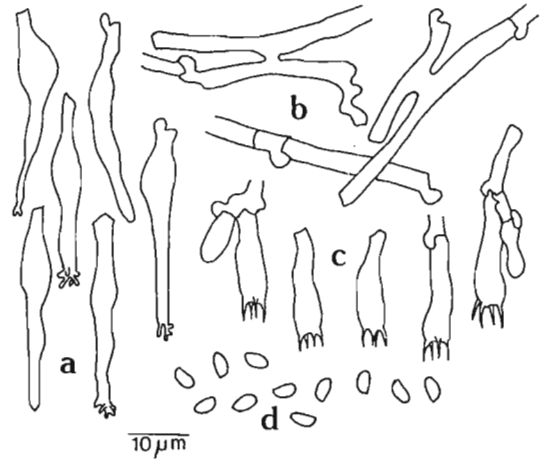

Fig. 5. Microscopic elements of *Phlebia acanthocystis* (RLG 18637, holotype): (a) cystidia, (b) subicular hyphae, (c) basidia, and (d) basidiospores.

the small, ellipsoid basidiospores, and the ventricose-rostrate cystidia with apical pegs or knobs. Although the occurrence of this characteristic cystidia is variable, they are easiest to observe before squashing out the mount. The development of the apical protuberances on the cystidia is variable from a few to many pegs or knobs.

We examined more than 70 collections of *P. acanthocystis* but cite only 12 specimens above. It appears to be very common in some localities on the island of Hawai'i such as Kipuka Puaulu (Bird Park) and Honokaia Boy Scout Camp.

Phlebia subfascicularis (Wakef.) Nakasone & Gilb., comb. nov. (Figs. 3, 4, 6)

Acia subfascicularis Wakef., Trans. Royal Soc. South Australia 54: 155. 1930, as *'subfasciulari'*.

Odontia subfascicularis (Wakef.) G. H. Cunn., Proc. Linn. Soc. New South Wales 77: 294. 1953, as *'subfasciularia'*.

Columnodontia subfascicularis (Wakef.) Jülich, Persoonia 10: 327. 1979, as *'subfasciularia'*.

Mycoacia subfascicularia (Wakef.) Hjortstam, Mycotaxon 54: 188. 1995, as *'subfasciularia'*.

Basidiomata resupinate, widely effused, up to 14 × 4 cm, 60–800 µm thick, soft ceraceous to crustaceous, densely to sparsely spinose, grandinioid or tuberculate, hymenium between aculei smooth, felty, not reacting in KOH; cracks infrequent, inconspicuous in thinner areas, but often extensively cracked in thicker areas; context brownish yellow to dark brownish black, sometimes interspersed with columns of white, crystalline materials; hymenial surface spinose or grandinioid, up to 6 aculei or sterile hyphal pegs per millimeter, subceraceous to ceraceous, aculei terete, slightly tapering toward apex, up to 1 × 0.3 mm, single or fused at base forming clumps, sometimes arranged in broad warts with one or more acute, yellow to brownish yellow apices, thinner grandinioid areas brownish orange (5C6) to light brown (5D7) and spinose and tuberculate areas light brown (6D6) to brown [6(E-F)6, 7E6], becoming white to light brownish yellow toward apices; margins typically distinct but not differentiated, closely appressed, adherent, abrupt or thinning out and blending into substrate, concolorous with hymenium, grandinioid, edges indistinct or narrow, closely attached, white to cream-colored, granular to pulverulent.

Hyphal system monomitic aculei consisting of a core of parallel, vertically arranged thick-walled terminal end cells and large, hyaline crystals protruding through apex, up to 65 µm diam, then enclosed by subhymenial and hymenial layers, apices sterile, composed of thick-walled terminal end cells with or without a thin outer covering of subicular hyphae. Subiculum between aculei thin, up to 150 µm thick, a dense tissue of agglutinated mycelia, in some specimens with two layers, a basal layer next to substrate composed of agglutinated, brown-colored subicular hyphae 4–6 µm diam, nodose septate, with walls up to 1 µm thick, and an upper layer of hyaline subicular hyphae 2–4.5 µm diam, nodose septate, with thin, hyaline, smooth walls; sometimes with a layer of large, coarse, hyaline crystals at substrate interface, up to 60 µm thick. Subhymenium often indistinct, thickening, up to 650 µm thick, a dense layer of vertically arranged subhymenial

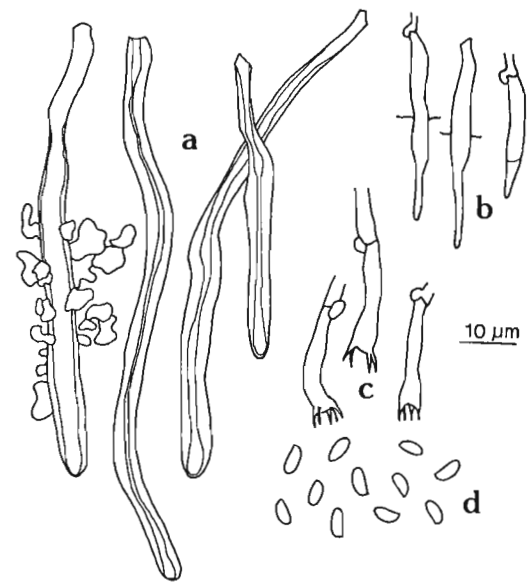

Fig. 6. Microscopic elements of *Phlebia subfascicularis* (RLG 18426): (a) thick-walled terminal end cells, (b) hymenial cystidia, (c) basidia, and (d) basidiospores.

hyphae, not agglutinated; subhymenial hyphae 1.5–4 µm diam, nodose septate, short celled and frequently branched, with thin, hyaline, smooth walls. Hymenium a dense palisade of mature and developing basidia and hymenial cystidia, elements not agglutinated but difficult to separate, embedded in a pale yellow, mucilaginous material. *Pseudocystidia* cylindrical, often tapering slightly toward apex and base, up to 100 × 5–6 µm, clamped at base, arising from subiculum and forming a central column within aculei; walls up to 3 µm thick but thinning toward apex and base smooth or roughened, dark opaque yellow to brownish yellow, often encrusted with large, hyaline crystals. *Cystidia* rare, subulate, 20–35 × 2.5–3 µm, tapering to 1.5–3 µm diam at base, subtended by a basal clamp connection, arising in hymenium, protruding up to 18 µm beyond hymenium; walls thin, hyaline, smooth. *Basidia* clavate to narrowly clavate, 16–20 × 3–5 µm, tapering to 2–3 µm diam at base, with a basal clamp connection, 4-sterigmate; walls thin, hyaline, smooth; few mature basidia observed. *Basidiospores* abundant, short cylindrical to ellipsoid, adaxial side straight or slightly depressed, 4–4.5 × 1.8–2.2 µm, walls thin, hyaline, smooth, negative in Melzer's reagent.

Habitat. On corticate and decorticate woody angiosperms.

Distribution. Australia, New Zealand, Hawaiian Islands (O'ahu).

Type Specimen Examined. Australia: South Australia, Mount Lofty, (on decorticate wood), 5 May 1928, J.B. Cleland, W, K(M):32854 (HOLOTYPE: K and ISOTYPE: BPI-US0261411 of *A. subfascicularis*).

Specimens Examined. United States: Hawaiian Islands, O'ahu, Honolulu District, Manoa Falls Trail, on *Ficus microcarpa* L. f. (Chinese banyan), 7 Oct. 1991, RLG 18424, 18426 and 18430. New Zealand: Auckland, Upper Piha Valley, on (bark and wood of) *Cordyline australis* (G. Forst.) Hook. f., Apr. 1948, J.M. Dingley, PDD 18093 (PDD). Purewa, Orakei bush, on (bark of) *Neopanax arboreus* (L.) Allan, Dec. 1948, D.W. McKenzie, PDD 18087 (PDD); Otago, Lake Wilkie, Catlins on (bark of) *Weinmannia racemosa* Linn. f., Apr. 1957, S.D. & P.J. Brook, PDD 18103 (PDD); Wellington, Waverly, 400 ft, on *Eucalyptus globulus* Labill., Dec. 1946, G.S. and E.E. Chamberlain, PDD 18086 (PDD); Westland, Ahaura, Orwell Creek, on (bark of) *Nothofagus fusca* (Hook. f.) Oerst., Apr. 1956, J.M. Dingley, PDD 18088 (PDD).

Remarks. Phlebia subfascicularis is characterized by aculei and hyphal pegs composed of a core of thick-walled terminal end cells encased in large, hyaline crystals, cylindrical basidiospores with a slight depression on the adaxial side, dark purple colored basidioma, and cheesy or soft ceraceous texture. The thick-walled terminal end cells are observed only in well-squashed mounts.

Although a distinctive taxon, *P. subfasicularis* may be confused with *P. fuscoatra* (Fr.: Fr.) Nakasone and *Mycoacia brunneofusca* Hjortstam & Ryvarden. The longer basidiospores (5–6 × 2–2.2 µm) and absence of thick-walled terminal end cells in the aculeus core of *P. fuscoatra* distinguishes it from *P. subfascicularis*. *Phlebia subfascicularis* and *M. brunneofusca* share many similarities such as thick-walled terminal end cells, subulate cystidia, and thick, dark-colored basidiomata with a soft ceraceous texture. However, *M. brunneofusca* develops paraphysoid hyphidia in the hymenium, which are lacking in *P. subfascicularis*. Furthermore, the basidiospores in P. *subfascicularis* are distinctly cylindrical, whereas in *M. brunneofusca*, the spores are ellipsoid (4–5 × 2.5–3 µm).

Because *M. brunneofusca* is morphologically closely allied to *P. subfasicularis*, we propose the new combination, *Phlebia brunneofusca* (Hjortstam & Ryvarden) Nakasone & Gilb. (Basionym: *Mycoacia brunneofusca* Hjortstam & Ryvarden, Mycotaxon 60: 183. 1996). Examination of the holotype and paratype specimens of *M. brunneofusca* revealed distinct differences between the specimens. The holotype specimen is thick with a homogeneous context, whereas the paratype is much thinner with two distinct layers. In addition, the holotype possesses subulate hymenial cystidia and paraphysoid hyphidia; both of these structures are lacking in the paratype. The thick-walled terminal end cells are easily observed in the holotype because they are dark brown and only lightly encrusted with crystals. However, in the paratype specimen, these structures are more difficult to observe, because they are dark yellow and completely enveloped by coarse, hyaline crystals.

Mycoacia kurilensis Parmasto (Figs. 7, 8, 9)

Izv. Akad. Nauk Estonsk. S.S.R., Ser. Biol. 16: 386. 1967.
= *Phlebia heterocystidia* S.H. Wu, Acta Bot. Fenn. 142: 29. 1990.
= *Phlebia odontoidea* S.H. Wu, Acta Bot. Fenn. 142: 29. 1990.

Basidiomata annual, widely effused, up to 15 × 4 cm, thin, up to 250 µm thick, adherent, ceraceous, spiny to verruculose, hymenium between aculei porulose at first, then felty, smooth; yellow to brown but with a heterogeneous quality because of the contrasting white to light-colored areas between and at the base of the aculei and the darker colored parts of the upper aculei, cracks lacking; aculei conical to compressed, ceraceous to brittle, 3–5 per mm, up to 1 mm long × 300 µm diam, single or fused, gradually tapering to apex or blunt and obtuse, sometimes aculei with multiple tufts or penicillate apices, often with refractive, golden brown, dried-out mucilaginous materials deposited on apex that disappear in KOH, brittle, often breaking off to expose a dark golden brown central core enclosed by a lighter colored hymenial layer, pale yellow (4A3), brownish orange [5C(3-4)], light brown (5D5), yellowish brown (5D4) darkening to light brown (6D5) to brown [6D8; 6E(5-6)]; margins closely appressed, adherent, abrupt or gradually thinning out and fibrillose to woolly, aculei becoming shorter and smaller, concolorous with hymenial area between aculei. *Hyphal system* monomitic aculeus trama composed of vertical, conglutinate, parallel subicular hyphae often branching from clamp connections, with numerous H-connections, and embedded in yellowish brown resinous materials, then enclosed by subhymenial and hymenial layers; apices composed of halocystidia and capitulate to cylindrical terminal cells, rarely covered by hymenium. Subiculum up to 200 µm thick, bilayered with a thin layer, about 10 µm thick, of compact, agglutinate, thick-walled subicular hyphae arranged parallel to substrate, then forming a wider upper layer of vertical hyphae arranged in a sparse to dense layer, with abundant brownish yellow resinous materials that dissolve in KOH; subicular hyphae 2–4 µm diam, nodose septate, moderately to frequently branched, often branched from clamps, conglutinate; walls hyaline, slightly thickened to

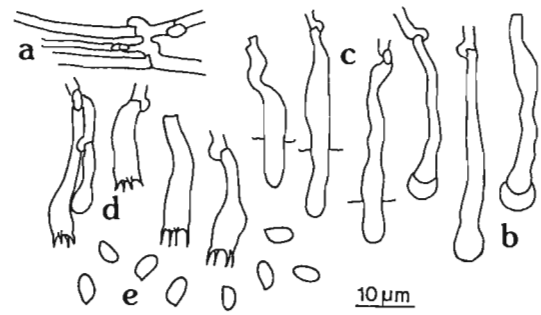

Fig. 9. Microscopic elements of *Mycoacia kurilensis* (RLG 17416): (a) subicular hyphae, (b) capitate cystidia, (c) hymenial cystidia, (d) basidia, and (e) basidiospores.

0.7 µm thick, smooth. Subhymenium up to 25 µm thick, consisting of dense array of parallel, conglutinate and often indistinct subhymenial hyphae and brownish yellow mucilaginous materials that dissolve in KOH; subhymenial hyphae 2–3 µm diam, nodose septate; walls hyaline, slightly thickened, smooth. Hymenium a dense palisade of cystidia and basidia. *Cystidia* of two types: (a) capitate cystidia clavate to cylindrical, 14–36 × 3.5–6 µm, with a slightly expanded apex and enclosed by a thin, hyaline, globose membrane up to 7 µm diam, tapering to 1.5–3 µm diam at base, clamped at base, abundant to rare, especially noticeable in apices of smaller aculei; walls hyaline, thin, smooth; (b) cylindrical to clavate, occasionally fusiform, 16–33 × 4–6.5 µm, rarely with filiform apical extensions, tapering at base to 2–2.5 µm diam, with a basal clamp, embedded or protruding up to 15 µm beyond hymenium, rare or absent; walls hyaline, thin, smooth. *Basidia* short clavate, 13–20 (–25) × 4–6 µm, tapering to 2–3 µm diam at base, clamped at basal septum, 4-sterigmate; walls hyaline, thin, smooth. *Basidiospores* ellipsoid with adaxial side flattened, 4–5(–5.5) × 2–2.5 µm; walls hyaline, slightly thickened, smooth, negative in Melzer's reagent.

Habitat. On bark and wood of angiospermous branches.

Distribution. Taiwan, Japan, eastern Russia (Kuril Islands), United States (Hawai'i, Mississippi).

Type Specimens Examined. Russia: (Sachalin region), Kunašir (island), Gorjatsojë ozero, on (decorticate) *Alnus maximowiczii* Callier ex C.K. Schneid., 5 Oct. 1960, E. Parmasto (HOLOTYPE of *M. kurilensis*: TAA 13034) Taiwan: Nantou, Sun-Moon Lake, alt. 800 m, on branch of angiosperm (bark and wood), 26 Oct. 1988, S.H. Wu 881026-47 (ISOTYPE of *P. heterocystidia*: H). Hsinchu, Wufeng Hsiang, Chinchuan, alt. 500 m, on branch of angiosperm (bark and wood), 20 Aug. 1988, S.H. Wu 880820-6 (HOLOTYPE of *P. odontoidea*: H).

Specimens Examined. Japan: Kagoshima Prefecture, Oshima-gun, Uken-son, Mt. Iwandake, on decaying (corticate) branch of broad-leaved tree, 26 Nov. 1984, E. Nagasawa (TMI 14580), *ut P. heterocystidia*. Okayama Prefecture, Maniwa-gun, Kawakami-son, on (bark) of decaying branch of *Quercus* sp., 18 Sept. 1991, N. Maekawa (TMI 12777), *ut P. heterocystidia*. Taiwan: Pingtung, Taimali, alt. 850 m, on (corticate) branch of angiosperm, 19 May 1989, S.H. Wu 890519-3 (H, paratype). Taipei, beside highway between Hsintien and Piglin, alt. 200 m, on (wood and bark of) branch of *Ficus fistulosa* Reinw. ex Blume, 17 Apr. 1988, S.H. Wu 880417–11 (H, paratype), *ut P. heterocystidia*. United States: Hawaiian Islands, Hawai'i, Ka'u District, Kipuka Puaulu, HVNP, on (decorticate) *Osmanthia sandwicensis* (Gray) Knobl. (olopua), 20 Aug. 1991, RLG 17416 (ARIZ). South Hilo District, Stainback Highway, on (corticate) *Fraxinus uhdei* (Wenzig) Lingelsh. (tropical ash), 10 Oct. 1991, RLG 18511 (ARIZ). Hamakua District Kalopa State Park, on (corticate) hardwood branch, 2 Aug. 1991, RLG 17198 (ARIZ); Hilo Baptist Church, on (decorticate branches of) *Hibiscus tiliaceus* L. (hau), 6 Aug. 1991, RLG 17216 (ARIZ). Mississippi, Harrison County, Harrison Experimental Forest, on (decorticate) hardwood, 4 Dec. 1982, M. Blackwell 1167 (ARIZ, AN00405).

Remarks. Mycoacia kurilensis is distinguished by its spiny to verruculose hymenial surface, often with a shiny droplet of dried-out mucilagenous material capping the aculei, and the small, ellipsoid basidiospores. The hymenophore is quite variable, ranging from small, short verrucae to distinct, well-developed aculei. The capitate cystidia can usually be found on the smaller, young aculei; however, in some specimens, they are apparently absent. *Resinicium pinicola* (J. Erikss.) J. Erikss. & Hjortstam is similar to *M. kurilensis* but has slightly narrower basidiospores [4–5 × 2(–2.5) µm], longer aculei (1–2 mm), lacks cylindrical to clavate hymenial cystidia, and occurs wood and bark of gymnosperms.

The holotype specimen of *M. kurilensis* has well-developed aculei although the microscopic features are poorly preserved. Because *M. kurilensis*, *P. odontoidea*, and *P. heterocystidia* cannot be distinguished microscopically and have similar habitat and host preferences, they are considered conspecific. In the holotype of *P. odontoidea*, we observed capitate cystidia in the aculeate apices that were not described by Wu (1990). In addition, the basidiospores we observed were shorter than those reported in the original description and are well within the range of *M. kurilensis*. Earlier, Hjortstam and Larsson (1995, p. 48) proposed that *P. odontoidea* was a synonym of *P. heterocystidia*. We concur with their conclusion. Although the collection of *M. kurilensis* from Mississippi has smaller basidiospores (4–4.5 × 2–2.5 µm) and more frequent clavate, hymenial cystidia than the other collections, we consider these variations to be relatively minor deviations.

The generic placement of *M. kurilensis* is not certain at this time. *Mycoacia* was recently placed in synonymy under *Phlebia* (Nakasone, 1997); however, the affinities of *M. kurilensis* lie clearly with *Resinicium sensu lato* and not with *Phlebia sensu stricto*. Until further molecular and morphological data are available, we defer proposing any taxonomic changes to *M. kurilensis*.

ACKNOWLEDGMENTS

We thank curators of the following herbaria for loaning specimens that were indispensable for this study: BPI, H, K, PDD, TAA, and TMI. We also thank Drs. J. P. Lindsey and H. H. Burdsall, Jr., who provided helpful corrections and suggestions to an earlier draft of this manuscript.

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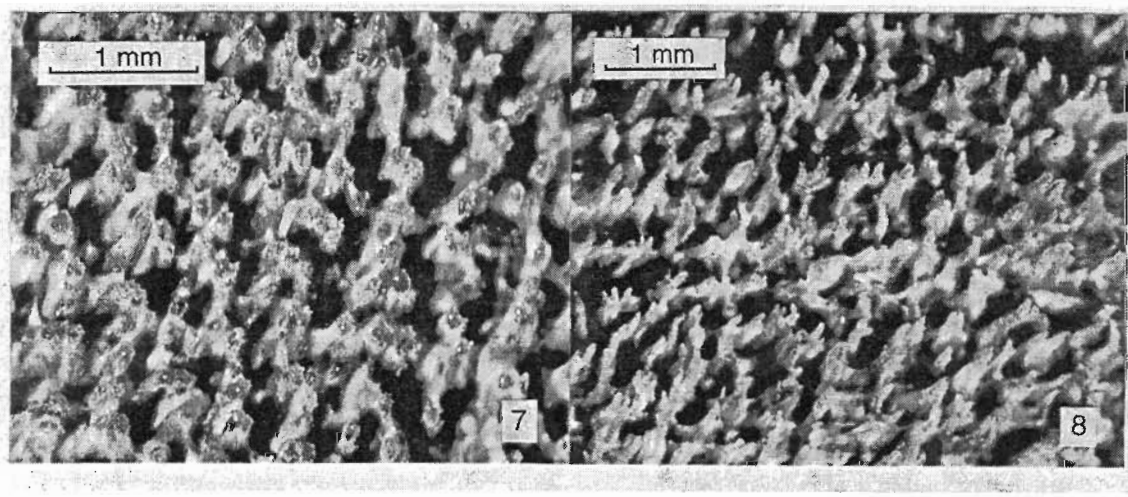

Fig. 7. Basidiomata of *Mycoacia kurilensis* (RLG 17198).
Fig. 8. Basidiomata of *Mycoacia kurilensis* (RLG 17216).

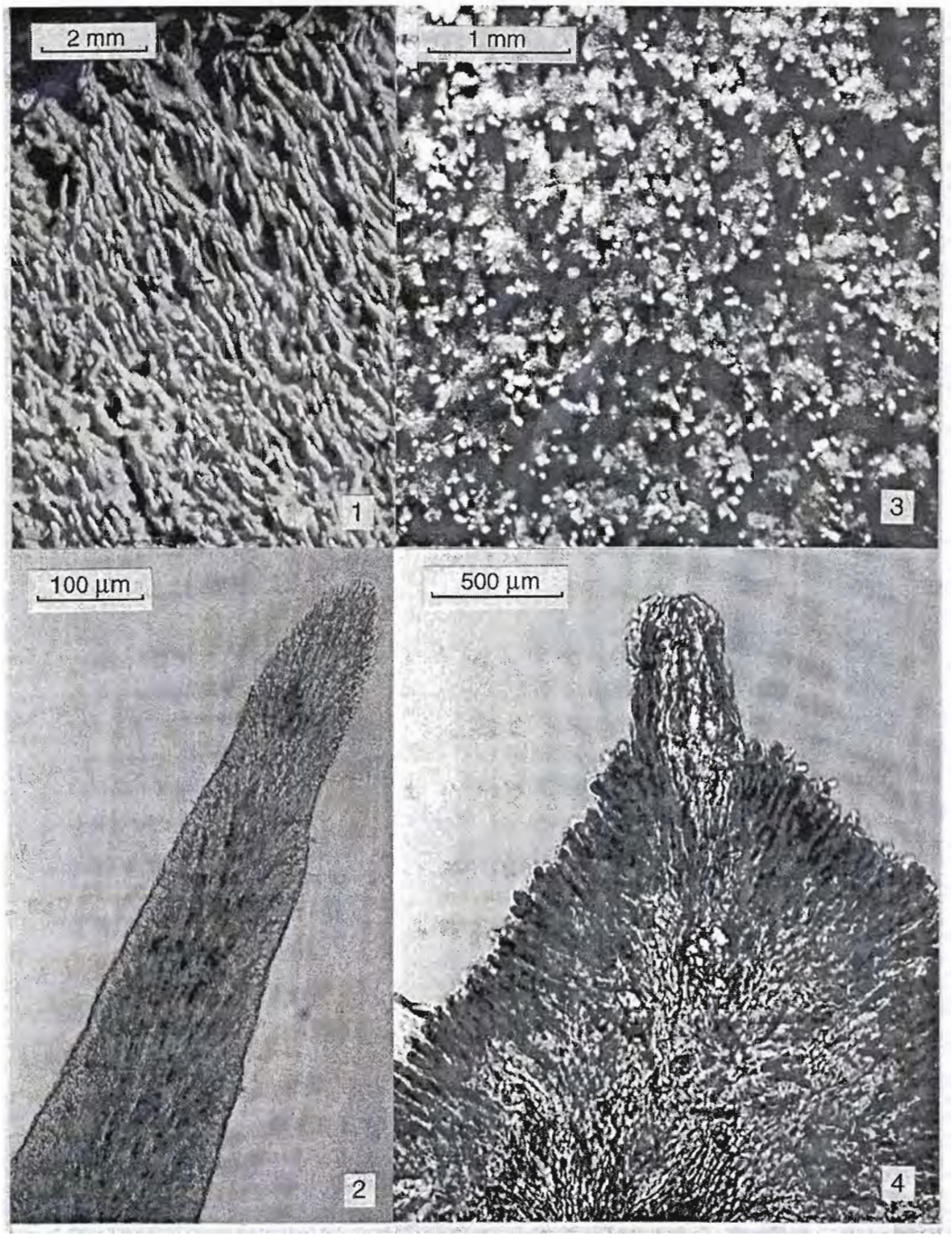

Fig. 1. Basidioma of *Phlebia acanthocystis* (RLG 18286).
Fig. 2. Photomicrograph of an aculeus of *P. acanthocystis* (RLG 17347) shows the encrusted hyphae in the trama.
Fig. 3. Basidioma of *Phlebia subfasciculatis* (RLG 18424).
Fig. 4. Photomicrograph of an aculeus of *P. subfasciculatis* shows the core of heavily encrusted, terminal end cells protruding through the apex (RLG 18426).

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Steccherinum bourdotii in North Europe

Tuomo Niemelä
Botanical Museum, P.O.Box 47, FINB00014 University of Helsinki, Finland

Abstract: *Steccherinum bourdotii* Saliba & A. David is reported as new to Estonia and Finland. This hydnaceous species mostly bears small caps, resembling *Irpex lacteus* (Fr.: Fr.) Fr. or *I. oreophilus* (Lindsey & Gilb.) Niemelä, comb. nova, but its spines are regularly cylindrical. In the microscope it is characterized by globose spores, encrusted skeletocystidia, dimitic hyphal structure and clamped generative hyphae. Skeletal hyphae are weakly but clearly cyanophilous, which is a common character of *Antrodiella* Ryvarden & Johansen, *Flaviporus* Murrill, *Flavodon* Ryvarden, *Irpex* Fr., *Junghuhnia* Corda, and *Steccherinum* Gray, and supports the proposed close relationship between these genera. Relationships between the above-listed genera are discussed, and the importance of cystidia and hymenophoral configuration in generic taxonomy is discussed. The new combination *Junghuhnia brownii* (Humboldt) Niemelä, is proposed.

INTRODUCTION

This paper is dedicated to Prof. Erast Parmasto on the occasion of his 70th birthday. It deals with species and genera of the family Steccherinaceae Parm., described by Parmasto (1968) in his pioneering work *Conspectus Systematis Corticiacearum*. Recently Parmasto (1995) redefined the concept of the family.

Steccherinum bourdotii Saliba & A. David was first reported from France by Saliba and David (1988). In that paper a description was given, supplemented with cultural characters and interfertility tests. The species was considered to be the same as *Mycoleptodon dichroum* (Pers.) sensu Bourdot & Galzin, but the true *Hydnum dichroum* Pers. and another possible older name, *H. pudorinum* Fr. were shown to be linked with *Steccherinum ochraceum* (Pers.) Gray on the basis of spore characters. In addition to France, *S. bourdotii* was reported also from several other Central and South European countries, and South America. Further records of the species have accumulated since the description, but to my knowledge none from North Europe. The species was not listed in the monograph *Nordic Macromycetes* (Hansen & Knudsen, 1997).

In this paper I give further details on *S. bourdotii* and report it as new to Estonia and Finland.

MATERIALS AND METHODS

The paper is based on collections by Juha Kinnunen (Helsinki), Uwe Passauer (Vienna), Reima Saarenoksa (Helsinki) and Pertti Salo (Helsinki); I am indebted to these collectors for the material. The specimens are deposited in Helsinki (H), and some of them as duplicates in Tartu (TAA). Notes on the ecology and distribution of the species in Germany were given by Dr. Helga Große-Brauckmann (Seeheim). Dr. Jan Holec (Prague) arranged the loan of *Mycoleptodon murashkinskyi* (Burt) Pilát from PRM.

Microscopy was studied, and measurements and drawings were made in Cotton Blue (abbreviated as CB); Melzer's reagent (IKI) and 5% potassium hydroxide (KOH) were used for supplementary information. CB+ means cyanophilous, CB- acyanophilous; similar abbreviations are used for IKI and KOH. For spore dimensions, 30 spores were measured from each specimen fertile enough. In presenting the variation of the spore size, 5% of the measurements from each end of the range are given in parentheses. Abbreviations: L = mean spore length (arithmetical mean of all the spores); W = mean spore width (arithmetical mean of all the spores); Q = quotient of the mean spore length and the mean spore width (L/W ratio, variation of the specimen means); (n=x/y) = x measurements from y specimens.

STECCHERINUM BOURDOTII

Basidiocarp annual or growing for 2 years, pileate or effused-reflexed and seldom resupinate, minute, at base mostly 1-2 cm wide, projecting 0.5-1 cm from substrate, fully grown pileus 3-4 mm thick (spines included). Upper surface cream, overwintered base greyish or greenish (algae), tomentose, with a few indis-

tinct zones; edge sharp. Lower surface white at sterile margin; spines at first cream, but becoming pale reddish grey, cylindrical. Section: context duplex with 0.5-1 mm thick, pale greyish or greenish tomentum, and 1 mm thick, white, dense and homogeneous context proper; between them indistinct, brown, thin cortical layer; subiculum white, homogeneous.

Dimitic, hyphae unchanged in KOH, IKI-. Tomentum made up of very thick-walled, CB+, (2.5-)3.2-4.8(-5.3) µm thick hyphae in a loose texture; they look like skeletals, but have here and there clamp connections, and hence are sklerified generative hyphae. Generative hyphae in context and trama thin-walled and with clamp connections, skeletal hyphae (2.1-)3-4.5(-5.1) µm in diam, thick-walled, weakly but distinctly CB+. Skeletocystidia strongly developed, narrow clavate, heavily encrusted along several tens of µm; juvenile skeletocystidia at spine apices smooth and rather thin-walled, differing from normal hyphal ends by their greater width. Low hyphal pegs common in hymenium. Basidia 16-24 x 4.8-6 µm, basidioles 14-21 x 4.2-5.4 µm; some basidioles with tapering apex, but well-differentiated cystidioles lacking. Spores subglobose, thin-walled, IKI-, CB-, (3.7-)4.1-5.1(-5.8) x (2.9-)3.2-4.1(-4.8) µm, L=4.54 µm, W=3.63 µm, Q=1.23B1.28 (n=150/5).

Specimens examined:

Estonia. Jõgeva: Umbusi, *Alnus glutinosa* in swampy alder forest, 19.IX.1993 Kinnunen 36 (H, TAA). **Finland**. Uusimaa: Helsinki, *A. glutinosa* in grass-herb forest with deciduous trees, 1.IX.1990 Saarenoksa 29090, 8.IX.1990 Saarenoksa 31090; *Alnus* in grass-herb forest, 16.IX.1995 Saarenoksa 10195 (all in H). Etelä-Häme: Pälkäne, *Sorbus aucuparia* in lakeside alder-dominated forest, 2.V.1988 Salo 558 (H, TAA). **Austria**. Nieder-Österreich: Wien, *Aesculus hippocastanum* in tree row bordering an alley, 25.XII.1982 Passauer (sub nom. *Steccherinum robustius*, Crypt. Exsicc. Mus. Hist. Nat. Vindobonensi 4922, H).

DISCUSSION

Steccherinum bourdotii resembles small individuals of *Irpex lacteus* (Fr.: Fr.) Fr., or big pileate specimens of *S. ochraceum* and *S. oreophilum* Lindsey & Gilb. It differs from *S. ochraceum* by its stronger pileus, more robust and more spaced spines and reddish-grey (not ochraceous) colour of the hymenophore. *I. lacteus* and *S. oreophilum* have flat teeth, initially almost pores, while the spines of *S. bourdotii* are cylindrical. The best differentiating character, however, is the almost globose shape of the spores. Skeletal hyphae are somewhat thicker than in *S. ochraceum*.

Steccherinum murashkinskyi (Burt) Maas Geesteranus also has cylindric spines, but its basidiocarps are bigger, caps are strongly projecting, and spores are ellipsoid or thick cylindric, (3-)3.1-4.1(-4.8) x (1.7-)1.8-2.2(-2.3) µm, L=3.59 µm, W=1.99 µm, Q=1.79-1.81 (n=128/6) (specimens PRM 156151, 717089B717093; cf. Maas Geesteranus 1962, 1974, Domański 1981).

Saliba and David (1988) originally reported *Steccherinum bourdotii* from France, Croatia, Germany, Italy, Romania, and Argentine. In Germany it is not rare (Große-Brauckmann, in litt. 1998), and is found especially in alluvial forests. Krieglsteiner (1991) published a map on the distribution in western Germany and Berlin, and showed the species to be found especially in river valleys and in the northern coastal lowland. Dunger (1995) listed further localities from what is now East Germany. Tortić (1989) found that the species may even be common in some Croatian lowland forests. Hallenberg (1991) compared materials from Turkey and Romania, and found them to be normally compatible. Große-Brauckmann (1986) discussed the characters of the species)tentatively called by her as 'pseudorobustius') and listed specimens from West Germany, Switzerland, Austria and Belgium. She also included materials of *S. bourdotii* from the Jahn herbarium, which Jahn (1969) had published as *S. robustius* (J. Erikss. & Lundell) J. Erikss.

In the above-listed papers *S. bourdotii* has been reported to grow on *Acer, Aesculus (A. hippocastanum), Alnus, Carpinus (C. betulus), Corylus (C. avellana), Fagus, Juglans, Prunus (P. avium, P. padus), Quercus (Q. robur), Robinia (R. pseudoacacia), Salix* and *Ulmus*; Saliba & David (1988) report one find from *Pinus*. *Sorbus aucuparia* is a new host reported here.

The northernmost finds are from the southern

coastline of Finland, plus a single find from southern Central Finland. All this implies that the species has a southerly distribution in Europe, and favours mesic lowland sites, rich in forbs and broadleaved trees.

Dai and Niemelä (1997) discussed the relationships between the genera *Antrodiella* Ryvarden & Johansen, *Flaviporus* Murrill, *Flavodon* Ryvarden, *Irpex* Fr., *Junghuhnia* Corda and *Steccherinum* Gray. They are distinctly related, as seen in many microscopical details, e.g. dimiticity with slightly cyanophilous skeletals, narrow hyphae, and fairly small spores; they all belong to the white-rot fungi.

The limits between these genera are somewhat vague, however. Dai and Niemelä (1997) considered the most important separating characters to be (a) whether the hymenophoral configuration is truly hydnoid with cylindric aculei or spines, or truly poroid or reticulate/dentate, and (b) whether the cystidia are hymenial (arising from generative hyphae of the subhymenium) or skeletocystidia (terminal ends of skeletal hyphae). Radially symmetric, cylindrical spines were considered to be profoundly different from the flat, irpicoid teeth, which originate from tube walls through incision; hence these two spine types have different ontogeny. Constantly poroid hymenophoral type is rather well separated from the at first reticulate and finally irpicoid type, and so poroid and irpicoid species could be separated in different genera, as well as they could be merged together. The presence or absence of clamp connections varies in this group from species to species, and is unimportant at generic level. If the above principles are accepted for the division of this generic complex, the following conclusion would emerge:

Antrodiella: truly poroid; if cystidia are present, they are of the hymenial type. - All species of *Antrodiella*.

Junghuhnia (incl. *Flaviporus*): truly poroid; with skeletocystidia but without hymenial cystidia. Many species have strong pigmentations, ranging from brick red to orange and ochraceous, and finally yellow. - Species: *J. nitida* (Pers.: Fr.) Ryvarden, *J. collabens* (Fr.) Ryvarden, *J. luteoalba* (P. Karsten) Ryvarden, etc.; ***Junghuhnia brownii* (Humboldt) Niemelä, comb. nova** (basionym: *Boletus brownii* Humboldt, Florae Fribergensis Specimen:101, 1793).

Irpex (incl. *Flavodon*): shallow tubes have lacerate walls, and walls split up into teeth during later growth, or teeth are flat from the beginning; with skeletocystidia but without hymenial cystidia. - Species: *I. lacteus*, *I. flavus* Klotzsch; ***Irpex oreophilus* (Lindsey & Gilb.) Niemelä, comb. nova** (basionym: *Steccherinum oreophilum* Lindsey & Gilb., Mycologia 69:194, 1977).

Steccherinum: truly hydnoid with cylindric and uniform spines, or with cone-shaped aculei, or smooth; with skeletocystidia but without hymenial cystidia. - *S. bourdotii*, *S. murashkinskyi*, *S. ochraceum*, *S. fimbriatum* (Pers.: Fr.) J. Erikss., *S. litschaueri* (Bourdot & Galzin) J. Erikss., etc.

If a more comprehensive generic delimitation is preferred, the next natural step would be to merge *Irpex*/*Flavodon* and *Junghuhnia*/*Flaviporus* together. *Junghuhnia pseudozilingiana* (Parmasto) Ryvarden (Parmasto 1959) might be somewhere in between. The step after that would be to lump *Irpex*, *Flavodon*, *Junghuhnia*, *Flaviporus* and *Steccherinum* in a single genus, separate from *Antrodiella*. At present I prefer the four-genus division as outlined above.

Nomenclaturally *Steccherinum* (Gray, 1821; see Maas Geesteranus 1974) is older than *Irpex*, but *Irpex* was sanctioned by Fries (1828), and must be adopted if the two are merged together. The priority of *Irpex* over *Steccherinum* was also acknowledged by Parmasto (1995). The proposal of Knudsen and Hansen (1996) to merge *Junghuhnia* into *Steccherinum*, but anyhow to leave *Irpex* separate, is not logical. Besides, they did not comment on the placement of the related genera *Flaviporus* and *Flavodon*.

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Table 1. Differences and similarities between some species of *Irpex* and *Steccherinum*.

Character	S. bourdotii	S. ochraceum	I. lacteus	I. oreophilus
Pileus surface	tomentum	matted	tomentum	glabrous, lustrous
Pileus thickness (spines included)	1-4 mm	0.8-1 mm	2-5 mm	1-2.5 mm
Spines	cylindric	cylindric	flat teeth	flat teeth
Spines per mm	3-4 (-5)	4-5 (-6)		
Clamps	+	+	-	+
Spores	subglobose	ellipsoid	thick cylindric	ellipsoid

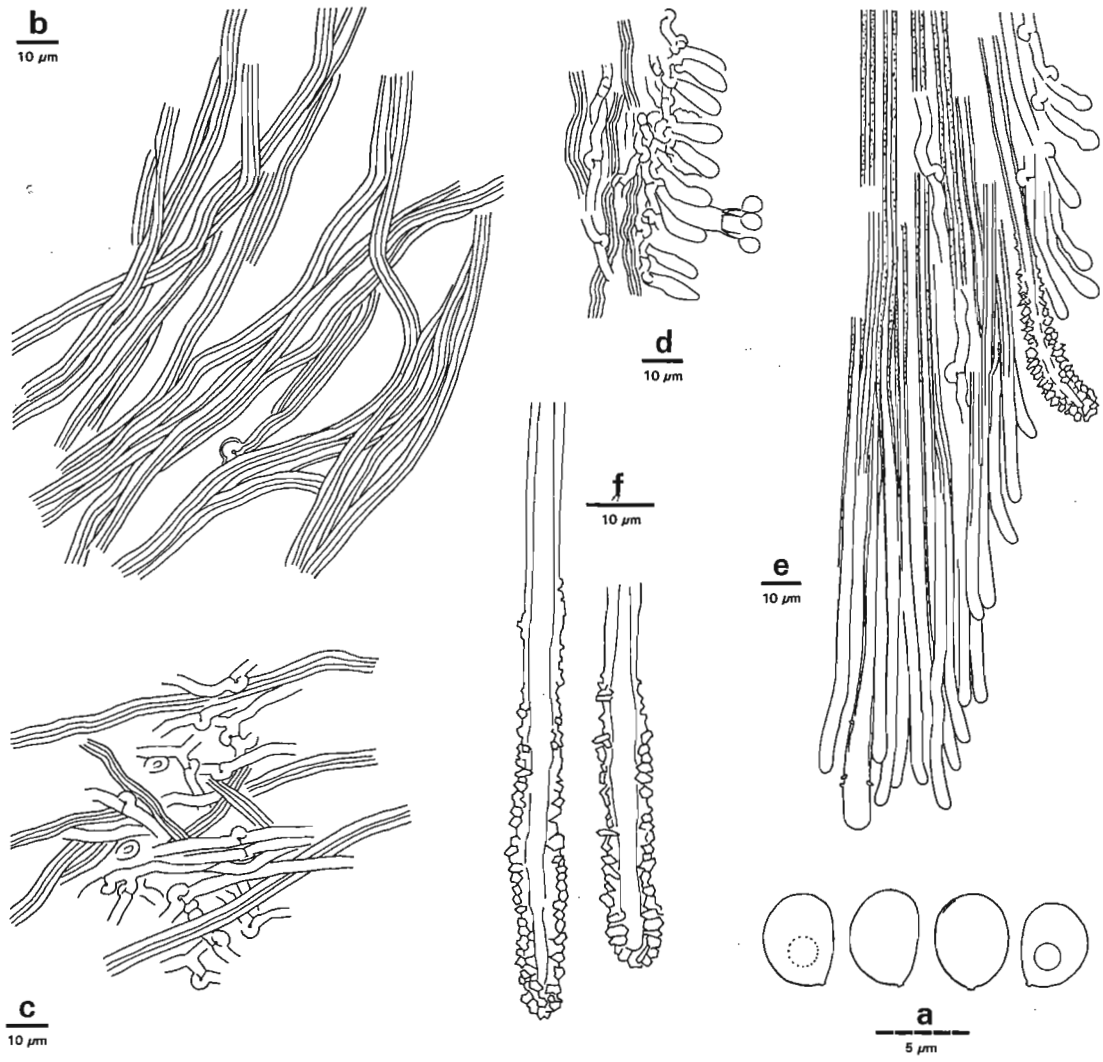

Fig. 1. *Steccherinum bourdotii*, specimen Kinnunen 36. - a) spores, b) sklerified hyphae from tomentum, c) dimitic structure of context, d) hymenium and spine trama, e) spine apex with mature and juvenile skeletocystidium, f) skeletocystidia. Drawn in Cotton Blue.

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The genus *Elmerina* (Heterobasidiomycetes) in Japan

María Núñez
Botanic Garden and Museum, University of Oslo, Trondheimsvn. 23B, 0562 Oslo, Norway

Abstract: Three species of *Elmerina* are reported from Japan. *Elmerina borneensis* is cited for the first time for temperate Asia, and *E. hexagonioides* comb. nov. constitutes the first world record of the species after it was described from Malaysia. A world key of *Elmerina* species is provided.

INTRODUCTION

Protomerulius Møller (= *Aporpium* Singer, Ryvarden 1991) and *Elmerina* Bres. are the only poroid genera known in Heterobasidiomycetes. Bandoni (1984) placed both genera in the family Aporpiaceae (Auriculariales), because they share a dimitic hyphal system and a myxarioid type of basidia development, compared to the monomitic, non-poroid Exidiaceae.

The differences between *Protomerulius* and *Elmerina* lie in probasidia morphology and ontogeny: while probasidia in *Protomerulius* are obpyriform to globose and become septate at early stages of development, even before sterigmata start to form, *Elmerina* probasidia are clavate and remain aseptate. In this genus, only the upper cell (epibasidium) divides during sterigmata development (Bandoni, 1984, Núñez, 1997).

Since basidia septation in *Elmerina* is not visible until maturity, the genus has long been kept in Homobasidiomycetes (Humphrey, 1938; Parmasto, 1984; Ryvarden, 1993) until Reid (1992) discovered the heterobasidiomycetous nature of *Elmerina*.

Species of *Elmerina* and *Protomerulius* have primarily a tropical distribution, except for *P. caryae* (Schwein.) Ryvarden, which is a cosmopolitan species. *Elmerina* is distributed in Pacific Australasia, and only *E. holophaea* (Pat.) Parmasto has been cited for temperate Asia and Australia (Parmasto, 1984). This species, described from Vietnam by Patouillard in 1907, was later described as *Protodaedalea hispida* in 1955 in Japan by Imazeki (Imazeki, 1955; Núñez 1997).

Two new species of *Elmerina* have recently been found new for the Japanese mycoflora, viz. *E. borneensis* and *E. hexagonioides*. These records greatly extend the distribution of *Elmerina* towards northern temperate areas. Since the description of these species is not easily available, I include here the description of the Japanese material.

Elmerina borneensis (Jülich) Reid, Persoonia 14:469, 1992.

JAPAN: MN1076. Nishiyama-no-kami, Okuchi, Kagoshima prefecture, Kyushu, 1995, on *Castanopsis*, 13.11.95, leg. M. Núñez (O, TFM).

Basidiocarps annual, resupinate, effused up to 8 cm wide, pulvinate and up to 4 mm thick, brittle, margin abrupt, pore surface buff brown, not glancing, pores angular to hexagonal, 1-2 mm wide, slightly smaller towards the margin, tubes up to 3 mm long, with numerous hyphal pegs easily seen with a lens, dissepiments lacerate, context fibrose, concolorous with the pore surface or slightly lighter, up to 1 mm thick.

Hyphal system dimitic, generative hyphae with clamps, hyaline, thin-walled, negative in Melzer's reagent, in the trama up to 3 µm wide, sinuous, frequently branched, in the context up to 4 µm wide, difficult to find, skeletal hyphae hyaline to yellowish, straight, unbranched, 3-6 µm wide, with a regular lumen, hyphal pegs composed of parallel, clavate skeletal hyphae up to 8 µm wide, becoming encrusted with an amorphous matter.

Cystidia not seen.

Probasidia clavate, aseptate, 25-30 x 8-9 µm.

Epibasidia 6-8 x 5-7 µm, transversally septate and giving rise to four basidiospores.

Basidiospores broadly ellipsoid to amygdaliform, hyaline, thin-walled, smooth, negative in Melzer's reagent, 8-10 x 5-6 µm.

Substrata. On hardwoods.
Distribution. Pacific Australasian species, known from Australia (Queensland), Malaysia (Sarawak), and warm-temperate Japan (Kyushu).
Remarks: This is the only resupinate species in the genus. The record from Japan is the first one outside the tropics.

Elmerina hexagonioides (A. David & Jaquenoud) Núñez, comb. nov.

Basiomym: *Aporpium hexagonioides* A. David & Jaquenoud, Gardens' Bull., Singapore 29:151, 1976.
JAPAN: MN556, Ogawa Forest, Ibaraki prefecture, 650 m.o.s.l., on dead hardwood, 11.8.94, leg. M. Núñez & T. Hattori (O, TFM). Fig. 1.
Basidiocarps annual, pileate, dimidiate with a narrow basis or broadly attached and with a resupinate part, 6 x 3 cm wide, up to 4 mm thick, flexible when fresh, not shrinking when dry, but becoming rigid, pilear surface cream to straw-coloured, darker at the base, azonate or with a light brown band close to the margin, covered by antler-like hairs up to 1 mm long, most abundant at the base, radially arranged forming crests towards the margin, margin undulate to lobate, and then deeply divided, seeming several pilei fused together, pores angular to hexagonal, cream when fresh, drying straw-coloured, 1-3 mm wide, not radially arranged, dissepiments lacerate, tubes up to 4 mm long, densely covered with hyphal pegs, which are easily seen with a lens, context thin, fibrose, straw-coloured, up to 2 mm thick.
Hyphal system dimitic, generative hyphae with clamps, hyaline, thin-walled, dextrinoid in the trama and up to 3 µm wide, skeletal hyphae abundant, hyaline, thick-walled, parallel and straight, dextrinoid and up to 4 µm wide in the trama, forming hyphal pegs 100 x 30 µm, in the context up to 6 µm wide, pilear hairs formed by clavate hyphal ends 20 x 6 µm arranged in hyphal tufts 100 x 60 µm.
Probasidia clavate, thin-walled, aseptate, 30-32 x 8-9 µm. *Epibasidia* 9-12 x 8 µm, septate when mature and then giving rise to four basidiospores.
Basidiospores ellipsoid to slightly allantoid, with a prominent lateral apiculus, hyaline, thin-walled, negative in Melzer's reagent, 10.5-12.5 x 4.5-5.5 µm, usually glued in pairs.
Remarks: This is the second collection known of the species, which was described from Singapore. Reid (1992) places the species in synonymy with *E. cladophora* since they have similar basidiospores. However, there are several macroscopic differences between them: basidiocarps of *E. cladophora* are flabelliform to substipitate, brown to reddish-brown when dry, and have radially arranged pores, up to 1 mm wide. *Elmerina hexagonioides* has dimidiate basidiocarps, cream to buff when dry, and hexagonal to irregular pores without any arrangement, usually up to 2 cm wide.

Key to *Elmerina* species (a key to *Protomerulius* species is given by Setliff & Ryvarden (1982):

1. Basidiocarps resupinate ..... *E. borneensis*
1. Basidiocarps pileate 2
2. Basidiocarps pinkish, up to 5 cm thick, watery when fresh, drying resinous and shrinking down to 5 mm thick, hymenial surface daedaloid ..... *E. holophaea*
2. Basidiocarps white to cream, up to 1 cm thick, leathery, not shrinking when dry, hymenial surface poroid 3
3. Basidiocarps substipitate, drying brown to reddish-brown, pores radially arranged ..... *E. cladophora*
3. Basidiocarps dimidiate, drying cream to buff, pores not radially arranged ..... *E. hexagonioides*

DISCUSSION

The genus *Elmerina* has a Pacific Australasian distribution, including both tropical and temperate areas. The new records of *E. borneensis* and *E. hexagonioides* for Japan have notably extended the distribution of these two species. Parmasto (1984) was the first one to record *Elmerina* species for temperate East Asia, as far North as Primorsk in Far East Russia. Today, only the type species, *E. cladophora*, is not known from temperate East Asia.

The distribution of *Elmerina* species may point to a distribution centre in the Asian tropics, and further migration towards temperate areas in both hemispheres. *Heterobasidion insulare* (Murrill) Ryvarden is a well-known example in Polyporaceae s.l. with a similar Pacific Australasian distribution, from Australia (Cunningham, 1965) to Vietnam (Parmasto, 1986) and Japan (Imazeki et al., 1988).

The extension in these species distribution may have been possible by the existence of a continuous forest corridor from East Siberia through temperate East Asia to South East Asia since the rising of the Quinghai-Xizang plateau in China, after the Indian plate collided with Asia 45 million years ago (Chang, 1983).

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On nomenclature of some Aphyllophoroid fungi (Hymenomycetes, Basidiomycota)

Erast Parmasto
Institute of Zoology and Botany, Estonian Agricultural University 181 Riia St., EE 51014 Tartu, Estonia. E-mail: e.parmasto@zbi.ee

Abstract. Nomenclaturally correct names and citations are proposed for the aphyllophoroid fungi currently named *Campanella cucullata* (Jungh.) Lloyd, *Castanoporus castaneus* (Lloyd) Ryvarden, *Cotylidia diaphana* (Schwein. ex Berk. & M.A. Curtis) Lentz, *Galzinia incrustans* (Höhn. & Litsch.) Parmasto, *Piloderma reticulatum* Jülich, and *Radulomyces fuscus* (Lloyd) Ginns. *Veluticeps setosa* Cunn. is shown to be an illegitimate name.

There are several names of corticioid and related fungi (species of Corticiaceae s.l.) recently in use but based on illegitimate basionyms. These names are given as if correct ones in the versions 1 and 1.1 of the author's database CORTBASE (Parmasto, 1997). In the following list, incorrect names in use are given in CAPITALS; correct names (incl. a new combination) are in **bold CAPITALS**.

CAMPANELLA CUCULLATA (Jungh.) Lloyd, Mycol. Notes 58: 815 (1919). Basionym: *Merulius cucullatus* Jungh., Praem. fl. crypt. Javae 76 (1838) **non** *M. cucullata* Brond., Rec. plantes crypt. Agenais 1: 11 (1828) = *Platygloea peniophorae* Bourdot & Galzin, Bull. Soc. Mycol. France 25 (1): 17 (1909) *Achroomyces peniophorae* (Bourdot & Galzin) Wojewoda, Fl. Polska, Grzyby 8: 246 (1977).

The oldest available taxonomic synonym is *Cantharellus junghuhnii* Mont., Ann. Sci. Nat., Bot. II 16: 318 (1841) **CAMPANELLA JUNGHUHNII** (Mont.) Singer, Lloydia 8 (3): 192 (1945).

CASTANOPORUS CASTANEUS (Lloyd) Ryvarden, Gen. Polyp. 121 (1992). Basionym: *Merulius castaneus* Lloyd, Mycol. Writ. 4: 555 (1916) **non** *M. castaneus* G. Mey., Prim. fl. Ess. 302 (1818) *(n. v.)*, correct name unknown, **non** *M. castaneus* (Pat.) Kuntze, Rev. gen. pl. 3: 494 (1898).

The name *M. castaneus* Lloyd was first combined in another genus by Lloyd in 1921. According to the ICBN, Art. 58.3 (Greuter, 1994), this combination may be treated as a *nomen novum*: *Irpex castaneus* Lloyd, Mycol. Writ. 6: 1060 (1921). It then becomes the legitimate basionym for **CASTANOPORUS CASTANEUS** (Lloyd, 1921 **non** 1916) Ryvarden.

COTYLIDIA DIAPHANA (Schwein. ex Berk. & M. A. Curtis) Lentz, Agric. Monogr. U.S.D.A. 24: 12 (1955). Basionym: *Thelephora diaphana* Schwein. ex Berk. & M. A. Curtis, J. Acad. Nat. Sci. Philadelphia II 2 (6): 278 (1854) **non** *Thelephora ('Thaelaephora') diaphana* Schrad., Spic. fl. Germ. 1: 186 (1794), correct name unknown.

Of the taxonomic synonyms of *T. diaphana* Schwein. ex Berk. & M. A. Curtis, the oldest is *Thelephora sullivantii* Mont., Syll. crypt. 176 (1856); its type was restudied by Lentz (1955: 12) and Reid (1965: 74). A new combination, *Cotylidia sullivantii* (Mont.) would be the correct name for *C. diaphana*, but this would replace a widely used name with an epithet not used for nearly 200 years.

To save the well-known name *C. diaphana* a proposal has been submitted to the "Taxon" in September 1998 to reject *T. diaphana* Schrad.

GALZINIA INCRUSTANS (Höhn. & Litsch.) Parmasto, Eesti NSV Tead. Akad. Toim., Biol. 14 (2): 225 (1965). Basionym: *Corticium incrustans* Höhn. & Litsch., Sitzungsber. K. Akad. Wiss. Wien, Math.-nat. Kl. I 115: 1602 (1906), **non** *Corticium incrustans* Pers., Observ. mycol. 1: 39 (1796) : Fr., Syst. mycol. 1: 448 (1821) *Sebacina incrustans* (Pers.: Fr.) Tul., Ann. Sci. Nat., Bot. V 15: 225 (1871).

Corticium rubropallens sensu Bres., Ann. Mycol. 1 (1): 97 (1903) **non** *C. rubropallens* (Schwein.) Massee, J. Linn. Soc., Bot. 27: 145 (1890) *Hyphoderma rubropallens* (Schwein.) Ginns, Mycotaxon 44 (1): 208 (1992) was asserted to be the correct name for this species by Bourdot & Galzin (1911: 258), but this is based on Bresadola's misidentification. Another species, possibly identical with *Corticium incrustans*

Höhn. & Litsch. is *Corticium roseopallens* Burt in Lyman, Proc. Boston Soc. Nat. Hist. 33: 173 (1907); its para- or isotypes were studied by Bourdot & Galzin (1928: 216) and Rogers & Jackson (1943: 299). A new combination, *Galzinia roseopallens* (Burt) would be the correct name for *Galzinia incrustans*, but this would cause the replacement of a widely used name.

The only way to save *G. incrustans* is to accept GALZINIA INCRUSTANS Parmasto, Eesti NSV Tead. Akad. Toim., Biol. 14 (2): 225 (1965) as a *nomen novum*.

PILODERMA RETICULATUM Jülich, Willdenowia, Beih. 7: 235 (1972), a substitute of *P. reticulatum* (Litsch.) Jülich, Ber. Deutsch. Bot. Ges. 81 (9): 417 (1968); basionym: *Corticium reticulatum* Litsch., Ann. Mycol. 39 (2-3): 124 (1941) **nec** *C. reticulatum* (Fr.: Fr.) Fr. Hymenomyc. Eur. 658 (1874), correct name unknown, **non** *C. reticulatum* Berk. & Broome, J. Linn. Soc., Bot. 14: 69 (1873) *Septobasidium reticulatum* (Berk. & Broome) Pat., Bull. Soc. Mycol. France 24: 2 (1908) *nom. ill.* = *Corticium flavovirens* Massee, J. Linn. Soc., Bot. 27: 154 (1890), no combination in *Septobasidium* based on this basionym published, **non** *Corticium reticulatum* (Berk.) Berk. & M. A. Curtis in Cooke, Grevillea 20 (93): 13 (1891), correct name unknown.

Piloderma reticulatum is a species possibly synonymous with *P. byssinum* (P. Karst.) Jülich (cf. Eriksson, Hjortstam & Ryvarden, 1978: 1195 and Hjortstam, 1998: 41). **If** the species is acceptable, *Athelia reticulata* Parmasto, Eesti NSV Tead. Akad. Toim., Biol. 16 (4): 382 (1967) may be treated as a *nomen novum*. Correct citation of the name is **PILODERMA RETICULATUM** (Parmasto) Jülich. This citation has been used already in the CBS Aphyllophorales database <www.cbs.knaw.nl/www/aphyllo/database.html>.

RADULOMYCES FUSCUS (Lloyd) Ginns, Canad. J. Bot. 54 (1-2): 131 (1976). Basionym: *Merulius fuscus* Lloyd, Mycol. Writ. 7: 1348 (1925) **non** *M. fuscus* With., Arr. Brit. pl. ed. 3, 4: 149 (1796) = *Agaricus umbelliferus* L. Sp. pl. 2: 1175 (1753) : Fr. Syst. mycol. 3, Index: 46 (1832) *Omphalina umbellifera* (L.: Fr.) Quél., Enchir. fung. 14 (1886).

Lloyd's species was combined in the genus *Serpula* and later in *Cerocorticium*. *Serpula fusca* W.B. Cooke, Mycologia 49 (2): 218 (1957) is treated as a *nomen novum*. Thus the correct citation for the name is **RADULOMYCES FUSCUS** (W.B. Cooke) Ginns.

VELUTICEPS SETOSA G. Cunn., Bull. New Zealand Dept. Sci. Industr. Res. 145: 332 (1963) **non** *V. setosa* (Berk. & M. A. Curtis) Cooke, Grevillea 8 (48): 149 (1879), basionym: *Hymenochaete setosa* Berk. & M. A. Curtis, Grevillea 1 (11): 165 (1873) a Hyphomycete *sec.* Burt, 1918: 368 and Léger, 1998: 306.

This species is accepted by Hjortstam (1998: 52); hopefully a *nomen novum* will be published for it by some mycologist who knows the genus well and will study its type.

ACKNOWLEDGEMENTS

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Folia Cryptog. Estonica, Fasc. 33: 105–108 (1998)

Panaeolus atrobalteatus sp. nov., a member of *Panaeolus* stirps *Subbalteatus* (Agaricales, Strophariaceae)

D. N. Pegler[1] & A. Henrici[2]
[1]The Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AB, UK
[2]57 Clarendon Road, London W11 4JD, UK

Abstract: *Panaeolus atrobalteatus* from London, England is proposed as a new species, with a full, illustrated account and discussion. A key to the *P. subbalteatus* complex is provided.

INTRODUCTION

During the course of a three-year survey by the London Natural History Society of all aspects of the natural history of the gardens of Buckingham Palace, London, very large numbers of basidiomata of a species of the genus *Panaeclus* (Fr.) Quél. were observed growing over one flower-bed. The bed had been recently treated with a compost prepared within the Palace's own recycling centre, consisting largely of recycled vegetable matter from the garden, but also containing a relatively small proportion of horse manure, prepared within the Palace's own recycling centre. The main flush, estimated at *ca* 3000 basidiomata, occurred during a mild period in late November; there was a second fruiting in the same bed in January. Much of the garden had received an apparently similar composting regime, but no basidiomata were seen in any other bed. The species grew either solitary or in small fasciculate tufts, suggestive of *P. subbalteatus* (Berk. & Broome) Sacc., but macro- and microscopical differences indicated an undescribed taxon and the following species is proposed as new.

Panaeolus atrobalteatus Pegler & Henrici, sp. nov.

Pileus 3 — 7 cm latus, campanulato-convexus, subumbonatus dein applanatus, hygrophanus, in statu uvido olivaceo-niger, in statu pallide olivaceo-bubalinus, laevis, non viscidus, nonstriatus. Lamellae adnexae vel late adnatae, pallide bubalino-brunneae dein atrofumosae, moderate confertae, cum duabus ordinibus lamellularum intermixtae. Stipes 5 — 8 x 0.3 — 0.5 cm, cylindricus, cavus, pallide roseobrunneus, ad basim albus. Velum nullum. Caro tenuis, fragilis, pallide brunnea; hyphae inflatae, fibulatae. Sporae in cumulo atrae, 8.5 — 11 x 6 — 7.5 x 4.5 — 6.0 µm, late limoniformes, atrofuscae, opacae, crassitunicatae, laeves, poris germinationis praeditae. Basidia 24 — 34 x 8 — 9.5 µm, cylindrico-clavata, 4 - sporigera. Acies lamellarum steriles. Cheilocystidia copiosa, 27 — 35 x 6.5 — 11 µm, lageniformia, hyalina, tenuitunicata. Chrysocystidia nulla. Cutis pilei sphaerocytis constituta. Caulocystidia adsunt. Typus: Anglia, Londinum, 24 Nov. 1997, Henrici, ***K****(M)55726.*

Basidiomata agaricoid, thin-fleshy, solitary or in small fascicles of 2 — 4. *Pileus* 3 — 7 cm diam., campanulate to strongly convex or subumbonate expanding to applanate; surface strongly hygrophanous, black with an olivaceous tint (Ridgway 'Olivaceous Black', Munsell 2.5GY/2.3/0.2) when moist, fading from the centre to 'Deep Olive -Buff' (M.4.5Y/6.9/2.5) or 'Pale Olive-Buff' (M.5Y/8.3/1.5) and initially leaving a dark, outer belt, smooth, dry, not viscid, non-striate; margin entire, finally radially fissile, not appendiculate. *Lamellae* ascendant, adnexed to broadly adnate, pale buffy brown ('Avellaneous', M.7YR/6.5/3.0) finally dark grey brown ('Blackish Brown', M.1R/2.7/8.3), variegated when young, moderately crowded, with lamellulae of two lengths; edge pale. *Stipe* 5 — 8 x 0.3 — 0.5 cm, cylindrical, hollow; surface pale with dull flesh pink tones ('Pale Flesh Color', M.2YR/8.1/3.7), longitudinally ridged-striate, with upper third covered by a white pruina; base attached to a white mycelium. *Veil* none. *Context* up to 5 mm thick at disk, pale brown, brittle, consisting of hyaline, thin-walled hyphae, 2 — 5 µm diam., in-

flated to 30 µm diam., with small clamp-connexions; *odour* and *taste* not distinctive. *Spore* deposit black. *Basidiospores* (from print) 8.5 — 11 x 6 — 7.5 x 4.5 — 6.0 (9.4 ± 0.7 x 6.4 ± 0.45 x 5.0 ± 0.81) µm, Q = 1.86, broadly limoniform, sometimes subhexagonal in face-view; ellipsoid in profile, dark fuscous brown, opaque or nearly so, thick-walled, smooth, with an apical, truncating germ-pore, often abaxially inclined. *Basidia* 24 — 34 x 8 — 9.5 µm, cylindrico-clavate, tetrasporic, with stout sterigmata. *Lamella-edge* sterile, with crowded cheilocystidia. *Cheilocystidia* 27 — 35 x 6.5 — 11µm, lageniform with a cylindrical, tapering or subcapitate neck, 3.5 — 7 µm wide, hyaline, thin-walled, with few contents. *Pleurocystidia* none; *chrysocystidia* none. *Hymenophoral trama* regular, hyaline, of hyaline, thin-walled hyphae, 2 — 4 µm diam., inflated to 20 µm diam. *Subhymenial layer* 8 — 12 µm wide, pseudoparenchymatous. *Pileipellis* a stratified epithelium of hyaline elements, 22 — 37 x 17 — 30 µm, subglobose, pyriform to inflated clavate, hyaline, thin-walled, with occasional, scattered pileocystidia, similar to the caulocystidia. *Caulocystidia* forming fascicles on the upper stipe, 22 — 35 x 4.5 — 7.5 µm, sinuoso-cylindrical to subcapitate, thin-walled.

Specimens examined: England, London, Buckingham Palace gardens, Grosvenor Place beds, on composted soil, 24 Nov. 1997, Henrici, K(M)55726, holotypus; 14 Jan. 1998, Henrici, K(M)55727.

Panaeolus atrobalteatus belongs within a complex of species, typified by *P. subbalteatus*, characterized by a combination of characters. These include a hygrophanous pileus which fades from the centre leaving a dark outer belt, the absence of a partial veil, and the lack of chrysocystidia or other pleurocystidioid structures. This is the largest group within the genus, containing about nine species, largely North temperate in their distribution. Apart from *P. subbalteatus*, the following species are included: *P. acuminatus* (Schaeff.) Quél., *P. fimicola* (Fr.) Gillet, *P. fontinalis* A. H. Sm., *P. moellerianus* Sing., *P. olivaceus* Møll., *P. rickenii* Hora, *P. speciosus* P. D. Orton and *P. uliginosus* J. Schaeff.

Panaeolus atrobalteatus is readily characterized by the strongly hygrophanous pileus which is almost black when moist, very pale when dry but displaying distinctly olivaceous tints; a relatively short stipe; and small, limoniform basidiospores. *Panaeolus guttulatus* Bres. has similar colouration to *P. atrobalteatus* but belongs to another group with only weakly hygrophanous pilei and has spores which are narrower and not strongly limoniform in face-view. It is restricted to woodland litter in central Europe, and is well illustrated by Breitenbach & Kränzlin (1995, pl. 314). *Panaeolus fontinalis*, from North America (Michigan), is a tall species, with a rigid, elongate stipe and similar small, non-limoniform spores.

Although it has small spores, *P. atrobalteatus* clearly belongs to the Stirps *Subbalteatus*. Its closest relative seems to be *P. subbalteatus*, also with a conspicuous marginal zone to the pileus when drying, also subfasciculate, and growing in similar habitats. Indeed it was also collected from a nearby bed at the same site, mulched with similar compost, but three months earlier and only growing in smaller numbers. It differs chiefly in the larger spores (12 — 14 µm long), but also in exhibiting red-brown rather than olivaceous tints in both the moist and dry states. Singer (1960) recognized a further species, *Panaeolus moellerianus* from the Faeroe Islands, formerly confused with *P. subbalteatus* (Møller, 1945), but distinguished on the basis of the tall stipe, the wrinkled-reticulate pileal surface, and the slightly smaller spores.

Another species requiring consideration is *P. uliginosus*, with similar spores to *P. atrobalteatus*, but this is a slender species with a small, unexpanding pileus, growing in unenriched damp grassland. According to Bresinsky (1966), the type collection has small spores, 9 — 11 µm long.

The remaining hygrophanous species, *P. acuminatus*, *P. fimicola*, *P. olivaceus*, *P. rickenii* and *P. speciosus* all have much larger spores. *Panaeolus olivaceus* is a rare species but widespread in northern locations in Europe, with a pileus which is olive-brown rather than blackish when moist. *Panaeolus speciosus*, described from Perthshire, Scotland (Orton, 1969), growing on fresh dung, has a similar though more robust habit and very large spores, measuring 14 — 20 µm long. *Panaeolus acuminatus*, *P. fimicola* and *P. rickenii* are coprophilous species with an elongate, rigid stipe and a conical to papillate pileus.

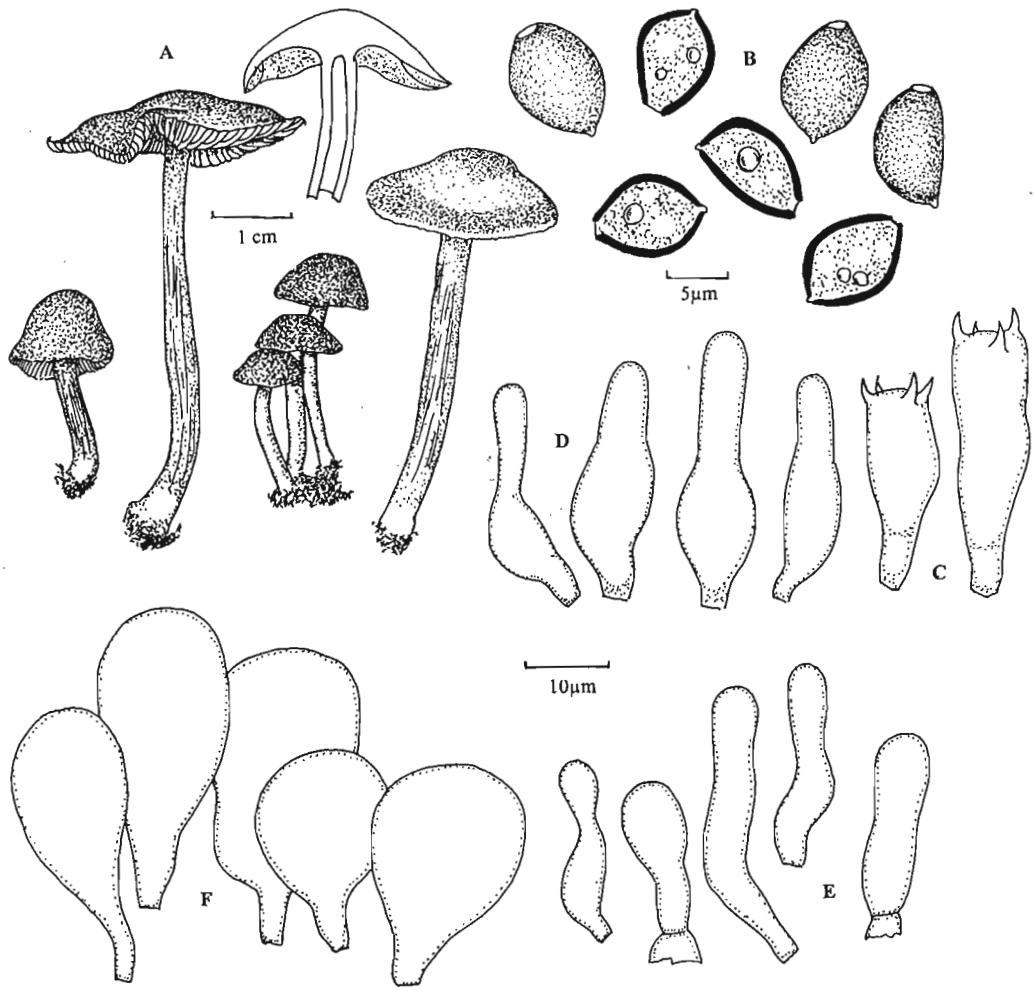

Fig. 1. *Panaeolus atrobalteatus* (K(M)55726, holotype). A, Habit and section; B, basidiospores; C, basidia; D, cheilocystidia; E, caulocystidia; F, epithelial elements.

Key to Section *Panaeolus* stirps *Subbalteatus*

1. Pileus soon expanding to convex, applanate or depressed 2
- Pileus not expanding more than to convex, 1 - 3.5 cm diam. 8
2. Spores large, 14 - 20 x 10 - 12 x 8 - 10 µm; pileus 2 - 7.5 cm diam., date brown, fading with marginal zone; on horse and sheep dung, Scotland ..... 1. *P. speciosus*
- Spores smaller, up to 14 µm long; usually on enriched soil but not on fresh dung 3
3. Basidiomata thick-set; stipe 0.3 - 0.5 cm wide, generally less than twice pileal diameter; typically fasciculate; on enriched soil, flower beds, etc.; pileus with well defined marginal belt when drying 4
- Basidiomata more slender, gregarious but never fasciculate; stipe elongate, 0.15 - 0.3 cm wide,

up to four times the pileal diameter 6
4. Spores small, 8.5 - 11 x 6 - 7.5 x 4.5 - 6 µm; stipe less than twice the pileal diameter; pileus 3 - 7 cm diam., olivaceous black, drying to olivaceous buff; England ..... 2. *P. atrobalteatus*
- Spores larger, up to 14 µm long; pileus 1.5 - 5 cm diam., with brick-red to chestnut brown tints, drying to clay-buff, but usually retaining colour of moist pileus at margin; North temperate 5
5. Spores 11 - 12 (- 14.5) x 8 - 8.5 µm; pileus conspicuously reticulate-wrinkled; Faeroe Is., Atlantic ..... 3. *P. moellerianus*
- Spores 12 - 14 x 7.5 - 8.5 x 6.5 - 7.5 µm; pileus finely rugulose at most; North temperate ..... 4. *P. subbalteatus*
6. Spores 11 - 14 x 7 - 8 µm; pileus dull grey brown, often subpapillate; on manured pastures; North temperate (chrysocystidia present and spores with oblique germ-pore, see *P. ater* (J. E. Lange) Kühner & Romagn.) ..... 5. *P. fimicola*
- Spores up to 11 µm long 7
7. Pileus conical, subpapillate, dark brown, with concentric zoning, not expanding; spores 9 - 11 x 6 - 8 µm; in wet grassland, Europe ..... 6. *P. uliginosus*
- Pileus conical soon expanding, dark olive brown paling to greyish olive, pruinose; spores 7 - 9 x 4 - 5 µm; North America ..... 7. *P. fontinalis*
8. Pileus dark olive brown paling to greyish beige, with a striate margin; stipe up to twice the pileal diameter; spores 12 - 15 x 8 - 10 x 7 - 8 µm; Europe ..... 8. *P. olivaceus*
- Pileus dark reddish brown, devoid of olive tints; stipe elongate, up to four times the pileal diameter; on manured grassland; North temperate 9
9. Pileus constricted towards apex, at times papillate; spores 12 - 15 x 9 - 11 x 7 - 9 µm ..... 9. *P. acuminatus*
- Pileus paraboloid, not constricted, blackish brown; spores 13 - 16 x 9.5 - 11.5 x 7 - 9 µm ..... 10. *P. rickenii*

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Tyromyces sibiricus nov. sp.

Tatiana Penzina[1] and Leif Ryvarden[2]

[1]Siberian Institute of Physiology and Biochemistry of Plants, P.O. Box 1243, 664 033 Irktusk, Russia. E. mail: maxp@max.irk.ru

[2]Botany department, University of Oslo, P.O. Box 1045, Blindern, N-0316 Oslo, Norway. E-mail: leif.ryvarden@bio.uio.no

Abstract: *Tyromyces sibiricus* Penzina & Ryvarden is described based on a collection from a living *Populus suaveolens* in the Baikal area, Siberia, Russia. The species is characterized by a villose, orange to light brown upper surface, tiny pores and globose basidiospores.

INTRODUCTION

During collecting in the Barguzin range in the Baikal area of Siberia, one of us (T.P) came across a soft, pale orange, applanate and villose polypore of unknown identity causing white rot in the host. A microscopical examination revealed a monomitic hyphal system and globose to subglobose non-amyloid basidiospores. From this it was evident that the species belonged in *Tyromyces*. A search in available literature based on all names published in the genus (see Bondartsev, 1953; Gilbertson & Ryvarden, 1986-87; Ryvarden & Gilbertson, 1993-94; Zhao & Zhang, 1992; Núñez & Ryvarden, 1998) gave no clue to its identity and herewith it is described as new.

DESCRIPTION

Tyromyces sibiricus Penzina & Ryvarden nov. sp.

Fructificatio lignicola, spathulata vel flabelliformis, pileus villosus, pallide brunneus ad cinereus, pori fascies albida, pori angulati, 2-3 per mm, contextus albus, systema hypharum monomiticum, hyphae generatoriae fibulatae, 3-5 µm in latae, basidiae claviformes 10-20 µm longae, basidiosporae crassetunicatae, leves, non-amyloideae, globosae, 4.5-5 µm in diametero.

Holotype: Russia, Baikal, Siberia, in the dark taiga zone of Barguzin range (700-1700 m), along the Frolikcha mountain river. Coll.T. Penzina 176, 4. August, 1996. Herb O, isotype in K.

Basidiocarp annual, sessile, broadly attached or dimidiate with contracted base; fleshy and flexible-soft when fresh, fragile when dry and rather light in weight, single or imbricate, pulvinate to applanate, up to 7(12) x 12(20) x 4(6)cm; upper surface pink to pale orange when young, quickly paling to ochraceous-buff in dry or old specimens; tomentose or velutinate in young specimens becoming hispid and radially fibrillose with age, azonate; margin broad and involute, velutinate in young, narrow and hirsute when old or dry; pore surface lemon-yellow-white when young to cream-white when dry or old; pores circular to slightly angular and thin-walled, 4-5 per mm, in parts with slight lacerate dissepiments; context white to pale cream, with radial fibre direction and rough fibrillose when dry; tube layer concolorous with pore surface, up to 10 mm thick.

Hyphal system monomitic, generative hyphae with clamps at the septa, thin- to slightly thick-walled, 3-5 µm wide in the trama, thin to very thick-walled and 3-10 µm in the context, some hyphae thick-walled and without clamps for over 300 µm, and thus they can be interpreted as intercalary skeletal hyphae.

Basidia collapsed in the type.

Basidiospores globose, thin-walled and with a large oil drop making many basidiospores appear thick-walled, non-amyloid, 4.5-5 µm in diameter.

Type of rot. White rot in living *Populus suaveolens*.

Ecology. On living *Populus suaveolens* in a forest with *Populus* and *Chozenia arbutifolia*.

Distribution. Known only from the type locality

(see above).

Remarks. The type locality is situated in an area with fairly high precipitation (annual precipitation 700-1000 mm) and favorable climate due to many hot-water springs. The species was present at the base of the living tree from the end of July to mid August.

The closest relative seems to be *Tyromyces kmetii* (Bres.) Bondartsev & Singer which is also orange to apricot coloured in living specimens. However, this species has ellipsoid basidiospores (4-4.5 x 2.5-3 µm) and a more glabrous surface, sometimes with tufts of agglutinated hyphae. Further, the contextual generative hyphae have distinct, stout, short sidebranches of a type not seen in *T. sibiricus*.

T. subgiganteus (Berk. & Curt.) Ryvarden, known only from Eastern America, has almost the same basidiospores as *T. sibiricus*, but a whitish basidiocarp which dries brown and remarkably shrunken.

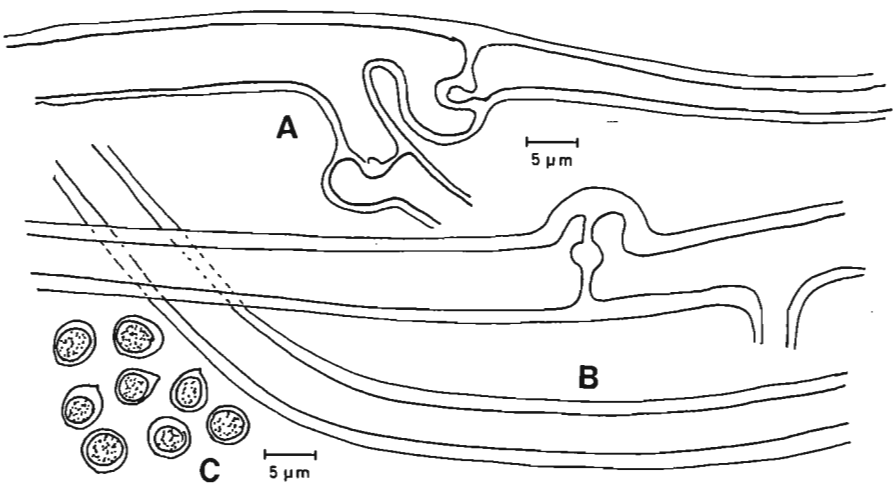

Fig. 1. *Tyromyces sibiricus*, A) generative hyphae from the context, B) generative hyphae, part of 300 um long segment without clamps (intercalary skeletal hyphae?), C) basidiospores. From the holotype.

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Peter Roberts, Royal Botanic Gardens, Kew, has kindly revised the manuscript for which we express our gratitude.

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Mating systems of three Mexican Aphyllophorales

Ronald H. Petersen[1] & Joaquin Cifuentes Blanco[2]
[1]Botany Department, University of Tennessee, Knoxville, Tennessee, 37996 USA
[2]Facultad de Ciencias, Universidad Nacional Autonoma de Mexico, Coyoacan, 14510 D.F., Mexico

Abstract: Three collections of Aphyllophorales from Mexico, *Cymatoderma caperata*, *C. dendriticum*, and *Echinochaete brachyporus* exhibit tetrapolar mating systems. Cymatoderma dendriticum produces asexual spores in culture.

INTRODUCTION

The literature on mating systems of certain groups of hymenomycetes, notably polypores and agarics, is growing, but mating systems of stereoid fungi have been less explored. The genus *Cymatoderma* has been reported from Mexico by several worker (Frutis and Guzman, 1983; Guzman and Garcia Saucedo, 1973; Guzman-Davalos, et al., 1983; Portugal et al., 1985; Weldon and Guzman, 1978; Weldon et al., 1979). Although Reid (1965) has furnished keys to the stipitate stereoid fungi, it is still difficult to arrive at an adequate identification of *Cymatoderma* taxa. Less difficult was identification of *Echinochaete brachyporus*, where the work of Núñez and Ryvarden (1995) was informative.

MATERIALS AND METHODS

Single-basidiospore isolates (SBIs) were established using the methods by Gordon and Petersen (1991). Colors reported in alpha-numeric fashion are from Kornerup and Wanscher (1978), and those within quotation marks are from Ridgway (1912).

RESULTS

3.1. Cymatoderma caperatum (Berk. et Mont.) Reid 1956. Kew Bull. 1955: 635.

° *Thelephora caperata* Berk. et Mont. 1849. Ann. Sci. Nat. Bot. III 2: 241.
° *Stereum caperatum* (Berk. et Mont.) Masser 1890. Jour. Linn. Soc. Bot. 27: 161.
° *Cladoderris caperata* (Berk. et Mont.) Pat. 1900. Essai Tax. 73.
= *Stereum hylocrater* Speg. 1884. Ann. Soc. Ci. Argent. 17: 77.
= *Stereum goliath* Speg. Am. Soc. Ci. Argent. 17: 77.

Figs. 1-3, 7.

Basidiome morphology: Basidioma substipitate to stipitate or sessile. *Pileus* up to 140 mm. broad, infundibuliform to flabelliform, greyish orange (5B3) with margin tinted greyish ruby (12D4), tough-spongy, deeply tomentous (up to 6 mm deep) or strigose to almost smooth at or near margin, sulcate to folded, with knifelike ridges more evident when dried, margin wavy when mature. *Hymenophore* smooth to slightly folded, pale yellow (4A2), sometimes greyish magenta (13D4) toward margin. *Stipe* 10-20 x 6 -15 mm, cylindric, concolorous to pileus, smooth, with a spongy-tomentous basal pad. Lignicolous on dead wood; Mesophytic Montane Forest. Micromorphology: *Basidiospores* (Fig. 1) 9-12.5 x 4.5-5.5 µm, subcylindrical, hyaline, inamyloid, smooth, thin-walled. *Basidia* 22-27 x 5-7 µm, cylindrical, hyaline; sterigmata 4. *Gloeocystidia* (Fig. 2) 25-30 x 3-4.5 µm, flexous ventricose-cylindrical, sometimes mucronate, emergent up to 20 µm from hymenial surface. Context dimitic; hyphae hyaline to yellowish, thin- to thick-walled, unbranched to branched, frequentlyclamped, tightly irregularly interwoven. Epicutis with loosely interwoven brownish hyphae and scattered hyphal tufts (Fig. 3); hyphae yellow-brown, thick-walled (wall often obscuring cell lumen).

Culture morphology: colonies white, loosely cottony, variable in quantity of aerial mycelium from sparse to finely cottony, not zonate; odor of old cigarette ashes or soil under hayfield. Hyphal differentiation: 1) aerial hyphae very slender (2-3.5 µm diam), flagelliform but not skeletal, clamped when appropriate; 2) in compatible pairings, dikaryon hyphae often stouter (2.5-5 µm diam), conspicuously clamped, with

side branches clamped at origin; 3) aerial hyphae often delicately incrusted with small, amorphous crystals, and agar-surface hyphae occasionally heavily incrusted. No evidence of asexual propagules was seen.

Mating system: When 12 SBIs were paired in all combinations, a tetrapolar mating system was revealed (Fig. 7). Isolates 8, 13* = A_1B_1; 15, 18* = A_2B_2; 11*, 16, 19 = A_1B_2; 7*, 10, 12, 14, 17 = A_2B_1.

Subordinate mating types were assigned based on pairings 8/13 x 11/16/19, an ill-defined flat indicative of common-A; 15/18 x 7/10/12/14/17, ill-defined flat plus lethal reaction also indicative of common-A. This analysis was not perfect, but especially 8/13 x 11/16/19 seemed relatively inequivocal.

Contact zone morphologies were as follows: 1) overgrown, undifferentiated in compatible and incompatible pairings; 2) ill-defined flat morphology with vague crevasse, sometimes accompanied by lethal reactions in common-A pairings; 3) ill-defined barrage, with some increased branching of aerial hyphae within contact zone, but not patterned. In one pairing (15 x 17) scattered clamps were observed on agar-surface or barely aerial hyphae, as though in a localized compatibility syndrome (Petersen and Ridley, 1996), perhaps patterned as common-B.

Commentary: The specimen for which a mating system is reported combines the following characters: 1) stipitate from a basal pad (not a sclerotium); 2) hispid to hispid-wooly tomentum on upper pileus surface from middle to over attachment (smoother outward); 3) truly infundibuliform stature; 4) upper surface not thrown up into knife-edge ridges; 5) basidiomata snow white with dull pallid lavender zone near the margin; 6) hymenial surface smooth, not in radiating or dichotomous ridges; 7) dimitic hyphal construction without gloeoplerous hyphal system; 8) generative hyphae not inflated; 9) clamp connections present; and 9) absence of cuticle and metuloids.

It seems clear that the specimen is *C. caperata* according to Welden (1960), although the hairy

	A_1B_1		A_2B_1					A_2B_2		A_1B_2		
	13	8	10	7	12	17	14	15	18	19	11	16
13		-	L-	-	-	L-	-	+	+	+	-	-
8	-		-	-	-	L-	-	+	+	-	-	-
10	L-	-		-	-	-	L-	L-	-	+	+	+
7	-	-	-		L-	-	-	L-	-	+	+	+
12	-	-	-	L-		L-	-	F-	-	+	+	+
17	L-	L-	-	-	L-		L-	L+	-	+	+	+
14	-	-	L-	-	-	L-		-	-	+	+	+
15	+	+	L-	L-	F-	L+	-		-	-	-	-
18	+	+	-	-	-	-	-	-		-	-	-
19	+	-	+	+	+	+	+	-	-		-	-
11	-	-	+	+	+	+	+	-	-	-		-
16	-	-	+	+	+	+	+	-	-	-	-	

Fig. 7. *Cymatoderma caperatum.* Self-cross mating grid.

processes on the pileus surface seem more wooly than antler-like. Reid (1965), however, included several species under *Podoscypha*. We cannot adequately separate these genera using Reid's (1965) key and descriptions, but the species identification seems clear, and the specimens are available for examination.

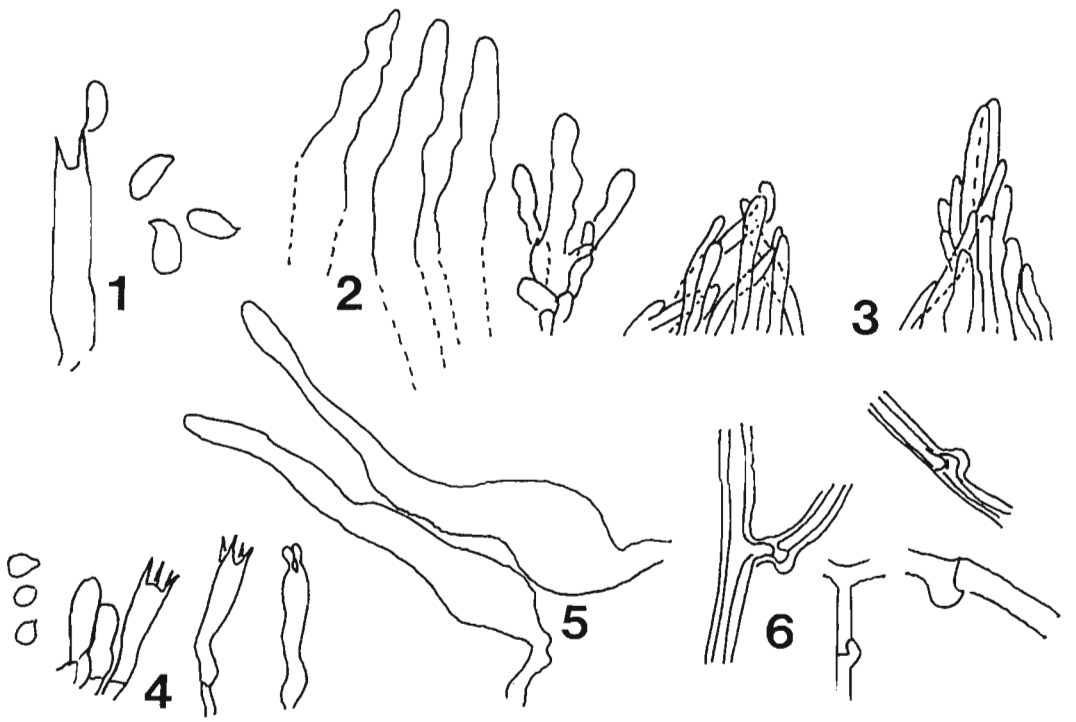
Specimens examined: EST. NAYARIT, Tepic County, km 7 detour to El Cuarenteño, Ecological Reserve Cerro San Juan, 30. VII. 1991, Ortega and Pérez-Ramírez-1379 (FCME-4601); EST. NAYARIT, slopes of Vulcan San Juan, 20.VII.96, coll. M. Rodriguez, on hardwood log, no. 8757 (TENN no. 54875). Additional sites are shown in Fig. 8.

3.2. Cymatoderma dendriticum (Pers.) Reid 1959. Kew Bull. 1958: 523.

° *Thelephora dendritica* Pers. 1827. Gaud. Voy. Uranie Bot. 176.
° *Cladoderris dendritica* (Pers.) Berk. 1842. Hooker's London Jour. Bot. 1: 152.
= *Thelephora crassa* Kunze Plantae Surinamense in Herbario Reichenbachiano.
° *Actiostoma crassa* (Kuntze) ex Klozsch in Meyen 1843. Nova Acta Akad. Caes. Leop.-Car. Nat. Cur. 19 (sup. 1): 237.
° *Cladoderris crassa* (Kl.) Fr. 1849. K. Vet. Akad. Handl. 1848: 142.
= *Cladoderris candolleana* (Lév.) 1846. Ann. Sci. Nat. Bot. III 5: 153.
= *Beccariella trailii* Cke. 1891. Grevillea 20: 33.
° *Cladoderris trailii* (Cke.) Lloyd. 1913. Mycol. Writ. 4: 5.
= *Cladoderris imbricata* Pat. 1922. Bull. Soc. Mycol. France 38: 86.
= *Stereum fenixii* Lloyd 1922. Mycol. Writ. 7: 1115.

Figs. 4-6, 9-12.

Basidiome morphology: Pileus (Fig. 9) up to 55 mm broad, spathulate to rarely dimidiate, matted/felted to deeply tomentous, "pale cinnamon pink" inward, suffused "cinnamon buff" inward,



Figs. 1-6. *Cymatoderma species.* 1-3. *C. caperatum.* 1. Basidia and spores; 2. Gloeocystidia; 3. Hyphal tufts. 4-6. *C. dendriticum.* 4. Basidia and spores. 5. Gloeocystidia. 6. Context hyphae.

tough-spongy. *Hymenophore* strongly radiately veined to folded, inward "wood brown,"outward "tilleul buff" to "pale cinnamon pink". Micromorphology: *Basidiospores* 3-4 x 2-3 µm, subglobose to broadly elliptical, hyaline, inamyloid, smooth, thin-walled. *Basidia* (Fig. 4) 19-25 x 4-5 µm, subcylindrical, hyaline; sterigmata 4. *Gloeocystidia* (Fig. 5) 70-120 x 12-15 µm, flexuous ventricous-cylindrical with acute to rounded apex, emergent up to 18 µm from hymenial surface. Context dimitic; hyphae (Fig. 6) hyaline to yellowish, thin- to thick-walled, unbranched to branched, often clamped, compactly irregularly interwoven. Epicutis interwoven; hyphae very pale to hyaline, parallel, branched, thick-walled or solid, clamped. Lignicolous on dead wood: Tropical Forest.

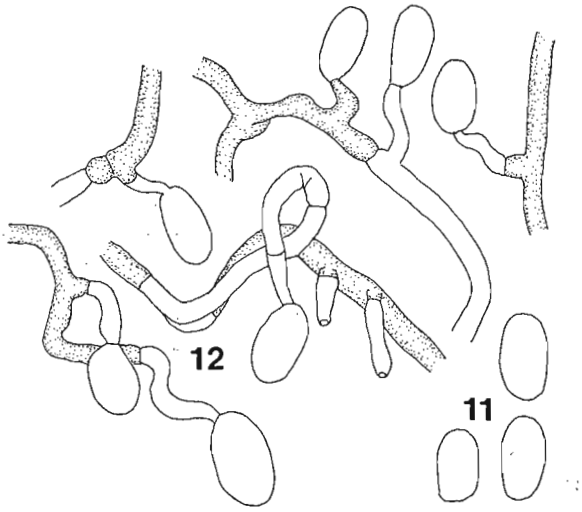
Colony morphology: Mycelial growth over 30 mm in six days, vigorous. Colonies loosely cottony, more so at margin, off-white, in age darkened to dull tan at margin, occasionally with ill-defined plumes near margin. Hyphal differentiation: Aerial mycelium composed of two hyphal types: 1) stout (4.5-7.5 µm diam), major hyphae with infrequent branching and clamp connections; and 2) slender (2.0-3.5 µm diam), as very long side branch complexes. Agar-surface and submerged hyphae not significantly different from aerial mycelium.

On some isolates, conidia were produced. Conidia (Fig. 10) broadly ellipsoid to ellipsoid, hyaline, multiguttulate, smooth, thin-walled, subtly truncate obliquely (and therefore appearing like basidiospores). Conidial production begins when a living hypha produces a side branch of varying lengths. From the branch apex a spore is blown out. The attachment of the conidium to the condiophore is narrower than the parent side branch (Fig. 11). All attached conidia were empty and dead (turgid conidia were observed separated from conidiophores), so further development could not be observed.

Mating system: When 12 SBIs were paired in all combinations, a tetrapolar mating system was revealed (Fig. 12). Isolates 1*, 3, 4, 6, 7, 11, 12 = A_1B_1; 8*, 9, 10 = A_2B_2; 2* = A_2B_1; A_1B_2

	A_1B_1							A_2B_2			A_2B_1	
	1	11	3	4	12	6	7	8	9	10	2	5
1		F	B	F	F	-F	F	+	+	+	B	-F
11	F		-F	F	F	B	F	+	+	+	F	-B
3	B	-F		-F	F	F	-B	+	+	+	B	B
4	F	F	-F		F	B	F	+	+	+	B	B
12	F	F	F	F		F	-	+	+	+	B	-B
6	-F	B	F	B	F			+	+	+	B	B
7	F	F	-B	F	-	-		+	+	+	-F	-B
8	+	+	+	+	+	+	+		-	-	-B	-
9	+	+	+	+	+	+	+	-		-	B	B
10	+	+	+	+	+	+	+	-	-		F	-
2	B	F	B	B	B	B	-F	-B	B	F		-
5	-F	-B	B	B	-B	B	-B	-	B	-	-	

Fig. 10. Cymatoderma dendriticum. Self-cross mating grid.



Figs. 11-12. *Cymatoderma dendriticum.* 11. Conidia. 12. Conidiophores and conidium production.

was not represented in the sample.

The subordinate mating type was assigned based on general barrage contact zone morphology equating to common-B. This evidence was imperfect, considering that intra-mating type pairings also showed abundant flat and barrage contact zone morphologies.

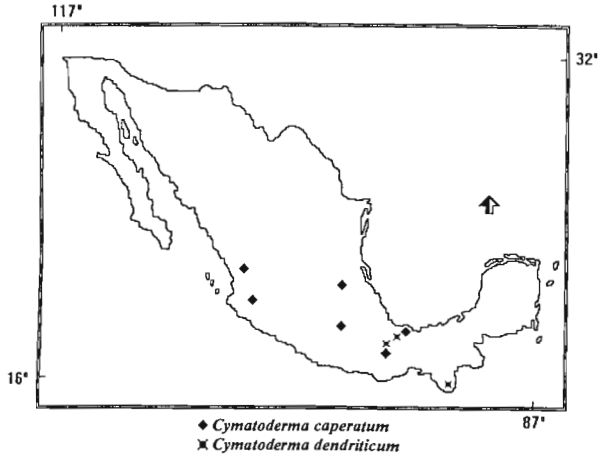


Fig. 8. Map of Mexico showing collecting sites for *Cymatoderma* species.

Barrage contact zone morphology appeared as an ill-defined transecting zone of congested hyphae. In rare instances this zone developed a narrow tan thatch. Flat contact zone morphology was observed as a narrow crevasse separating donor colonies. The crevasse was ill- to well-defined, and in cases of ill-defined crevasse, aerial mycelium over-arched the crevasse. Lethal reactions were confined to aerial hyphae, and not observed on agar-surface mycelium.

Commentary: We conjecture that asexual spores are produced in series, not singly only because the number of conidia in microscope mounts far outnumbered conidiophores. It would appear that the conidiophore does not proliferate after spore disarticulation, so the spores are not porospores. According to Hughes (1953), such spores would be blastospores, with inconspicuous hilum and non-proliferating conidiophore.

Specimen utilized: EST. CHIAPAS; vic. Tapachula, Campo de Rosario, 14° 58.266" N, 92° 09.402" W, coll. J. Cifuentes, on hardwood log, no. 3890 (TENN 55864). Additional sites are showing on Fig. 8.

3.3. **Echinochaete brachyporus** (Mont.) Ryvarden. Bull. Jard. Bot. Nat. Belg. 48: 101. 1978.

° *Polyporus brachyporus* Montagne. Ann. Sci. Nat. ser. 4, 1: 131. 1854. Fig. 13.

Basidiome morphology: Pileus laterally stipitate, deep maroon to russet, squarrose-scaly outward (perhaps yellow ochre with heavy stains); margin ivory-colored. *Pore* surface very pale buff when young, mellowing to dull cream color, and with small dark red stains. *Stipe* reticulate-glandular, concolorous with pileus. Flesh white, veiny outward, very tough. Odor none; taste none.

Mating system: When 12 SBIs were paired in all combinations, a tetrapolar mating system was revealed (Fig. 13). Isolates 6*, 19, 20 = A_1B_1; 5*, 7, 10 = A_2B_2; 11* = A_2B_1; 1, 4, 8*, 9, 21 = A_1B_2. Subordinate mating types were assigned

based on pairings 1/4/8/9/21 x 9/19/20, consistently lethal, indicative of common-A. In pairings 1 x 11, 4 x 11, and 11 x 21 very few clamp connections were found, but in all three pairings, strong lethal reactions accompanied compatibility.

No distinct flat contact zone morphologies could be identified. Lethals were plentiful and often severe, but were only consistent in the pattern identified above, on which mating types were based. In some cases, lethals were accompanied by sparse growth within the contact zone, but with no distinct borders and hyphae present within the crevasse.

Lethal reactions were clearly post-zygotic, for several pairings exhibiting strong lethals were also compatible. This is the same phenomenon as reported for *Xeromphalina* taxa by Johnson and Petersen (1997). Possible evolutionary advantages of such a strategy, in which potential compatible mates are heavily damaged or killed, remains unclear.

Colony morphology: Most SBIs formed a textura intricata after some time. Early development produced blunt antler-like processes on erect branches from agar-surface hyphae, of which the tips were brown. These hyphae interlocked and expanded to form the textura. In some instances, such stag-horn branch systems were formed, but were not blunt. As these hyphae became more numerous and intricate, a brown thatch was formed instead of textura intricata. The textura extended beyond the aerial colony margin as a hyaline textura submerged in the agar.

Most isolates caused the agar substrate to turn brown. This was reflected in brown pigment in hyphal walls, brown exudate droplets on aerial hyphae, and brown, resinous deposits submerged in the agar. In several pairings (i.e. 1 x 6, 4 x 20, 6 x 21, etc.) the agar of the contact zone was darker than the agar surrounding either donor colony.

The color of each SBI appeared to change, dictated by its mate. Thus SBI no. 1 was very dark brown in 1 x 4, white in 1 x 5, and tan in 1 x 6.

	A_2B_2			A_1B_2					A_2B_1	A_1B_1		
	5	10	7	8	9	21	1	4	11	20	19	6
5		L-	-	B-	-	-	-	-	L-	+	+	+
10	L-		-	-	-	-	-	-	-	+	+	+
7	-	-		L-	-	-	-	-	L-	+	+	+
8	B-	-	L-		L-	L-	L-	L-	+	L-	L-	L-
9	-	-	-	L-		-	-	-	+	-	-	L-
21	-	-	-	L-	-		-	-	+	-	-	L-
1	-	-	-	L-	-	-		-	+	L-	L-	L-
4	-	-	-	L-	-	-	-		+	L-	L-	L-
11	L-	-	L-	+	+	+	+	+		-	-	-
20	+	+	+	L-	-	L-	L-	L-	-		-	-
19	+	+	+	L-	-	L-	L-	L-	-	-		-
6	+	+	+	L-	L-	L-	L-	L-	-	-	-	

Fig. 13. *Echinochaete brachyporus.* Self-cross mating grid.

No pattern of colony color was found. Likewise, no pattern of lethal reactions was identified, except for that which caused assignment of subordinate mating types.

Specimen utilized: EST. MEXICO, Chapa de Mota, Quercus forest, 2600' elev., 8.VIII.96, coll. J. Cifuentes, no. 8464 (TENN no. 55293).

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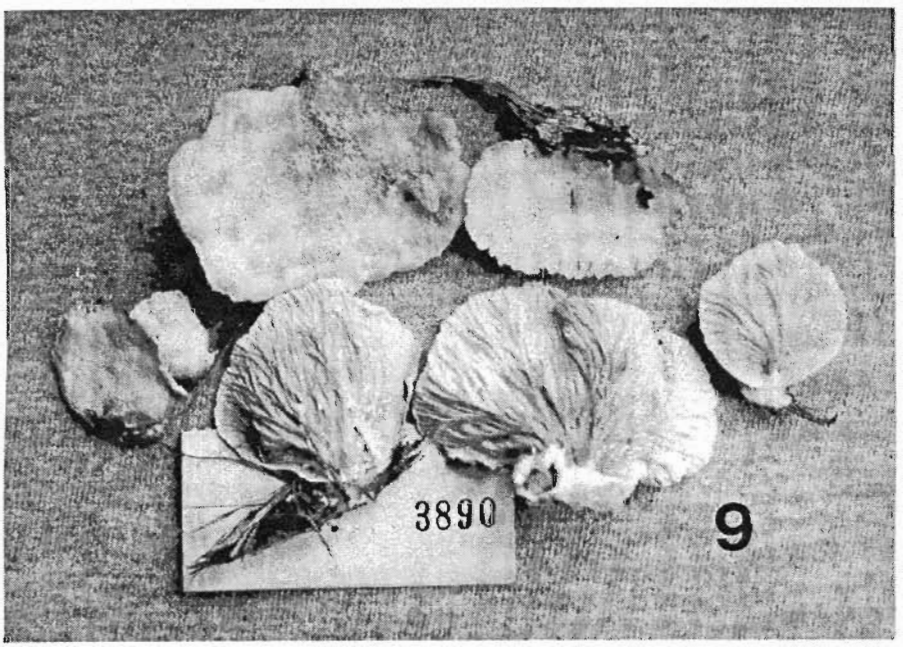


Fig. 9. *Cymatoderma dendriticum*, basidiomata. X 0.8X.

Folia Cryptog. Estonica, Fasc. 33: 119–122 (1998)

Two interesting Polypore species (Hymenochaetales) from Argentina

Mario Rajchenberg[1] & Jorge E. Wright[2]

[1]Centro de Investigación y Extensión Forestal Andino Patagónico, C.C. 14, 9200 Esquel, Chubut, Argentina
[2]Ciencias Biológicas, Universidad de Buenos Aires, Ciudad Universitaria, 2° pab. 4° piso, 1428 Buenos Aires, Argentina

Abstract: *Coltricia stuckertiana* (new combination) is found on soil in the Chaco phytogeographic region of Argentina. *Inonotus jamaicensis* is found on *Diostea juncia* and *Lomatia hirsuta* in the subantarctic forests of southern Argentina and also in the subtropical gallery forests along the Rio de la Plata estuary. Both species are described and illustrated. Cultural characteristics are provided for *I. jamaicensis*.

INTRODUCTION

Several years ago we rediscovered a *Coltricia* S. F. Gray species described by Spegazzini (1898) from northern Argentina at the turn of the century (Rajchenberg & Wright, 1987), but a paper with a full description of the species has never been published. Regular visits to the *Nothofagus*-dominated forests from southern Argentina have revealed the presence of a little known species of *Inonotus* P. Karst. Both species belong in the Hymenochaetales and are herein given full description.

MATERIAL AND METHODS

Microscopic examination of basidiocarps was made from freehand sections mounted in 5% KOH aqueous phloxine, Melzer's reagent and cotton-blue. Color names are in accordance with Munsell (1954). Herbarium abbreviations are according to Holmgren & Keuken (1974). Cultural studies were studied and described according to Nobles (1965). The species' code describing 6 wk old cultures follow the system of Nobles (1965), with the modifications summarized by Nakasone (1990).

RESULTS

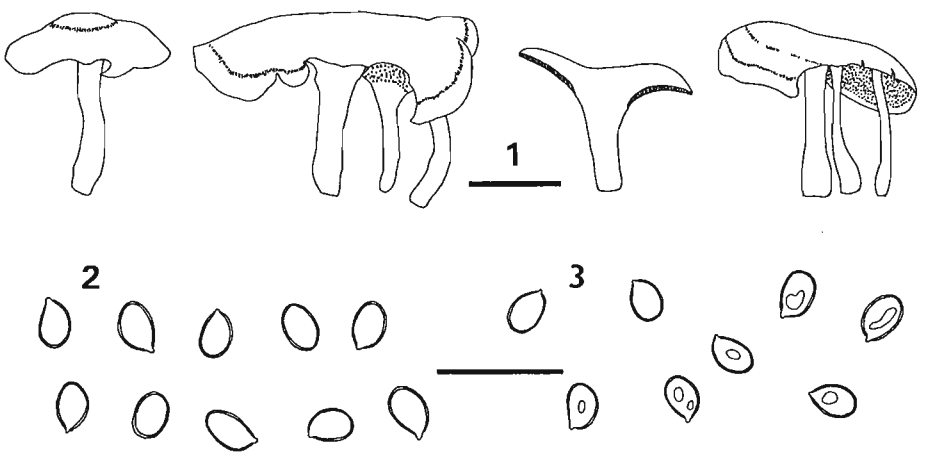
Coltricia stuckertiana (Speg.) Rajchenb. & Wright. *comb. nov.*

Basionym: *Polyporus stuckertianus* Speg., An. Mus. Nac. Buenos Aires 6: 163, 1898.
= *Polystictus chacoensis* Speg., Bol. Acad. Nac. Cienc. Córdoba 28: 378-379, 1926.
Figs. 1-3.

Basidiocarp 1-5 x 0.5-2.5 x 0.1-0.3 cm, annual, stipitate, solitary or gregarious, with one full, circular or orbicular pileus or several dimidiate, semicircular or partially circular pilei that fuse at the same or at different levels, forming a single, more or less circular pileus; the individual pilei being supported by one to several (up to 9) stipes that may be laterally fused or not. Pilei convex to infundibuliform, lobate, thin, woody to somewhat corky when dry, light in weight,. Pilear surface smoothly velutinate when young, light tobacco colored, yellow or brownish yellow (10YR 6/8), remaining so or glabrous when mature, delicately or roughly radially wrinkled, strong, dull brown (7.5YR 5/6, 5/8), reddish yellow (7.5YR 6/8) or yellowish brown (10YR 5/6, 5/8), darkening towards the margin, sometimes slightly sulcate; in some specimens it may be zonate, with 1-2 dark chestnut colored lines, becoming paler in colour towards the margin. Margin incurved, regular or lobate. Stipe central or eccentric, more rarely lateral, circular to flattened, up to 1-1.5(-2) cm long and 1-2-4(-5) mm diam., continuous below the soil surface, where it forms a rhizomorph. Context brilliant golden brown or concolorous with the pilear surface, corky or woody, 0.3-0.5 cm thick. Tubes short, up to 1(-2) mm long. Pores circular to angular, 4-6/mm. Dissepiments 35-90 µm wide.

Hyphal system monomitic. Generative hyphae simple-septate, with thin to thickened, hyaline to chestnut colored walls, 2-4(-5) µm diam. in the context; 2-3.5 µm diam. in the trama. Hairs on the pilear surface formed by branched, more or less compacted hyphae, 2-3 µm diam., septate.

Setae absent.
Basidia claviform, tetraspored, 11.5-14.5 x 4.5-5.0 µm. Basidioles subglobose to claviform, 10.5-14.5 x 4.0-6.0 µm.
Basidiospores broadly ellipsoid to ellipsoid, pale yellow, melleous or even light chestnut, (3.5-)4.0-4.5 x 3.0-3.5 µm , thin to slightly thick-walled, IKI-, acyanophilous.
Habitat: On soil.
Common name (wichita-mataco language) "hoh'nat la'wo" (according to A. Maranta).
Material studied: ARGENTINA, Chaco, Saenz Peña, 20 km E of Saenz Peña city, leg. C. E. Gómez 1076, 24.Apr.1966 (BAFC 23764). Victorino de la Plaza, woodland located 7 km NE from the route to Resistencia city, leg. C. E. Gómez 1122, 22.Apr.1966 (BAFC 23761) and C. E. Gómez 1126, 26.Apr.1966 (BAFC 23763). Chaco, track n° 8, limiting with Salta Province, in 'quebrachal-palmar' forest formation, leg. J. Morello, 17.Apr.1966 (BAFC 24536). Córdoba, '*habito serram*', leg. T. Stuckert, 1896 (Holotype of *Polyporus stuckertianus* Speg., LPS 25043). Quinta, leg. T. Stuckert, 3.May.1896 (LPS). Puesto en las Altas, leg. T. Stuckert, 14.May.1896 and 27.May.1897 (LPS). Punilla, Villa Independencia, leg. E. D. Gautier, Mar.11959 (BAFC 30503). Jujuy, between route 9 and Las Maderas dam, leg. N. Protomastro, Feb.1997. Salta, Luis Burela, on soil in 'mistol' (*Zizyphus mistol* Griseb.) woodland, leg. C. E. Gómez, 10.Apr.1961 (BAFC 30504). Rivadavia, Alto de la Sierra, Lat. 22° 44' S Long. 62° 30'W, growing among fallen leaves in underwood, leg. A. Maranta 555, 5.Feb.1984 (BAFC 30346 and 34549). Santiago del Estero, La Banda, leg. A. Mazzuchi, Mar.1921 (Lectotype of *Polystictus chacoensis* Speg., LPS 25317, Rajchenberg & Wright, 1987). La Banda, leg. A. Mazzuchi, Mar.1921 (LPS 25006 and 25007). El Copo, El Copo Reserve, in 'quebrachal' forest, leg. E. Protomastro, Apr.1986, (BAFC 30724 and 30725). Matará, Vilelas, in 'quebracho' forest, on soil associated with decayed fallen leaves, leg. M. Monasterio, 17.Feb.1966 (BAFC 23760). Tucumán, Trancas, 2 km W from Tapia town, '*ad terram in substantia putridissima immersain collinis gypseis in vegetatione chacoensi admodum xerophytica*', leg. R. Singer, 6.Jan.1952 (BAFC 24606).
Remarks: The stipitate habit, the monomitic hyphal system and the yellowish spores warrant the inclusion of this taxon in *Coltricia* S. F. Gray. It is distinct on account of the combination of medium-sized pores, small yellowish to pale brownish spores and lack of setae. It is restricted to the subxerophytic Chaco forests of Argentina and Paraguay and probably found in the same similar ecological areas in southern Brazil. *Coltricia pyrofila* (Wakef.) Ryvarden has similar spores, but they are hyaline. This species also has larger fruitbodies (2-8.5 cm in



Figs. 1-3. *Coltricia stuckertiana*: 1, habit of the basidiocarps, bar = 1 cm. 2-3, basidiospores; 2, from BAFC 30725; 3, from BAFC 34549, bar =10 µm.

diam., to 10-30 mm thick in the center) with longer and more expanded stipes (2-6.5 cm long, 5-30 mm in diam.) and pores 2-3/mm (Sharma, 1995; Ryvarden & Johansen, 1980).

Inonotus jamaicensis Murrill, Bull. Torrey Bot. Club 31: 597, 1904.

Fig. 4.

Fig. 4. *Inonotus jamaicensis*: basidiospores from BAFC 34575, bar = 10 µm.

Basidiocarp annual, pileate, effused-reflexed, woody, with or without large, resupinate portions. Pilei imbricated or not, semicircular or elongated, broadly attached, to 3.0-4.0 x 1.5-3.0 cm, triquetrous, convex or nodulose. Pilear surface velutinate to scrupose when young, yellow to brownish yellow (10YR 6/8, 7/8) or reddish yellow (7.5 YR 6/8), turning partly or completely glabrous, the hairs collapsing or wearing out and, then, reddish brown to dark reddish brown (5YR 3/3, 3/4, 4/4, 4/6). Pores round to subgyrose, 3-4.5(-5.5)/mm. Pore surface rich brown (7.5YR 5/6, 5/8), dark brown (7.5YR 4/4) with grayish tints, brown to dark brown (7.5YR 3/2, 4/2, 5/2) or reddish yellow (7.5 YR 6/8). Context to 5 mm thick, dark reddish brown, yellowish red (5YR 3/3, 3/4, 4/4, 4/6), or dark brown (7.5YR 3/3, 3/4). Tubes to 9-10 mm long.

Hyphal system monomitic. Generative hyphae simple-septate, 2-3(-4) µm diam., with distinct, hyaline to slightly melleous walls; or (3)4-6 µm diam., with chestnut colored walls, up to 1(-1.5) µm thick walls, always with a wide lumen. *Setae* absent.

Basidia clavate to subglobose, 13-15 x 7-8 µm, with 4 small sterigmata, up to 2 µm long. *Basidiospores*, abundant, broadly ellipsoid, ellipsoid or ovoid, with one straight side, 6.5-7.3 x 4.4-5 µm (x: 6.91±0.22 x 4.77±0.22 µm, L/W= 1.45), with reddish brown, chestnut to dark melleous, thickened walls, IKI -.

Habitat: On fallen or dead, standing stems and branches of *Lomatia hirsuta* (Lam.) Diels. ex Macbr. and *Diostea juncea* (Gill. & Hook.) Miers. Associated with a white, fibrous wood-rot.

Material studied: ARGENTINA, Buenos Aires, Magdalena, Estancia «El Destino», leg. M. Rajchenberg & D. Job, 28.Aug.1984. Chubut, Lago Puelo National Park, W arm of Lake Puelo, *ca.* Los Tineos stream, on stem and branches of a dead, standing *Diostea juncea* ('retamo'), in *Austrocedrus chilensis* (D. Don) Flor. & Boutl. forest, leg. M. Rajchenberg 11172, 10.May.1996 (BAFC 34575). Chubut, Los Alerces National Park, Lake Verde, path to Lake Menéndez, ca. 50 m from the bridge on river Arrayanes, on fallen trunk of *Lomatia hirsuta* ('radal') in *Nothofagus dombeyi* (Mirb.) Oerst. forest, leg. M. Rajchenberg 11116, 9.May.1996 (BAFC 34592). Los Alerces National Park, Lake Futalaufquen, Cerro Dedal, near the beggining of the track to the top of the mountain, on fallen branch of *Diostea juncea*, leg. M. Rajchenberg 11230, 9.May.1997 (BAFC 34591). JAMAICA, Underwood 23, Apr.1903 (NY, holotype).

Cultural studies. Strains CIEFAP Forest Research Center culture collection: n° 192 (from fruitbody tissue of BAFC 34575), n° 193 (from associated wood-rot of BAFC 34575), n° 194 (from fruitbody tissue of BAFC 34592).

Macroscopic features: Growth rapid, mycelium covering the dish at week 4. Mycelial mat abundant, homogeneously felty in all the dish or felty to woolly in the advancing mycelium and subfelty backwards, with felty streaks of mycelium reaching the inoculum. Margin felty, woolly or densely felty to woolly. Mat brownish yellow, reddish yellow or yellow (10YR 6/8, 7.5YR 7/8, 10YR 7/8) or very pale brown o pale yellow (10YR 7/4, 8/4, 2.5Y 8/6). Reverse bleaching, but developing beige, yellowish or light chestnut areas. Dark chestnut lines, crustose areas and/or fan-shaped spots or streaks not wider than 5 mm diam. may develop, that are hardly visible from the anverse because of abundant mycelium. Odor none.

Oxidase reaction: Gallic ac.: + to +++, growth traces; tannic ac.: +++, growth 15 mm; tyrosinase: - to +, growth 0 mm.

Microscopic features: Aerial mycelium formed with simple-septate, branched generative hyphae, with thin to slightly thickened, hyaline to slightly melleous walls, 1-6 µm diam., and fiber hyphae 1-4 µm diam., abundant, rarely branched, with thickened, light chestnut, rarely hyaline, walls, with/without a lumen. Fiber hyphae scarce on the agar surface; generative hyphae to 10 µm diam., but then devoid of cytoplasm. Some sclerified hyphae, 5-6 µm diam. develop on the aerial mat. Submerged mycelium with generative hyphae 2-5 µm diam. that are tortuous, hyaline, and develop digitiform, lateral processes or branches; fiber hyphae absent. Dark chestnut lines or crustose areas formed by a plechtenchyma made up of simple-septate, tortuous, much branched and entangled hyphae, with hyaline, melleous or dark chestnut walls, 1.5-3 µm diam.; all hyphae developing from generative that form much branched, lateral and curled branches with walls progressively chestnut in colour. Some wide, septate hyphae with thickened, chesnut walls also occur.

Species Code: 2.6.8.11.32.37.39.40.44.54.

Remarks: *Inonotus jamaicensis* is a little known species so far recorded and described from Jamaica (Murrill, 1904), Tristan da Cunha (Reid, 1955) and Arizona, USA (Gilbertson & Ryvarden, 1987). Our specimens fit well the descriptions, as well as the holotype at NY. The species is characterized by the ellipsoid, thick-walled, reddish brown spores, the lack of setae and the encrusted pilear surface. The pilei may present a black layer under the pilear surface.

ACKNOWLEDGMENTS

We are thankful to Dr. Leif Ryvarden (Oslo University, Norway) and Dr. Michael Larsen (USDA Forest Service, Rocky Mountain Res. St., Moscow, Idaho, USA) for critically reviewing the manuscript. L. Ryvarden also suggested *I. jamaicensis* as the possible name of specimens herein studied and provided useful literature. Ing. P. E. Guerra (CIEFAP Forest Research Center, Esquel) kindly confirmed the substrates through anatomical studies. The authors are members of the "Carrera del Investigador", National Research Council of Argentina (CONICET).

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Tyromyces fumidiceps – an addition to the polypore flora of North Europe

Pertti Renvall[1] and Jani Kaaro[2]
[1]Kuopio Natural History Museum, Myhkyrinkatu 22, FIN-70100 Kuopio, Finland
[2]Äppeltorp, FIN-10480 Antskog, Finland

Abstract: *Tyromyces fumidiceps* G. F. Atk., a wood-decomposing polypore (Basidiomycetes), is reported as new to Fennoscandia. It was found on a fallen trunk of *Alnus glutinosa* in Tammisaari, SW-Finland. The species is shortly described and compared with *Tyromyces canadensis* Overh. ex J. Lowe (*Antrodiella overholtsii* Ryvarden & Gilb.) and *T. galactinus* (Berk.) Bondartsev.

INTRODUCTION

Tyromyces fumidiceps G. F. Atk. is a wood-decomposing polypore which has a wide distribution in the eastern United States and Canada (Lowe, 1975; Gilbertson & Ryvarden, 1987). In Europe only a few localities are known. It is reported from Bielorussia, the former Czechoslovakia, France and the former Yugoslavia (David & Duhem, 1986; Ryvarden & Gilbertson, 1994; Bieri & Rivoire, 1996). Here we report *T. fumidiceps* as a new species to Fennoscandia and outline its affinities to closely related taxa.

MATERIALS AND METHODS

The study is based on a recent collection of *Tyromyces fumidiceps* from Finland (by JK) and on the microscopical examination of the type specimen and related species. The species was compared to *Tyromyces canadensis* (Overholts) J. Lowe (*Antrodiella overholtsii* Ryvarden & Gilb.) and *T. galactinus* (Berk.) Bondartsev. In addition to the type material all the specimens of these taxa were checked in the Botanical Museum, University of Helsinki (H) and in the personal herbarium of Tuomo Niemelä (Helsinki, abbreviated as T.N.).

SPECIMENS EXAMINED

Tyromyces fumidiceps G. F. Atk.

Finland. Uusimaa: Tammisaari, Skogby, Lilledamme, fallen trunk of *Alnus glutinosa* 5.VIII.1995 Kaaro *68*, (KUO), 29.VIII.1995 Kaaro *79* (from the same trunk as Kaaro *68*; KUO).
U.S.A. Florida: Alachua, 1938 Murrill *15261* (Isotype of *Polyporus avellaniealbus* Murrill *US0203591*, BPI), Arkansas, Weir (Holotype of *Polyporus smaragdinus* Lloyd, *US220940*, BPI) New York: Cayuga Lake Basin, Ithaca Flats, 24.VIII.1907, Humphrey (Holotype, CUP-A *22073*). Onondaga, Bridgeport, 3.IX.1979 Lowe *15883* (T.N.)

Tyromyces canadensis Overh. ex. J. Lowe
Canada. Ottawa: Dow's Swamp, 16.IX.1933 Groves *16860* (Isotype, T.N.)
Finland. Pohjois-Karjala: Lieksa Penttilä *1321* (T.N.), Perāpohjola: Rovaniemen maalaiskunta (Kujala *4260*, T.N.)
U.S.A. New York: Newcomb (Lowe *3361*, Lowe August 1947), Warrensburg (Lowe *2357*, Smith *762*)

Tyromyces galactinus (Berk.) Bondartsev
U.S.A. Ohio: Waynesville (Isotype, *US0214438*, BPI), Connecticut: East Hartford, 1903 Hanmer (*US0214435*, BPI)

The microscopical examination, the drawings and the writing of the text were done by the author Renvall. Microscopical characters were studied at magnifications up to x 1250 by using a Leica DMLS microscope and a phase contrast illumination. Drawings were made with the aid of a drawing tubus. In the text the following abbreviations are used: L = the mean spore length (arithmetical mean of all the spores, in µm), W = the mean spore width (arithmetical mean of all the spores, in µm), Q = quotient of the mean spore length and the mean spore width (L/W ratio; variation of the specimen means), (n = x/y) = x measurements of spores from y specimens. IKI refers to Melzer's reagent, CB to Cotton Blue and KOH to 5% po-

tassium hydroxide. CB– means acyanophilous, IKI– with neither amyloid nor dextrinoid reaction.

For each (fertile) specimen 30 basidiospores were measured. In presenting the variation of the spore size, 5% of the measurements have been excluded from each end of the range, and are given in parentheses. Basidia and cystidioles were measured to the nearest 0.5 µm. Spores were measured in CB from sections cut from the tubes. Basidia and cystidioles were measured in KOH. CB was used in drawing the figures.

RESULTS AND DISCUSSION

Tyromyces fumidiceps G.F. Atk. Ann. Mycol. 6: 61, 1908 (CUP!) (Fig. 1)

Polyporus smaragdinus Lloyd, Myc. Writ. 5: 818, 1919 (BPI!; PAC).

Tyromyces avellaniealbus Murrill, Torrey Bot. Club Bull. 65: 657 1939 (FLAS; BPI!; SYRF).

Good descriptions of the species have been given, e.g., by Lowe (1975) and Ryvarden & Gilbertson (1994). A more detailed microscopical description with notes on the Finnish material is presented below.

Hyphal structure monomitic. Generative hyphae hyaline, thin-walled, IKI- and CB-, with frequent cross-walls and clamp connections.

Context: Hyphae 2.5-5.3 µm in diam, with numerous short side branches (1.5-2.5 µm in diam), mostly radially arranged in bundles but among them plenty of interwoven, more randomly oriented hyphae, usually without encrustation, but some hyphae variably encrusted, thorn-like type of encrustasion (Keller, 1979) seen in all the specimens studied, some hyphae covered with oily globules. Without distinct basal layer. Upper surface made up of a few collapsed, more densely packed hyphae and dirt.

Tubes: Hyphae slightly interwoven to subparallel, occasionally to frequently branched, somewhat thinner than in context, with clusters of crystalloid elements, exuding oily substance (seen especially well in CB;). Hymenium uneven, consisting of cells of several sizes and types. Basidia clavate to almost pyriform, basally clamped and with four sterigmata, 10-15 x 5-6 µm, basidioles somewhat smaller. Cystidia absent but non-projecting, at basal parts somewhat thick-walled, hyphoid, subulate or fusoid cystidioles frequent, 8-12 x 2.5-4 µm.

Basidiospores numerous, ellipsoid to ovoid, thin-walled, smooth, with an oildrop, IKI-, CB-, (3-)3.1-4.1 x 2.1-2.9 µm, L = 3.5, W = 2.5, Q = 1.34-1.48 (n = 150/5).

Notes on the Finnish material

The Finnish material of *Tyromyces fumidiceps* accords well with the earlier descriptions of the species. Like the North American collections also the Finnish specimens derive from an annually flooded area. They mostly consist of resupinate fruit bodies but a few 2-3 cm wide semicircular pilei with greyish upper surface were also present. When fresh the greenish to olive tint of the pore surface and the fragrant lemonlike scent attracted attention. In dry condition the fragile and lacerated tubes were characteristic.

Also in the microscope the Finnish material is almost identical with the North American specimens. All the specimens exude coagulating substance which gives the mount (especially in CB) characteristically oily and messy appearence. The hyphal structure as well as the hymenium are alike. In addition, spores measure 3.2-4.1 x 2.1-2.9 µm, L = 3.6, W = 2.4, according well with the variation of the holotype (3.2-3.9 x 2.1-2.9 µm, L = 3.6, W = 2.6).

Identification

In the field *Tyromyces fumidiceps* reminds many species of *Tyromyces* P. Karst. or *Postia* Fr. Its basidiocarps are annual, mostly white and soft. However, the greenish tint of tubes, the fragrant scent and the lacerated tubes separate it from such species as *Tyromyces chioneus* (Fr.) P. Karst. and *Postia tephroleuca* (Fr.) Jülich (incl. *Postia lactea* (Fr.) P. Karst.). In the microscope uneven hymenium, monomitic hyphal structure, short side branches of contextual hyphae, oily globules and numerous small spores confirm the identification. As pointed out already by Lowe (1975) old herbarium specimens of *Tyromyces fumidiceps* are often almost totally covered by whitish crystals. This striking feature is evidently due to the oily substances of basidiocarp.

Tyromyces canadensis (see the description by

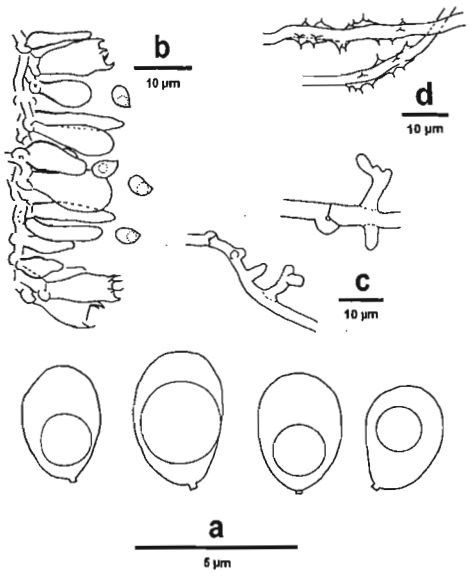

Fig. 1. *Tyromyces fumidiceps* G. F. Atk., specimens *Kaaro* 79 (a, c), *Lowe* 15883 (b,d). - a: Basidiospores. - b: Basidia, basidioles and cystidioles. - c: Side branches of generative hyphae from context. - d: Encrusted generative hyphae from context.

Niemelä, 1985) seems to be the closest relative of *T. fumidiceps*. Externally the former can be fairly easily identified by its thinner basidiocarps which have constricted base, striate upper surface and inrolled margin. In addition, the tubes of *T. canadensis* are pale ochraceous to toffee-coloured and totally lack the faint greenish tint typical to *T. fumidiceps*.

In the microscope, however, these species are almost identical. Both are monomitic, have characteristic contextual hyphae with short finger-like side branches and small, shortly ellipsoid spores. In *T. canadensis* spores measure 3.2-4 x 2.2-3 µm, L = 3.6, W = 2.6, Q = 1.33-1.41 (n = 60/2). Even the cystidioles with slightly thickened walls at basal parts are almost alike. The species can be, however, identied by the characteristics of the tube trama. In *T. canadensis* trama is made up of generative hyphae which are tightly glued together, run more parallelly than in *T. fumidiceps* and lack the side branches characteristic for *T. fumidiceps*. In addition, unlike *T. fumidiceps*, *T. canadensis* does not exude oily substance.

There has been an unfortune confusion on the hyphal structure and nomenclature of *Tyromyces canadensis*. In the original description Lowe (1975) erroneously stated that the species is dimitic and there are true skeletal hyphae in the trama. His consept was adopted by Ryvarden and Gilbertson (1984, 1993) who, however, rejected the name given by Lowe as an invalid and redescribed the species as *Antrodiella overholtsii* Ryvarden & Gilb. However, as beautifully shown already by Niemelä (1985) *Tyromyces canadensis* fits *Tyromyces* better. It is a white rot fungus which has a monomitic hyphal structure and the trama consists merely of generative hyphae, while the species of *Antrodiella* Ryvarden & Johans. produce tough basidiocarps with strongly dimitic (trimitic) hyphal structure. Niemelä (1985) also showed that the description by Lowe is valid and legitimate, and *Tyromyces canadensis* Overh. ex J. Lowe is therefore the correct name for the species. This has been accepted, e.g., by Knudsen and Hansen (1997).

Tyromyces galactinus is another species closely related to *T. fumidiceps*. So far it is, however, known only from North America (Ryvarden & Gilbertson, 1994). According to Gilbertson & Ryvarden (1987) *T. galactinus* and *T. fumidiceps* have similar spores but different hyphae. In addition, the former is characterized by a white sappy context and a strigose to hispid pileus, and basidiocarps turn pale ochraceous during drying.

ACKNOWLEDGEMENTS

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Oliveonia and the origin of the holobasidiomycetes

Peter Roberts
The Herbarium, Royal Botanic Gardens, Kew, Surrey TW9 3AE, England
E-mail: p.roberts@rbgkew.org.uk

Abstract: *Oliveonia* is considered to link exidioid and corticioid fungi through an evolutionary pathway independent of the *Ceratobasidiales*, thus rendering holobasidiomycetes polyphyletic. The new family *Oliveoniaceae* is proposed to accommodate *Oliveonia* and is placed within the *Exidiales*. The new genus *Oliveorhiza* is proposed for the *Rhizoctonia*-like anamorph of *Oliveonia*. The new species *Oliveorhiza anapauxilla* is described. *Monosporonella* and *Sebacinella* are considered synonyms of *Oliveonia*, and the new combinations *O. citrispora*, *O. nodosa*, *O. termitophila*, and *Ceratosebacina calospora* proposed.

Oliveonia Donk is a genus of resupinate *Basidiomycetes* having at the same time holobasidia and self-replicating (repetitive) basidiospores. As such, it is currently assigned to the *Ceratobasidiales* Jülich (Hawksworth *et al*, 1995)., along with *Ceratobasidium* D. P. Rogers and *Thanatephorus* Donk. The genus was originally separated from *Ceratobasidium* by possessing cystidia and pyriform basidia with narrow sterigmata (Olive, 1957, as *Heteromyces* [nom. illeg.]).

Olive (1957) thought it possible that *Oliveonia* "may have evolved in the same line of evolutionary development as that which gave rise to *Ceratobasidium*", but considered it "even more likely that [*Oliveonia*] evolved by loss of basidial septation directly from a *Sebacina*-like ancestor". Reinvestigation of the genus suggests that Olive was correct, and that *Oliveonia* represents an evolutionary line independent of the *Ceratobasidiales* connecting exidioid heterobasidiomycetes with corticioid holobasidiomycetes.

Eriksson *et al.* (1979) considered *Oliveonia* "close to *Ceratobasidium*" and claimed that the difference between the basidia "is small and can hardly be used as an argument for generic separation". However, comparative examination shows that the basidia of *Oliveonia* are typically stalked, smaller than in *Ceratobasidium* (minimum width 4 - 6 µm for *Oliveonia* compared to 6.5 - 13µm for *Ceratobasidium*), and more elongated (maximum Q = 1.8 - 2.0 for *Oliveonia*, 1.2 - 1.4 for *Ceratobasidium*). This supports Olive's original diagnosis and Talbot's (1965) observation that the basidia of the two genera are distinct.

Eriksson *et al.*(1979) also claimed that "the nature of the hyphae is strikingly alike", but examination shows that the hymenial hyphae of *Oliveonia* are agglutinated and narrow (1.5 - 5 µm diam.) whilst those of *Ceratobasidium* are open and typically wider ((1.5 -) 3 - 9 µm diam.). The septal pore ultrastructure of *Oliveonia* species has never been investigated, but *Monosporonella termitophila* Oberw. & Ryvarden, a species known from a single collection from the interior of an old termite mound in Zambia, appears to be congeneric with *Oliveonia* and is said to have septal pores with continuous parenthesomes (Oberwinkler & Ryvarden, 1991) similar to those in the *Exidiales* R. T. Moore and *Tulasnellales* Rea, but distinct from the septal pores with perforate parenthesomes found in the *Ceratobasidiales* (Langer, 1994; Andersen, 1996).

Cladistic analysis (PAUP 3.1.1) of morphological characters among holobasidiomycetous taxa with self-replicating basidiospores showed the *Ceratobasidiales (Ceratobasidium*, *Thanatephorus*, and segregate genera) forming a monophyletic clade distinct from *Oliveonia*, *Sebacinella* Hauerslev, and the isolated genus, *Heteroacanthella* Oberw. However, bootstrap and other statistical support for such a topology was absent or weak. Cladistic analysis based on molecular sequences (ITS 1 & ITS 2 of 5.8S rDNA), involving *Ceratobasidium*, *Thanatephorus* (inc. *Uthatobasidium* Donk), *Oliveonia*, and *Heteroacanthella* species, produced a similar tree in which the *Ceratobasidiales* form a monophyletic clade separate from the *Heteroacanthella-Oliveonia* clade. This disposition was supported by bootstrapping (Fig. 1).

Taken together, both the morphological and

molecular data support the separation of *Oliveonia* and the *Ceratobasidiales*, as does what little is known of the ultrastructure. Further evidence is provided by examination of genera which appear similar to *Oliveonia* and the *Ceratobasidiales*. *Oliveonia*, and in particular *O. pauxilla* (H. S. Jacks.) Donk, shows a marked resemblance to *Endoperplexa* P. Roberts, and in particular *E. enodulosa* (Hauerslev) P. Roberts. Morphologically, the latter species differs only in possessing septate and slightly more ovoid basidia. The agglutinated, unclamped hyphae, cystidia, and even the shape and size of the basidiospores are indistinguishable. Examining the two species side by side it would be difficult to draw any conclusion other than that they are closely related (Fig. 2). Both species additionally produce a *Rhizoctonia*-like anamorph in culture, similar to *R. globularis* Saksena & Vaartaja, now referred to *Opadorhiza* T. F. Andersen & R. T. Moore. The two anamorphs are morphologically indistinguishable.

In the *Ceratobasidiales*, a similar close relationship can be demonstrated between the type species of *Ceratobasidium*, *C. calosporum* D. P. Rogers, *Tulasnella deliquescens* (Juel) Juel, and *Ceratosebacina longispora* (Hauerslev) P. Roberts (together with its unclamped counterpart, *Ceratosebacina calospora**). All species in this "calospora complex" share a similar hymenial morphology, similar hyphae, and unusual and distinctive basidiospores which are indistinguishable between the taxa (Fig. 3). The sole morphological difference lies in the basidia, a difference which currently places the four species in three different orders. Again, it is difficult to draw any conclusion other than that the taxa in the "calospora complex" are closely related.

The hypothesis suggested by the foregoing, and supported by the evidence to date, is that *Oliveonia* is derived from an ancestor in *Endoperplexa*, whilst *Ceratobasidium* (and, as a side-branch, *Tulasnella* J. Schröt.) is derived from an ancestor in *Ceratosebacina* P. Roberts. The transition from septate basidia to holobasidia thus occurred along at least two separate pathways.

It seems probable that these pathways have in turn led to separately derived groups of corticioid fungi. The *Ceratobasidiales*, and in particular *Thanatephorus*, have been considered ancestral to the corticioid genus *Botryobasidium* Donk (Langer, 1994), whilst *Oliveonia* has been linked to *Repetobasidium* J. Erikss. (Oberwinkler, 1982). The ramifications of these separate pathways deserve further study.

The nomenclature of *Oliveonia* is briefly reviewed, as follows.

Oliveoniaceae P. Roberts fam. nov.

Basidiomata effusa, ceracea. *Hyphae* agglutinatae, fibulatae vel efibulatae, doliporis parenthesomatibus continuis. *Cystidia* praesentia vel absentia. *Basidia* aseptata, laevia. *Basidiosporae* inamyloideae, per repetitionem germinantes. *Typus familiae*: *Oliveonia* Donk.

Having been excluded from the *Ceratobasidiales*, *Oliveonia* is here referred to the *Exidiales*, based on its septal pore ultrastructure and close morphological resemblance to *Endoperplexa*. The new family *Oliveoniaceae*, typified by having dolipores with continuous parenthesomes, self-replicating basidiospores, and smooth, aseptate basidia, is proposed to accommodate the genus.

Oliveonia Donk, *Fungus* 28: 20 (1958).

Sebacinella Hauerslev, *Friesia* 11: 95 (1976).
Monosporonella Oberw. & Ryvarden, *Myc. Research* 95: 377 (1991).

Anamorph: **Oliveorhiza P. Roberts gen. nov.**

Opadorhiza similis, hyphae moniliformes efferens, sed teleomorphosa *Oliveonia*.
Typus generis: *Oliveorhiza anapauxilla* P. Roberts.

Hymenium: dense, at least when young, comprising one or more layers of basidia, with scattered cystidia in the type species, arising from narrow, agglutinated, subhymenial hyphae. *Hyphae:* binucleate (where known), 1.5 - 3 µm diam. in the hymenium, thin-walled, often agglutinated, with or without clamp-connexions; subicular hyphae sometimes wider, up to 5 µm diam., with slightly thickened walls. *Cystidia:*

***Ceratosebacina calospora (Bourdot & Galzin) P. Roberts comb. nov.**
Exidiopsis calospora Bourdot & Galzin, *Bull. Soc. Myc. France* 39: 263 (1924).

if present, tubular, obtuse, up to 100 µm long with age, but more frequently 10 - 20 µm long and inconspicuous, thin-walled, hyaline, projecting with age. *Basidia:* globose to widely clavate (Q = 1.0 - 2.0), 5 - 14 x 4 - 10 µm, narrowly stalked, pleural (arising laterally from the hymenial hyphae) in young or thin basidiomes. *Sterigmata:* 1 - 4, up to 10 µm long. *Basidiospores:* subglobose to oblong or citriform, producing secondary spores by replication.
Type species: *Oliveonia fibrillosa* (Burt) Donk.

Heteromyces L. S. Olive, the original name for the genus, is a homonym of *Heteromyces* Muller, 1889, and hence illegitimate. The name *Oliveonia* was proposed by Donk (1958) to replace it. The genus *Metabourdotia* L. S. Olive was proposed at the same time as *Heteromyces* for a species similar to *O. fibrillosa*, but said to have partially septate basidia. The type and only specimen has been re-examined and appears identical to *O. fibrillosa*, no septate basidia having been found. However, it seems best to treat *Metabourdotia* as a *nomen dubium*, unless and until further collections are made. If *Metabourdotia* were considered synonymous with *Oliveonia*, its name would have priority.
Monosporonella was proposed to accommodate a single specimen of a monosterigmate species found inside an old termite mound. Re-examination of this specimen shows that it differs from *O. pauxilla* only in having monosterigmate basidia, and *Monosporonella* is here considered a synonym of *Oliveonia*.
Sebacinella was proposed to accommodate two species similar to *Oliveonia*, but lacking cystidia. The genera are here considered synonymous.

Oliveonia citrispora (Hauerslev) P. Roberts comb. nov.

Sebacinella citrispora Hauerslev, *Friesia* 11: 96 (1976).
Oliveonia citrispora is distinguished by its narrow, clamped hyphae, lack of cystidia, and variously citriform basidiospores.

Oliveonia fibrillosa (Burt) Donk, Fungus 28: 20 (1958).

Sebacina fibrillosa Burt, *Ann. Miss. Bot. Gard.* 13: 335 (1926).

Peniophora heterobasidioides D. P. Rogers. *Univ. Iowa Stud. Nat. Hist.* 17: 30 (1935).

Ceratobasidium fibrillosum (Burt) D. P. Rogers & H. S. Jacks., *Farlowia* 1: 327 (1943).

Oliveonia subfibrillosa Hallenb., *Mycotaxon* 11: 456 (1980).
Oliveonia fibrillosa is distinguished by its cystidia, clamped hyphae, and ventrally depressed, oblong basidiospores. The type description and illustration of *Peniophora heterobasidioides* shows that it is a synonym of *O. fibrillosa*, as already noted by Olive (1957). *Oliveonia subfibrillosa* was distinguished by its smaller basidiospores, but re-examination of the type collection shows that the spores fall within the normal range for *O. fibrillosa*, and the two taxa are here regarded as synonyms.

Oliveonia nodosa (Hauerslev) P. Roberts comb. nov.

Sebacinella nodosa Hauerslev, *Friesia* 11: 95 (1976).
Oliveonia nodosa is distinguished by its narrow, clamped hyphae, lack of cystidia, and small basidiospores.

Oliveonia pauxilla (H.S. Jacks.) Donk, Fungus 28: 20 (1958).

Corticium pauxillum H.S. Jacks., *Can. J. Res. C.* 28: 724 (1950).

Anamorph: **Oliveorhiza anapauxilla P. Roberts sp. nov.**

Opadorhiza globularis similis, sed teleomorphosa *Oliveonia pauxilla*. Holotypus: ex cultura pura: Anglia, Surrey, Esher Common, ex *Castanea*, 16 Nov. 1996, A. Henrici, K(M) 56241. (Type culture: KC1149)

Oliveonia pauxilla is distinguished by its cystidia, unclamped hyphae, and oblong basidiospores with a large, snout-like apiculus. Specimens isolated into culture were found to have binucleate hyphae and produced an anamorph with monilioid hyphae, said not to occur in *Oliveonia* by Sneh *et al.*(1991). This anamorph is here proposed as a new species, *Ceratorhiza anapauxilla*, distinguished from

other rhizoctonioid fungi by its teleomorph, and also by its comparatively narrow, hyaline, non-monilioid hyphae (2 - 5 µm diam.). The monilioid compartments are very variable, often globose, in short chains, and of isolated occurence, but also ellipsoid or irregular, in long chains, and occuring in large clusters. All variations may be present within a single culture.

Oliveonia termitophila (Oberw. & Ryvarden) P. Roberts comb. nov.

Monosporonella termitophila Oberw. & Ryvarden, *Myc. Res.* 95: 378 (1991).

Oliveonia termitophila is morphologically identical to *O. pauxilla*, except for its unusual monosterigmate basidia. On this character alone, the taxon is retained here as a distinct species, albeit it based on a single specimen. The substratum (inside an old termite mound) is also unusual, but it would seem probable that *O. termitophila* is generally saprotrophic, in common with the other species in the genus.

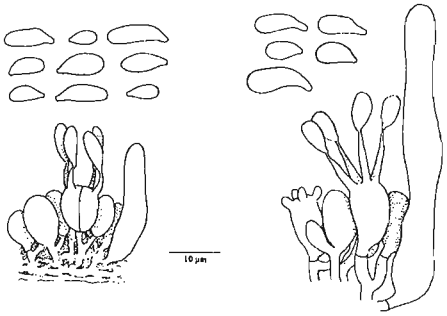

Fig. 2. *Endoperplexa enodulosa* (left) and *Oliveonia pauxilla* (right) basidiospores; hymenial sections showing basidia, cystidium, and agglutinated hyphae.

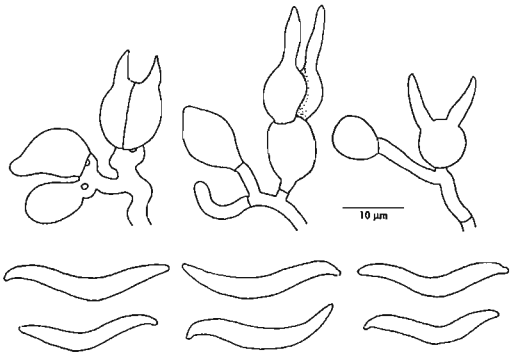

Fig. 3. The "calospora complex": (left) *Ceratosebacina longispora*, basidia and basidiospores; (centre) *Tulasnella deliquescens*, bisterigmate form, basidia and basidiospores; (right) *Ceratobasidium calosporum*, basidia and basidiospores.

KEY TO *OLIVEONIA* SPECIES

1. Hyphae with clamp connexions. Cystidia present or absent 2
1. Hyphae lacking clamp connexions. Cystidia present, though often inconspicuous 4
2. Cystidia present, though often inconspicuous. Basidiospores oblong (Q = 1.6 - 2.3), often ventrally depressed, (5 -) 6.5 - 8.5 (- 10.5) x (3.5 -) 4 - 5 (- 6) µm ..... *O. fibrillosa*
2. Cystidia absent. Basidiospores subglobose, ellipsoid, or citriform 3
3. Basidiospores citriform (appearing biapiculate), 6 - 10 x 3.5 - 8 µm ..... *O. citrispora*
3. Basidiospores smaller, subglobose to ellipsoid (Q = 1.1 - 1.6), (2.5 -) 3 - 5.5 (- 6) x 2 - 4 µm ..... *O. nodosa*
4. Basidia consistently monosterigmate ..... *O. termitophila*
4. Most basidia bearing 2 - 4 sterigmata ..... *O. pauxilla*

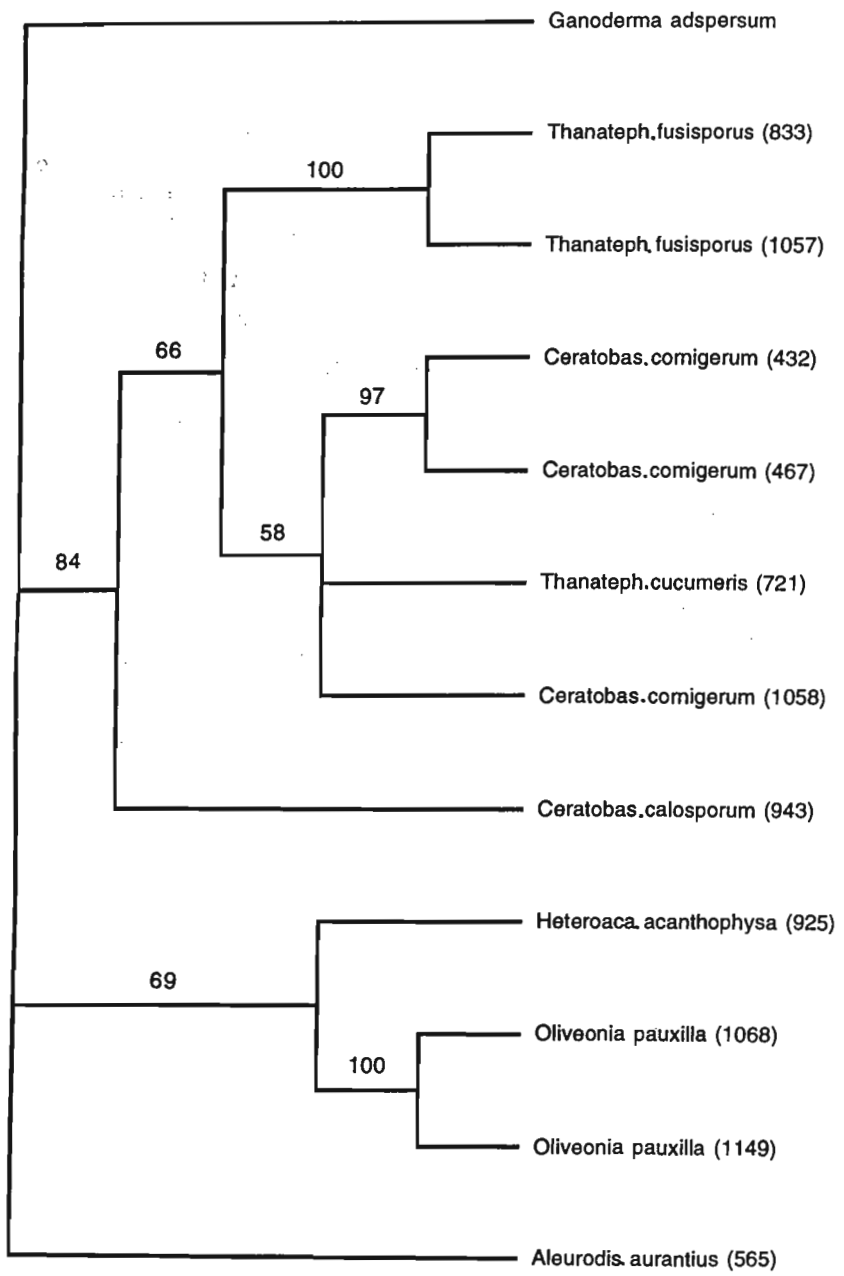

Fig. 1. Cladogram (bootstrap analysis, 1000 replicates, *Ganoderma* as outgroup) derived from ITS 1 & ITS 2 rDNA sequences. *Ceratobasidium-Thanatephorus* and *Heteroacanthella-Oliveonia* appear as separate clades. Numbers indicate percentage bootstrap support. (*Aleurodiscus aurantius* was included because morphological similarities suggested a possible relationship with *Heteroacanthella*, an hypothesis not supported here.)

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On the genera *Sarcodontia, Radulodon* and *Pseudolagarobasidium*

Joost A. Stalpers
Centraalbureau voor Schimmelcultures, P.O. Box 273, 3740 AG Baarn, The Netherlands

Abstracts: The genera *Sarcodontia* and *Radulodon* are considered as closely related, while *Pseudolagarobasidium* is a synonym of the latter. The genera share a resupinate hydnoid basidiome, globose to broadly ellipsoid spores, an astatocoenocytic behaviour and a bipolar mating system. *Acia licentii* is considered a synonym of *Radulodon copelandii.*

When Ryvarden (1972) proposed the genus *Radulodon*, he compared it with *Mycoacia, Hyphoderma, Hypochnicium, Basidioradulum* and *Radulomyces*, and considered the combination of hydnoid hymenophore and globose spores as distinctive. As both characters also occur in *Sarcodontia* (not mentioned in the discussion), Ryvarden might have considered this the correct generic name. The fact that the spines are somewhat more concrescent in *Radulodon* than in *Sarcodontia* has never been considered important at the generic level. Maekawa (1993) proposed to classify *Mycoacia copelandii* (Pat.) Aoshima & Furukawa in *Radulodon*, reasoning along similar lines as Ryvarden and also not considering *Sarcodontia*. Wu (1990) could not accept *Radulodon* for *Pseudolagarobasidium* because the spores of *Radulodon* are globose to subglobose and have thicker walls (despite the fact that the description of the spores of both accepted species contained the word 'subglobose').

MATERIAL EXAMINED

Herbarium specimens:
Radulodon americanus: USA, Ithasca Lake, 16-IX-1977, L. Ryvarden no 14273 (K, O); Canada, Petawawa Experimental Forest, on *Populus grandifolia*, 8-X-1967, Berit & John Eriksson (K); Norway, Ladalen, on *Populus tremula*, 25-V-1993 (O). *Radulodon erikssonii*: Norway, Jordetägg, on dead *Populus tremula*, 14-5-1995, H. Andersen (O). *Hydnum calcareum*: Australia, Kurrumburra, Martin 1027, type (K); Australia, Kangaroo Ground, on fallen, rotten trunk, 12-VII-1953, E.M. Davies nr 3643 (K). *Sarcodontia setosa*: Germany, Württemberg, on fallen trunk of *Malus*, 21-X-1969, R. Kautt; *Radulodon copelandii* (as *Sarcodontia*): China, Jilin, Chang Bai Shan Forest Reserve, on *Larix olgensis*, IX-1983, Ryvarden no 21596 (O); China, Jilin, Chang Bai Shan Forest Reserve, on *Acer* sp., IX-1983, Ryvarden no 21760 (O). *Pseudolagarobasidium subvinosum*: Sri Lanka (Ceylon), XI-1867, no 180, type (K); India, Kerala, 9-XI-1984, J. K. Sharma no 052 (K). *Hydnum pseudomucidum*: Sri Lanka (Ceylon), Hakgala, IV-1919, Petch no 5962
Cultures:
Radulodon americanus: CBS 463.48 (DAOM 166599), Canada, British Columbia, M.K. Nobles, ex *Populus tremelloides*; CBS 100846 (FCUG 578) Canada, Quebec, ex *Populus*; CBS 100848 (FCUG 735), Canada, Ontario, ex *Populus*. *Radulodon erikssonii*: CBS 100849 (FCUG 1988), Switzerland, Ticino. *Sarcodontia setosa*: CBS 155.63, France, J. Boidin; CBS 150.80, The Netherlands, W. Loerakker, ex *Malus silvestris*.

ANALYSIS OF SOME CHARACTERS

1. Spines.
At first sight the texture of the spines seems to be quite different. In *Sarcodontia setosa* (Pers.) Donk they are ceraceous, acute and single or sometimes concrescent in pairs. Branching is rare, and branches are always much narrower and smaller than the parent spine. Occasionally warts are present at the base of a spine. *Radulodon copelandii* (Pat.) N. Maekawa, *Radulodon erikssonii* Ryvarden and *Hydnum pseudomucidum* Petch also have ceraceous, acute, single and unbranched spines. *Pseudolagarobasidium subvinosum* (Berk. & Br.) S. H. Wu has more membranaceous spines, which are often concrescent to raduloid structures, but there are also slender, simple spines, which may be slightly fimbriate at the apex.

Table 1. Distribution of characters in the species concerned. Spine structure: s=single, c=concrescent and flattened, b=bundles; apex of spines: a=acute and agglutinated, f=fimbriate; texture of spines: c=ceraceous, m=membranaceous; gloeocystidia: a=absent, u=uncertain or indistinct, i=immersed, p=projecting; quasibinding hyphae: a=absent, b=present; basidia: c=clavate; cyanophilic spores: + =present, - =absent, ± =variable.

Species	spine structure	spine apex	spine texture	gloeo-cystidia	quasibind-ing hyphae	basidia	spore-wall
S. setosa	s,c	a	c	a	a	c	c
R. copelandii	s	a	c	u,i	a	c	c
R. pseudomucidus	s	a	c	i	a	c	c
R. erikssonii	s	a	c	i/p	a	c	a/c
R. americanus	b	f	c-m	u,i	p	c	a/c
R. calcareus	b	f	m	p	p	c	a
R. subvinosus	s,c	a-f	m	p	a	c	a
Acia licentii	s	a	c	u	a	c	±

However, the difference between ceraceous and membranaceous is rather vague in this group, as is illustrated by Hjortstam & Ryvarden (1986), who called *Amethicium luteoincrustatum* membranaceous, while Hjortstam (1995, sub *Cericium*) considered it ceraceous. Both *Radulodon americanus* and *Pseudolagaro-basidium calcareus* (Cooke & Massee) S. H. Wu have more or less membranaceous, simple, fimbriate spines, which at first sight seem to originate from a common, raised base. However, section of such a structure reveals, that the spines are recognizable as distinct entities to the very base, but are fasciculate, sometimes connected by relatively loose, white mycelium. The effused part of the basidiome is in all cases membranaceous, with a non-gelatinized subiculum.

2. Hyphae

The hyphal system is in all cases monomitic, consisting of thin- to thick-walled hyphae with clamps (except *Radulodon casearium* (Morgan) Ryvarden, which could not be studied). In all cases there is a central cylinder in the spines, which contains more or less parallel hyphae, and often also crystals. The central hyphae may be relatively wide and scarcely septate in the more ceraceous species, but such hyphae can also be found in the more membranaceous species, although they are less abundant. However, there are two complicating factors:

a. *Sarcodontia setosa* often grows on a vertical substrate and is then capable to form nodulose structures, from which the spines arise. These structures mainly consist of thick-walled hyphae, which may produce swellings up to 35 µm diam. (sometimes called 'sclerocysts'), while the thickness of the wall may exceed 7 µm. I have not found similar structures in any of the other species.

b. Wu (1990) described a structure that he called 'quasi-binding hyphae'. Such hyphae are hyaline, thin- to thick-walled, terminally much-branched, 1-2 µm wide. They are the same hyphae which Hjortstam & Ryvarden (1986) described as 'thin-walled skeletal hyphae' for *Amethicium luteoincrustatum*, and somewhat later by Hjortstam (1995), when he transferred the species to *Cericium*, as 'arboriform (binding-type) hyphae'. These hyphae are known from *Pseudolagarobasidium calcareum*, and they are also present in *Radulodon americanus*. Although these hyphae are quite characteristic, it is often hard to demonstrate them in dried material. I found them only in sections near the substrate, especially in gaps.

Similar hyphae have been described for species of the genera *Licrostroma, Amethicium, Cystostereum, Crustoderma, Phlebia* s.l., and *Laeticorticium ussuricum*, but I am not convinced that these hyphae are homologous in all cases.

3. Gloeocystidia

For a number of species (gloeo)cystidia have been described: *Pseudolagarobasidium calcareum, P. subvinosum* and *Radulodon eriksonii*. In all cases the cystidia are immersed or slightly projecting, thin-walled, with homogeneous and hyaline contents and they are sulpho-negative, which makes it difficult to decide whether they should be called gloeocystidia or cystidia. Generally they stain more strongly with cotton blue than hyphae and basidia. It is even more difficult when the morphological differences from young basidia become slight, as is the case in *Radulodon americanus*. The collection from Norway is here considered to be *R. americanus* rather than *R. erikssonii*, but it differs fron american specimens by having many and slightly larger gloeocystidia. *Hydnum pseudomucidum* also has gloeocystidia, subclavate to cylindrical; they may resemble pseudocystidia (gloeoplerous hyphae), as also in *P. subvinosum*, where some gloeocystidia are more than 100 µm long. In *Radulodon copelandii* a single structure was observed that could have been a gloeocystidium. It would, however, be misleading to consider the species as having gloeocystidia.

4. Hyphidia

Hyphidia could be demonstrated in all specimens examined. They were all unbranched and not or slightly projecting, 2.5-3.5 µm wide. The occurrence is irregular, sometimes quite abundant, but sometimes also hard to find. They are of the same type as found in *Radulomyces*.

5. Basidia

The basidia are clavate to flexuous-clavate, 20-35(-40) x 6-8 µm (in *P. calcareum* 14-20 x 4.5-5.5 µm, in *S. crocea* 18-30 x 4.5-6 µm).

6. Spores

The spores are globose to broadly ellipsoid, with 1-2 big oil drops and thin or slightly thickened walls. In the latter case the walls are always cyanophilous, in the former case the reaction is variable. One should be aware, that strong contrasts may suggest broader dimensions, and that a cyanophilous wall will more easily be interpreted as thick-walled than a non-staining wall. The reaction in *P. subvinosum* has been reported as cyanophilous by Jang & Chen (1985), and as not cyanophilous by Wu (1990); I agree with the latter observation. There is, however, a problem with this stain, as none of my permanent slides (in lactic acid/cotton blue in PVA) after one week of preservation showed any cyanophilous spore-wall for all species examined, while the cell contents were still perfectly stained.

7. Type of rot

All specimens examined provoked a distinct white rot, except *H. pseudomucidum*, which was growing on brown bark. The reaction of the species with alpha-naphthol is variable: there is never a reaction after 3 hours or one day, but later there may be an open ring or even a spot. This is a typical reaction for many species of the Meruliaceae, where lignin-degrading enzymes are only produced in response to an external stimulus (a phenolic compound) rather than under general cultural conditions. A similar reaction is also known for example for *Merulius, Phlebia, Mycoacia, Cystidiophorus*, but also from the poroid genera *Hapalopilus, Spongipellis, Fibuloporia, Ischnoderma* and *Aurantioporus*. All species of these genera (as far as known) are also bipolar (unifactorial) and have an astatocoenocytic nuclear behaviour.

8. Cultural characters

Cultures of *Sarcodontia setosa, Radulodon americanus, R. erikssonii* are so similar, that they can be accomodated in a single description:

Growth rate 40-80 cm radius in 14 days on Oxoid malt agar, 30-50 cm on Cherry decoction agar. Advancing zone appressed, hyphae distant. Aerial mycelium appressed or locally downy or farinaceous, flamed. Marginal hyphae hyaline, thin-walled, with no or rare simple septa, 4-8 µm wide, branching wich narrower, septate and clamped hyphae, 2-4 µm wide. Aerial hyphae hyaline, with thin- to somewhat thickened walls, (1.5-)2-4.5(-5) µm wide. Chlamydospores abundant in aerial mycelium, thick-walled (up to 2 µm), ellipsoid to subglobose, 8-16 x 6.5-11 µm.

Cultures of *S. setosa* have a remarkable sweet odour, which may disappear after many years in culture.

TAXONOMY

The broad-spored members of *Sarcodontia*, *Radulodon* and *Pseudolagarobasidium* are closely related. Not only are they all resupinate, membranaceous-ceraceous and hydnoid, but they have also clavate to flexuous-clavate basidia and globose to broadly ellipsoid spores; moreover, all species have a unifactorial (bipolar) mating system and show an astatocoenocytic nuclear behaviour. The type species of *Radulodon* and *Pseudolagarobasidium* are hardly different and have to be regarded as conspecific, and *Pseudolagarobasidium* in the original sense is a synonym of *Radulodon*. A third species, *P. concentricum* (Cooke & Ellis) Hjortstam, with narrowly ellipsoid to subcylindrical spores, narrow basidia and brown, thick-walled subicular hyphae can either be placed in *Phlebia* s.l. as proposed by Kropp & Nakasone (1985), which I prefer at the moment, or accepted in *Pirex* Hjortstam & Ryvarden, of which it is the type (Hallenberg & al. 1985).

The specimens of *Radulodon copelandii*, which were both collected in China, agreed with the emended description of *Acia licentii* Pilát by Ryvarden (1976). The description of Maekawa (1993) of Japanese material mainly differs in the mentioning of 'paraphysoid hyphae' (which are present in the material examined), and slightly thick-walled spores. I see no reason to distinguish these taxa and consider *A. licentii* as a synonym of *R. copelandii*. The species shares several characters with *Sarcodontia setosa*: ceraceous spines, globose, slightly thick-walled spores, practical absence of gloeocystidia, but it does not have the thick-walled, swollen subicular hyphae. On the other hand it closely resembles *R. eriksonii*, which only differs in having abundant gloeocystidia.

For the moment I am inclined to keep *Sarcodontia* separate from *Radulodon* on behalf of the subicular hyphae and sclerocysts. However, molecular data may prove otherwise. The basidiospores of *Hydnum pseudomucidum*, which are sometimes broader than long, strongly resemble those of *Gloeocorticium cinerascens* Hjortstam & Ryvarden. This species has a smooth hymenophore and conspicous monilioid gloeocystidia, which are amyloid and SA-. Hjortstam & Ryvarden (1986) compared it with *Radulomyces*, but *Radulodon* may even be closer.

Cericium luteoincrustatum (Hjortstam & Ryvarden) Hjortstam is probably quite close to *Radulodon*. The species is not hydnoid, but even to tuberculate, and the spores are ellipsoid, but the presence of 'quasi-binding hyphae' and immersed to slightly projecting gloeocystidia suggest a relationship. Anyway, it is stated that the species here accepted in *Radulodon* and *Sarcodontia* are closely related, not that other phlebioid genera may not contain other close relatives.

The genus *Radulomyces* has often been mentioned as a close relative. Indeed is resembles *Radulodon* in several respects: there are globose to broadly ellipsoid, thin- to somewhat thick-walled spores, sinuous-clavate basidia and a ceraceous basidiome. However, typical species have a loose consistency (nearly hygrophanous), there are no thick-walled hyphae and the species are even to tuberculate, except *R. molaris*, which is raduloid with irregular to flattened teeth with a sterile apex. Cultures of *Radulomyces* lack an astatocoenocytic behaviour, possess tyrosinase, have a different reaction with alpha-naphthol and often have crustose areas; they are thus quite distinct from *Sarcodontia*/*Radulodon*.

KEY TO THE RESUPINATE HYDNOID SPECIES WITH GLOBOSE TO BROADLY ELLIPSOID SPORES

1a. Spores 8-13 x 6.5-8 µm. Cf. *Radulomyces molaris*

1b. Spores up to 8 µm long. 2

2a. Basal hyphae thick-walled, often with irregular swellings (sclerocysts). Hymenial surface yellow to orange yellow, often with reddish tinges. Odour distinctly sweet.
Basidiome effused, ceraceous to membranaceous. Hymenial surface hydnoid, becoming brownish when old, yellowish parts becoming reddish or purplish in KOH. Spines cylindrical, sometimes concrescent, ceraceous, 5-10(-15) x 0.2-0.6 mm. Margin velutinous or forming a mat of

yellowish mycelium. Generative hyphae in mat and substrate thick-walled, 3-5 µm wide, with clamps, often producing thick-walled swellings up to 35 µm wide. Tramal hyphae thin- to slightly thick-walled, 2-4 µm wide, with clamps. Basidia clavate, 18-35(-45) x 4-6 µm. Spores hyaline, subglobose to broadly ellipsoid, somewhat thick-walled, 4.5-6 x (3-)3.5-4.5 µm. On angiosperms, preferably on Rosaceae. ..... **S. crocea** (Schw.) Kotlaba
Syn.: *Hydnum setosum* Pers.; *H. luteocarneum* Secr.; *Sarcodontia mali* S. Schulzer; *H. schiedermayri* Heufler; *H. amplissimum* Berk. & M. A. Curtis; *H. subvelutinum* Berk. & M. A. Curtis; *H. earleanum* Sumstine; *H. foetidum* Velen.
Ref.: Kotlaba 1954; Eriksson et al., 1981; Breitenbach & Kränzlin, 1986.

2b. Basal hyphae without irregular swellings. Hymenial surface not orange yellow. Odour not sweet 3

3a. Spores globose to subglobose, (5.5-)6.5-7.5 x (4.8-)5.5-7.2 µm.
Basidiome effused, ceraceous to membranaceous, cartilagineous when dry. Hymenial surface hydnoid, cream-coloured to pale brown, becoming purplish when old, hydnoid. Spines slender, simple or sometimes concrescent and flattened, ceraceous, up to 12 x 0.8 mm. Margin tomentose, white. Hyphae hyaline, thin- to slightly thick-walled, ???, with clamps. Hyphidia present, rare. Gloeocystidia narrowly clavate or capitate to cylindrical, 30-60 x 6-11 µm, not projecting. Basidia clavate, 16-25 x 5.5-7 µm. .....
..... **R. pseudomucidus (Petch) Stalpers comb. nov.**
Bas.: *Hydnum pseudomucidum* Petch 1916, Ann. R. bot. Gdns Peradeniya 6: 156.

3b. Spores smaller 4

4a. Clamps absent.
Basidiome effused, membranaceous. Hymenial surface cinereous to buff when dry, hydnoid. Spines up to 8 x 0.5 mm, often concrescent. Quasi-binding hyphae present, thick-walled, 1.5-2 µm wide. Generative hyphae hyaline, thin-walled, 2-3.5 µm wide, often encrusted. Basidia clavate, 5-5.5 µm wide. Spores subglobose, 5-6 x 4-5.5 µm. .....
..... **R. casearius** (Morgan) Ryvarden. Ref.: Gilbertson, 1964.

4b. Clamps present 5

5a. Apex of spines fimbriate.
Basidiome effused, membranacous. Hymenial surface raduloid to hydnoid. Spines cylindrical or fused, 3-6 per mm. Subicular hyphae thin- to somewhat thick-walled, with clamps. Subhymenial hyphae, thin-walled, somewhat agglutinated. Hyphidia present. Cystidia cylindrical to irregular-flexuous, thin-walled, immersed or hardly projecting. On angiosperms. 6

5b. Spines with agglutinated axis, apex not fimbriate 8

6a. Hymenial surface raduloid to hydnoid, cinnamon buff to olive brown. Narrow, much-branched hyphae absent.
Spines up to 0.6 mm long. Margin fimbriate. Subicular hyphae yellowish to brownish, 2.5-5(-5.5) µm. Brownish excreted material abundant. Cystidia 35-110 x 7-10.5 µm. Basidia (sub)clavate, 20-30 x 6-6.7 µm. Spores (5-)5.5-6.5 x 4-5 µm. .....
..... **R. subvinosus (Berk. & Br.) Stalpers comb. nov.**
Bas.: *Hydnum subvinosum* Berk. & Br. 1875, J. Linn. Soc. Bot. 14: 60
Syn.: *Pseudolagarobasidium leguminicola* J.C. Jang & T. Chen
Ref.: Wu 1990

6b. Hymenial surface hydnoid, spines often concrescent in fascicles, pale ochraceous to ochraceous salmon to buff. Quasi-binding hyphae may be present, thin- to thick-walled, 1-2 µm wide. .
..... 7

7a. Gloeocystidia fusiform, subclavate or cylindrical, 40-110 x 6-11 µm. Spores subglobose to broadly ellipsoid, 4.8-6 x 3.2-4 µm.
Hymenial surface hydnoid, pale ochraceous salmon to buff. Spines up to 1.2 mm long. Margin white. Subicular hyphae hyaline, with slightly thickened walls, 1.5-3 µm wide. Crystals present in subiculum. Basidia subclavate, 14-20 x 4.5-5.5 µm. .....
..... **R. calcareus** (Cooke & Massee) Jülich. Ref.: Jülich, 1978; Wu, 1990.

7b. Gloeocystidia absent or small, clavate to cylindrical, 25-40 x 8-10 µm. Spores globose to

subglobose, (4-)4.5-6.5 x 4-5.5 µm.
Hymenial surface ochraceous to salmon or buff, pale tan when dry, hydnoid. Spines cylindrical, often concrescent at the base, 1-6 mm long. Margin white. Subicular hyphae typically somewhat thick-walled, 2-5 µm wide. Subhymenial hyphae 1.5-4.5 µm wide. Hyphae thin- to lightly thick-walled. Basidia sinuous-clavate to urniform, 20-40 x 5-8(-10) µm. On angiosperms. ..... **R.americanus** Ryvarden. Ref.: Ryvarden, 1972.

8a. Gloeocystidia present, clavate to fusiform, often with narrowed, hyphoid apex, 35-70 x 6-10(-13) µm.
Basidiome effused, ceraceous to membranaceous, cartilagineous when dry, up to 0.3 mm thick. Hymenial surface hydnoid, whitish when young, becoming yellow and finally pale tan. Spines cylindrical, sometimes fused, up to 3 x 0.7 mm. Margin white. Subicular hyphae thin- to usually somewhat thick-walled, 2-5 µm wide. Subhymenial hyphae thin-walled, (1.5-)2-3 µm wide. Hyphidia present. Basidia sinuous-clavate, 20-40 x (5-)6-8(-10) µm. Spores subglobose, slightly thick-walled, 5-6.5(-7) x 4.5-6 µm. On *Populus*. .... **R. erikssonii** Ryvarden. Ref.: Ryvarden, 1972; Eriksson & al. 1980.

8b. Gloeocystidia absent.
Basidiome effused, ceraceous. Hymenial surface hydnoid, greyish-cream to ochraceous when young, brownish when old. Spines cylindrical, 5-10 x 0.2-1 mm. Margin thinning out, fimbriate, white. Hyphae thin- to thick-walled, 2-6 µm wide, with clamps. Simple hyphidia may be present. Basidia clavate to subcylindrical, 20-35 x 6-7.5 µm. Spores globose to subglobose, slightly thick-walled, 5-6.5(-7) x 4.5-6(-6.5) µm diam. On angiosperms, rarely on gymnosperms. ..... **R. copelandii** (Pat.) N. Maekawa
Syn.: *Acia licentii* Pilát. Ref.: Pilát, 1940; Ryvarden,1976; Imazeki et al., 1988; Maekawa, 1993.

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An attempt to a list of indicator fungi (Aphyllophorales) for old forests of beech and fir in former Yugoslavia

Milica Tortić
10000 Zagreb, Livadiava 16, Croatia

Abstract: For the forests of beech fir in former Yugoslavia, 36 indicator Aphyllophorales of old and primeval forests are proposed. Many were found only in few localities, but since those were mostly national parks and nature reserves, their affinity to old forests can be supposed. At the end are listed additional 11 ones, found only in one locality, a national park, which seem also to be characteristic for this type of forest. It is curious that among the fungi discussed some are considered as taiga species, whilst some others have their main area of distribution in southern parts of Europe.

INTRODUCTION

In the proposed list of indicator Aphyllophorales for old forests in Estonia (Parmasto & Parmasto, 1997), about half are marked as occurring in similar lists in some neighbouring countries, which was to be expected. The unexpected, however, was, that nearly half of them, several considered as taiga species, are known about 15-20 degrees latitude to the south, in the territory of former Yugoslavia, from some old forests or at least those not particularly disturbed by human intervention.

The aim of my mycological investigations was simply to make an inventory of polypores and corticia in the region named, in as many localities as possible, but this gave me an idea to try and compile, mainly from my notes, a list of indicator species for the most widely distributed and the most investigated forests there, those of beech resp. beech and fir. It is only a tentative list, and some more species could be surely added. However, even as it is, it may be interesting to mycologists, since it includes both species which occur mainly in North Europe, as well as those whose area seems to be mainly in the south and reaches only to the Central Europe, or they are at least rare in the north. Also, and this is the chief reason for writing this article, no other mycologist had the opportunity to visit as many localities in former Yugoslavia as I did, and since this territory is now dismembered into several states, many years, or even decades, will probably pass before a single person would be able to investigate it all without trouble, as I had the fortune to do.

SHORT DESCRIPTION OF THE INVESTIGATED REGION

The region is mainly mountainous and the mountains are in the west connected with Alps, but lie otherwise south of the rivers Sava and Danube, reaching into Albania, Greece, and Bulgaria. North of those rivers there are only some single mountains. Beech forests start above the belt of oak forests at about 500-700 m altitude, then comes a belt of beech and fir and finally again beech up to about 1400-1800 m. The altitudes vary with the height of the mountain, the higher the mountain, the higher the belts. In the lower beech belt there is often an admixture of maple (*Acer* spp.) and spruce; in that of beech and fir occurs mostly also spruce in smaller or larger quantities and maple. Quite a number of associations were described in those forests after the school of Braun-Blanquet, which differ according to floristic composition of accompaining plants, type of soil, geological substrate, exposition etc., but still show many similarities. For the present purpose they are taken in broad sense, having in common the most important tree species, i.e. *Fagus sylvatica*, in southeastern parts of the region *F. moesiaca*, *Abies alba*, in south *A. borisii-regis*, and *Picea abies*. In this belt lie several National parks, as well as nature reserves, but also more or less old forests, not much influenced by human intervention, particularly in less accessible sites.

In various places, inside or above this belt, are developed also other forests, as those of spruce or of pine, the mycoflora of which is less known and their indicators cannot be stated yet.

MATERIALS AND METHODS

There are publications, old and new, about fungi from all countries in this region, but since in most of them only common Aphyllophorales are mentioned, I cite here only few which were of use for this paper: those by Hoèevar et al. (1980,1985,1995) where results of phytocenological investigations (fungi included) in nature reserves in Slovenia, mostly those of beech and fir, were published. I had opportunity to visit those reserves together with the first author or alone, at least once each. In Macedonia Aphyllophorales were studied by Karadelev (1993), particularly in the south; I visited some of his localities and examined many of his finds. Pilát & Lindtner (1938) investigated fungi in the mountain Šar Planina, at the boundary of Serbia and Macedonia, as well as in some localities in Macedonia and found many interesting species. Their exsiccata are deposited in the Natural Museum, Prague (PRM) and the duplicates in the Natural Science Museum, Beograd (BEO), where is also preserved a large collection of fungi from various groups, among them many Aphyllophorales, collected by V. Lidntner in several localities in Serbia and Macedonia, mainly from beech and fir forests. This collection is particularly important for the mycoflora of this part of the region. I had opportunity to study this collection but not to visit Lindtner's localities, except once the mt. Goè. However, beech or beech and fir forests there are apparently rather old, since many species were growing on logs and trunks.

Otherwise, the main source of data for this article are my own independent investigations. I tried to visit chiefly old or so-called virgin forests of beech and fir, and concentrated on several national parks: NP Risnjak and particularly NP Plitvièka jezera (=Lakes of Plitvice, Plitvice in short) both in Croatia. The last named was visited more than 40 times. Owing to the considerable distance, collecting trips to the NP Sutjeska in Bosnia, with the famous virgin forest Peruæica were possible unfortunately only few times, and the NP Mavrovo, still much farther off, in Macedonia, was visited only once. Of course the most often investigated localities were those not very far from my home town, in Croatia and Slovenia; many far off ones, now in several other countries, were visited only once or twice. In some of them as far as I know, no other mycologist ever set foot, but there are more, surely as interesting, where neither I had the opportunity to come.

In the further text national parks and some places (for instant mountains) are named, otherwise mostly the number of localities and their distribution in the region.

Many interesting species found during those investigations were published, but the papers are not cited here.

Although at least parts of some of the national parks, as well as nature reserves are considered as virgin or primeval forests, some trunks or logs of felled trees can be found in all. Probably many years have passed after the last cutting down, still, traces of human interference are observable. This leads to a curious fact that several rare species, here proposed as indicators, grow predominantly on cut surface of logs and trunks, which can be perhaps explained by their preference to grow on wood, not on the bark.

In spite of all endeavours, the results are, to my regret, rather fragmentary. The number of localities I was able to compile for species presented here is ridiculously low: except for a few frequent ones, at most about thirty, down to a handful, although hundreds of kms apart. At the end, I even present several (11) species with only one locality known, which may be characteristic of old forests, since they were found in national parks.

PROPOSED INDICATOR FUNGI

Old forest indicator fungi are the ones (more or less easily recognised) distributed mainly or only in old forests not much affected by forest management (Parmasto & Parmasto 1997). For this purpose are used preferably wood-rotting species of Aphyllophorales which grow on trunks, standing and prostrate, and on logs. Such substrate is not found in managed forests, where only small branches and stumps are left. It is obvious that polypores with large carpophores need large pieces of wood, but not a few corticia develop also only on trunks and logs, where they sometimes cover considerable surfaces. Often is the wood on which they grow very rotten; this is an indication that they are successors to species which settle on freshly fallen or only a little destroyed wood. Unfortu-

nately, I had not time and opportunity to study the successions on wood, and have only noted whether the wood was rotten or not. All those species may be rare even in suitable sites, or can be rather frequent there and absent elsewhere. On the other hand, some fungi may be generally not very rare, and are more or less distributed in many localities and on several hosts, but are particularly common and abundant in old and virgin forests on their preferred tree species and deserve to be included into indicators. They (four of them) are discussed first, then follow others in alphabetical order, and as an addition, those found only in one locality. For comparison, the ones occurring in Estonian list are marked by an asterisk; there are some more in that list which are known also here, but either do not seem to be particularly characteristic for beech and fir or occur only in other types of forests.

For each species some notes about their substrate, as well as their distribution in the investigated region and often also in Europe are added. The data about the distribution in Europe of some corticia were taken from the maps in forthcoming book: European corticiaceous fungi, sent to me kindly by prof. L. Ryvarden (Oslo), for which I render him here my thanks.

The most conspicuous and widely spread in forests of beech and fir, producing usually many carpophores on standing living or dead trees, prostrate trunks, logs, stumps are *Fomes fomentarius* (L.: Fr.) Kickx, predominantly on *Fagus*, rarely on *Acer* spp. (as *A. pseudoplatanus*, *A.obtusatum*), *Fomitopsis pinicola* (Sw.: Fr.) P. Karst., preferring *Abies* or *Picea*, but found also on *Fagus*, *Ganoderma applanatum* (Pers.) Pat., mostly on *Fagus*, more rarely on *Abies* and *Polyporus squamosus* Huds.: Fr. on *Fagus*, rarely *Acer*, twice quite unexpectedly on a stump and a living trunk of *Abies*. All occur also elsewhere and on various other hosts, in lesser quantities. Of course, as the perennial carpophores of the first three are present throughout the year, this gives an additional impression about their abundance, whilst the carpophores of the fourth, often very large and numerous, can be observed only during summer months, not later than August. They were noted in all or almost all investigated localities, in the whole region, and are often cited in phytopathological papers (especially the first), where only their general occurrence, for instance in this or that mountain, is given.

**Amylocorticium subincarnatum* (Peck) Pouzar. Aparently rare in Europe, noted only in few countries. It was collected only in four localities: several times in Plitvice, and once each in another locality in Croatia, a nature reserve in Slovenia and in NP Sutjeska in Bosnia, growing on prostrate trunks and logs, often very rotten, mainly Picea; in Plitvice three times also on *Abies*. Sometimes rather abundant.

**Amylocystis lapponica* (Romell) Singer is, according to Ryvarden and Gilbertson (1993) a typical taiga species, following the spruce, with a boreal eastern distribution. Its most southern localities were up to recently in Central Europe until it was surprisingly found 1981 in NP Plitvice and the next year still farther south, in NP Sutjeska, in each locality on trunks of *Picea*. In Plitvice it was repeatedly observed during several years, sometimes on the same trunk.

**Anomoporia myceliosa* (Peck) Pouzar (*Ceriporiopsis myceliosa* (Peck) Ryvarden and Gilb.). NP Plitvice (abundant), Mt.Igman in Bosnia and Mt.Kopaonik in Serbia, on logs and trunks of *Picea*. In the fourth locality, in Macedonia, it grew on *Pinus*, probably in a pine forest. Everywhere found only once. The localities are hundred of kms apart. A number of European collections under that name proved recently to be the similar *A. kamtschatica* (Parmasto) M. Bondartseva (Niemelä 1994), and it may be that one or more of the above cited finds represent this species.

**Antrodia crassa* (P. Karst.) Ryvarden. In Fennoscandia growing particularly on *Pinus*, in central Europe on *Picea* (Ryvarden & Gilbertson, 1993). It was found in NP Plitvice, NP Sutjeska and also two other localities in Bosnia, everywhere on prostrate trunks, logs, stumps of *Picea*, and was published also from a coal mine in Slovenia, on mine timber (Šarič 1957).

Antrodia variiformis (Peck) Donk. Very rare in Europe, known only from few countries. In the investigated territory found in five far apart localities, everywhere only on wood of *Abies*: a nature reserve in Slovenia, NP Risnjak and Plitvice in Croatia, NP Sutjeska in Bosnia and mt. Korab in Macedonia. In NP Sutjeska it seems to be frequent, since it was noted three times, once covering at least a half of a fallen

trunk of *Abies*. Some finds were curious: in the NP Risnjak it fructified abundantly on a wooden (*Abies*) bench in front of a forest lodge, and in NP Plitvice only one small carpophore was observed on a small log of *Abies* during several years.

Bondarzewia mesenterica (Schaeff.) Kreisel. In all 14 localities in natural parks (Plitvice, Risnjak, Sutjeska), nature reserves, and more or less old forests in Slovenia, Croatia, Serbia and Bosnia, mostly singly on roots at or near the base of living trees and stumps of *Abies*.

Botryohypochnus isabellinus (Fr.) J. Erikss. In a nature reserve in Slovenia, Nat.parks Risnjak and Plitvice in Croatia, NP Mavrovo and some mountains in Macedonia, in all 8 localities. On prostrate trunks and logs, rarely prostrate branches of *Fagus* and *Abies*, once on *Picea*, sometimes abundant; once, however, in an oak forest in Macedonia, on *Quercus* (Karadelev, 1993).

Crustomyces subabruptus (Bourdot & Galzin) Jülich. Several nature reserves in Slovenia, NP Plitvice and NP Sutjeska, several forests in Bosnia and Macedonia, alltogether about 14 localities. On bark and wood (sometimes very rotten) of prostrate trunks, logs, thick branches, mostly *Fagus*, rarely *Picea* and *Abies*, once *Salix* sp.; at Plitvice rather frequent. It occurs mainly in Central Europe.

Cystostereum murraii (Berk. & M. A.Curtis) Pouzar. Preferably on *Abies*, more rarely *Picea*, on bark and wood of prostrate trunks, sometimes at the cut surface, a few times on standing dead trees, rarely on dead branches (once on living tree). Once noted on *Fagus*. This agrees with the statement by Kotlaba (1987) who found it in Czechoslovakia predominantly on *Abies*, rarely *Picea*, exceptionally on *Fagus*. Sometimes very abundant, particularly in Plitvice, where it was observed many times on many places. In all 14 localities known in Slovenia, Croatia, Bosnia and Serbia. In Europe found in Scandinavia, central and western Europe, also Spain.

Dacryobolus karstenii (Bres.) Oberw. ex Parmasto. For the moment only four localities registered, but two are in National parks Plitvice and Sutjeska, where it was found three resp. two times on prostrate trunks of *Picea*, in Sutjeska also of *Abies*. Sometimes abundant. A pleasant smell of coumarin can be noted in fresh exemplars, but sometimes , probably in older, the less pleasant one of *Fomitopsis pinicola*. In BEO are preserved specimens from south of Serbia and from Macedonia, which grew apparently in different types of forests, on wood of *Pinus leucodermis* and *P. nigra*. In Pindus mt. in Greece it was collected on *Pinus nigra* and *Abies borissii-regis* (unpublished). In Europe known in Scandinavia, central and western Europe.

**Dentipellis fragilis* (Pers. : Fr.) Donk is widespread in the investigated region; about 17 localities were established, mostly far apart. Not rare in NP Plitvice and several nature reserves in Slovenia; in other localities (Bosnia, Serbia, Macedonia) mostly single finds. Prefers apparently old forests. Grows regularly on prostrate, sometimes standing, rotten trunks, logs, stumps of Fagus, often in abundance. Once noted on prostrate trunk of *Picea* and once on standing dead trunk of *Abies*. It is rare in nordic countries, in Finland endangered, in Poland in the list of threatened plants (Koski-Kotiranta & Niemelä, 1988).

**Fomitopsis rosea* (Alb. & Schwein.: Fr.) P. Karst. On prostrate logs of *Picea*, in old or not particularly managed forests, in all the region (11 localities) except Macedonia, probably because *Picea* occurs there only in the most northern part. However, it was noted also on worked wood: in a coal mine (Šarič, 1957), on a fence post, on a log in a timberyard. Its occurrence in houses, mines and similar places is mentioned by Ryvarden and Gilbertson (1993) This is a curious distribution for a species, which is really very rare in forests.

Ganoderma carnosum Pat. apparently prefers *Abies* and was found on stumps (sometimes rotten), at the base of standing dead, very rarely living trees, usually singly; once it grew on the stump of *Pinus heldreichii*. It was observed in about 15 localities, as some nature reserves in Slovenia, NP Risnjak and NP Plitvice (about twenty times) in Croatia, and several localities with more or less old forests of beech and fir in Bosnia, Serbia, Macedonia. South-central European species (Ryvarden & Gilbertson, 1993).

Gloeocystidiellum ochraceum (Fr. : Fr.) Donk. Five far apart localities: A nature reserve in Slovenia, NP Risnjak and NP Plitvice (four times) in Croatia, lower slopes of mt. Durmitor in Crna Gora, and Crni Kamen in Šar Planina in Ser-

bia. Mostly on prostrate trunks or logs, sometimes very rotten, of *Abies*, on the underside and also on cut surfaces; only once on a branch. Rarely also on *Picea*. It is one ot the more important wood-decomposers of *Picea* and *Pinus* in boreal forest (Eriksson & Ryvarden, 1975). Seems to be mainly distributed in north Europe. Since in the inestigated region it apparently goes over to *Abies*, it may turn out to be not rare there.

**Hapalopilus salmonicolor* (Berk. & M. A.Curtis) Pouzar (*Sarcoporia salmonicolor* (Berk. & M. A.Curtis) Pouzar). Only five localities known for the moment: NP Plitvice and NP Sutjeska, in the first on prostrate rotten trunks of *Abies*, on the underside, once abundant, in the second prostrate large rotten trunk of *Picea*, small specimen; also published from mt.Ostrvica (south of Serbia), on *Picea* (Pilát & Lindtner, 1938), and found in a nature reserve in Slovenia. Curiously it was collected, also in Slovenia, in a small mixed village wood, on stump of a conifer. In Macedonia it was noted on *Pinus* peuce in mt. Pelister (Karadelev 1993). Widespread but rare in Europe in coniferous forest ecosystems from northern Norway to the Mediterranean. Especially on *Pinus*, more rarely on *Picea* and *Abies* (Ryvarden & Gilbertson, 1993).

Hericium alpestre Pers. About 11 or 12 localities in Nationalparks (Risnjak, Plitvice, Sutjeska), nature reserves, and some other rather old forests, everywhere except Macedonia, on logs, prostrate large rotten trunks (on those sometimes on the cut surface), standing dead and living trunks, mostly singly or few specimens. Mainly on *Abies*, only three times on *Picea* at Plitvice, where it is frequent. Apparently known for the moment only in Central Europe.

**Hericium coralloides* (Scop. : Fr.) Gray. Distributed in the whole region, down to the boundary with Greece, in 25 localities in national parks, nature reserves and more or less old beach forests on dead standing and prostrate trunks and logs of *Fagus*, sometimes on very rotten wood, singly or a few specimens. There are, however, a few finds on *Quercus* and *Morus* from near human habitations, for instance in parks. (Karadelev, 1993). In Fennoscandia it grows typically in virgin forests, mostly on *Betula*, but already in Denmark it is found on *Fagus* on which it occurs mostly in Central Europe (Koski-Kotiranta & Niemelä, 1987).

Inonotus nodulosus (Fr.) P.Karst. was found in the investigated region only on *Fagus*, on dead standing and prostrate trunks, logs, branches, stumps, sometimes on firewood, in about 30 localities, down to the border with Greece, in national parks, nature reserves and more or less old forests, and is particularly frequent at Plitvice, where it was observed during almost every visit, often on very rotten wood.

Ischnoderma benzoinum (Wahlenb. : Fr.) P. Karst. National parks , nature reserves, forests with old trees, on prostrate trunks, logs, stumps, also standing dead, rarely living trees mainly of *Abies*, but also *Picea*, sometimes abundant. In the region about 25 localities; not yet found in Macedonia. At Plitvice found many times. Like the next species, it is at first soft and sappy (leptoporoid phase) and becomes hard at the end of summer and beginning of autumn (fomitoid phase). Unexpectedly it was found in a park of a small town near Zagreb, on a stump of conifer, which agrees with the statement by Niemelä and Kotiranta (1986) that it occurs in Finland both in virgin forests, as well as ones influenced by man.

Ischnoderma resinosum (Fr.) P. Karst. In the mycological literature considered as rather rare southern European species, but it is distributed more or less in all the territory investigated and is even more frequent than the preceeding (over 30 localities), down to the boundary with Greece. It is particularly abundant in national parks, on logs, prostrate trunks, stumps, standing dead, a few times also living trunks, mainly *Fagus*, once prostrate trunk of *Acer* cf. *obtusatum*, singly or several. Carpophores develop later than those of *I. benzoinum*, are in the leptoporoid phase when those of the first are already dry and hard, and become hard only late in autumn or even in winter. It may, however, appear, although rarely, in managed forests on a casual large log, and was found even in town parks, once on living Aesculus hippocastanum, once on dead branch of living *Tilia* sp. and also at the same time and in the same park as *I. benzoinum*, on a stump of *Fagus*.

Phellinus chrysoloma (Pers.) Donk. NP Risnjak, NP Plitvice on several places, an old forest in mt. Velebit in Croatia, two localities in Slovenia,

and two in Bosnia, On dry branches (particularly at their base) on living trees of *Picea* and *Abies* - more frequent on the first, also on prostrate branches, on cut surface of logs, on prostrate trunks. Only 7 localities known up to now, but is frequent in some, particularly at Plitvice.

**Phellinus nigrolimitatus* (Romell) Bourdot & Galzin. NP Plitvice often, on one log observed during several years, NP Sutjeska and another locality in Bosnia, one locality in Serbia. At the side of prostrate trunks and logs of *Picea*, often noted as very rotten, once on cut surface, sometimes abundant. According to Ryvarden and Gilbertson (1994) it is especially common on *Picea*, also found on *Abies* and *Pinus*, and is seemingly unable to fruit in comercialized forest without old fallen trunks.

**Phlebia centrifuga* P. Karst. Two nature reserves in Slovenia, NP Plitvice (found there nearly a dozen times on various places), NP Sutjeska. Prostrate rotten trunks, logs, once also stump, mostly *Abies*, also *Picea*, twice *Fagus*; once on cut surface. It is one of the characteristic species for virgin (spruce) forests in North Scandinavia and has a preference for untouched nature (Eriksson et al., 1981). Known also in Central Europe.

Phlebia georgica Parmasto. Three nature reserves in Slovenia, NP Risnjak, NP Plitvice, NP Sutjeska. On very rotten prostrate trunks, branches and stumps of *Abies* and *Picea*, sometimes abundant. In Plitvice observed a dozen times. Except in Scandinavia found also in Central Europe and Spain.

Podofomes trogii (Fr.) Pouzar. NP Risnjak , NP Plitvice, in both several times, also a nature reserve in Slovenia, a locality in Bosnia and mountain Goè in Serbia. Usually singly, at stumps, once at the base of dry standing trunk of *Abies*. Restricted to Central Europe and west Asia; on *Abies*, mostly on calcareous soils (Ryvarden & Gilbertson, 1994).

**Pycnoporellus fulgens* (Fr.) Donk. In several nature reserves in Slovenia, in one of them in great quantities, in NP Plitvice rather rare, found only three times, on three places, and in two mountains in Serbia, on prostrate trunks and logs, stumps of *Abies*, once *Pinus*; wood may be very rotten. This agrees with the statement of Kotlaba (1984) who cites it from Czechoslovakia mainly on *Abies*, only few finds from *Picea*. According to Ryvarden and Gilbertson (1994) is a rare species, distinctly restricted to old forests, most common in Europe on *Picea*, but also found on *Abies* and *Pinus*.

**Rigidoporus crocatus* (Pat.) Ryvarden. NP Plitvice, NP Risnjak, and NP Sutjeska, also some nature reserves in Slovenia and two other localities, one in Croatia, one in Bosnia. On prostrate trunks and logs mainly *Abies*, sometimes also *Fagus* and *Picea*. A rare species in Europe (Ryvarden & Gilbertson, 1994)

**Skeletocutis odora* (Sacc.) Ginns. On prostrate trunks (once noted as rotten) of *Picea* and *Abies*, sometimes covering a rather large surface. Six localities: NP Plitvice where it was collected several times, NP Sutjeska, also three mountains in Serbia and mt.Kouf at the boundary of Macedonia and Greece. In Fennoscandia a typical taiga species, and usually found in virgin forests. In northern Europe almost exclusively on *Picea*, in central Europe also on *Abies* (Ryvarden & Gilbertson, 1994).

**Skeletocutis stellae* (Pilat) Jean Keller. Although only 4 localities known, it is not rare in Plitvice where it was found many times; also noted in Sutjeska, a nature reserve in Slovenia and a rather old forest in Bosnia. Everywhere on prostrate, often rotten and sometimes very large trunks of *Picea* and *Abies*, twice on cut surface ot the trunk. Ryvarden and Gilbertson (1994) consider it in Fennoscandia as a typical taiga species growing especially on *Picea*, and Niemelä (1998) states that its presence is a strong indication of the virgin state of forests of spruce and pine.

Sparassis nemecii Pilát & J.Veselsky. At the base of living trees or at rotten stumps of *Abies* in some nature reserves in Slovenia, in NP Risnjak and some localities in its vicinity in Croatia, and NP Sutjeska in Bosnia; in all about 10 localities. It was published in older literature from the vicinity of Risnjak as *Sparassis crispa* (or *S. ramosa*), but since the substrate was sometimes given as *Abies*, it is surely this species.

Stereum insignitum Quél. According to Kotlaba (1985) it has in Europe submediterranean distribution, from southern parts of Central Europe southwards. In the region of former Yugoslavia it seems to be characteristic for beech as well as beech and fir forests, and was found in more than 60 locaities in national parks, nature reserves, also in many rather old moun-

tain forests in all the region; down to the boundary of Macedonia with Greece. The host, when known, was *Fagus*, only in three instances Ostrya. The species grows preferably on logs, prostrate and standing dead trunks, often very abundantly; sometimes it was noted on injured parts of living trunks and on stumps. In managed forests it is very rare, and was found very few times on fallen branches or stumps.

Veluticeps abietina (Pers. : Fr.) Hjortstam & Telleria (*Columnocystis abietina* (Pers. : Fr.) Pouzar) occurs in Fennoscandia, also in central Europe, mostly on *Picea* (Jülich, 1984). It was found in three localities in Slovenia, one of them at the border ot the city of Ljubljana, in the NP Plitvice in Croatia, also in NP Sutjeska and mt.Igman in Bosnia, on prostrate trunks and logs (usually on cut surface), stumps, once branch of *Picea*. At Plitvice found several times, once with *C. ambigua*.

Following species were found in only one locality (a national park), the first at Sutjeska and the rest at Plitvice. Some were noted only once, some two or three times, not always in the same place. They are apparently rare here as well as elsewhere in Europe, but seem to be characteristic for old forests and may occur in further localities.

Gelatoporia subvermispora (Pilat) Niemelä. The single find was in NP Sutjeska, on wood of a fallen shattered trunk of *Picea*. Known in few countries in Europe where it prefers *Picea*. In Finland it occurs in several localities in various biotopes, not necessarily old forests (Niemelä, 1985).

**Anomoporia bombycina* (Fr.: Fr.) Pouzar. Found once, in the Plitvice NP, a not particularly large specimen on prostrate trunk of *Abies*.

Antrodiella citrinella Niemelä & Ryvarden is known from several places in Fennoscandia, and a few in Central Europe and is considered as restricted to the boreal coniferous forests in virgin state (Ryvarden & Gilbertson, 1993). At Plitvice it was found two times in one place, in the interval of 6 years, on cut surface of a small log and on cut surface and the side of a stump of *Picea*, each time a few small specimens, once in close company with *Antrodia serialis*.

Flavophlebia sulphureoisabellina (Litsch.) K. H.Larss. & Hjortstam. For the moment found only in three places in Plitvice NP, several kms apart in a straight line, in all five times, on the bark of prostrate trunks of *Abies*, sometimes rather abundant, once with Piloderma croceum. Noted in few countries of Central Europe, on *Abies*.

**Junghuhnia collabens* (Fr.) Ryvarden is, according to Ryvarden and Gilbertson (1993) a boreal taiga species, occurring in North, Central and Eastern Europe on dead wood of conifers, especially *Abies* and *Picea*. Up to now it was found only at Plitvice six times, in four places several kms apart, on prostrate trunks and logs, sometimes with very rotten wood, on *Abies*, twice also on *Picea*, at the side or on cut surface.

Junghuhnia fimbriatella (Peck) Ryvarden. Collected in Plitvice two times in the course of 6 years, in two places at least ten kms apart in a straight line, on a small log and rotten prostrate trunk of *Fagus*. In Europe rare, found in few countries.

Phellinus pouzarii Kotl. is known from few European countries, on wood of *Abies* where it preferably grows on cut surfaces (Kotlaba, 1984). In the investigated region it was found only in Plitvice, where it was noted several times in two places, only few kms apart, always on cut surfaces of large, rather rotten, logs or trunks of *Abies*, every time one or two carpophores.

Skeletocutis jelicii Tortič & A. David (*Ceriporiopsis jelicii* (Tortič & A. David) Ryvarden & Gilb.). Described from Plitvice, where only a very small carpophore was collected on a big prostrate trunk of *Abies*. Not refound there (or elsewhere), although looked for. It is known also from three localities in Finland on *Picea* and is there considered as endangered species, which is here probably also.

Skeletocutis papyracea A. David. In Plitvice found four times in one place, on prostrate trunks of *Picea* and *Abies*, on the last named once very abundant. Known from few countries in Europe, everywhere apparently few localities, mostly on *Pinus sylvestris*. In Finland found both in virgin and managed forests, on fallen decorticated trunks of pine; spruce is a less common substrate (Niemelä, 1998).

Spongipellis delectans (Peck) Murrill. At Plitvice it was found twice in the interval of 17 years, in two places several kms apart, on logs of *Fagus*, once at the cut surface, once at the side, both times a few carpophores. Ryvarden and

Gilbertson (1994) consider it a rare species in Europe, although noted in many countries. *Veluticeps ambigua* (Peck) Hjortstam & Telleria (*Columnocystis ambigua* (Peck) Pouzar) was collected at Plitvice four times, in two places 7-8 kms apart in a straight line, on logs (mostly on cut surface) and prostrate trunks of *Picea*, sometimes abundant, growing once together with *C.abietina* and once with *Amylostereum areolatum*. Rare and known in few countries of Central Europe.

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List of physcioid macrolichens of Russian Far East and Siberia

Hans Trass
Institute of Botany and Ecology, University of Tartu, 38 Lai St., EE 2400 Tartu, Estonia

Abstract: 81 physcioid (*Physciaceae, Lecanorales*) macrolichen species have so far been found in the Russian Far East and Siberia (*Phaeophyscia* - 20 species, *Heterodermia* - 20, *Physconia* - 13, *Physcia* - 11, *Anaptychia* - 8, *Pyxine* - 3, *Phaeorrhiza* - 2, *Dimelaena, Dirinaria, Hyperphyscia, Tornabea* - 1 species each). The most species-rich area lies in the south-eastern (glaciation-free) corner of Primorski territory (Primorje, Primorski krai), where the still surviving deciduous forests offer refugial protection for many pantropical and subtropical species of physcioid macrolichens, particularly of the genus *Heterodermia*.

INTRODUCTION

Despite the large territory of the Russian Far East and Siberia not many lichenologists have studied seriously the extremely interesting lichen flora of this area. First of all should mention such well-known scientists as A. Elenkin, V. Savitsh, A. Oxner, M. Tomin, K. Rassadina, O. Blum, L. Knyazheva, J. Skirina, A. Mikulin, T. Makryi, N. Sedelnikova and a few others. The lichen flora of this territory is estimated to consist of about 2000 lichen species, less than two-thirds of this flora composition has so far been ascertained.

This short paper consisting of the list of physcioid macrolichens of the Russian Far East and Siberia is dedicated to Dr. Erast Parmasto, my friend and colleague on his 70th birthday. With Erast I participated in 1960 (together with nine young Estonian scientists) in the first Far East Kamtschatka expedition led by the writer and historian, current President of the Republic of Estonia, Lennart Meri. Erast Parmasto as an outstanding mycologist has greatly influenced to the formation of my theoretical opinions in the study of lichenized fungi and my interest in the Far East flora and vegetation, where I have participated in many expeditions up to 1986.

MATERIALS CONSIDERED

Altogether about 4500 specimens of physcioid macrolichens collected by the author and other lichenologists in various parts of Southern, Northern, Western and Eastern Siberia and the Far East of Russia were studied. The author's study area lies mainly in Primorski territory, Kamtschatka Peninsula, Lake Baikal region, Taimyr Peninsula, Central Asia and Kazakhstan. Besides simply collecting herbarium materials I together with my colleagues have compiled many descriptions (relevés) of lichen communities, studying especially the problems of air pollution impact on the vegetation using the index of poleotolerance (IP) and the index of atmospheric purity (IAP). This data, also concerning physcioid lichens, has been partly published earlier (Trass, Pärn & Zobel, 1988).

THE SPECIES

During the last decades some new papers concerning Far East and Siberian lichens have been published (Knyazheva, 1973; Makryi, 1990; Mikulin, 1986; Moberg, 1995; Pärn & Trass, 1990; Sedelnikova, 1977, 1985; Skirina, 1995; Skirina & Knyazheva, 1985; Tshabanenko, 1986; Urbanavichene, 1998). In these papers new species were added to the list of lichen species of the region. During my trips to the Russian Far East and Siberia in 1960, 1961, 1971, 1972, 1973, 1977, 1978, 1979, 1980, 1984, 1985, 1986 I have paid special attention to the lichen family *Physciaceae* and have now compiled the list of physcioid macrolichens on the basis of my collections, the examination of herbarium materials in TU, LE, KW, VL, H, TUR, UPS, S, LD and using the available literature sources. Of the 81 species presented in the list 10 - *Anaptychia palmulata, Dirinaria applanata, Heterodermia chilensis, H. leucomela, Phaeophyscia chloantha, P. imbricata, P. squarrosa, Physcia albinea, P. subpulverulenta,*

P. venusta are indicated according to literature sources only.

Russian Far East and Siberia is divided into different administrative units (Turlais, 1997; area in thousands of km²): *Far East* - Tshukotski Autonomous district, in Russian okrug (737,7), Koryakski Autonomous district (301,5), Kamtshatskaya region, in Russian oblastj (170,8), Magadanskaya region (461,4), Khabarovski territory, in Russian krai (788,6), Sakhalinskaya region (87, 1), Primorski territory (165, 9), Jewish Autonomous region (36,0), Amurskaya region (363,7); *Eastern Siberia* - Republic of Sakha, Yakutia (3103, 2), Republic of Buryatia (351, 3), Republic of Tyva (170, 5), Republic of Khakassia (61, 3), Krasnoyarski territory (1 710, 0), Taimyrski Autonomous district (862, 1), Evenkiiski Autonomous district (767, 6), Irkutskaya region (745, 5), Ustj-Ordynski Buryatski Autonomous district (19,0), Tshitinskaya region (412, 5), Aginski Buryatski Autonomous district (19, 0); *Western Siberia* - Republic of Altay (92, 6), Altayski territory (169, 1), Kemerovskaya region (95, 5), Novosibirskaya region (178, 2), Omskaya region (139, 7), Tomskaya region (316, 9), Tyumenskaya region (161, 8), Khanti-Mansiiski Autonomous district (523, 1), Yamalo-Nenetski Autonomous district (750, 3).

The list gives data only for species distribution in large administrative and regional units, not in specific localities.

Anaptychia bryorum Poelt - Primorski territory; scattered

A. ciliaris (L.) Körb. - Western Siberia; rare

A. crinalis (Schleich.) Vezda - Eastern Siberia; rare

A. desertorum (Rupr.) Poelt - Southern Siberia; rare (locally scattered)

A. isidiata Tomin - Primorski and Khabarovski territory, Amurskaya region; relatively common

A. palmulata (Michx.) Vain. - Primorski territory; very rare (Insarov & Ptshelkin, 1983, 1983a; Skirina, 1995)

A. setifera Mereschk. ex Räs. - Western Siberia (rare); Central Asia (scattered)

A. ulotrichoides (Vain.) Vain. - boreal and subarctic regions of Siberia and Far East; scattered

Dimelaena oreina (Ach.) Norm. - Western Siberia, Lake Baikal area; rare

Dirinaria applanata (Fée) Awasthi - Primorski territory; rare (Skirina, 1995)

Heterodermia boryi (Fée) K.P. Singh - Primorski territory; scattered & S.R. Singh

H. casarettiana (Massal.) Trevis. - Primorski territory; very rare

H. chilensis (Kurok.) Swinsc. & Krog - Primorski territory; very rare (Skirina, 1995)

H. corallophora (Tayl.) Skorepa - Primorski territory; rare

H. dendritica (Pers.) Poelt - Primorski territory; rare

H. diademota (Tayl.) Awasthi - Amurskaya region; Primorski territory, Jewish Anatonomous region; scattered

H. dissecta (Kurok.) Awasthi - Primorski territory, rare

H. hypocaesia (Yasuda) Awasthi - Primorski territory; very rare

H. hypochraea (Vain.) Swinsc. & Krog - Primorski territory; very rare

H. hypoleuca (Ach.) Trevis. - Primorski territory; common

H. intermedia Trass - endemic of Primorski territory, Sikhote-Aline mountain range; very rare

H. isidiophora (Vain.) Awasthi - Primorski territory, Khabarovski territory, Amurskaya region, scattered

H. japonica (Sato) Swincs. & Krog - Irkutskaya region, Primorski territory, scattered

H. leucomela (L.) Poelt - I have not seen true *H. leucomela* from Siberia and Far East of Russia, though there are records in literature (Sedelnikova, 1985)

H. microphylla (Kurok.) Skorepa - Primorski territory, Kurile Islands, Khabarovski territory; rather common

H. obscurata (Nyl.) Trevis. - Altayski territory, Primorski territory; rare

H. podocarpa (Bél.) Awasthi - Primorski territory; very rare

H. propagalifera (Vain.) Dey - Altaiski territory, Primorski territory; scattered

H. speciosa (Wulf.) Trevis. - Tšhukotski Autonomous district, Primorski territory, Khabarovski territory, Amurskaya region, Republic of Sakha (Yakutia), Irkutskaya region, Republic of Buryatia; here and there common

H. subascendens (Asah.) Trass - Primorski territory; very rare

Hyperphyscia adglutinata (Flörke) Mayrh. & Poelt - Western Siberia; very rare
Phaeophyscia chloantha (Ach.) Moberg - Island Sakhalin; very rare (Moberg, 1995)
P. ciliata (Hoffm.) Moberg - scattered in Western and Eastern Siberia
P. constipata (Norrl. & Nyl.) Moberg - in borealmost (and subarctic) parts of Western and Eastern Siberia; rare
P. denigrata (Hue.) Moberg - Primorski territory, Jewish Autonomous region, Sakhalin Island and Kurile Islands; scattered
P. endococcina (Körb.) Moberg - Eastern Siberia, Khabarovski territory; rare
P. erythrocordia (Tuck.) Essl. - Primorski territory; rare
P. exornatula (Zahlbr.) Kashiw. - Primorski territory; rare
P. hirtuosa (Krempelh.) Golubk. - in many territories and regions (exxept arctic ones), scattered
P. hirsuta (Mereschk.) Essl. - Primorski territory; rare
P. hispidula (Ach.) Essl. - in several Far East territories and regions (except subarctic and arctic ones), scattered
P. imbricata (Vain.) Essl. - Primorski territory, Kurile Islands; rare (Insarov & Ptshelkin, 1988; Skirina, 1995)
P. kairamoi (Vain.) Moberg - Primorski territory, Amurskaya region, Irkutskaya region, Khabarovski territory, Island Sakhalin; scattered
P. melanchra (Hue) Hale - Primorski and Khabarovski territories; rare
P. nigricans (Flörke) Moberg - Eastern Siberia; rare
P. orbicularis (Neck.) Moberg - Eastern and Western Siberia; rare (little collected?)
P. primaria (Poelt) Trass - in several regions of Eastern Siberia and Far East; rare
P. pyrrhophora (Poelt) Awasthi & Joshi - Primorski and Khabarovski territories; Lake Baikal area; rare
P. rubropulchra (Degel.) Essl. - Eastern Siberia; rare
P. sciastra (Ach.) Moberg - in several regions and territories of Siberia and Far East; common
P. squarrosa Kashiw. - Primorski and Khabarovski territories; rare (Moberg 1995)
Phaeorrhiza nimbosa (Fr.) Mayrh. & Poelt - Eastern Siberia; Republic of Tyva; rare
P. sareptana (Tomin) Mayrh. & Poelt - Republic of Tyva; Rebublic of Sakha, Lake Baikal area; rare
Physcia adscendens (Fr.) Oliv. - Primorski and Khabarovski territories; scattered
P. aipolia (Humb.) Fürnr. - Western and Eastern Siberia, Far East; common
P. albinea (Ach.) Malbr. - Subarctic Middle Siberia; rare (Moberg & Zhurbenko, 1994)
P. biziana (Massal.) Zahlbr. - Western Siberia; rare
P. caesia (Hoffm.) Fürnr. - in several territories and regions of Siberia and Far East; very common
P. dubia (Hoffm.) Lett. - Western Siberia; rare
P. phaea (Tuck.) Thoms. - Arctic Siberia, Lake Baikal area; rare
P. semipinnata (Gmel.) Moberg - Western Siberia; rare
P. stellaris (L.) Nyl. - in several regions and territories of Siberia and Far East; common
P. tenella (Scop.) D.C. - Western and Eastern Siberia; scattered
P. vitii Nadv. - Eastern Siberia; locally scattered
Physconia detersa (Nyl.) Poelt - Primorski territory; rare
P. distorta (With.) Laundon - Far East territories; rare
P. enteroxantha (Nyl.) Poelt - Eastern and Western Siberia; scattered
P. grisea (Lam.) Poelt - Western and Eastern Siberia; rare
P. grumosa Kashiw. & Poelt - Primorski territory; rare
P. hokkaidensis Kashiw. - Primorski and Khabarovski territories; rare
P. kurokawae Kashiw. - Eastern Siberia; rare
P. lobulifera Kashiw. - Primorski territory; rare
P. muscigena (Ach.) Poelt - high-mountain and arctic regions and territories of Siberia and Far East; common
P. perisidiosa (Erichs.) Moberg - Western Siberia; rare
P. servitii (Nadv.) Poelt - Primorski territory; very rare
P. subpulverulenta (Szatala) Poelt - Primorski territory; very rare (Skirina, 1995)
P. venusta (Ach.) Poelt - Kurile Islands; very rare (Insarov & Ptshelkin, 1988)
Pyxine endochrysoides (Nyl.) Degel. - Western Siberia; rare

P. sibirica Tomin - Primorski territory; scattered
P. sorediata (Fr.) Mont. - Primorski and Khabarovski territories, Lake Baikal area; scattered to common
Tornabea atlantica (Ach.) Osth. - Southern Siberia, rare (more common in Central Asian republics, particularly in Turkmenistan)

DISTRIBUTION PATTERNS

Physcioid macrolichens of Russian Siberia and Far East (81 species) can be divided into several distribution patterns. Surprisingly high is the number of pan- and subtropical species in the sout-eastern (glaciation-free) corner of Primorski territory, where luxuriant species-rich deciduous forests of the Sikhote-Alin mountains slopes offer refugial protection for many pantropical species (e.g., *Heterodermia casarettiana, H. corallophora, H. dendritica, H. diademata, H. hypocaesia, H. hypochraea, H. isidiophora, H. podocarpa*, etc.). Part of the species belong to the East Asian subtropical element, with areal and mass centre in Russian Far East, Japan, China and Korea (*Heterodermia dissecta, H. subascendens*). Groups of species belong to the temperate East Asian element (*Anaptychia isidiata, Phaeophyscia imbricata, P. primaria, P. squarrosa*), to the temperate Eurasian element with areal centre in Siberia (*Phaeophyscia kairamoi, Physcia vitii*), to the arctic-alpine element (*Physcia phaea, Anaptychia ulotrichoides, Physconia muscigena*), to the Central Asian element (*Anaptychia desertorum, Phaeorrhiza nimbosa, P. sareptana, Tornabea atlantica*), and many to the cosmopolitan element (*Phaeophyscia nigricans, P. orbicularis, Physcia caesia, P. stellaris*, etc.). One species has so far been proposed as a strict endemic for the Sikhote-Aline mountain range (*Heterodermia intermedia*).

Phytogeographically the most intresting phenomenon is the rich penetration of tropical *Heterodermia*'s to the Russian Far East lichen flora.

SUBSTRATES

Of the 81 species 60 are predominantly epiphytic, 8 epilithic and 13 epigeic and/or epibryic. Many species are growing on various substrates - trees and bare rocks, trees and mossy rocks, on earth, mosses and trees. Largest proportion of species are hemerophobic, occuring in virgin forests, high mountain habitats, etc. A few species grow in habitats changed by the activities of man. For example, *Heterodermia diademata* on trees of cultivated lands, *H. isidiophora* is a poleotolerant species growing in city avenues. Typical moderately toxitolerant species are *Phaeophyscia nigricans, P. orbicularis, Physcia adscendens, P. aipolia, P. caesia, P. stellaris, P. tenella, Physconia distorta, P. enteroxantha, P. perisidiosa.*

CONCLUSION

As we can see from the list the larger part of physcioid macrolichens are rare species in the Russian Far East and Siberia. The assesment "very rare" is given to 14 species (*Anaptychia palmulata, Heterodermia casarettiana, H. chilensis, H. hypocaesia, H. hypochraea, H. intermedia, H. podocarpa, H. subascendens, Hyperphyscia adglutinata, Phaeophyscia chloantha, Physconia servitii, P. subpulverulenta, P. venusta, Torneba atlantica*), "rare" to 38 species. Almost all of these species are in great danger of extinction. Only 10 species are locally common (*Anaptychia isidiata, Heterodermia hypoleuca, H. microphylla, H. speciosa, Phaeophyscia sciastra, Physcia aipolia, P. caesia, P. stellaria, Physconia muscigena, Pyxine sorediata*). Only 1 physcioid macrolichen (*Torneba atlantica*) has been included in the "Red Book of USSR" (Trass, Matzkewitsh & Tolpysheva, 1984). I am convinced, that all very rare and a large part of rare species should be included in the "Red Book". To my knowledge about half of the recorded physcioid macrolichen species are growing in the territories of existing nature reserves. Many very rare and rare species only grow outside reserves (for example, *Anaptychia desertorum, heterodermia dissecta, Phaeophyscia rubropulchra, P. squarrosa, Phaeorrhiza nimbosa, Physconia grumosa, Pyxine sibirica*, etc.). They need organized protection to survive, in order to maintain the biodiversity of the very peculiar nature of Siberia and the Far East. Considering the uneconomic and ferocious policies of many local authorities concerning the utilization of the nature resources, particularly forests, the fate

of the flora including many very sensitive physcioid macrolichens seems to be irredeemable (see Well & Williams, 1998).

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