Taxonomic studies on members of thelotrematoid Ostropales (lichenized Ascomycota) in Australia

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ABSTRACT

A taxonomic revision of the Australian members of trentepohlioid, ecolumellate thelotremataceaen Graphidaceae (Ostropales, lichenized Ascomycota) is presented. This species-rich group of crustose, predominantly tropical and subtropical lichens has been neglected for a long time, and is still poorly known. Particularly the studies for Australia are highly fragmentary.

Approximately 4000 specimens, including a total of c. 500 type specimens, herbaria collections, and almost 1000 samples collected during two field trips, were examined morphologically, anatomically, and chemically. A total of 103 species of 13 genera (including one newly described genus) could be identified. 33 species are new records for Australia, and 20 species were described new to science. Of the currently listed 71 names of this group for Australia, 50 are accepted as valid species. The remaining names and species, listed in an appendix, proved to belong to other genera, be synonymous to other taxa or falsely identified collections. 21 species (including species not known for Australia) are newly combined and several new synonyms are proposed.

In the taxonomic part an introduction is provided, including a historical overview of the development of generic concepts and delimitations within the treated group. This is followed by a brief presentation of earlier taxonomic studies and collections of thelotrematoid lichens in Australia. It also provides a general treatment of the climatic and biogeographical conditions of the continent. Further, the main characters are described, including anatomical, morphological and chemical features. The ecology and distribution of thelotrematoid lichens are discussed. All treated species are described and illustrated, their distribution is mapped, and a key for the identification provided. An overview of the distinguishing characters between genera is presented in a table.

To illuminate the phylogenetic relationships within this group, three phylogentic analyses were carried out using partial sequences of nuclear and mitochondrial ribosomal DNA loci. The first analysis employed a combined dataset of the mitochondrial SSU (mtSSU) and the nuclear LSU (nuLSU) of 105 species of Ascomycetes. As a result, it could be shown that the hitherto separted two families of Ostropales, Graphidaceae and Thelotremataceae, are not monophyletic, but form several lineages within one strongly supported monophyletic group. Consequently, Thelotremataceae is reduced to synonymy with Graphidaceae. The second and third analyses were carried out using a single dataset of nuLSU and mtSSU sequences respectively. In the nuLSU analysis 40 specimens of 38 species were included, in the mtSSU analysis 50 specimens of 25 species were examined. These analyses showed that all genera of thelotrematoid lichens included in the study are para- or polyphyletic, with the sole exception of *Diploschistes*, and that the present generic concept within Graphidaceae needs revision. The new genus *Melanotopelia* is introduced based on molecular and morphological evidence.

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0. Deutschsprachige Zusammenfassung: Taxonomische Studien von Mitgliedern der thelotrematoiden Ostroplaes (lichenisierte Ascomycota) in Australien

Die Ordnung Ostropales (Ascomycota) besteht aus sechs Familien und ist durch gelatinisierte, hemiangiocarpe Fruchtkörper und funktionell unitunikate Asci gekennzeichnet. Wie in dieser Studie gezeigt wird, bilden zwei der Familien, die Graphidaceae und die Thelotremataceae, keine einheitlichen monophyletischen Gruppen. Als nomenklatorische Konsequenz werden daher die Thelotremataceae mit den Graphidaceae synonymisiert. Die ehemalige Familie Thelotremataceae (im Folgenden thelotrematoide Flechten genannt) bildet eine der größten Gruppen innerhalb der Ostropales, mit über 1000 beschriebenen Namen (Frisch, 2006; Hale, 1981), von denen zur Zeit über 500 als Arten akzeptiert sind (ebd.).

Diese Arten sind verteilt auf derzeit 21 akzeptierte Gattungen und drei zusätzliche, informelle Artengruppen: *Acanthotrema, Ampliotrema, Chapsa*, *Chroodiscus, Diploschistes, Fibrillithecis, Gyrotrema, Ingvariella, Leptotrema, Leptotrema schizoloma*-Gruppe, *Leucodecton, Melanotopelia, Melanotrema, Myriotrema, Nadvornikia, Ocellularia, Ocellularia clandestina*-gruppe, *Pseudoramonia, Redingeria, Reimnitzia, Stegobolus, Thelotrema, Thelotrema glaucopallens*-Gruppe und *Topeliopsis*. Es handelt sich um krustenbildende, vornehmlich lichenisierte Ascomycota, die in der Mehrzahl rindenbewohnend sind, und durch einen meist trentepohlioiden Fotobionten (außer *Diploschistes*) und rundliche, eingesenkte bis aufstrebende Peri- oder Apothezien mit unverzweigten Paraphysen und distoseptierten Ascosporen charakterisiert sind. Sie bilden eine bedeutende Komponente in der Biodiversität tropischer bis subtropischer Regenwaldökosysteme, sind aber auch in trockeneren Habitaten und in temperierten Zonen zu finden.

Kenntnisse über Taxonomie, Systematik, Biogeografie und Ökologie in dieser Gruppe sind jedoch nur ansatzweise vorhanden, und bis in die jüngste Vergangenheit hinein sind keine bedeutenderen systematischen Untersuchungen durchgeführt worden. Die Gründe hierfür liegen traditionell zum einen - wie bei nahezu allen regenwaldbewohnenden Individuen - am erschwerten Probenzugang und der Problematik der oft kaum erreichbaren Habitate. Zumal die Verterter der hier behandelten Gruppe vorzugweise in höheren Bereichen bzw. in der Baumkronenzone der Regenwälder zu finden sind. Zum anderen liegen die unterscheidungs-kritischen Merkmale, oft bis in die Familien-Ebene reichend, im mikroskopischen Bereich. Mit den unzureichenden optisch-technischen Methoden der historischen Flechtenforschung war jedoch eine weitere Differenzierung der Taxa, bzw. die Untersuchung von Mikrostrukturen nahezu unmöglich. Zusätzlich spielt in den moderneren taxonomischen und systematischen Untersuchungen die Sekundärstoffchemie eine bedeutende Rolle für die Unterscheidung verschiedener Gruppen. Die Existenz dieser Substanzen wurde zwar bereits in der zweiten Hälfte des 19. Jhs. erkannt, jedoch waren auch hier die technischen Analysemöglichkeiten stark eingeschränkt.

Abgesehen von Redingers Abhandlung (1936) der brasilianischen Vertreter der thelotrematoiden Flechten, beschränken sich die Veröffentlichungen bis ins ausgehende 20. Jh. in erster Linie auf floristische Untersuchungen, und die systematische Einteilung fußte aus heutiger Sicht auf recht groben Kriterien. Als bedeutendste Forscher im Bereich der thelotrematoiden Flechten in der zweiten Hälfte des 19. Jhs. sind Nylander (z. B. 1858, 1859, 1862) und Müller Argoviensis (z. B. 1887b, 1890, 1894) zu nennen. Letzterer führte auch ein Ascosporen-basiertes Gattungskonzept (1887b) ein, das bis in die 70er Jahre des 20. Jhs. und darüber hinaus Anwendung fand (z. B. Hale 1978, Nagarkar & al. 1988). Demnach wurden vier Hauptgattungen unterschieden, die sich nach Septierung und Pigmentierung der Ascosporen richteten: *Thelotrema* mit farblosen, mauerförmigen, *Ocellularia* mit farblosen querseptierten, *Leptotrema* mit braunen, mauerförmigen und *Phaeotrema* mit braunen, querseptierten Ascosporen. Dieses Konzept ermöglichte zwar eine einfache und vergleichsweise gut differenzierte Einteilung der Arten, war aber in hohem Maße artifiziell. Durch Salisbury (1971, 1972a, 1972b, 1978) wurde daher zunächst ein informelles Gliederungssystem eingeführt, das wenige Jahre später von Hale (1980, 1981) in ein formalistisch gültiges Gattungskonzept übertragen wurde. Hales Konzept, welches mit einigen Modifikationen bis heute Anwendung findet, legt nicht mehr die Ascosporenmorphologie zugrunde, sondern berücksichtigt in erster Linie Merkmale des Fruchtkörperrandes.

Es wird im vorherigen Abschnitt bereits andeutungsweise ersichtlich, dass die thelotrematoiden Taxa, die lange Zeit ein wissenschaftliches Schattendasein fristeten, mit dem Zeitalter der modernen Lichenologie zunehmend in den Fokus der Wissenschaft rückten. Seit dem ausgehenden 20. Jh. bis in die heutige Zeit gibt es eine Vielzahl meist kleinerer Studien, die sich in erster Linie auf einzelne Untergruppen und/oder auf meist kleinere geografische Untersuchungsgebiete beschränken (z. B. Guderley & Lumbsch, 1996; Hale, 1974b, 1978b, 1981; Homchantara & Coppins, 2002; Kalb, 2001; Kantvilas & Vezda, 2000; Lücking, 1992a, Lücking & Grube, 2002; Lumbsch, 1985, 1989; Lumbsch & Elix, 2003; Matsumoto, 2000; Nagarkar & Hale, 1989; Nagarkar & al., 1986, 1987, 1988; Patwardhan & Kulkarni, 1977b; Patwardhan & al., 1985; Purvis & al., 1995; Salisbury, 1972a, b; Sipman, 1992a, b). Als erste Studie, die sowohl auf einer ausführlichen systematischen Untersuchung basiert, als auch eine detailierte taxonomische Behandlung nahezu aller Gattungen beinhaltet, ist die von A. Frisch und seinen Mitarbeitern kürzlich erschienene Monografie zu nennen (Frisch, 2006; Frisch & Kalb, 2006; Frisch & al., 2006), die sich vornehmlich auf den afrikanischen Kontinent konzentriert. Für den australasischen Raum allerdings ist das Wissen um die thelotrematoiden Flechten in hohem Maße bruchstückhaft. Bis auf die Arbeiten von Lumbsch (1989), der die Gattung *Diploschistes* behandelt, Kalb (2001) und Frisch & Kalb (2006a), die vor allem die Gattung *Topeliopsis* in Australien untersuchen, und Kantvilas & Vezda (2000), die sich auf verschiedene Gruppen der tasmanischen Vertreter beschränken, sind keine weiteren nennenswerten Studien durchgeführt worden.

Die hier vorliegende Arbeit hat daher zum Ziel, die taxonomischen Verhältnisse des größten Teiles dieser Gruppe für den australischen Kontinent zu beleuchten, und stellt eine Revision der trentepohlioiden (d. h. ausgenommen der Gattung *Diploschistes*), nicht-columellaten (d. h. ausgenommen der Gattungen *Gyrotrema, Melanotrema, Ocellularia, Redingeria* und *Stegobolus*), thelotrematoiden Graphidaceae (d. h. ausgenommen der Graphidaceae s. str.) dar. Im Rahmen des Gesamtprojektes sind die columellaten Taxa ebenfalls bearbeitet worden, die Ergebnisse dieser Untersuchungen werden jedoch an anderer Stelle veröffentlicht.

Insgesamt wurden ca. 4000 Proben anatomisch, morphologisch und chemisch untersucht. Die untersuchten Individuen setzen sich zusammen aus allen erhältlichen australischen Typus-Proben, aus großen Teilen auch außer-australischer Typen, aus allen erhältlichen, australischen Aufsammlungen verschiedener Herbarien und schließlich aus den selbstgesammelten Proben aus Queensland, Neusüdwales und Victoria. Nach Möglichkeit wurden die Proben vorzugsweise anhand des Vergleiches mit dem Typusmaterial bestimmt oder, falls dies nicht möglich war, nach den Angaben in den Artbeschreibungen der Literatur. Proben die auf diese Art und Weise nicht bestimmt werden konnten, sind entweder provisorisch in bereits vorhandene Arten aufgenommen, oder aber als neue Art ausgewiesen worden. Im Falle einer zu geringen Probenmenge oder aber wenn sich die Aufsammlung in einem schlechten Zustand befand, wurden die Proben vorläufigen, informellen Namen zugewiesen.

So konnten insgesamt 103 Arten bestimmt werden, davon 33 als neu für Australien und 20 als neu für die Wissenschaft. Von den 71 zur Zeit für Australien bekannten Arten (McCarthy, 2007) konnten nur 50 bestätigt werden. Die Übrigen stellten sich entweder als anderen Gattungen zugehörig, als Synonyme anderer Arten oder aber als falsch bestimmt heraus. Von den oben aufgeführten 24 Gattungen und Artengruppen kommen die folgenden 13 in Australien vor und sind hier behandelt: *Chapsa, Chroodiscus, Fibrillithecis, Leptotrema, Leptotrema schizoloma*-Gruppe, *Leucodecton, Melanotopelia, Myriotrema, Nadvornikia, Pseudoramonia, Reimnitzia, Thelotrema* und *Topeliopsis*. Außerdem konnten Spezies folgender sieben Gattungen aus Australien identifiziert werden, die in dieser Studie jedoch nicht behandelt werden: *Ampliotrema, Diploschistes, Ingvariella, Melanotrema, Ocellularia, Ocellularia clandestina*-Gruppe und *Stegobolus*.

Wie bereits erwähnt, wird das auch dieser Studie zugrunde liegende, ursprüngliche Gattungskonzept (Hale, 1980, 1981; Salisbury, 1971, 1972a, 1972b 1978) zwar heute noch allgemein akzeptiert, wurde aber zum großen Teil weiter ausdifferenziert. Neben der schon früh in die Thelotremataceae eingegliederten, und in ihrer Umschreibung seither weitestgehendst konstanten Gattung *Diploschistes* (die sich von allen anderen Gattungen durch einen trebouxioiden Fotobionten unterscheidet), sind von den drei trentepohlioiden, nach Excipulumstruktur unterschiedenen Hauptgattungen (*Thelotrema*: Excipulum unkarbonisiert, mit lateralen Paraphysen; *Myriotrema*: Excipulum unkarbonisiert, ohne laterale Paraphysen; *Ocellularia*: Excipulum karbonisiert, ohne laterale Paraphysen) im Laufe der Zeit weitere Gattungen nach zusätzlichen Merkmalen der Fruchtkörpermorphologie oder sonstigen Kennzeichen ausgegliedert worden (z. B. Frisch, 2006; Frisch & Kalb, 2006; Guderley & Lumbsch, 1996; Kalb, 2001, 2004; Kantvilas & Vezda, 2000). So werden die hinzugekommenen, hier akzeptierten und behandelten Gattungen des weiteren wie folgt unterschieden:

Laterale Paraphysen und ein unkarbonisierter Ascomarand kommen außer in *Thelotrema* noch in *Chapsa, Reimnitzia* (hier ist die Exsistenz der lateralen Paraphysen allerdings, wie gezeigt werden konnte, zweifelhaft) und *Topeliopsis* vor. *Chapsa* ist in erster Linie durch die *Geaster*-artigen, oft sehr großen und offenen Fruchtkörper mit aufrechtem oder zurückgebogenem Rand unterschieden; *Reimnitzia* hat ähnlich geformte Ascomata, ist jedoch in verschiedenen Punkten der Thallusmorphologie (Auftreten von Isidien, Thallus auffällig dick und mit säulenartig angeordneten Kristallen) und durch mehrere Mikromerkmale des Hymeniums, der Asci und der Ascosporen abweichend; *Topeliopsis* ist charakterisiert durch urnenförmige, stark zerschlitzte bis schuppige Ascomata mit auffällig dickem, mit dem Thallusrand verwachsenem Excipulum und unverdickten, regelmäßigen und deutlich parallelen Paraphysen.

Eine Sonderform, die sonst nur bei *Diploschistes* bekannt ist, nämlich das gemeinsame Auftreten von lateralen Praphysen und deutlicher Karbonisierung des Excipulums, tritt bei den Mitgliedern der *Leptotrema schizoloma*-Gruppe und in den Gattungen *Melanotopelia* und *Pseudoramonia* auf. Die erstgenannte Gruppe unterscheidet sich durch regenerierende Fruchtkörper mit deutlich mehrlagigen und rissigen Rändern. *Melanotopelia* hat urnenförmige, eher ganzrandige, *Pseudoramonia* deutlich gestielte Ascomata.

In den übrigen Gattungen, bei denen gemeinschaftlich laterale Paraphysen fehlen, sind *Nadvornikia* und *Chroodiscus* am deutlichsten zu unterscheiden. *Nadvornikia* hat als einzige Gattung mazaediöse Ascomata, *Chroodiscus* umfasst ausschließlich blattbewohnende, tropische Arten mit *Geaster*-artigen Fruchtkörpern. Die Unterscheidung der Gattungen *Fibrillithecis, Leptotrema, Leucodecton,* und *Myriotrema* ist hingegen schwieriger. Ein sehr ähnliches, aus prosoplectenchymatösen Hyphen gebildetes Excipulum ist in *Fibrillithecis* und *Myriotrema* zu finden. In ersterer Gattung weist es jedoch eine ungewöhnliche, deutlich fibrillöse Struktur auf, wohingegen die meisten, und eher typischen Vertreter in *Myriotrema,* durch kleine, sehr zahlreich auftretende, eingesenkte Fruchtkörper charakterisiert sind. *Leptotrema* und *Leucodecton* unterscheiden sich vor allem durch ein paraplectenchymatöses Excipulum, die Gattung *Leptotrema* ist außerdem durch unverdickte Ascuswände und eine unterschiedliche Ascosporenentwicklung abgegrenzt.

Auf den DNA-Sequenzdaten basierende phylogenetische Untersuchungsmethoden sind in der modernen Systematik im Laufe der letzten Jahre zu einem wichtigen Bestandteil geworden. Die Methoden haben sich gerade im Bereich der Mykologie, wo unzureichende oder sehr variabel ausgebildete phänotypische Merkmale die Regel sind, als unverzichtbares Werkzeug zur Ermittlung von Verwandtschaftsverhältnissen etabliert. Im Bereich der Graphidaceae bzw. ihrer thelotrematoiden Untergruppe sind molekulare Studien bisher allerdings rar. Neben einigen Analysen, in die jeweils nur wenige Taxa dieser Gruppe miteinbezogen wurden (Grube & al., 2004; Kauff & Lutzoni, 2002; Lücking & al., 2004; Miadlikowska & al., 2006; Winka & al., 1998), sind hier noch die eher ausführlicheren Arbeiten von Frisch & al. (2006), Lumbsch & al. (2004a), Martín & al. (2003) und Staiger & al. (2006) zu nennen, die sich im Spezielleren mit den Graphidaceae s. lat. auseinandersetzen.

Im Rahmen der vorliegenden Studie wurde deshalb ein Versuch unternommen, die Phylogenie der Graphidaceae auf verschiedenen Verwandtschaftsebenen mittels molekulargenetischer Verfahren zu beleuchten. Hierzu wurden insgesamt drei Analysen durchgeführt, unter Zuhilfenahme zweier molekularer Marker, der mitochondrialen, kleinen Untereinheit (mtSSU) sowie der nukleären, großen Untereinheit (nuLSU) der ribosomalen DNA (rDNA). Das analysierte Material setzte sich dabei zu großen Teilen aus selbst gesammelten Proben der Australienexkursionen sowie aus Frischmaterial anderer Aufsammlungen zusammen. Zusätzlich wurden Sequenzdaten benutzt, die in der Internetdatenbank GenBank (USA National Center for Biotechnology Information, NCBI) erhältlich waren.

Das vornehmliche Ziel der ersten, mit einem kombinierten Datensatz beider Gene (mtSSU/nuLSU rDNA) operierenden Analyse war es, die Monophylie der Thelotremataceae zu testen. Dazu wurden die Sequenzdaten von insgesamt 105 Ascomyceten verglichen. Die nahe Verwandtschaft der Thelotremataceae und Graphidaceae, traditionell einzig unterschieden durch die Fruchtkörperform (rundlich in Thelotremataceae vs. länglich in Graphidaceae), wurde zwar schon in früheren Untersuchungen erkannt und diskutiert (z. B. Frisch, 2006; Staiger, 2002; Staiger & al., 2006), genaue Umschreibungen beider Familien fehlten jedoch bisher. Das Ziel der beiden anderen Analysen, die jeweils mit einem Einzeldatensatz (nuLSU bzw. mtSSU) durchgeführt wurden, war die detailliertere Untersuchung der Gattungen *Topeliopsis* bzw. *Thelotrema*. Für die nuLSU-Analyse wurden dabei 40 Individuen aus 38 verschiedenen Arten der Gattungen *Acanthotrema, Chapsa*, *Chroodiscus, Diploschistes, Melanotopelia, Myriotrema, Ocellularia, Thelotrema* und *Topeliopsis* getestet. Für die mtSSU-Analyse wurden 50 Individuen aus 25 Arten der Gattungen *Chapsa* und *Thelotrema* untersucht.

So konnte gezeigt werden, dass die beiden vormals getrennten Familien Thelotremataceae und Graphidaceae phylogenetisch keine einheitlichen Gruppen bilden und ihre bisherige systematische Einteilung nicht den natürlichen Verhältnissen entspricht. Darüberhinaus konnte gezeigt werden, dass mit Ausnahme der *Diploschistes*, keine der in die Analysen einbezogenen Gattungen in ihrer bisherigen Umschreibung Monophylie aufweisen kann. Es wird daher darauf hingewiesen, dass das bisher gebräuchliche Gattungskonzept nach Hale (1980, 1981) bzw. Frisch (2006) und Frisch & Kalb (2006) in seiner jetzigen Form weiterer Überarbeitungen bedarf. Als nomenklatorische Konsequenz der molekularen Analysen wird neben der Synonymisierung der Familien Thelotremataceae und Graphidaceae, die Aufstellung einer neuen Gattung *Melanotopelia* vorgeschlagen.

1. Introduction

Over 20% of all known species of fungi are lichenized, i.e. form stable, self-supporting, symbiotic associations with photosynthetic partners such as green algae and cyanobacteria. Since lichens predominantly belong to the euascomycetes (c. 98%), which results in almost half of the taxa in Ascomycota being lichenized, this form of symbiosis is one of the most important lifestyles in fungi. Lichens occur worldwide and in all habitats from the tropics to the polar regions. They play important ecological roles, including fixation of atmospheric nitrogen, stabilizing soil surfaces in semi-arid regions, providing an environment for small arthropods or making rocky surfaces inhabitable for other organisms by deteriorating them. Despite their importance for a variety of ecosystems, the abundance of lichen species, and their omnipresence in the natural landscape, our understanding of biodiversity and phylogenetic relationships is surprisingly poor. This is mainly due to the lack of information on numerous species, but particularly tropical, crustose groups that exhibit few morphological characters are notoriously understudied.

Within the phylum Ascomycota the order Ostropales currently consists of six families. It is characterized by strongly gelatinized ascomata with a hemiangiocarpous ontogeny and functionally unitunicate asci. The Thelotremataceae is one of the largest families in Ostropales and comprises more than 1000 described names (Frisch, 2006; Hale, 1981), of which more than 500 are currently accepted species (ibid.). These usually corticolous, crustose lichens have a mostly trentepohlioid photobiont (except in *Diploschistes*), and are further characterized by rounded, immersed to emergent, peri- to apothecioid ascomata with unbranched paraphyses and predominantly distoseptate ascospores. They form an important component in the biodiversity of subtropical and tropical rainforest ecosystems, but are also found in drier habitats and in temperate regions. However, the taxonomic, systematic, biogeographical and ecological knowledge of this group is rudimentary, and until most recently, no major systematic treatments were available.

Except for Redinger (1936), who studied the thelotremataceaen Graphidaceae of Brazil, up until the end of the 20th century, the vast majority of publications dealing with this group were restricted to floristic treatments and often not more than simple species lists. With the entering of modern lichenology, the Thelotremataceae gained more and more attention and several studies, predominantly limited to taxonomical approaches of smaller geographical regions and/or focused on particular sub-groups were done (e.g. Guderley & Lumbsch, 1996; Hale, 1974b, 1978b, 1981; Homchantara & Coppins, 2002; Kalb, 2001; Kantvilas & Vezda, 2000; Lücking, 1992a, Lücking & Grube, 2002; Lumbsch, 1985, 1989; Lumbsch & Elix, 2003; Matsumoto, 2000; Nagarkar & Hale, 1989; Nagarkar & al., 1986, 1987, 1988; Patwardhan & Kulkarni, 1977b; Patwardhan & al., 1985; Purvis & al., 1995; Salisbury, 1972a, b; Sipman, 1992a, b). A first more detailed monograph including the majority of genera and also dealing with systematic aspects, was presented by Frisch and his co-workers (segmented in three papers: Frisch, 2006; Frisch & Kalb, 2006; Frisch & al. 2006) predominantly addressing the thelotremoid lichen biota of Africa. Concerning the research on the Australian continent, besides Lumbsch (1989), who treated the genus *Diploschistes*, Kalb (2001) and Frisch & Kalb (2006a), predominantly addressing the genus *Topeliosis*, and the studies of Kantvilas & Vezda (2000) focusing on Tasmania, thus far our knowledge of Thelotremataceae have been highly fragmentary.

The present study is aiming at a revision of trentepohlioid (i.e. excluding the genus *Diploschistes*), ecolumellate (i.e. excluding the genera *Gyrotrema, Melanotrema, Ocellularia, Redingeria* and *Stegobolus*) thelotrematoid lichens of Australia. The results of the revision of columellate taxa for the continent will be presented elsewhere. The study is based on the morphological, anatomical and chemical examinations of a total of c. 4000 specimens. These specimens include all available type material from Australia (and in large parts types from other continents), all accessible herbaria collections of this group from Australia and the material collected during two field trips to Queensland, New South Wales and Victoria. Where possible, the specimens were assigned to existing taxa, either (preferably) by comparison with the type specimen or, if the specific type was unavailable, by verification of the data provided in literature. Collections that could not be placed in described species were either provisorically included to existing species or new species were introduced.

Currently c. 20 genera are accepted for Thelotremataceae (Eriksson, 2006; Frisch, 2006), 16 of which are known to occur in Australia (McCarthy, 2007). The circumscription of the genera, however, is controversial. In the traditional classification, the ascospore septation and coloration was used schematically to distinguish genera (Müller Argoviensis, 1887b). Since the work of Hale (1980, 1981) and Salisbury (1971, 1972a, 1972b 1978), the genera in the family are delimited mainly by the structure and pigmentation of the ascomata margin. These characters, however, have so far scarcely been tested by molecular data. To approve that the inferred phylogenies represent the evolution of the organisms, it was additionally attempted to further illuminate the phylogenetic relationships within the family applying molecular methods. Therefore, a total of three analyses were carried out employing datasets of two different molecular markers from the nuclear and mitochondrial genome.

2. Taxonomic part

2. 1. Historical overview

In traditional lichenology taxonomic concepts have often been subjective and highly inconsistent between researchers. Taxonomic groups were circumscribed based on easily recognizable features, and even more so in early times of lichen research, when modern optical devices were not available. Further, accessible collections were largely restricted to northern-hemisphere biotas, while the sampling of tropical regions or other inaccessible parts of the world remained poor. Hence, it is not surprising that Graphidaceae, a family of predominantly subtropical to tropical taxa that chiefly occur in the canopy of primary rainforests and which are often distinguished by micro-morphological characters is still poorly understood. With the recently developed tools of molecular phylogeny and a broader sampling of these individuals, researchers are gaining a better understanding of the natural relationships in this group (e.g., Frisch & al., 2006; Staiger & al., 2006).

Thus, supported by molecular analysis it could be shown (part 3) that Thelotremataceae and Graphidaceae, traditionally separated by their ascoma shape (orbicular vs. lirelliform), form several lineages within one strongly supported monophyletic group. Consequently Thelotremataceae is regarded synonymous to Graphidaceae. In the following, the focus is set on the former family Thelotremataceae, which is thus referred to as thelotremataceaen Graphidaceae or thelotrematoid lichens, respectively. I will briefly give an overview of the historic development of generic concepts and delimitations within this group. For a more detailed treatment dealing with the history of systematics in thelotremataceaen Graphidaceae see Frisch (2006), for an historical overview of the developments in Graphidaceae s. str. see Nakanishi (1966) and Staiger (2002).

The family Thelotremataceae was described by Stizenberger (1862) referring to *Lecanorei* subtribe *Thelotremei* (Nylander, 1861a), although a subtribe *Thelotremee* was already introduced almost ten years earlier by Trevisan (1853a). The first described species in thelotremataceaen Graphidaceae was *Lichen lepadinus* Ach. (Acharius, 1798), which subsequently was transferred to its own genus *Thelotrema* (Acharius, 1803). After several additions (Acharius, 1804, 1812a), *Thelotrema* included seven species (*T. cavatum*, *T. discoideum*, *T. fumosum*, *T. henatomma*, *T. obturatum*, *T. terebratum, T. urceolare*) and two varieties of *T. lepadinum*, characterized by a crustose thallus and thelotremoid ascomata. Other thelotrematoid taxa were grouped in numerous genera, including *Porina*, *Pyrenula*, and *Urceolaria*. With the inclusion of microscopical characters, the classification was redefined by Fée (1824, 1825, 1837) and Meyer (1925). Fée introduced two new genera (*Ascidium, Myriotrema*) and accepted *Thelotrema* (restricted to tropical species) and *Volvaria* (introduced by De Candolle, in Lamarck & De Candolle, 1805) in which he grouped *T. lepadinum*. Meyer did not accept the genus *Thelotrema* but introduced three new genera *Ocellularia* (later conserved against *Ascidium*), *Anthrocarpum* (=*Thelotrema*) and *Porophora* (nom. superfl. pro *Ascidium*).

With increasing appreciation of ascospore characters in the course of the 19th century the recently resurrected genera (Frisch, 2006) *Leptotrema* (Montagne & Van Den Bosch, 1855), *Stegobolus* (Montagne, 1845), *Chapsa* and *Leucodecton* (Massalongo, 1860) were introduced. Nylander (1862), however, did only accept two genera, *Ascidium* and *Thelotrema*, the latter consisting of four informal groups based on ascospore characters. Müller Argoviensis (1887b), finally developed a generic concept, solely based on ascospore characters, which was accepted until the 1970s (e.g., Hale, 1978; Nagarkar & al., 1988), with four major genera: *Phaeotrema* (ascospores brown, transversally septate), *Leptotrema* (ascospores brown, muriform), *Ocellularia* (ascospores hyaline, transversally septate) and *Thelotrema* (ascospores hyaline, muriform). Three years later, Müller Argoviensis (1890) added *Chroodiscus* for foliicolous taxa.

This concept was recognized as artificial by many workers, but it was not until the end of the 20th century that attempts were made towards a more natural classification. First Salisbury (1971, 1972a, 1972b 1978) proposed to abandon ascospore characters for the generic delimitation. He suggested to merge all species into a single genus *Thelotrema*, with three subgenera distinguished by the morphology of the ascoma margin, each divided into different species groups characterized by further ascomata features: *Thelotrema* sect. *Ascidium* (including the *T. discolor*-, *T. cavatum*- and *T. discoideum*-group) - carbonized with absent lateral paraphyses; *Thelotrema* sect. *Myriotrema* (including the *T. compunctum*- and the *T. bahianum*-group) – non-carbonized with absent lateral paraphyses; *Thelotrema* sect. *Thelotrema* (including the *T. lepadinum*- and the *T. platycarpum*-group) - non-carbonized with present lateral paraphyses. Subsequently, Hale (1980, 1981) implemented Salisbury's concept with minor modifications and introduced three major genera equivalent to Salisbury's subgenera: *Myriotrema* (=*T.* sect. *Myriotrema*), *Ocellularia* (=*T.* sect. *Ascidium*) and *Thelotrema* (=*T.* sect. *Thelotrema*). Ever since, Hale's classification was broadly accepted (e.g., David & Hawksworth, 1995; Sipman, 1993, 1994; Matsumoto, 2000; Homchantara & Coppins, 2002; Frisch, 2006) and is still in use, although it was also soon realized that the distinction in three large genera was too coarse and did not mirror phylogenetic relationships. However, some authors (Poelt & Vezda, 1981; Purvis & al., 1995) rejected Hale's classification and suggested to place all core genera in one large genus *Thelotrema* following Salisbury's proposal. On the other hand, numerous smaller homogeneous groups were divided and introduced as separate genera in subsequent years: *Ampliotrema* (Kalb, 2004), *Chroodiscus* (Kantvilas & Vezda, 2000; Lücking, 1992; Lücking & Kalb, 2000; Lumbsch & Vezda, 1990), *Ingvariella* (Guderley & Lumbsch, 1996), *Nadvornikia* (Tibell, 1984), *Pseudoramonia* (Kantvilas & Vezda, 2000), *Reimnitzia* (Kalb, 2001), *Topeliopsis* (Kantvilas & Vezda, 2000; Kalb, 2001).

Recently, Frisch (2006) and Frisch & Kalb (2006) described five new genera (*Acanthotrema*, *Fibrillithecis, Gyrotrema, Melanotrema*, *Redingeria*) and resurrected four formerly described genera (*Chapsa*, *Leptotrema, Leucodecton, Stegobolus*). Meanwhile, other genera formerly included were transferred to other families, e.g. *Conotrema* to Stictidaceae (Eriksson & al., 2003), *Gyrostomum* to Graphidaceae (Staiger, 2002), *Ramonia* to Gyalectaceae (Eriksson & al., 2003), *Tremotylium* (=*Minksia*) to Roccellaceae (Makhija & Patwardhan, 1995). The systematic position of *Phaeotrema* is still uncertain, according to Salisbury (1978) its type species *Pyrenula subfarinosa* is a non-lichenized fungus. In contrast to the above mentioned three main genera, *Diploschistes*, an additional, species-rich genus included in Thelotremataceae, forms a homogeneous species-group that is also well supported by molecular data (Lumbsch & al., 2004a; Frisch & al., 2006). It was placed in its own family (Diploschistaceae) by Zahlbruckner (1905), but has been placed in Thelotremataceae for a long time (Gilenstam, 1969).

2. 2. Taxonomic studies and collections of trentepohlioid thelotremataceaen Graphidaceae in Australia

Until recently all contributions to the knowledge of thelotrematoid lichens in Australia were restricted to floristic studies. The majority of known species from this continent are based on collections made by early naturalists in the late 19th century. Amongst the most important collectors of this time were F. M. Bailey (1827-1915), an appointed colonial botanist and curator at the Queensland Museum (Brisbane); the New Zealand botanist and passionate lichenologist C. Knight (1808-1891), who collected in New Zealand, but also in Queensland and New South Wales; the educationist and scientist J. Shirley (1849-1922), who conducted field trips throughout Queensland; the naturalist and plant collector W. A. Sayer (fl. 1886-1897) who was an official participant of expeditions to Pacific northern Queensland; and the Presbyterian minister and amateur botanist F. R. M. Wilson (1832-1903), who is regarded the pioneer in Australian lichenology. He mainly collected in Victoria, but also in New South Wales and southern Queensland.

The first record of Australian thelotrematoid lichens was made by Nylander and Krempelhuber (in Nylander, 1864). They introduced *Thelotrema bicavatum* and *T. lacteum* based on collections of Hochstetter from an unknown locality in Australia. Subsequently, Stirton (1881) described *T. profundum* [=*Ocellularia profunda*] and *Endocarpon baileyi* [=*Leptotrema wightii*] based on Bailey collections. The most active worker on Australian lichens in the late 19th century, however, was Müller Argoviensis (1882, 1887a, b, 1888a, 1891a, b, 1892, 1893a, b, 1895d), who described 36 species and one variety for Australia. The new taxa were mostly based on collections from Sayer, C. Knight, Shirley, Bailey and Wilson from the Brisbane and Cairns area (Queensland) and other locations in New South Wales and Victoria. His contemporary C. Knight described five species for Australia based on his own, Bailey's and Shirley's collections from southern Queensland. Another species from southern Queensland was described by Wilson (1893), based on his own collection: *O. cricota* [=*T. lacteum*].

Besides two publications by Jatta (1911), who introduced the first Tasmanian taxa of trentepohlioid thelotrematoid lichens, and Räsänen (1949) who described two new species and three varieties in the course of a review of Wilson collections in H, for most of the 20th century, however, thelotremataceaen Graphidaceae in Australia have been neglected. It was until recent times before this group regained scientific attention, and several new taxa were described: *Chroodiscus australiensis* (Lumbsch & Vezda, 1990); *C. asteliae* [=*Chapsa*], *C. lamelliferus* [=*Chapsa lamellifera*], *C. australis* ssp. *tasmanicus* [=*Chapsa tasmanica*], *C. minor* [=*Chapsa minor*], *Topeliopsis muscicola* [=*T. muscigena*], *Pseudoramonia richeae*, *Topeliopsis rugosa* [=*Melanotopelia*] (Kantvilas & Vezda, 2000); *T. acutispora*, *T. corticola* [=*T. decorticans*], *T. vezdae* [=*T. subdenticulata*] (Kalb, 2001b); *T. darlingtonii*, *T. elixii* (Frisch & Kalb, 2006a); *Stegobolus carneopustulatus* (Frisch & Kalb, 2006b); *Thelotrema eungellaense*, *T. gallowayanum* (Mangold & al., 2007a); and *Ocellularia kalbii* (Mangold & al., 2007b).

For the present treatment I studied a large number of samples collected by various researchers collected within the last c. 40 years in addition to material gained in two field trips that were particularly focused on thelotrematoid lichens. The largest collections include those by J. Elix, J. Hafellner, M. E. Hale, K. Kalb, G. Kantvilas, H. Streimann and L. Tibell.

2. 3. Geography of Australia

Australia is the world's smallest continent (7,741,220 km^2) and is situated between the Indian and the Pacific Oceans (c. 10-43º S [including Tasmania] and 113-153º E). The Australian continent comprises a variety of biogeographical regions, ranging from deserts to tropical rainforests and seacoasts to alpine reaches of up to 2,228 m (Mt. Kosciuszko, New South Wales). In this chapter, I will provide a brief overview of the climate and the vegetation forms of Australia with special emphasis on the distribution of the here treated species group. A more extended summary of the Australian Vegetation is given by Beadle (1981), Specht (1970, 1981), Specht & Specht (1999) and also Walter & Breckle (1991). Lichenological aspects of this topic are discussed by Stevens (1987) and Lumbsch (1994), in Barlow (1981) the historical developments of the flora in Australia are treated. A detailed presentation of the ecological relationships of the Tasmanian lichen biota is provided by Kantvilas & al. (Kantvilas, 1988, 1990; Kantvilas & Jarman, 1988, 1991; Kantvilas & Minchin, 1989).

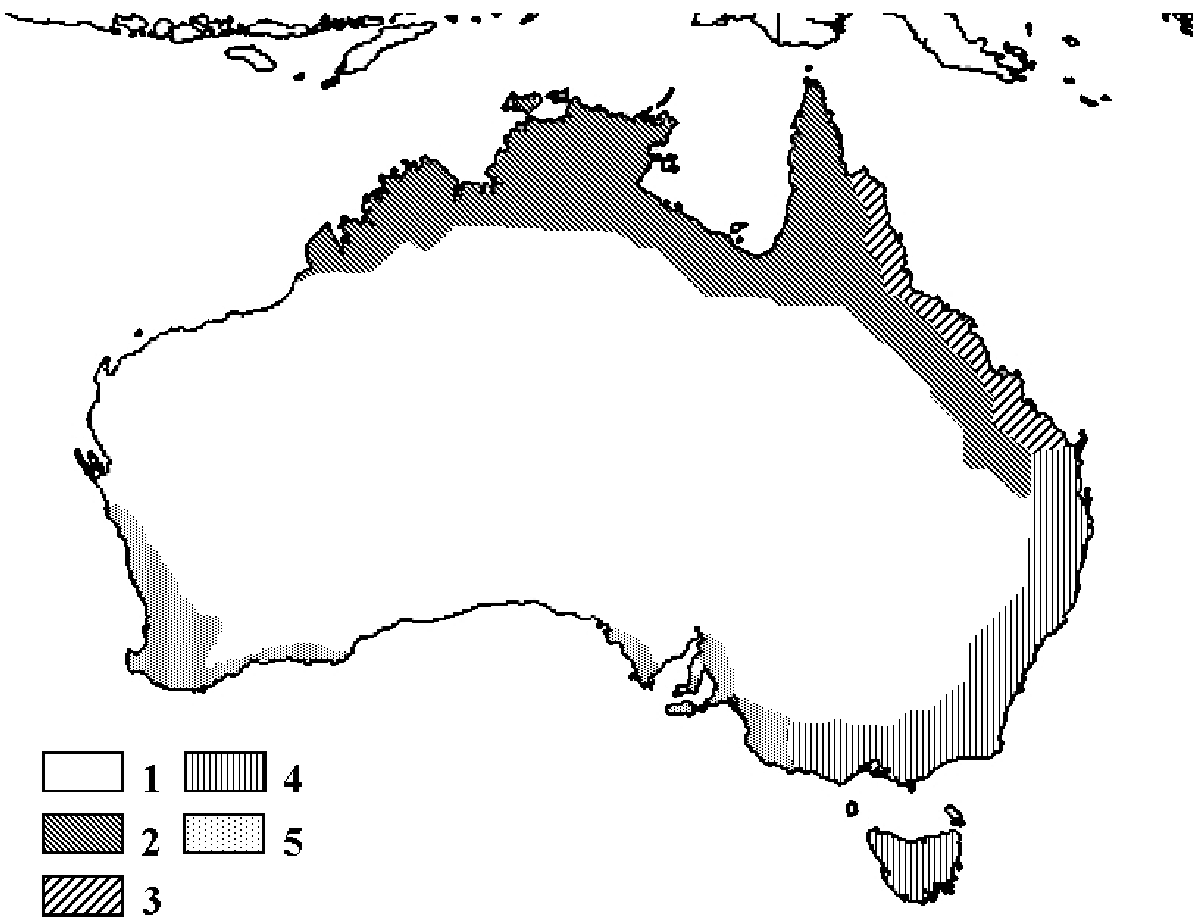

Fig. 1. Main biogeographical zones in Australia (for explanation see text).

Most of Australia is dominated by arid climates with dry grass- or shrublands or dry woodlands or more rarely dry forests (fig. 1: zone 1). Areas with higher precipitation are restricted to the oceanic regions of northern, eastern and parts of southern Australia. These regions are distinguished in the tropical and subtropical northern and northeastern sections (zones 2+3), and the temperate southeastern and southwestern sections (zones 4+5). The south of Western Australia as well as parts of South Australia and Victoria (zone 5) have a Mediterranean climate with a winter rain season and are dominated by dry sclerophyll forests (Western Australia), Mallee woodlands and -shrubs or, in drier areas, Chenopod shrublands. A temperate climate with a more uniform distribution of precipitation periods is found in south-eastern Australia, including Tasmania, most of Victoria and eastern New South Wales (zone 4), where cool- to warm-temperate rainforests and wet or dry sclerophyll forests occur. However, the native vegetation forms of this region have been highly transformed by anthropogenic factors, and major primary extends have been cleared. An overview of all currently existing rainforest areas is given in fig. 2.

Remnants of subtropical and tropical low- and highland rainforests (fig. 2) and in drier regions several forms of Eucalypt forest communities as well as mangroves are found along the northeastern Pacific coast of Queensland, to the west limited by the Great Dividing Ranges (zone 3). This comparatively narrow strip includes the humid regions in Australia, with predominantly monsoonal climate and peak precipitations during the rain seasons in summer and winter. Only in the wider Cairns area in northern Queensland higher rainfalls persist throughout the year. Most of northern Australia, however, has a tropical monsoonal climate with higher rainfalls restricted to the summer months (zone 2). These regions are dominated by savannah with gallery forests, but also smaller areas of rainforests and more humid Eucalypt forests as well as mangroves along the east coast of Cape York (Queensland) and north Northern Territory.

Fig. 2. Distribution of rainforests in Australia (black dots).

2. 4. Materials and Methods

2. 4. 1. Examined collections

Specimen and type material of thelotremataceaen Graphidaceae from the following herbaria was examined: ABL, B, BCRU, BG, BM, BP, BRI, C, CANB, COLO, DUKE, E, F, FH, G, GLAM, GZU, H, HIRO, HO, L, M, MEL, MSU, NSW, NY, PERTH, RAMK, S, TNS, TUR, UPS, US, WELT, WIS and the private herbarium of Klaus Kalb (Germany). Also, the following herbaria were visited to study and loan collections: C, F, US and WIS. Additionally material was collected on two field trips. The first in September and October 2003 in collaboration with T. Lumbsch, where the focus was set on the biotas of Pacific Queensland, the second in February and March 2005, in partial collaboration with J. Elix, where collections were made in Victoria, Pacific New South Wales and northern Queensland. The specimens were collected using a knife or hammer and chisel, and the material was stored in consecutively numbered paper bags where they remained for drying. Specimens on certain types of bark were also additionally pressed in a plant press (to avoid the curling of the bark). In total, about 4000 specimens were examined for this study.

2. 4. 2. Methods

All specimens were morphologically, anatomically and chemically examined. Habit characters were observed by using a low-magnification dissecting microscope (Zeiss Stemi) with magnifications from 10x to 50x. Further, thalli and ascomata were cut using a razor blade and a freezing microtome (Leica SM2000R), and examined in water, iodine (Lugol's solution, Merck), potassium hydroxide solution and lactophenol cotton blue with a compound microscope (Zeiss Axioskop 2plus) at magnifications from 100x to 630x. Images of the habit, ascomata- and thallus-sections and ascospores were taken by using the above-mentioned optical devices, a camera-fixture and a digital mirror reflex finder camera (Nikon Coolpix). The images were subsequently processed with the computer programs iPhoto and Adobe Photoshop.

Secondary metabolites were identified by examination under UV-light, spot tests, and thin layer chromatography. Spot tests were made by applying drops of potassium hydroxide solution (K), calcium hypochlorite solution (C) and paraphenylenediamine solved in ethanol (PD) directly on the thallus and the ascomata of the specimen.

Thin layer chromatography (TLC) was carried out after Lumbsch (2002) using acetone extractions of preferably substrate-free samples of the lichen thallus and ascomata, that were applied on silica plates and developed in two solvent systems: A = toluene/dioxin/glacial acetic acid (180:45:5), and B' = hexane/methyl tert-buthyl ether/formic acid (140:72:18). In two steps, the plates were first observed under UV-light, and finally after treatment with 10% concentrated sulfuric acid solution and charring at 110º C. The secondary metabolites finally were determined on the plates according to their color after charring (with and without UV-light) and their position in relation to the reference pure substances (stictic, norstictic and psoromic acid and atranorin) and the front of the solvent system (Rf-class).

An additional molecular examination was carried out for selected specimens of the fresh material from the above-mentioned field trips; see part 3 for material and methods.

2. 4. 3. Citations

Author names of taxa are cited following Kirk & Ansell (1992). Descriptions of collection localities and other data concerning the examined specimens are given as follows: Country, State/Province and - according to the provided data - additional administrative units and/or further descriptions of the site, date (only if the first mentioned specifications are fragmentary or missing), *collector(s) name(s)* and *collecting number* (herbarium acronym[s], voucher number of the herbarium [if name of collector or collecting number is missing]).

2. 4. 4. Abbreviations

B/MCMC: Bayesian analysis using Markov chain Monte Carlo methods
C: Calcium hypochlorite solution
Distr.: District
Hwy.: Highway
I: Iodine
Isl.: Island(s)
K or KOH: Potassium hydroxide solution (10%)
LSU: Large subunit
MP: Maximum parsimony
mt: Mitochondrial
NP.: National Park
nu: Nuclear

PD:	Paraphenylenediamine solved in ethanol
PP:	Posterior probability
rd.:	Road
rDNA:	Ribosomal DNA
SF.:	State Forest
SSU:	Small subunit
TLC:	Thin layer chromatography
UV:	Ultraviolet light
!:	Type specimen studied

2. 5. Main characters of trentepohlioid thelotremataceaen Graphidacae

In the following I will provide a brief introduction of the main characters of thelotrematoid Graphidaceae. A more detailed account can be found in chapter 2. 9., where the individual genera are discussed. Besides Frisch's (2006) detailed studies of the morphology and anatomy of thelotrematoid lichens, only a few more specific publications are available. A detailed treatment of the ascoma ontogeny, in particular of columellate taxa, can be found in Redinger's monograph of the Brazilian Thelotremataceae (1936). In Hale (1974a, 1981) the focus is set on thallus anatomy with special emphasis of cortex structures. A study dealing with pycnidial structures in thelotrematoid lichens was done by Matsumoto & Deguchi (1999). Concerning the genus *Diploschistes*, more detailed information is found in Lumbsch (1989) and Lumbsch & al. (1997), where particularly the ascospore ontogeny of the genus is discussed.

2. 5. 1. Thallus

Morphology

As in other species of Graphidaceae the thallus of thelotrematoid lichens is crustose. It may be hyposubstratic or episubstratic, in a few cases the thallus is partly bulging and ±flaking away from the substrate. The thallus size and thickness is highly variable and ranges from a few millimeters in diameter (e.g. in *Chroodiscus*) and entirely hyposubstratic thalli (e.g. *Thelotrema pachysporum, "Thelotrema" guadeloupensis*) to specimens that cover large areas of sometimes several decimeters in diameter (e.g. in *Myriotrema album* or *Thelotrema porinaceum*) and can be up to 1 mm high (e.g. *Leptotrema wightii, Leucodecton glaucescens*). In some taxa, a high intraspecific variability in thallus morphology could be observed due to altering habitat factors, such as humidity or density and hardness of the substrate. The thallus color varies from bright to dark and may be grayish to greenish or brownish. Especially in thin thalli, the thallus color is often influenced by the substrate.

The thallus surface can vary from shiny to ceraceous to dull or pruinose, and from continuous to rugose to distinctly verrucose or verruculose. In some species of various genera the surface has a reticulate structure and/or forms a grainy-speckled pattern caused by large crystals in the medulla (e.g. *Leptotrema wightii*, *Leucodecton glaucescens Myriotrema phaeosporum, Reimnitzia santensis, Thelotrema oleosum*). The thalli are either unfissured or distinctly fissured to sometimes rimose or areolate. A prothallus is formed by most taxa (absent in *Chroodiscus*), which is predominantly rather indistinct and thin and brown.

Anatomy

The thallus anatomy in thelotremataceaen Graphidaceae is variable. Although some species are stratified, and upper cortex, algal layer and medulla can be distinguished, most taxa show a more diffuse anatomical structure. A thallus cover is either absent, or consists of a variably thick layer of weakly conglutinated and loosely arranged hyphae (protocortex). In some species, a variably thick true cortex of highly conglutinated and ±densely arranged to cartilaginous irregular or periclinal hyphae is present. Many species also show intermediates of these cortex types, sometimes even within a single specimen. In contrast, Frisch (2006), who follows the terminology of Poelt (1989) and Büdel & Scheidegger (1996) summarizes all cortex structures under the term 'phenocortex' and lists four different types (see there).

The species treated here all have a trentepohlioid photobiont. Abundance of algal cells differs widely between specimens. In some species the algal layer is well-developed and continuous but can be also discontinuous or almost absent. In this case photobiont cells are scattered throughout the entire thallus. In predominantly hypophloedal specimens, algal cells are also found amongst the hyphae that penetrate the substrate layer. The algal layer is often interrupted by large oxalate crystals, in some species these crystals are organized in columns. The presence of oxalate crystals is also variable. Species that produce secondary metabolites may contain additional thalline crystals; the most prominent example is *Leptotrema wightii*, which contains bright red anthraquinone crystals. A distinct medulla layer is rather unusual and occurs in epiphloedal taxa with thicker thalli. In *Reimnitzia santensis* sometimes lower cortex-like structures are found in the basal thallus regions.

Vegetative propagules

Several forms of vegetative reproduction are known for thelotrematoid lichens, isidia occur in two Australian species of *Myriotrema* and in *Reimnitzia* (in *Pseudoramonia* isidia-like structures are present, which probably represent immature ascomata). Soralia are known from one member of *Leucodecton*, otherwise soralia as wells as schizodiscs are predominantly known for columellate species (not treated here).

2. 5. 2. Ascomata

Morphology

Ascomata in thelotremataceaen Graphidaceae are predominantly hemiangiocarpous, peri- to apothecioid or *Geaster*-like and open by a single pore, or mazaedious. Sizes of mature ascomata range from c. 100 µm to c. 5 mm in diameter. They are predominantly roundish to slightly irregular, occur solitary to distinctly fused and their position relative to the thallus reaches from deeply immersed to distinctly emergent or stipitate. In some genera, ascomata develop in succession (*Pseudoramonia*, *Melanotopelia*) or are regenerative (*Chapsa*, *Leptrotrema schizoloma*-group). A well developed, incurved to recurved, entire to lacerate thalline rim is mostly present, in some cases it can become strongly eroded with age. The thalline rim is usually concolorous with the thallus or brighter, rarely whitish or conspicuously stained. Ascomata discs are flat to concave and often visible from the surface. They are predominantly whitish, grayish, brownish, flesh-colored or rarely distinctly reddish, and are epruinose to distinctly pruinose.

The ascoma morphology is an important character in thelotrematoid lichens that delimits several genera. The following morphological ascomata types can be distinguished:

– *Geaster*-like (chroodiscoid): predominantly large, conspicuous, immersed-erumpent, gaping, with distinctly exposed disc and fissured to lacerate or eroded, often layered margin; margins erect to recurved or exfoliating and usually proper exciple fused and not visible; ascomata regeneration common: *Acanthotrema* (not treated), *Chapsa, Chroodiscus and Reimnitzia*.
– mazaedious: large, conspicuous, distinctly emergent with visible mazaedium; non-regenerating: *Nadvornikia*.
– stipitate: medium-sized, conspicuous, peri- to apothecioid with distinctly stiped base and successive growth: *Pseudoramonia*.

– myriotremoid s. str.: predominantly small and numerous, inconspicuous, immersed, apothecioid with non-visible to partly visible disc; proper exciple free to fused, thallus margin entire and incurved to erect; non-regenerating: *Leptotrema*, *Leucodecton* and *Myriotrema* s. str. (='*M. olivaceum*-group').
– thelotremoid s. str.: predominantly medium-sized to large, ±conspicuous, emergent-sessile, apothecioid with partly visible disc; proper exciple visible in large parts, thallus margin entire to split, incurved to erect; exciple and thallus margin forming a double-pore; non-regenerating: *Thelotrema* (p. pt.) and *Myriotrema* s. lat. p. pt. ('*Myriotrema viridi-album*-group').
– perithecioid-thelotremoid: medium-sized to large, inconspicuous, immersed to emergent, perithecioid; apical proper exciple visible, fused or free, thallus margin entire to slightly split, incurved; non-regenerating: *Thelotrema* and *Myriotrema* s. lat. p. pt. (*M. desquamans, M. trypaneoides*).
– emergent-perithecioid: large, conspicuous to inconspicuous, ±emergent, perithecioid; proper exciple not visible or apically visible, then fused and fibrous, thallus margin incurved; non-regenerating: *Fibrillithecis* and *Myriotrema* s. lat. p. pt. (*M. eminens, M. frustillatum*), .
– topeliopsioid: large, conspicuous, emergent-sessile and predominantly subglobose to urceolate, peri- to apothecioid, then with partly visible, epruinose disc; proper exciple not visible, margin bright, squamulose to pruinose and incurved, sometimes layered, then lacerate and exfoliating; non-regenerating or with successive growth: *Melanotopelia* and *Topeliopsis*.
– layered-carbonized: small to large, conspicuous to inconspicuous, immersed-erumpent to raised, peri- to apothecioid, then with partly visible, epruinose disc; proper exciple visible but indistinct, margin split to lacerate and distinctly layered, layers concentrically striated, alternating in dark and bright; regenerating: *Leptrotrema schizoloma*-group.

Sterile specimens were generally not treated, except for sterile collections of *M. frustillatum* that could be identified by their isidia-type and chemistry, and four other sterile collections that were tentatively included in *T. bicinctulum*.

Anatomy

The presence of lateral paraphyses is a unique character that is only known from Ostropomycetidae. The presence or absence of these is a generic character in the family. Further characters of ascomata anatomy at generic level include the structure of the proper exciple and, to some extend, the structure of the paraphyses-tips and the micro-morphology of the ascus walls (for a compilation of all genera delimiting characters see also table 4) The ascospore morphology, on the other hand, is of major importance for the delimitation of species. Further, in several genera (which will be treated elsewhere) a columella is present.

Proper exciple: The proper exciple can be entirely fused to the thalline rim or be entirely free, with several intermediate stages. Its thickness ranges from evanescent or very thin to very thick, and it is either formed of paraplectenchymatous or prosoplectenchymatous hyphae. Usually it is hyaline or yellow, brown or orange internally and becomes more dark colored towards the margins and apices. Several taxa have distinctly dark or slightly carbonized proper upper exciple, an entirely distinctly dark or carbonized exciple is present in the members of the *Leptotrema schizoloma*-group, *Melanotopelia* and *Pseudoramonia*. The proper exciple can include substrate particles and/or is often apically ±covered by granules. Many taxa show a ±distinct amyloid reaction, which is mostly located in the lower exciple at the intersection to the subhymenium.

Frisch (2006) distinguishes three different exciple types in his revised generic concept, which, however, include the presence or absence of lateral paraphyses. Accordingly, in *Myriotrema* and *Fibrillithecis* an ‘*Ocellularia*-type’ exciple is present, a ‘*Leucodecton*-type’ exciple is found in *Leptotrema* and *Leucodecton*, and a ‘*Thelotrema*-type’ exciple is characteristic for the genera with chroodiscoid ascomata and *Thelotrema* and *Topeliopsis*. (For further comments and explanations of the exciple-types see under chapter 2.9., but see also in Frisch [ibid.]).

Subhymenium and hypothecium: The subhymenium is predominantly indistinct, evanescent to thin, rarely thick, and usually concolorous with the proper exciple, but sometimes also conspicuously dark pigmented. In some species with regenerating ascomata, a distinct, hyaline, gelatinous I+ purple hypothecial area can be present, which represents newly developing hymenial tissue.

Hymenium: The colorless, non-amyloid hymenium in thelotrematoid lichens is discoid to cupular, clear to inspersed, weakly to strongly conglutinated and can be from c. 50 to 400 µm high. The paraphyses are simple to slightly branched, c. 1-3 µm thick, straight to ±bent or apically curly, parallel to ±interwoven. Sometimes also irregular paraphyses with a distinct septation occur. The paraphyses tips are either not thickened or ±distinctly thickened and simple to ±irregular. As mentioned above, all of the here treated species lack a columella. Nevertheless, columella-like structures often occur in species with strongly fused ascomata and resemble excipular tissue.

Lateral paraphyses: Lateral paraphyses (following Henssen, 1995) (‘periphysoids’ in Frisch [2006]) are present or absent. They are mostly clearly separated from the proper exciple, but sometimes also basally difficult to distinguish from it. They are predominantly clear, very rarely interspersed and range from up to c. 10-50 µm in length. Although the presence of lateral paraphyses is usually easy to recognize, in some cases inconspicuous and easily overlooked lateral paraphyses occur.

Epihymenium: An epihymenial layer is variously developed, it is indistinct to very thick, predominantly hyaline to more rarely yellowish or brownish, in *Chroodiscus australiensis* conspicuously orange to reddish. It can be egranulose to distinctly granulose, the granules are fine to coarse and grayish to brownish.

Ascus: The asci are 1-, 2-, 4- or 8-spored, non-amyloid, unitunicate and clavate. The ascus walls are usually not thickened and a ±distinct tholus with an absent to small, tapered to roundish ocular chamber is developed. The tholus mostly becomes, particularly in asci bearing large ascospores, ±indistinct in later stages of development. However, several deviant forms of asci could be observed and the taxonomical relevance of this feature is unclear. Frisch (2006) lists up to five main ascus-types, and for the re-introduced genus *Leptotrema* he considers the ascus morphology as a main delimiting character. In my observations, I could find inconsistencies in several taxa, a ‘*Leptotrema*-type’ ascus (distinct tholus absent, ascus walls evenly thickened in younger stages, thin at maturity) could also be found in other genera, for example in *Chapsa* (*C. lamellifera*), *Leucodecton* (*L. compunctellum*), *Myriotrema* (*M. frustillatum*) or *Thelotrema* (*T. oleosum*); a tholus with a large, distinctly tapered ocular chamber, reported for *Chapsa eitenii* and *C. zahlbruckneri* (Frisch ibid.) also occurs in *M. protoalbum* (see also table 4).

Ascospores: The ascospores occur uni- to triseriate, rarely quadriseriate, range from 6 up to 400 µm in length and form 2 up to 55 µm in width. They can be transversely septate or submuriform to densely eumuriform, with a single to multiple loci; hyaline to distinctly brown and non-amyloid to strongly amyloid. The ascospores are mostly straight, but can also be distinctly bent, their form can be subglobular, ellipsoid, oblong, clavi- or fusiform, bifusiform, bacillar-fusiform, bacillar or cylindrical with roundish to distinctly acute ends. In some taxa, particularly in members of *Ocellularia*, the ascospore ends are conspicuously tapered and appendix-like (see also Mangold & al., 2007b). The ascospore wall consists of a variably thick endospore, a variably thick epispore and a variably thick or absent perispore (in the following also referred to as halo). The epispore marginally determines the shape of the ascospore, internally it is delimited by the loci and near the septae it merges into the endospore (in the following, the epispore is referred to as cell wall). The marginal epispore (also referred to as 'exospore') is mostly smooth, but sometimes – often towards the late maturity - it can be crenate or ornamented. The form of the endospore is internally determined by the loci and only distinct in eumuriform ascospores, in transversely septate and submuriform ascospores it internally merges with the septae (in the following the endospore is thus only specified in muriform ascospores). The halo (perispore) consists of a gelatinous substance that dissolves in KOH, and is usually distinct only in younger stages of the ascospore development. It is predominantly continuous, but in some taxa it can also be ±irregular. Frisch (2006) distinguishes further ascospore structures as a ring-like structure that resembles the internal loci wall, a middle lamella along the central septum, and two further layers of the ascospore wall, a mesospore and an 'epispore', which, according to Frisch (ibid.) - who follows the terminology of Janex-Favre (1964) - is used to describe a thin, gelatinous coating of the ascospore. Frisch (ibid.) also introduced the expressions of the 'thin-walled type' and the 'thick-walled type' ascospores to distinguish the ascospores of the genera *Acanthotrema* and *Chroodiscus* (having 'thin-walled type' ascospores) from the remaining genera. However, this phrasing is somewhat misleading since 'thick-walled type' ascospores can also have distinctly thin ascopore walls. The septation of the ascospores varies from species having distinct and thick septae (particularly in transversely septate ascospores), to species with indistinct, thin or absent septation, which can occur in multi-locular ascospores at late maturity or in small, submuriform ascospores with irregular loci arrangement. Further, the septation can be continuous and regular to discontinuous and irregular. The shape of the loci is roundish to angular, and subglobose, oblong, lentiform, cuboid or irregular; the end cells (if solitary) are either of the same shape as the remaining loci to more often hemispherical or conical.

Two special forms of ascospores are ascoconidia producing ascospores and the ascospores characteristic for the '*Ocellularia clandestina*-group'. The first are found in two species of *Topeliopsis* and will be treated below, the latter are found in *Chapsa halei* and in a recently introduced (Frisch ibid.) sub-group of *Ocellularia* (not treated here) and have been so far only known from there. The ascospores are mainly deviant in having strongly thickened walls that are non-amyloid, and angular loci that – in early development – are separated by "pored septae" (Frisch, ibid.: 334) and become centrally fused in later maturity.

2. 5. 3. Conidiomata

Pycnidia are known for all treated genera (the presence of pycnidia for *Chapsa* is newly reported) except *Chroodiscus, Melanotopelia, Nadvornikia, Pseudoramonia and Topeliopsis*. In two species of the latter genus, however, old ascospores generate ascoconidia (see under *Topeliopsis* for details). The pycnidia are either immersed or in ±strongly raised thallus warts, and open by a single, tiny pore, that often is surrounded by a dark area. The conidia are either bacilliform, fusiform, oblong, obovate or irregular, and range from 2-8(10) x 0.5-2 µm in size. For a more detailed treatment of conidiomata in thelotremataceaen Graphidaceae see Frisch (2006).

2. 5. 4. Chemistry

In the majority (approximately 70%) of the species secondary compounds are present, whereas in Graphidaceae s. str., lichen substances occur less frequently (Staiger 2002). The majority of compounds are β-orcinol depsidones; in addition, orcinol depsides (chiefly occurring in *Diploschistes*), xanthones, anthraquinones (and other pigments) and several unidentified substances are known.

The taxonomic relevance of secondary compounds in lichenized fungi was controversially discussed in numerous publications (e.g., Brodo, 1978; Culberson, 1969, 1986; Culberson & Culberson, 1976, 1994; Hawksworth, 1976; Elix, 1993; Elix & al., 1986; Esslinger, 1977, 1989; Feige & Lumbsch, 1995; Lumbsch, 1998a, b; Rogers, 1989). Particularly at the species level, the taxonomic interpretation of chemical differences remains problematic and needs further molecular studies. In the present treatment, morphologically indistinguishable chemotypes were consistently regarded conspecific and designated to chemical strains.

In the following, a compilation of detected compounds is provided, grouped in compound classes and chemosyndromes (where present). Newly identified substances (Elix, pers. com.) or unknown substances are marked with an asterisk and specified in a separate table. For Rf-values and spot characteristics of the known substances see Elix & al. (1995, 2000c) and Huneck & Yoshimura (1996).

β-Orcinol depsidones

Salazinic acid

Detected as singular, major compound in *Thelotrema circumscriptum* and *'Leptotrema' schizoloma* (strain II).

Stictic acid chemosyndrome

Includes variable concentrations of α-acetylconstictic, α-acetylhypoconstictic, consalazinic, constictic, cryptostictic, hypoconstictic, hyposalazinic, hypostictic and stictic acids. Predominant major compounds are constictic, hypostictic and stictic acid. In '*Thelotrema' zebrinum* substances of the protocetraric acid chemosydrome can co-occur. It is the most common chemosyndrome in the non-ocellularioid taxa (in *Ocellularia* s. lat. it is very rare), detected in 36 species of all genera except *Fibrillithecis, Pseudoramonia* and *Reimnitzia*:

Chapsa lordhowensis, C. megalophthalma, C. megaphlyctidioides, C. minor, C. phlyctidioides, C. platycarpa, Chroodiscus australiensis, C. parvisporus, Leucodecton albidulum, L. compunctellum, L. glaucescens, L. subcompunctum, Melanotopelia rugosa, Myriotrema desquamans (strain I), *M. eminens, M. phaeosporum, M. trypaneoides, Nadvornikia hawaiensis, Thelotrema alboolivaceum, T. bicinctulum, T. capetribulense, T. crassisporum, T. cupulare, T. cyphelloides, T. leucophthalmum, T. myriocarpum, T. porinoides, T. thesaurum, T. triseptatum, Topeliopsis azorica* (strain I), *T. darlingtonii, T. elixii, T. kantvilasii, T. tasmanica, 'Thelotrema' guadeloupensis* (strain I), '*Thelotrema' zebrinum.*

Norstictic acid chemosyndrome

Includes variable concentrations of connorstictic, norstictic and subnorstictic acids, rarely with co-occurring substances of the stictic acid chemosyndrome (α-acetylconstictic, hyposalazinic and stictic acid). The predominant major compound is norstictic acid. Detected in six species of the genera *Leucodecton, Myriotrema* and *Thelotrema*:

Leucodecton occultum, Myriotrema frustillatum, Thelotrema bicavatum, T. eungellaense, T. gallowayanum, T. porinaceum.

Protocetraric acid chemosyndrome

Includes variable concentrations of conprotocetraric, fumarprotocetraric, protocetraric, succinprotocetraric and virensic acids. Predominant major compounds are fumarprotocetraric and protocetraric acid. Detected in five species of *Chapsa, Pseudoramonia* and the '*Leptotrema' schizoloma*-group (predominantly found in the genus *Ocellularia*):

Chapsa asteliae, C. lamellifera, Pseudoramonia richeae, Thelotrema sp. I, '*Thelotrema' zebrinum* (see also under stictic acid chemosyndrome).

Hypoprotocetraric acid chemosyndrome

Detected in two *Myriotrema* species, *M. polytretum and M. viridalbum*. Includes variable concentrations of conhypoprotocetraric, conprotocetraric, convirensic, 4-0-demethylnotatic, 2-hydroxyhypoprotocetraric* (major in *M. polytretum*), 2-hydroxynornotatic* and hypoprotocetraric (major in *M. viridalbum*) acids. This chemosyndrome is more common in *Ocellularia* s. lat.

Psoromic acid chemosyndrome

Includes variable concentrations of 2'-0-demethylpsoromic, psoromic and subpsoromic acids. The predominant major compound is psoromic acid. In some specimens of *Fibrillithecis halei* an (additional) unknown sterol occurs, the 'platysporum unknown'*. The psoromic acid chemosyndrome is more common in *Ocellularia* and *Stegobolus,* but was also detected in eight species of *Fibrillithecis, Myriotrema* and *Thelotrema*:

Fibrillithecis halei, Myriotrema clandestinum, M. glaucophaenum, M. microporum, M. rugiferum, M. temperatum, Thelotrema foveolare, T. saxicola.

Olivaceic acid chemosydrome

In *Myriotrema olivaceum,* two chemical strains were detected, including variable concentrations of O-methylolivaceic*, norisonotatic, norsubnotatic and olivaceic* acids. Strain II (with O-methylolivaceic and norisonotatic acids) might be conspecific with *M. subterebrans* (Frisch 2006). Norisonotatic and norsubnotatic acid are also known for several taxa in *Ocellularia* s. lat.

Xanthones

Lichexanthone

Lichexanthone is the only known xanthone occurring in Graphidaceae, here it was found in *Myriotrema viridalbum* and *Thelotrema* sp. III. Predominantly found in *Melanotrema* and *Redingeria*, but also known from other taxa of *Myriotrema* and *Stegobolus*.

Anthraquinones

Two unknown anthraquinones, both turning purple in KOH, are found in *Chroodiscus australiensis* and *Leptotrema wightii,* respectively. In the latter species, deep red anthraquinone crystals are found clustered in the medulla, in TLC detectable as a low, grayish spot (after charring) with Rf-values of 33/14/14 (solvent systems A/B'/C). In *C. australiensis* the pigment crystals are orange to rust-red and scattered on the disc and the ascomata margin. In TLC, no spots were seen, probably due to low concentrations.

Unknown substance

In a chemical strain of *'Thelotrema' guadeloupensis* the 'cinchonarum unknown'* compound was detected. This substance often co-occurs with hirtifructic and conhirtifructic acid (='diacida unknowns') and is known for several *Ocellularia* species, but was also found in *Myriotrema*.

Chromatographic behavior of new or unknown substances

Table 1: TLC characteristics of the four hitherto unknown substances (according to Elix, pers. com.) and for the 'cinchonarum and platysporum unknowns'.

Compound name	Rf values for solvent system: A	B'	C	Spot characteristics (after charring)
2-hydroxyhypoprotocetraric acid	12	29	7	dark blue to dark gray or black
2-hydroxynornotatic acid	7	25	4	dark blue to dark gray
O-methylolivaceic acid	7	23	17	pale purplish to grayish-brown
olivaceic acid	2	14	4	pale purplish to grayish-brown
'cinchonarum unknown'	2	7	3	(dark) gray
'platysporum unknown'	53	57	60	(dark) brown with yellowish to greenish aurora under UV light

The following previously informal compound names used by several authors (e.g. Frisch, 2006; Hale, 1974a) could be assigned to the following secondary metabolites:

'*neoterebrans* unknown' =O-methylolivaceic acid
'*olivaceum* unknowns':
-high =norisonotatic acid
-medium =norsubnotatic acid
-low =olivaceic acid

2. 6. Ecology

The ecology of thelotrematoid lichens is poorly known, and the following is mainly based on field observations and the available data from the collection labels. A more detailed summary of the general ecology and habitat preferences of thelotremataceaen Graphidacae can by found in Frisch (2006). General treatments of the diversity and ecology of the lichen biota in tropical rainforests are provided by Coppins & Wolseley (2002), Galloway (1991), Lakatos & al. (2006) and Sipman & Harris (1989). Information on the substrate ecology of lichens is given by Armostrong (1988) and Brodo (1973).

2. 6. 1. Substrate

The majority of taxa occur on bark of various trees and shrubs. However, several species and some genera have a preference for other substrates, such as wood, leaves, bryophytes, detritus, soil and siliceous rock. Members of the genus *Chroodiscus* are strictly foliicolous, *Melanotopelia* and many species of *Topeliopsis* s. str. are found on bryophytes, where they often extend onto adjacent substrates (bark, wood, rock). Several (sub)alpine Tasmanian taxa show a preference for exceptional substrates and in two cases are substrate specific: *Chapsa asteliae* is only known from dead leafs of *Astelia alpina*, *Pseudoramonia richeae* grows exclusively on bark and dead leafs of *Richea scoparia*; some specimens of *Topeliopsis tasmanica* and *Chapsa lamellifera* were found inhabiting plant debris or peaty soil. The latter is further the only known species of *Chapsa* in Australia that is also lignicolous or muscicolous. Other facultative muscicolous species (which, however, initially settle on bark and subsequently overgrow adjacent bryophytes) include *Fibrillithecis halei*, *Leptotrema wightii* and *Reimnitzia santensis*. In *Thelotrema* a relatively high number of facultative saxicolous taxa are found (in Australia: *T. conveniens, T. porinaceum, T. saxatile, T. saxicola*).

2. 6. 2. Habitat

The highest species diversity of thelotrematoid lichens is found in tropical coastal, lowland to mid-range rainforests and subtropical rainforests in predominantly higher altitudes, where they mainly occur in the upper forest levels or on other more open localities with better light conditions as for example along creeks. At these sites, they often form the dominant elements in the epiphytic mycobiota, and sometimes extensive colonies are found. It could be observed that larger thalli were often formed by members of *Myriotrema* and some taxa of *Thelotrema*, whereas other species of the latter genus as well as *Chapsa* species generally are found in smaller individuals, and a noticeable number seem to preferable pioneer on younger trees, shrubs or on thinner twigs respectively. In those habitats, often a high density of various competitive species (mostly with Graphidaceae s. str.) is found. Secondary or disturbed forests show a significant decrease in diversity, as well as drier localities as monsoon forests or wet sclerophyll forests. Only in tropical mangroves, certain species (e.g. *Fibrillithecis halei*, *Leucodecton occultum*, *L. subcompunctum*, *Myriotrema phaeosporum, M. rugiferum, Thelotrema bicinctulum, T. lacteum*, *T. pachysporum*) are found, whereas subtropical mangroves lack any thelotrematoid species. *Leptotrema wightii* is the only species that also tolerates seasonally dry habitats, otherwise, no other member of thelotremataceaen Graphidaceae was found in the Pacific hinterland of Queensland.

The rainforests of the southern Pacific regions are poorer in species, however, many temperate species are only found there (e.g. *Chapsa megalophthalma*, *Thelotrema lepadinum*, *'Thelotrema' guadeloupense*, *Topeliopsis decorticans*). In the (sub)alpine forests of continental Australia (southern Great Dividing Ranges) thelotrematoid lichens are absent probably due to the low temperatures in winter, whereas the oceanic influenced (sub)alpine reaches of Tasmania are relatively rich in species. As noted by Frisch (2006) one of the reasons for the poorness of species diversity in temperate zones could lie in the increased competition caused by bryophytes and macrolichens. This might also be an explanation for the accumulative occurrence of muscicolous taxa in temperate zones, particularly of the genus *Topeliopsis*. In Tasmania, various habitats harbor thelotrematoid lichens, amongst them a high number of endemic species. Besides in rainforests, also in heath- and moorlands primarily members of *Chapsa*, *Thelotrema*, *Topeliopsis* and the *Leptotrema schizoloma*-group were found.

2. 7. Distribution

As shown in figure 3, trentepohlioid thelotremataceaen Graphidaceae occur in coastal Northern Territory, Pacific Queensland and New South Wales, Norfolk Island, southern Victoria, south-west Western Australia and Tasmania. Roughly five major distribution centers can be distinguished: the wider Cairns area (from Cape Tribulation to Townsville) in tropical northern Queensland and the Proserpine/Mackay area in tropical north-central Queensland; the northern Sunshine Coast area and the wider Brisbane area (northern Brisbane district to Gibraltar Ranges) in subtropical southern Queensland and northern New South Wales; and the western Tasmanian ranges (cool-temperate). (It should be mentioned that many of the collections from Brisbane date back to the late 19th century.) Smaller distribution centers are found in the Iron Ranges National Park (Cape York Peninsula, Queensland), and in New South Wales the Coffs Harbour/Taree area, the Barrington Tops area and the Sydney area (mainly Blue Mountains and Royal National Park).

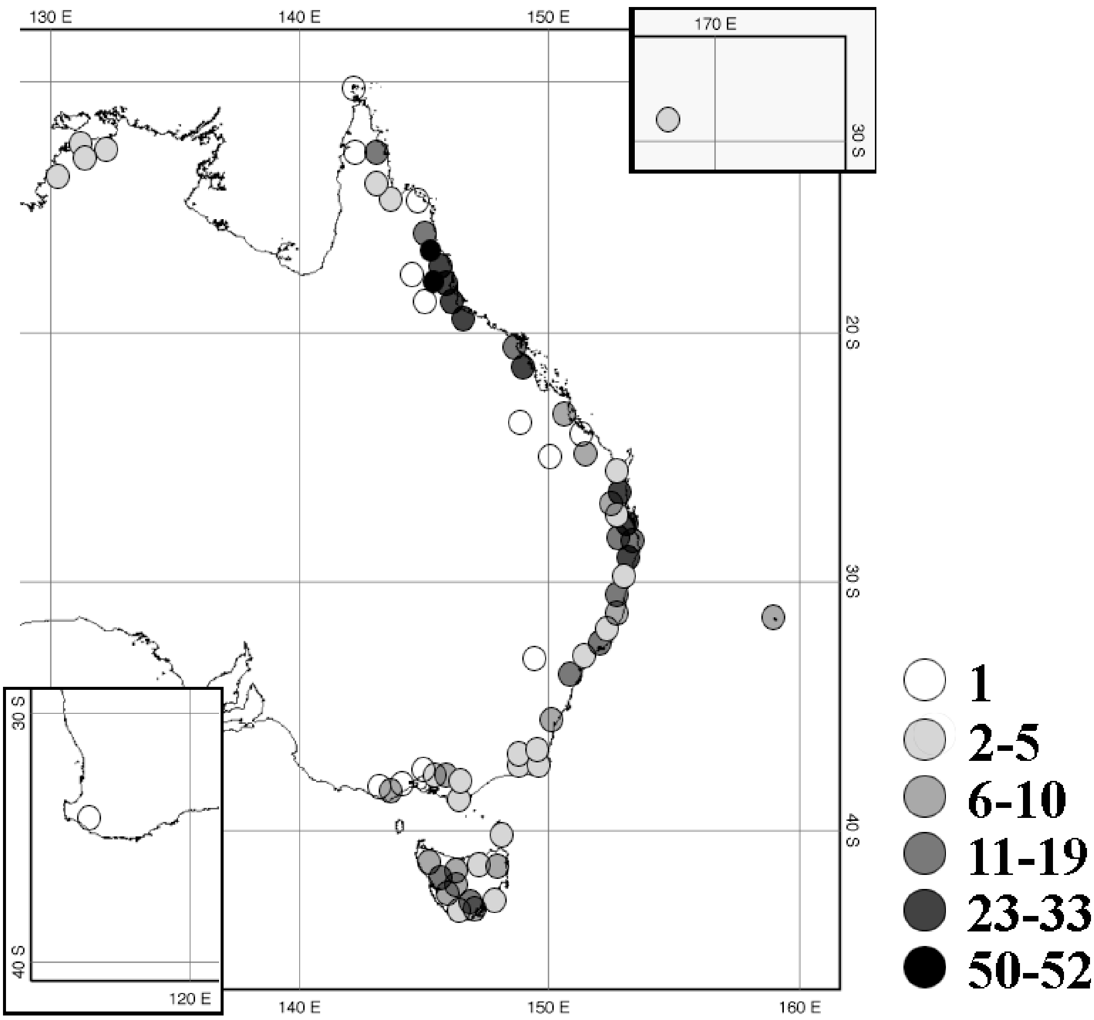

Fig. 3. Combined Australian distribution map of all treated species. [The gray tones of the circles indicate the number of species found in the region according to the legend. Insert upper right: Norfolk Island, insert lower left: southwest Western Australia (the latter also applies for the distribution maps used in the species descriptions)].

For Australia, the 103 known taxa can be grouped in seven different distributional types (table 2): **a)** strictly tropical (the largest group with 34 species), **b)** tropical to subtropical (28 species), **c)** tropical to warm-temperate (11 species), **d)** tropical to cool-temperate (1 species), **e)** strictly subtropical (8 species), **f)** subtropical to cool-temperate (12 species) and **g)** strictly cool-temperate (9 species).

Table 2: Australian distribution types of the treated species. (For an explanation of the code see text above; *: does also occur in the tropics at high altitudes.)

	Taxa
a) tropical	*Chapsa astroidea, C. halei , C. indica, C. lassae, C. leprieurii, C. megaphlyctidioides, C. niveocarpa, C. platycarpa, C. tibellii, Chroodiscus australiensis, C. parvisporus, Myriotrema desquamans, M. eminens, M. myrioporum, M. polytretum, M. protoalbum, M. subconforme, M. viridialbum, Reimnitzia santensis, Thelotrema adjectum, T. alboolivaceum, T. capetribulense, T. crassisporum, T. eungellaense, T. foveolore, T. lepadodes, T. monosporum, T. myriocarpum, T. polythecium, T. thesaurum, T. triseptatum, Topeliopsis laceratula, T. pseudoexanthismocarpa, "Thelotrema" parvizebrinum*
b) tropical-subtropical	*Chapsa alborosella, C. leprocarpa, C. phlyctidioides, C. pulchra, Fibrillithecis halei, Leucodecton albidulum, L. compunctellum, L. glaucescens, L. occultum, Myriotrema album, M. clandestinum, M. frustillatum, M. glaucophaenum, M. microporum, M. olivaceum, M. phaeosporum, M. rugiferum, M. trypaneoides, Nadvornikia hawaiensis, Thelotrema bicinctulum, T. cupulare, T. gallowayanum, T. leucophthalmum, T. oleosum, T. pachysporum, T. saxatile, T. saxicola, T. subadjectum*
c) tropical-warm-temperate	*Leptotrema wightii, Leucodecton subcompunctum, Thelotrema conveniens, T. defossum, T. diplotrema, T. lacteum, T. nureliyum, T. porinaceum, T. porinoides, T. pseudosubtile, T. rugatulum*
d) tropical-cool-temperate	*Thelotrema bicavatum*
e) subtropical	*Myriotrema temperatum, Thelotrema crespoae, T. circumscriptum, T. cyphelloides, T. nostalgicum, Topeliopsis darlingtonii, T. elixii, "Thelotrema" subzebrinum*
f) subtropical-cool-temperate	*Chapsa lordhowensis, Thelotrema megalophthalma, T. lepadinum, T. subtile, T. suecicum*, Topeliopsis acutispora, T. azorica, T. decorticans, T. subdenticulata, "Thelotrema" guadeloupensis, "Leptotrema" schizoloma*. "Thelotrema" zebrinum**
g) cool-temperate	*Chapsa asteliae, C. lamellifera, C. minor, C. subpatens, Melanotopelia rugosa*, Pseudoramia richeae, Topeliopsis kantvilasii, T. muscigena, T. tasmanica*

Regarding the worldwide distribution, 31 of the species are so far known to be endemic to Australia **[A]**, 6 species are Australasian **[B]**, 3 species subantarctic **[C]**, 21 species paleotropical **[D]**, two species paleosubtropical **[E]**, 39 species pantropical **[F]**, one species pantemperate **[G]**, and two species subcosmopolitan. **[H]** (the bold letters indicate the code for table 3).

Table 3: Distributional types of the treated species. (The suffix '+' indicates an extension into subtropical zones, '++' indicates an extension into temperate zones.)

	Taxa
[A] endemic	*Chapsa asteliae, C. halei, C. lassae, C. lordhowensis, C. megaphlyctidioides, C. minor, C. niveocarpa, C. pulchra, C. tibellii, Myriotrema frustillatum, M. temperatum. Pseudoramia richeae, Thelotrema crespoae, T. capetribulense, T. crassisporum, T. cyphelloides, T. eungellaense, T. gallowayanum, T. oleosum, T. pseudosubtile, T. subadjectum, T. thesaurum, T. triseptatum, Topeliopsis acutispora, T. darlingtonii, T. decorticans, T. elixii, T. kantvilasii, T. tasmanica, "Thelotrema" parvizebrinum, "Thelotrema" subzebrinum*
[B] Australasian	*Thelotrema monosporum, Chapsa lamellifera, C. megalophthalma, Leucodecton albidulum, Thelotrema circumscriptum, "Thelotrema" zebrinum*

	Taxa
[C] subantarctic	*Melanotopelia rugosa, Topeliopsis subdenticulata*
[C+] subantarctic	*"Leptotrema" schizoloma*
[D] paleotropical	*Chapsa indica, Myriotrema desquamans, M. eminens, M. polytretum, M. protoalbum, M. subconforme, Thelotrema polythecium, Topeliopsis laceratula, T. pseudoexanthismocarpa*
[D+] paleotropical	*Myriotrema microporum, M. phaeosporum, Thelotrema bicinctulum, T. cupulare, T. foveolore, T. nostalgicum*
[D++] paleotropical	*Chapsa subpatens, Thelotrema nureliyum, T. rugatulum, Topeliopsis muscigena*
[E++] paleosubtropical	*Thelotrema bicavatum, Thelotrema porinaceum*
[F] pantropical	*Chapsa astroidea, C. leprieurii, Chroodiscus australiensis, C. parvisporus, Myriotrema myrioporum, M. viridialbum, Reimnitzia santensis, Thelotrema adjectum, T. alboolivaceum, T. lepadodes, T. myriocarpum*
[F+] pantropical	*Chapsa alborosella, C. leprocarpa, C. phlyctidioides, C. platycarpa, Fibrillithecis halei, Leucodecton compunctellum, L. glaucescens, L. occultum, Myriotrema album, M. clandestinum, M. glaucophaenum, M. olivaceum, M. rugiferum, M. trypaneoides, Nadvornikia hawaiensis, Thelotrema leucophthalmum, T. pachysporum, T. saxatile, T. saxicola*
[F++] pantropical	*Leptotrema wightii, Leucodecton subcompunctum, Thelotrema conveniens, T. defossum, T. diplotrema, T. lacteum, T. porinoides, T. subtile, "Thelotrema" guadeloupensis*
[G] pantemperate	*Topeliopsis azorica*
[H] subcosmopolitan	*Thelotrema lepadinum, Thelotrema suecicum*

2. 8. Key to the treated species

1a Growing on dead or living leaves (foliicolous) **2**
1b Growing on different substrate than leaves (corticolous, lignicolous, muscicolous, saxicolous, terricolous or humicolous) **5**

2a Occurring in alpine habitats in Tasmania, growing on *Astelia* or *Richea*, ascospores longer than 12 µm, containing the protocetraric acid chemosydrome **3**
2b Tropical, ascospores up to 12 µm long, containing the stictic acid chemosydrome........ **4**

3a Ascomata *Geaster*-like, not stipitate ....***Chapsa asteliae***
3b Ascomata distinctly stipitate ....***Pseudoramonia richeae***

4a Discs reddish, ascospores up to 10 µm long, with 2(3) loci ... ***Chroodiscus australiensis***
4b Discs brownish, ascospores up to 12 µm long, with 2-4 loci .. ***Chroodiscus parvisporus***

5a Ascomata mazaedious, ascospores brown, bilocular .... ***Nadvornikia hawaiensis***
5b Ascomata without mazaedium, ascospores with more than 2 loci, or if bilocular, unpigmented.. **6**

6a Ascomata distinctly stipitate, endemic to (sub)alpine heathland shrubs in Tasmania .... ***Pseudoramonia richeae***
6b Ascomata immersed to strongly emergent but without stipes **7**

7a Ascospores transversely septate, rarely with a single longitudinal septum **8**
7b Ascospores (eu)muriform or submuriform **60**

8a Ascospores brown at maturity **9**
8b Ascospores hyaline throughout or yellowish to brownish only in over-mature or deceased ascospores **15**

9a Ascospores 1 per ascus .... ***Thelotrema crespoae***
9b Ascospores 4-8 per ascus **10**

10a Lateral paraphyses absent .... ***Leucodecton albidulum***
10b Lateral paraphyses present **11**

11a Ascospores with 4-8 loci **12**
11b Ascospores with 8-26 loci **14**

12a Pores small, up to 100(200) µm in diameter, proper exciple fused .... ***Topeliopsis kantvilasii***
12b Pores wide to gaping, exceeding 200 µm in diameter, proper exciple fused to free **13**

13a Species lacking secondary compounds, proper exciple fused to indistinctly free .... ***Chapsa leprieurii***
13b Species containing the stictic acid chemosydrome, proper exciple free .... ***Chapsa platycarpa***

14a Ascospores 30-75 µm long, with 8-18(20) loci, loci oblong .... ***Thelotrema pachysporum***
14b Ascospores (50)70-110(130) µm long, with (12)16-24(26) loci, cell walls usually becoming distinctly crenate, loci globose .... ***Thelotrema lacteum***

15a Proper exciple dark-brown to carbonized, thalline rim becoming distinctly layered, ascospores non-amyloid, 30-80 µm long .... ***Thelotrema zebrinum***
15b Proper exciple different or if dark and/or thalline rim layered, ascospores with amyloid reaction and/or smaller **16**

16a Mature ascospores non-amyloid **17**
16b Mature ascospores amyloid **28**

17a Ascospores up to 35 µm, with up to 11 loci **18**
17b Ascospores in average longer than 35 µm, with 10-35 loci **26**

18a Pores small, never exceeding 120 µm in diameter, ascomata not chroodiscoid........... **19**
18b Pores wide to gaping or ascomata distinctly chroodiscoid **20**

19a Lateral paraphyses and secondary compounds lacking .... ***Myriotrema protoalbum***
19b Lateral paraphyses present, containing the stictic acid chemosydrome .... ***Thelotrema bicinctulum***

20a Cool-temperate species .... ***Chapsa minor***
20b (Sub)tropical species **21**

21a Thallus ecorticate, surface dull and roughened **22**
21b Thallus corticate, surface shiny to waxy and smooth **24**

22a Discs epruinose or indistinctly pruinose, ascospores not exceeding 13 µm, with 3-6 loci .... ***Chapsa halei***
22b Discs distinctly pruinose, ascospores up to 25 µm, with 6-9 loci **23**

23a Older ascomata becoming distinctly chroodiscoid, ascospores halonate, cell walls thin, lacking secondary compounds .... ***Chapsa alborosella***
23b Older ascomata rather indistinctly chroodiscoid, ascospores non-halonate, cell walls moderately thick, containing the stictic acid chemosydrome .... ***Chapsa phlyctidioides***

24a Ascomata inconspicuous, up to 600 µm in diameter, disc rather indistinctly pruinose and brownish, thallus margin epruinose, off-white to reddish-brown, ascospores not exceeding 15 µm and with up to 5 loci .... ***Chapsa lassae***
24b Ascomata conspicuous, exceeding 600 µm in diameter, disc and inner thallus margin ±distinctly pruinose and bright, ascospores exceeding 15 µm and with more than 5 loci **25**
25a Hymenium up to 80 µm high, lateral paraphyses inconspicuous, ascospores up to 20(23) µm long, with up to 7(8) loci, lacking secondary compounds............ ***Chapsa astroidea***
25b Hymenium up to 70 µm high, lateral paraphyses conspicuous, ascospores up to 18 µm long, with up to 6(8) loci, containing the stictic acid chemosyndrome .... ***Chapsa megaphlyctidioides***

26a Ascomata perithecioid to apothecioid, pores up to 100 µm, containing the stictic acid chemosyndrome .... ***Topeliopsis darlingtonii***
26b Ascomata becoming chroodiscoid when mature, lacking secondary compounds **27**

27a Ascospores not exceeding 70 µm and with up to 24 loci, cell walls thin ***Chapsa pulchra***
27b Ascospores up to 110 µm, with up to 35 loci, cell walls thick .... ***Chapsa indica***

28a Ascospores exceeding 90 µm and 20 loci **29**
28b Ascospores up to 90(110) µm with up to 20(22) loci **34**

29a Proper exciple fused and usually not visible from the surface **30**
29b Proper exciple distinctly free and visible from the outside **32**

30a Thallus thick, distinctly corticate, thalline rim usually eroded in apical parts, corticolous, tropical species................................ ***Topeliopsis pseudoexanthismocarpa***
30b Thallus thin, covered by protocortex or indistinctly corticate, thalline rim entirely eroded with age, predominantly muscicolous, sub-tropical to cool-temperate species . **31**

31a Ascospores up to 130(150) µm with up to 32 loci, form bacillar, often distinctly bent, loci angular and pinched also in mature stages .... ***Topeliopsis acutispora***
31b Ascospores up to 100(110) µm with up to 24(25) loci, form fusiform and straight, loci in mature stages roundish .... ***Topeliopsis subdenticulata***

32a Ascospores not exceeding 150(170) µm and with up to 26(28) loci, containing the stictic acid chemosyndrome .... ***Thelotrema porinoides***
32b Ascospores up to 240 µm, with up to 38 loci, lacking secondary compounds or containing the protocetraric acid chemosyndrome.. **33**

33a Ascospores 4-8 per ascus, lacking secondary compounds .... ***Thelotrema nureliyum***
33b Ascospores 2-4 per ascus, containing the protocetraric acid chemosyndrome .... ***Thelotrema nostalgicum***

34a Ascospores small, up to 13 µm, with up to 2 loci .... ***Myriotrema myrioporum***
34b Ascospores exceeding 13 µm and with more than 2 loci **35**

35a Ascospores exceeding 50 µm **36**
35b Ascospores up to 50 µm **38**

36a Ascospores non-amyloid (to faintly amyloid), thalline rim distinctly split and layered, proper exciple fused to apically exposed, containing the stictic acid chemosyndrome .... ***Topeliopsis darlingtonii***
36b Ascospores amyloid, thalline rim entire to slightly split, proper exciple ±free, lacking secondary compounds **37**

37a Ascospores up to 60 µm, with up to 16 loci, predominantly with crenate surface............ .... ***Thelotrema pseudosubtile***
37b Ascospores up to 90(110) µm, with up to 20(22) loci, with entire surface....................... .... ***Thelotrema diplotrema***

38a Lateral paraphyses lacking, ascomata usually ±small, immersed or indistinctly emergent **39**
38b Lateral paraphyses present, ascomata large and distinctly emergent or chroodiscoid .. **46**

39a Proper exciple predominantly distinctly free, at least in mature ascomata. **40**
39b Proper exciple predominantly fused **42**

40a Thallus unfissured or slightly fissured, ascomata often becoming distinctly emergent, thalline rim typically strongly split to lacerate or eroded, ascospores up to 18(20) µm with up to 6(8) loci .... ***Myriotrema glaucophaenum***
40b Thallus becoming ±distinctly fissured to areolate, ascomata predominantly immersed, ascospores up to 16(18) µm with up to 4(5)loci **41**

41a Containing the 'olivaceum unknown' compound (strain I or II), thallus up to 600 µm high, proper exciple in section brown and apically darkened, ascospores up to 15 µm long .... ***Myriotrema olivaceum***
41b Containing the psoromic acid chemosyndrome, thallus up to 800 µm high, proper exciple in section grayish and apically not darkened, ascospores up to 16(18) µm long. .. .. ***Myriotrema microporum***

42a Thallus thin, up to 100 µm high, ascomata typically elongated and arranged in rows, ascospores non-amyloid to faintly amyloid .... ***Myriotrema protoalbum***
42b Thallus thick, exceeding 100 µm in height, ascomata different, ascospores distinctly to strongly amyloid **43**

43a Thallus usually distinctly fissured, surface verruculose to verrucose, subtropical .... ***Myriotrema temperatum***
43b Thallus unfissured, surface continuous, tropical to more rarely extending in the subtropics **44**

44a Thallus up to 300 µm high, ascospores up to 18(22) µm long with up to 4 loci, containing the hypoprotocetraric acid chemosyndrome .... ***Myriotrema polytretum***
44b Thallus exceeding 300 µm in height, ascospores longer than 18(22) µm (up to 25[28] µm), containing the psoromic acid chemosyndrome or lacking secondary compounds **45**

45a Lacking secondary compounds, thallus with abundant calcium oxalate crystals, ascospores frequently with a single, longitudinal septum .... ***Myriotrema album***
45b Containing the psoromic acid chemosyndrome, thallus without or with rather sparse calcium oxalate crystals, ascospores seldom with longitudinal septum............................ .... ***Myriotrema clandestinum***

46a Ascomata chroodiscoid, at least in older stages, proper exciple fused or indistinctly (apically) free (inner thalline rim layers sometimes might be confused with proper exciple!) **47**
46b Ascomata not chroodiscoid, proper exciple distinctly free **50**

47a Thallus thin, up to 150 µm high, with thin (up to 10 µm high), incontinuous cortex or ecorticate, ascospores up to 30 µm and with up to 10 loci **48**
47b Thallus thick, up to 400 µm high, distinctly corticate, ascospores up to 45 µm and with up to 12(14) loci .... ***Chapsa tibellii***

48a (Sub)tropical species, ascospores up to 24 µm long, with up to 8(x2) loci....................... .... ***Chapsa phlyctidioides***
48b Cool-temperate species, ascospores up to 30 µm long, with up to 10 loci **49**

49a Ascospores with thin cell walls, non-amyloid to faintly amyloid, containing the stictic acid chemosyndrome .... ***Chapsa minor***
49b Ascospores with thick cell walls, distinctly to strongly amyloid, lacking secondary compounds .... ***Chapsa subpatens***

50a In older ascomata thalline rim becoming layered, proper exciple dark brown to slightly carbonized... ***Thelotrema parvizebrinum***
50b Ascomata and proper exciple different or if thalline rim layered, proper exciple not dark, if proper exciple dark brown or carbonized, then only apically and thalline rim not layered **51**

51a Ascomata immersed **52**
51b Ascomata (at least in older stages) distinctly emergent **55**

52a Ascospores 15-20 µm long, with 4 loci .... ***Thelotrema triseptatum***
52b Ascospores exceeding 20 µm and with more than 4 loci **53**

53a Ascospores with thick cell walls, up to 40(45) µm long, with up to 14(16) loci, containing norstictic acid .... ***Thelotrema bicavatum***
53b Ascospores with thin cell walls, up to 35(40) µm long, with up to 11(12) loci, containing the stictic acid chemosyndrome or lacking secondary compounds **54**

54a Thallus ecorticate, ascospores with distinct halo, lacking secondary compounds............. .... ***Thelotrema defossum***
54b Thallus corticate (cortex sometimes incontinuous), ascospores with thin, indistinct halo, containing the stictic acid chemosyndrome .... ***Thelotrema bicinctulum***

55a Ascospores up to 23 µm long, with 4-6 loci .... ***Thelotrema alboolivaceum***
55b Ascospores exceeding 23 µm and with more than 6 loci **56**

56a Ascospores either becoming brownish in over-mature stages or with distinctly thick cell walls from early stages on, lacking secondary compounds **57**
56b Ascospores hyaline throughout and with unthickened cell walls in all developmental stages, containing depsidones **58**

57a Ascospores with thin cell walls in young stages, strongly amyloid, becoming brownish in over-mature stages, loci large .... ***Thelotrema subtile***
57b Ascospores with thick cell walls from early stages on, faintly amyloid, strictly hyaline, loci small .... ***Thelotrema suecicum***

58a Thalline rim in older ascomata becoming split to slightly lacerate or eroded and often slightly layered, thallus indistinctly fissured and distinctly verrucose, containing the stictic acid chemosyndrome .... ***Thelotrema capetribulense***
58b Thalline rim entire to slightly split, unlayered, thallus distinctly fissured, continuous to rarely distinctly verrucose, containing salazinic or norstictic acid **59**

59a Pores small, up to 200 µm in diameter, discs indistinctly pruinose, epihymenium thin, containing salazinic acid .... ***Thelotrema circumscriptum***
59b Pores wide, up to 300(500) µm in diameter, discs distinctly pruinose, epihymenium thick, containing norstictic acid .... ***Thelotrema bicavatum***

60a Ascospores 1-4 per ascus, eumuriform **61**
60b Ascospores 4-8 per ascus, eumuriform to submuriform **85**

61a Ascomata large, distinctly chroodiscoid, at least in older stages **62**
61b Ascomata small to moderately large, perithecioid to apothecioid **64**

62a Ascospores amyloid, containing the stictic acid chemosyndrome . ***Chapsa lordhowensis***
62b Ascospores non-amyloid, lacking secondary compounds **63**

63a Hymenium und lateral paraphyses interspersed with fine granules, ascospores up to 190 µm long, hymenium up to 200 µm high .... ***Chapsa niveocarpa***
63b Hymenium clear (lateral paraphyses interspersed), ascospores up to 130 µm long, hymenium up to 140 µm high .... ***Chapsa leprocarpa***

64a Hymenium inspersed **65**
64b Hymenium clear **67**

65a Ascospores hyaline, containing norstictic acid........................ ***Thelotrema porinaceum***
65b Ascospores hyaline or ±brownish at later maturity, lacking secondary compounds or containing the psoromic acid chemosyndrome.. **66**

66a Ascospores distinctly brownish only in over-mature stages, lacking secondary compounds .... ***Thelotrema saxicola***
66b Ascospores distinctly brownish at maturity, containing the psoromic acid chemosydrome .... ***Thelotrema oleosum***

67a Proper exciple distinctly carbonized or dark brown **68**
67b Proper exciple non-carbonized, if dark, then only apically **69**

68a Ascomata sessile, distinctly emergent, urceolate to subglobose, thalline rim margin rugose to entire, ascospores up to 230 µm, containing the stictic acid chemosyndrome ... . ***Melanotopelia rugosa***
68b Ascomata erumpent, ±emergent, hemispherical to rather indistinctly urceolate, thalline rim margin coarsely split to lacerate, ascospores up to 120(130) µm, lacking secondary compounds or containing salazinic acid .... ***Thelotrema schizolomum***

69a Lateral paraphyses lacking **70**
69b Lateral paraphyses present (in perithecioid ascomata often inconspicuous) **72**

70a Ascospores becoming distinctly brown, up to 130 µm long ***Leucodecton compunctellum***
70b Ascospores hyaline, up to 200 µm long **71**

71a Ascospores non-amyloid, containing norstictic acid .... ***Myriotrema frustillatum***
71b Ascospores amyloid, containing the stictic acid chemosyndrome .. ***Myriotrema eminens***

72a Thalline rim predominantly and in large parts distinctly split to lacerate or eroded, ±pruinose, proper exciple fused **73**
72b Thalline rim entire to slightly split, proper exciple free, at least in apical parts **77**

73a Ascospores non-amyloid, 2-4(8) per ascus, up to 100 µm .... ***Topeliopsis tasmanica***
73b Ascospores amyloid, 1-2 per ascus, up to 210 µm **74**

74a In older ascomata pores gaping to almost appearing chroodiscoid, ascospores hyaline, producing ascoconidia in over-mature stages, containing hypostictic and hypoconstictic acids as major compounds .... ***Topeliopsis elixii***
74b Pores rather small, only gaping in deceased, sterile ascomata, ascospores without ascoconidia, or if bearing ascoconidia, ascospores yellowish to brownish at late maturity, lacking secondary compounds or containing stictic acid as major compound **75**

75a Predominantly muscicolous, rarely corticolous, ascomata distinctly emergent, usually with reddish-brown base, ascospores up to 210 x 55 µm, becoming yellowish to brownish at late maturity and producing acoconidia .... ***Topeliopsis muscigena***
75b Muscicolous, saxicolous or corticolous, ascomata immersed to emergent, ascospores up to 160(170) x 45 µm, hyaline and not producing ascoconidia **76**

76a Corticolous, thallus dark and with distinct, thick, yellowish cortex, ascospores with thick cell walls .... ***Topeliopsis laceratula***
76b Corticolous, muscicolous or saxicolous, thallus pale, cortex indistinct or lacking, ascospores with thin cell walls .... ***Topeliopsis azorica***

77a Ascospores up to 100 µm, becoming distinctly brown **78**
77b Ascospores exceeding 100 µm, hyaline to yellowish or distinctly brown **79**

78a Ascospores 2-8 per ascus, becoming brown in rather late maturity, distinctly amyloid, with thick cell walls and ±distinctly tapered ends, loci large, usually undivided in ends of ascospores .... ***Thelotrema lepadodes***
78b Ascospores 1-4 per ascus, brown at early maturity, non-amyloid to faintly amyloid, with thin cell walls and indistinctly tapered ends, loci small, usually divided in ascospore ends .... ***Thelotrema monosporum***

79a Ascospores up to 350(400) µm long, with short, distinctly tapered ends .... ***Thelotrema gallowayanum***
79b Ascospores up to 230(250) µm long, ends different **80**

80a Ascospores 2-4 per ascus, containing norstictic acid .... ***Thelotrema eungellaense***
80b Ascospores 1 to rarely 2 per ascus, containing norstictic or psoromic acid or lacking secondary compounds **81**

81a Asci with thick walls and lacking tholus, ascospores distinctly amyloid, ascospore walls and endospore remaining non-amyloid , containing the psoromic acid chemosyndrome .. .. ***Thelotrema foveolare***
81b Asci and ascospores different, containing norstictic acid or lacking secondary compounds **82**

82a Ascospores hyaline to pale yellowish in over-mature stages **83**
82b Ascospores becoming distinctly pigmented with maturity **84**

83a Ascomata perithecioid, pores up to 80 µm in diameter, containing norstictic acid .... ***Thelotrema porinaceum***
83b Ascomata perithecioid to more often apothecioid, pores exceeding 80 µm in diameter, lacking secondary compounds .... ***Thelotrema rugatulum***

84a Ascospores non-amyloid, brown at early stages .... ***Thelotrema saxatile***
84b Ascospores amyloid, brown at late maturity .... ***Thelotrema conveniens***

85a Hymenium inspersed .... ***Myriotrema trypaneoides***
85b Hymenium clear **86**

86a Proper exciple distinctly carbonized to dark brown **87**
86b Proper exciple non-carbonized or if dark, then only apically **89**

87a Ascospores up to 35 µm .... ***Thelotrema subzebrinum***
87b Ascospores exceeding 35 µm, up to 130 µm **88**

88a Ascospores 1-4(6) per ascus, up to 120(130) µm, lacking secondary compounds or containing salazinic acid .... ***Thelotrema schizolomum***
88b Ascospores 4-8 per ascus, up to 60(70) µm, containing the stictic acid chemosyndrome or 'cinchonarum unknown' compounds .... ***Thelotrema guadeloupense***

89a Ascospores exceeding 80 µm **90**
89b Ascospores up to 80 µm **93**

90a Proper exciple fused, not visible from the outside, thalline rim lacerate, distinctly lobed and ±layered .... ***Topeliopsis tasmanica***
90b Proper exciple ±free and visible from the outside, thalline rim different **91**

91a Ascospores becoming brownish .... ***Thelotrema lepadodes***
91b Ascospores remaining hyaline **92**

92a Ascospores with thin cell walls, containing the stictic acid chemosyndrome ....
.... ***Thelotrema thesaurum***
92b Ascospores with thick cell walls, lacking secondary compounds ***Thelotrema lepadinum***

93a Ascospores becoming distinctly brownish **94**
93b Ascospores hyaline to yellowish **100**

94a Thallus shiny, distinctly corticate, pores tiny to small, up to 30 µm in diam., proper exciple fused .... ***Myriotrema desquamans***
94b Thallus predominantly dull and ecorticate, or shiny and corticate, then ascomata different **95**

95a Ascomata becoming chroodiscoid, lacking secondary compounds ***Reimnitzia santensis***
95b Ascomata perithecioid to apothecioid, containing stictic or norstictic acid, or an unknown anthraquinone (then thallus with reddish, K+ purple crystals) **96**

96a Thallus distinctly epiphloedal, thick, bulging away from substrate and with ±distinct reticulate pattern, calcium oxalate crystals conspicuous, abundant and often arranged in columns **97**
96b Thallus different, proper exciple predominantly free **99**

97a Thallus with conspicuous reddish, K+ purple crystals, containing an unknown anthraquinone .... ***Leptotrema wightii***
97b Thallus without red crystals, containing the stictic acid chemosyndrome **98**

98a Ascomata clustered, often forming stromata-like structures, pores wide, disc visible, proper exciple predominantly free .... ***Leucodecton glaucescens***
98b Ascomata arrangement differently, pores small, disc non-visible, proper exciple predominantly fused .... ***Myriotrema phaeosporum***

99a Ascospores becoming brownish at rather early stages, up to 35(40) µm long, containing norstictic acid .... ***Leucodecton occultum***
99b Ascospores becoming brownish at late stages, up to 45(50) µm long, containing the stictic acid chemosyndrome .... ***Leucodecton subcompunctum***

100a Ascospores with more than 12 x 4 loci **101**
100b Ascospores up to 11(12) x 4 loci **108**

101a Proper exciple fused **102**
101b Proper exciple becoming ±free, at least in older ascomata **105**

102a Ascomata apothecioid, lacking secondary compounds .... ***Topeliopsis decorticans***
102b Ascomata becoming chroodiscoid, containing the stictic or protocetraric acid chemosyndrome **103**

103a Ascomata margins weakly layered, warm-temperate to subtropical species, containing the stictic acid chemosyndrome, ... ***Chapsa megalophthalma***
103b Ascomata margins strongly layered, cool-temperate species, containing the protocetraric acid chemosyndrome, ... **104**

104a Epiphytic on *Astelia*, ascomata up to 1.5 mm in diameter, ascospores amyloid .... ***Chapsa asteliae***
104b Substrate different, ascomata exceeding 1.5 mm in diameter (up to 3 mm), ascospores non-amyloid .... ***Chapsa lamellifera***

105a In older ascomata pores wide to gaping, up to 1.5 mm in diameter, containing the stictic acid chemosyndrome, ... ***Thelotrema leucophthalmum***
105b Pores small to wide, up to 500 µm in diameter, lacking secondary compounds **106**

106a Ascospores up to 135 µm, ascomata becoming distinctly emergent, subtropical to cool-temperate species.. ***Thelotrema lepadinum***
106b Ascospores up to 80 µm, ascomata immersed to indistinctly emergent, predominantly tropical species, extending into the subtropics **107**

107a Thallus rather thin, ascomata immersed, proper exciple distinctly free and visible, thalline rim not layered, ascospores up to 35 µm, cell walls thin, but endospore distinctly thickened .... ***Thelotrema subadjectum***
107b Thallus thick, ascomata immersed to slightly emergent, proper exciple often only indistinctly free and only partly visible, thalline rim becoming ±layered, ascospores up to 80 µm, cell walls thick, endospore not thickened .... ***Thelotrema adjectum***

108a Ascospores non-amyloid, lateral paraphyses present (sometimes inconspicuous) **109**
108b Ascospores faintly to distinctly amyloid, lateral paraphyses present or lacking **113**

109a Proper exciple fused, lacking secondary compounds .... ***Thelotrema polythecium***
109b Proper exciple ±free, containing the stictic acid chemosyndrome **110**

110a Thalline rim becoming distinctly split to lacerate and lobed, ascomata chroodiscoid .... ***Thelotrema cupulare***
110b Thalline rim entire, slightly split or somewhat eroded, ascomata apothecioid **111**

111a Thallus ecorticate, ascomata immersed .... ***Thelotrema cyphelloides***
111b Thallus corticate, ascomata immersed to slightly or distinctly emergent **112**

112a Thallus thin, ascomata large, up to 600 µm in diameter, ascospores up to 20 µm and 7 x 4 loci .... ***Thelotrema crassisporum***
112b Thallus moderately thick, ascomata small, up to 350 µm in diameter, ascospores up to30(40) µm and 11(12) x 4 loci .... ***Thelotrema myriocarpum***

113a Lateral paraphyses present, ascospores only faintly amyloid, containing the stictic acid chemosyndrome **114**
113b Lateral paraphyses lacking (fibrillous apical proper exciple might be confused for lateral paraphyses!), ascospores distinctly amyloid, chemistry different **115**

114a Thallus hypophloedal and ecorticate .... ***Thelotrema cyphelloides***
114b Thallus moderately thick and corticate.................................. ***Thelotrema myriocarpum***

115a Thallus thin, ascomata immersed, lacking secondary compounds .... ***Myriotrema subconforme***
115b Thallus moderately thick to thick, ascomata immersed to distinctly emergent, with secondary metabolites **116**

116a Pores becoming wide to gaping, exceeding 300 µm in diameter (up to 600 µm), containing the hypoprotocetraric acid chemosyndrome .... ***Myriotrema viridialbum***
116b Pores small, up to 100(200) µm in diameter, chemistry different **117**

117a Ascomata large, conspicuous, up to 1(1.5) mm in diameter, proper exciple thick, bearing apical fibrillae, containing the psoromic acid chemosyndrome and/or 'platyspora unknown' compounds .... ***Fibrillithecis halei***
117b Ascomata small, inconspicuous, up to 400 µm in diam., proper exciple different, containing the psoromic acid chemosyndrome .... ***Myriotrema rugiferum***

2. 9. Genera

The following table provides an overview of the genus delimiting characters in the here treated group. Accepted genera in thelotremataceaen Graphidaceae that are treated elsewhere include: *Acanthotrema, Ampliotrema, Diploschistes, Gyrotrema, Ingvariella, Melanotrema, Ocellularia, Redingeria* and *Stegobolus.*

Table 4: Main genus delimiting characters and other features of the treated groups. Explanation of the code: **X** =applicable in most cases, X =applicable in fewer cases, - =not applicable. [*: for further explanations see part 2. 5. 2.; [a]: aseptate in *C. anomalus*; [b]: not tested in most species; [c]: the type species *L. zollingeri* contains the hypoprotocetraric acid chemosyndrome; [d]: paraphyses tips and ascus structure could not be observed due to the mazaedium; [e]: isidia-like structures often present, probably representing immature ascomata (see part 2. 9. 9.); [f]: presence of lateral paraphyses uncertain (see part 2. 9. 10.); [g]: a 'key-hole appearance' of the ascus tips was reported for some specimen (see part 2. 9. 10.); [h]: ascoconidia.]

		Chapsa	***Chroodiscus***	***Fibrillithecis***	***Leptotrema***	***Leucodecton***	***Melanotopelia***	***Myriotrema***	***Nadvornikia***	***Pseudoramonia***	***Reimnitzia***	***Thelotrema***	***Topeliopsis***	***L. schizoloma-group***
Substrate														
	bark	**X**	-	**X**	**X**	**X**	X	**X**	**X**	**X**	**X**	**X**	X	**X**
	rock	X	-	-	-	-	-	-	-	-	-	X	X	-
	leaves	X	**X**	-	-	-	-	-	-	**X**	-	-	-	-
	bryophytes	X	-	X	-	-	**X**	-	-	-	X	-	**X**	-
	wood	X	-	-	-	-	-	-	-	-	-	-	X	-
	soil	X	-	-	-	-	-	-	-	-	-	-	-	-
	peaty soil/plant debris	X	-	-	-	-	-	-	-	-	-	-	X	-

		Chapsa	*Chroodiscus*	*Fibrillithecis*	*Leptotrema*	*Leucodecton*	*Melanotopelia*	*Myriotrema*	*Nadvornikia*	*Pseudoramonia*	*Reimnitzia*	*Thelotrema*	*Topeliopsis*	*L. schizoloma-* group
Thallus														
	-predominantly hyposubstratic	**X**	-	X	-	**X**	**X**	X	X	**X**	**X**	**X**	**X**	**X**
	-predominantly episubstratic	X	**X**	**X**	**X**	**X**	X	**X**	**X**	**X**	X	X	**X**	X
	-cortex:													
	distinctly corticate (true cortex present)	**X**	-	**X**	-	-	**X**	**X**	-	X	-	X	X	-
	ecorticate, with protocortex	**X**	**X**	-	**X**	**X**	-	X	**X**	**X**	-	**X**	**X**	**X**
	ecorticate, cortex structures absent	X	-	-	-	X	-	-	**X**	-	**X**	X	-	-
	-oxalate crystals:													
	conspicuous, large, ±columnar	-	-	-	**X**	X	-	X	-	-	**X**	X	-	-
	-vegetative propagules:													
	isidia present	-	X	X	-	-	-	X	-	- [e]	**X**	X	-	-
	soralia present	-	-	-	-	X	-	-	X	-	-	-	-	-
Ascomata	**-morphology*:**													
	Geaster-like	**X**	**X**	-	-	-	-	-	-	-	**X**	-	-	-
	mazaedious	-	-	-	-	-	-	-	**X**	-	-	-	-	-
	stipitate	-	-	-	-	-	-	-	-	**X**	-	-	-	-
	myriotremoid s. str.	-	-	-	**X**	**X**	-	**X**	-	-	-	-	-	-
	thelotremoid s. str.	-	-	-	-	-	-	X	-	-	-	**X**	-	-
	perithecioid-thelotremoid	-	-	-	-	-	-	X	-	-	-	**X**	-	-
	emergent-perithecioid	-	-	**X**	-	-	-	X	-	-	-	-	-	-
	topeliopsioid	-	-	-	-	-	**X**	-	-	-	-	-	**X**	-
	layered-carbonized	-	-	-	-	-	-	-	-	-	-	-	-	**X**
	-proper exciple:													
	evanescent to rather thin	**X**	**X**	-	-	-	-	X	-	-	-	**X**	-	-
	rather thick to distinctly thick	X	X	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	X	**X**	**X**
	prosoplectenchymatous (to fibrillous)	-	-	**X**	-	-	-	**X**	-	-	**X**	-	-	-
	paraplectenchymatous	**X**	**X**	-	**X**	**X**	**X**	-	**X**	**X**	-	**X**	**X**	**X**
	rather pallid	**X**	**X**	**X**	-	-	-	-	**X**	-	-	**X**	**X**	-
	rather strongly pigmented	-	-	-	**X**	**X**	-	**X**	-	**X**	**X**	X	X	X
	distinctly carbonized	-	-	-	-	-	**X**	-	-	**X**	-	-	-	**X**
	-hymenium:													
	inspersion present	-	-	-	-	-	-	X	-	-	-	X	X	-
	in parts ±distinctly branched (except epithecium)	-	-	-	**X**	**X**	-	**X**	-	-	X	X	-	-
	paraphyses tips distinctly thick and/or irregular	X	-	**X**	**X**	X	-	**X**	? [d]	-	**X**	**X**	-	-
	paraphyses tips regular, unthickened or slightly thickened	**X**	**X**	-	-	**X**	**X**	X	? [d]	**X**	-	X	**X**	**X**
	lateral paraphyses present	**X**	-	-	-	-	**X**	-	-	**X**	X [f]	**X**	**X**	**X**

		Chapsa	***Chroodiscus***	***Fibrillithecis***	***Leptotrema***	***Leucodecton***	***Melanotopelia***	***Myriotrema***	***Nadvornikia***	***Pseudoramonia***	***Reimnitzia***	***Thelotrema***	***Topeliopsis***	***L. schizoloma*-group**
	-ascus:													
	walls thickened, tholus absent	-	-	-	-	X	-	X	? [d]	-	- [g]	X	-	X
	walls unthickened, tholus present (at least in younger stages)	**X**	**X**	**X**	-	**X**	**X**	**X**	? [d]	**X**	**X**	**X**	**X**	**X**
	walls unthickened, tholus absent	X	-	-	**X**	-	-	-	? [d]	-	-	-	-	-
	ocular chamber conspicuous, large, distinctly tapered	X	-	-	-	-	-	X	? [d]	-	-	-	-	-
	-ascospores:													
	rather small (≤30 µm long)	**X**	**X**	**X**	**X**	X	-	**X**	**X**	**X**	**X**	X	X	X
	very large (>130 µm long)	X	-	-	-	-	X	X	-	-	-	X	**X**	-
	transseptate	**X**	**X** [a]	-	-	X	-	**X**	**X**	**X**	-	X	X	**X**
	submuriform to eumuriform	X	X	**X**	**X**	**X**	**X**	**X**	-	-	**X**	**X**	**X**	**X**
	cell walls (and endospore) rather thin	**X**	**X**	-	**X**	-	-	X	-	**X**	-	X	X	**X**
	cell walls (and endospore) rather thick	X	-	**X**	-	**X**	**X**	**X**	**X**	-	**X**	**X**	**X**	X
	hyaline	**X**	**X**	**X**	-	X	**X**	**X**	-	**X**	-	**X**	**X**	**X**
	brown	X	-	-	**X**	**X**	X	X	**X**	-	**X**	X	X	X
	non-amyloid	**X**	**X**	-	**X**	**X**	**X**	X	**X**	**X**	**X**	X	X	**X**
	faintly to strongly amyloid	X	-	**X**	**X**	X	X	**X**	-	-	X	**X**	**X**	X
Conidia														
	bacilliform	-	-	**X**	**X**	X	-	X	-	-	**X**	-	**X** [h]	-
	irregular, oblong or ellipsoid	**X**	-	-	-	**X**	-	-	-	-	-	**X**	**X** [h]	-
	fusiform	-	-	-	-	-	-	**X**	-	-	**X**	-	-	-
Chemistry														
	β-orcinol depsidones	X	**X** [b]	**X**	**X** [c]	**X**	**X**	**X**	**X**	**X**	-	**X**	X	**X**
	xanthones	-	-	-	-	-	-	X	-	-	-	X	-	-
	anthraquinones	-	X	-	**X**	-	-	-	-	-	-	-	-	-
Distribution														
	tropical to subtropical	**X**	**X**	**X**	**X**	**X**	X	**X**	**X**	-	**X**	**X**	X	X
	warm- to cool-temperate	**X**	-	-	X	X	**X**	-	-	**X**	-	**X**	**X**	**X**

2. 9. 1. ***Chapsa*** Massal., Atti Reale Ist. Veneto Sci. Lett. Arti, ser. 3, 5: 256 (1860). Type species: *Chapsa indica* Massal.

Asteristion Leight., Trans. Linn. Soc. London 27: 163 (1869). *Asteristium* Clements, The genera of fungi: 76 (1909). *Thelotrema* sect. *Asteristion* (Leight.) Matsum., J. Hattori Bot. Lab. 88: 16 (2000). Type species: *Asteristion erumpens* Leight. =*Chapsa platycarpa* (Tuck.) Frisch.

THALLUS – Crustose, very rarely partly bulging and flaking away from substrate, predominantly corticolous, rarely saxicolous, lignicolous, terricolous, humicolous, muscicolous or foliicolous. Predominantly ±thin, mainly hyposubstratic with minor episubstratic parts, c. 50-200 µm high, more rarely moderately thick and with ±distinct episubstratic parts, up to c. 400 µm high. Mostly pale, in shades of gray with greenish, tannish, yellowish or whitish tones, more rarely dark and in shades of olive with brownish or yellowish tones. Surface dull to distinctly shiny, rarely waxy, smooth to rough or pruinose, in predominantly hypophloedal thalli often with protuberant substrate structures, predominantly continuous to slightly verrucose or verruculose, rarely distinctly verrucose to verruculose. Predominantly unfissured, rarely distinctly fissured. Prothallus thin to indistinct, brown. Corticate to ecorticate, either without true cortex and covered by a c. 10-20 µm thick, discontinuous to continuous protocortex, rarely with distinctly conglutinated parts forming a true cortex; or covered by a c. 20-50 µm thick, hyaline to ±yellowish true cortex consisting of irregular to periclinal hyphae. Algal layer continuous to more rarely discontinuous, poorly to well developed, calcium oxalate crystals absent to abundant, small to large, scattered to clustered, rarely forming layers in lower thallus. Distinct medulla layer absent to more rarely present in thicker thalli and in ascomata area. Vegetative propagules not seen.

ASCOMATA – Predominantly ±conspicuous, rarely inconspicuous (*C. halei*, *C. subpatens*), (moderately) large to very large, c. 0.6-5 mm in diam., roundish to ±irregular, particularly fused ascomata usually appearing distinctly irregular and/or ±branched, rarely somewhat elongated. Apothecioid in younger stages, becoming ±distinctly chroodiscoid with age, rarely indistinctly chroodiscoid throughout development. Erumpent, in regenerating ascomata often becoming ±sessile with successive ascomata generations. Mostly solitary to ±distinctly fused, rarely only marginally fused or strictly solitary, in some taxa ascomata ±frequently distinctly clustered in groups of several ascomata, then the individual ascomata often distinctly smaller than in solitary growing ascomata. In majority of species ascomata regenerating, then with ±distinctly layered thalline rim. Immersed to slightly raised or with an annular margin, rarely distinctly emergent in regenerating ascomata, then depressed-urceolate to cupular. Disc entirely to partly visible from surface, at least in older stages, white, gray, flesh-colored or brownish, usually ±distinctly pruinose, more rarely epruinose. Proper exciple usually not visible from the surface to more rarely visible when becoming partly detached or in ascomata with strongly recurved thalline rims, ±whitish, rarely brownish, very rarely proper exciple distinctly visible from surface and forming an inner margin/pore. Thalline rim margin pore-like only in younger stages or in ascomata with distinctly layered thalline rim, in older stages predominantly gaping, distinctly split and lobed to lacerate or eroded. Thalline rim unlayered to distinctly layered, epruinose to ±distinctly pruinose, whitish or brighter than thallus to more rarely brownish, yellowish or reddish-brown (usually due to protuberant substrate) internally and concolorous with thallus marginally, rarely concolorous with thallus throughout, predominantly erect to recurved, in layered margins often exfoliating. Proper exciple fused to slightly detached or apically exposed, very rarely distinctly free. Predominantly evanescent to thin, rarely distinctly thickened. Hyaline to rarely pale yellowish internally, yellow to brown, rarely orange marginally, in distinctly hypophloedal taxa often with substrate particles incorporated, apically sometimes more darkish and often covered by granules. Exciple non-amyloid to more rarely ±distinctly amyloid at the base. Subhymenium indistinct, evanescent to thin and with same color as basal exciple, rarely darkish brown to slightly carbonized, in some species with a distinct, hyaline, amyloid, lateral area. Hymenium non-amyloid, discoid to somewhat cupular, often with a ±broader base, up to c. 70-200 µm high, non-inspersed, predominantly clear, in *C. niveocarpa* distinctly interspersed, weakly to moderately, more rarely strongly conglutinated. Paraphyses un-thickened to rarely ±thickened, straight to slightly bent, parallel to slightly interwoven, unbranched, tips unthickened to ±distinctly thickened, sometimes ±distinctly irregular. Lateral paraphyses present, inconspicuous to conspicuous, usually clearly separated from proper exciple, rarely not clearly separated (*Topeliopsis*-type), up to c. 20-45 µm long, predominantly clear, but sometimes also interspersed. True columella or columellar structures absent. Epihymenium (moderately) thin to (very) thick, predominantly hyaline, rarely pale yellowish or ±brownish, with fine to coarse granules.

Asci 1-8-spored, non-amyloid, clavate, ascus walls unthickened (fide Frisch 2006 distinctly thickened ascus walls in *C. eitenii* and *C. zahlbruckneri*), tholus predominantly present, in *C. lamellifera* absent, in younger stages predominantly thin to thick, becoming thin or not visible at maturity, rarely remaining distinctly thickened throughout development. Ascospores uni- to quadriseriate, very small to very large, 9-190 x 2-50 µm, predominantly transversely septate to more rarely (eu)muriform. Cell walls thin to moderately thick, more rarely distinctly thick, smooth to rarely crenate, in muriform ascospores endospore thin to moderately thick, non-halonate to distinctly halonate, especially in younger stages, thin to very thick, sometimes ±distinctly irregular. Ascospores hyaline to sometimes slightly yellowish or grayish at late maturity, rarely distinctly brown, non-amyloid to strongly amyloid. Oblong to ellipsoid or fusi- to claviform, rarely bacillar to bacillar-fusiform with roundish to acute ends, straight to more rarely ±bent, with 3-35 loci in transversely septate ascospores, with 8-18 x 1-6 or multiple loci in muriform ascospores, solitary end cells hemispherical to conical, loci small to large, roundish to angular, ±irregular, subglobose, oblong or lentiform, more rarely ± cuboid, transverse septae thin to ±distinctly thickened, regular to irregular, in densely muriform ascospores often distinct only younger stages, becoming indistinct and vanishing with age.

PYCNIDIA – Only found in *C. lordhowensis*, see there for description.

CHEMISTRY – Secondary compounds present or absent, if present, then predominantly of the stictic acid, rarely the protocetraric acid chemosydrome.

ECOLOGY AND DISTRIBUTION – The *Chapsa* species in Australia predominantly occur on tree bark, rarely on dead wood, mosses, soil, siliceous rock, debris or on leaves in altitudes ranging between sea level and 1250 m. The greatest diversity of species is found in rainforests, rarely wet sclerophyll forests and monsoon forests, in tropical to sub-tropical climates of north-western Northern Territory, Pacific Queensland and northern New South Wales and on Lord Howe Island. Fewer species were found in rainforests, rarely wet sclerophyll forests and (sub)alpine heathlands, in warm- to cool-temperate climates in Pacific southern New South Wales, in southern Victoria and on Tasmania. At present state of knowledge, amongst the 19 species known in Australia, seven are endemic (*C. halei, C. lassae, C. lordhowensis, C. megaphlyctidioides, C. niveocarpa, C. pulchra, C. tibellii*), four are subantarctic (*C. asteliae, C. lamellifera, C. megalophthalma, C. minor*), two are paleotropical to paleotemperate (*C. indica, C. subpatens*) and six are pansubtropical to pantropical (*C. alborosella, C. astroidea, C. leprieurii, C. leprocarpa, C. phlyctidioides, C. platycarpa*).

NOTES – This genus was recently resurrected (Frisch, 2006) to accommodate taxa formerly grouped in *Chroodiscus* and *Thelotrema*, here in particular the members of the '*Thelotrema platycarpum*-group' (Salisbury, 1972b) and *Thelotrema* subgen. *Asteristion* (Matsumoto, 2000). The genus name was introduced by Massalongo in 1860 and was neglected ever since.

The taxa in *Chapsa* are characterized by a predominantly corticolous, thin thallus, typically large, chroodiscoid ascomata with fused to indistinctly free proper exciple (except *C. platycarpa*, which has a distinctly free proper exciple), un-branched, discoid to rarely slightly cupular hymenia and the presence of lateral paraphyses. The most similar genera are

Acanthotrema (not treated here, for differences see Frisch, 2006), *Chroodiscus, Reimnitzia, Thelotrema* and *Topeliopsis*. *Chroodiscus* is readily distinguished by smaller thalli, smaller ascomata without lateral paraphyses and a strictly foliicolous growth, *Reimnitzia* is distinguished by a thick, *Leptotrema wightii*-like, isidiate thalli with columnar calcium oxalate crystals, a slightly branched hymenium and probably absent lateral paraphyses (see observations there). *Thelotrema* and *Topeliopsis* predominantly differ by never distinctly chroodiscoid ascomata, although the distinction to *Chapsa* is sometimes difficult since certain taxa (e.g. *T. cupulare, T. leucophthalmum, T. polythecium*) also often have ±gaping apothecia with somewhat recurved margins. Most species in *Thelotrema* can be further distinguished by the distinctly free proper exciple and rather sessile than erumpent ascomata. The latter also applies for *Topeliopsis*, which further differs by a predominantly muscicolous growth, never distinctly discoid hymenia and usually thicker exciples with indistinctly separated lateral paraphyses.

In the original resurrection (Frisch, 2006) the genus is further characterized by distinct and rigid paraphyses that have moniliform, branched or rarely simple tips and ascospores "of the thick-walled type" (ibid.).

Given the generally great inter- and intraspecific variability in thelotremoid lichens, *Chapsa* can be considered a rather well separated group, which is also confirmed by the results of the molecular analyses (see part 3). Amongst the Australian taxa only the position of *C. platycarpa* is uncertain for the above mentioned morphological differences, however, in the single-gene molecular phylogeny presented by Frisch & al. (2006) it is well supported within *Chapsa* as a sister to *C. indica*.

Ocellularia punicea (Müll.Arg.) Mangold & Lumbsch comb. nov. ined., known from southern Queensland was recently combined to *Chapsa* (Caceres, 2007). This taxon has ascomata with absent lateral paraphyses and a distinctly carbonized proper exciple and is thus rejected from the genus.

<u>Species descriptions:</u>

Chapsa alborosella (Nyl.) A. Frisch

Bibl. Lichenol. 92: 91 (2006). Bas.: *Graphis alborosella* Nyl., Ann. Sci. Nat., Bot., sér. 4, 19: 372 (1863). *Thelotrema alborosellum* (Nyl.) Tuck., Gen. Lich.: 139 (1872). *Ocellularia alborosella* (Nyl.) Santesson, Symb. Bot. Upsal. 12(1): 308 1952). *Chroodiscus alborosellus* (Nyl.) Kalb, Lich. Neotrop. Fasc. XX (No. 456-475): 8 (1991). Type: Colombia [Nova Granata], 2000 m, 1860, *Lindig 2694* (H-Nyl.7635!-holotype; BM!-, FH-Tuck.!-isotypes).

ILLUSTRATION – Fig. 4.

Thallus predominantly hypophloedal to slightly epiphloedal, very thin, up to c. 50 µm high, pale gray to grayish-green to pale yellowish-green. Surface dull to slightly shiny, smooth to slightly pruinose, often with protuberant substrate structures, continuous, unfissured. Cortex structures absent or covered by an incontinuous, very thin protocortex up to 10 µm thick. Algal layer continuous and well developed, calcium oxalate crystals sparse and scattered. Vegetative propagules not seen. Ascomata conspicuous, (moderately) large, up to c. 1.2 mm in diam., roundish to irregular, apothecioid when young, becoming chroodiscoid at maturity, erumpent, solitary to marginally fused, often clustered in groups of two to several ascomata, sometimes regenerating, immersed. Disc entirely to partly visible from surface, pale brown to grayish, distinctly pruinose. Proper exciple not visible from surface, thalline rim split, lobed to eroded, sometimes slightly layered, inside often pruinose, whitish or with protuberant substrate, concolorous with thallus outside, slightly incurved to erect or recurved. Exciple fused, thin to evanescent, colorless internally to pale yellowish-brown or (pale) brownish marginally, apically often covered with fine grayish granules, non-amyloid. Hymenium up to c. 90 µm high, non-inspersed, strongly conglutinated, paraphyses ±straight, parallel to slightly interwoven, unbranched, slightly thickened apically, lateral paraphyses present, inconspicuous, up to c. 20 µm long. Epihymenium moderately thick, hyaline to pale grayish-brown, with grayish granules and crystals. Asci 8-spored, tholus thin, absent at maturity. Ascospores (very) small, transversely septate, cell walls (moderately) thin, ±distinctly halonate, hyaline, non-amyloid, rarely oblong to usually fusi- to claviform with roundish to (sub-)acute ends, loci predominantly angular, end cells hemispherical to conical, septae thin, regular to irregular, 10-25 x 3-6 µm with 6-9 loci. Pycnidia not seen.

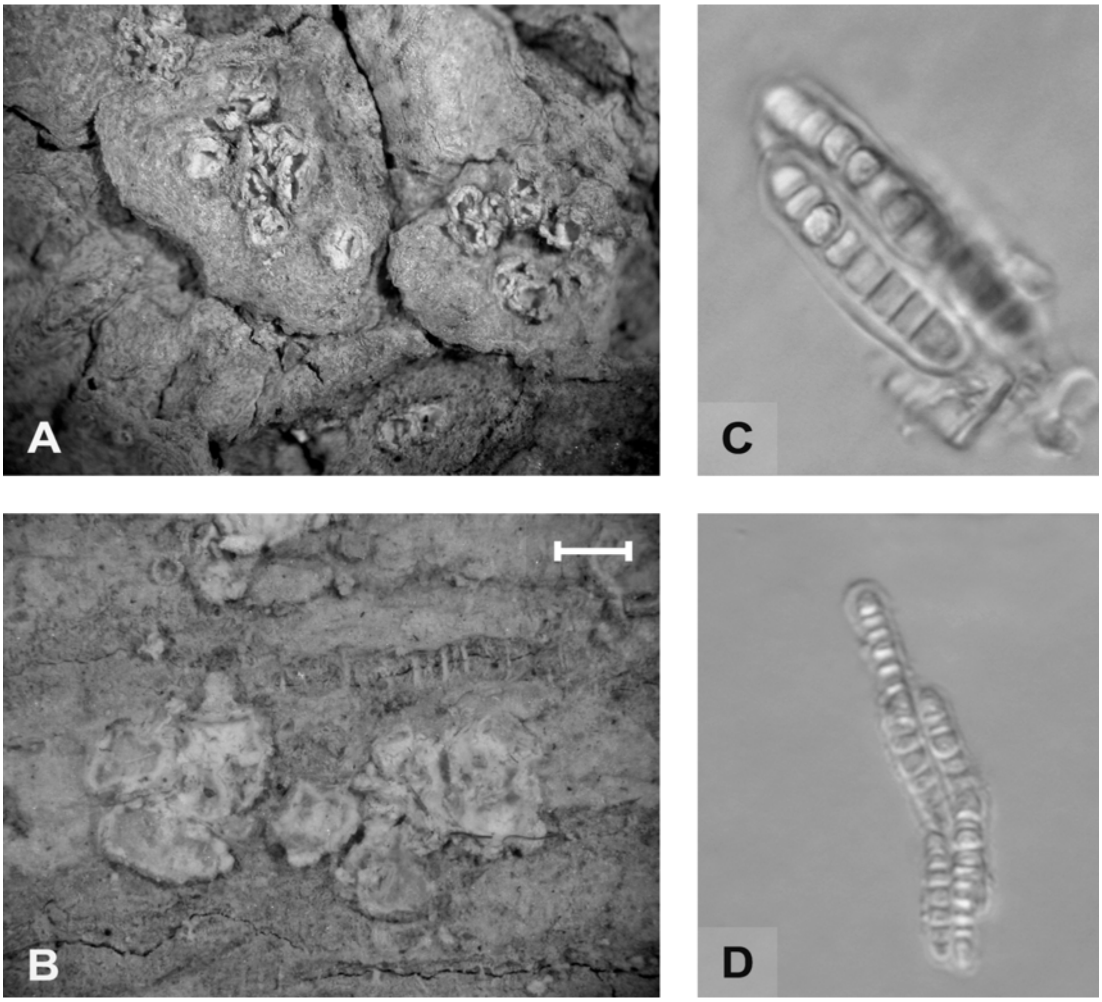

Fig. 4. *Chapsa alborosella*: growth habit (**A**), ascomata (**B**) and ascospores (**C, D**). A.: *Mangold 19 zh*; B., D.: FH-isotype; C.: *Hale 830729*. Bar= A: 1.2 mm; B: 0.8 mm; C: 10 µm; D: 15 µm.

CHEMISTRY – Thallus K-, C-, PD-; no compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Chapsa alborosella* was collected in Australia on tree bark in warm-temperate to tropical rainforests at an altitude of ca. 800 m. It is very rare in Australia, only known from two locations in Queensland and New South Wales. This is the first report for Australia, thus far it was known from the Neotropics (Hale, 1978, 1981;

Sipman, 1992), Africa (Frisch, 2006), India (Nagarkar & al., 1988), Sri Lanka (Hale, 1981) and Japan (Matsumoto, 2000), indicating that the species has a pantropical distribution and extends into subtropical regions.

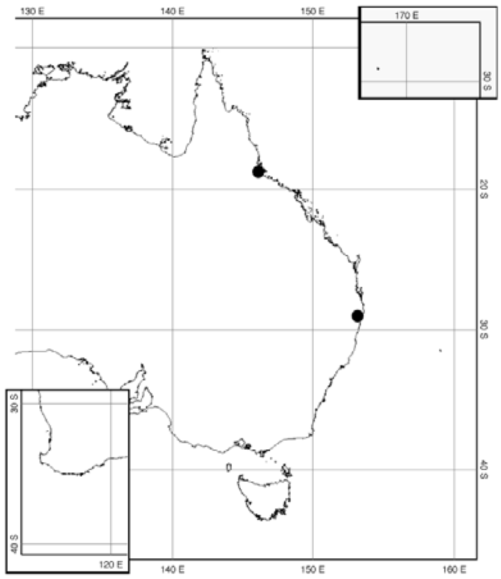

Fig. 5. Australian distribution of *C. alborosella*.

NOTES – This taxon is characterized by a thin, mostly hypophloedal, ecorticate thallus, pruinose apothecial discs and small, transversely septate, hyaline, non-amyloid ascospores with thin cell walls and the lack of secondary metabolites. Similar Australian species include *C. astroidea* and *C. lassae*, which, however, are readily distinguished by a thicker, corticate thallus and ±smaller ascospores. *Chapsa halei* also differs in having smaller ascospores (see also under this species). Another similar species is *C. diploschistoides* from Africa that differs in having a thicker, verrucose thallus less recurved ascomata margins and slightly larger ascospores (see also Frisch, 2006: 99 for a more detailed discussion).

Thelotrema platycarpellum Vain. has been considered a synonym of *C. alborosella* by Hale (1981) and a distinct species by Frisch (2006), is regarded synonymous with *C. astroidea* here (see also under this species).

SPECIMENS EXAMINED – Australia, Queensland, 18 km S of Ravenshoe on Tully Falls Rd., *Hale 830729* (US). New South Wales, Mt. Warning NP., *Mangold 19ze, 19zh* (F).

Chapsa asteliae (Kantvilas & Vezda) Mangold comb. nov. ined.

Bas.: *Chroodiscus asteliae* Kantv. & Vezda, Lichenologist 32: 328 (2000). Type: Australia, Tasmania, Mt. Curly, *Kantvilas & Jarman 38/85* (BM!-isotype).

ILLUSTRATION – Fig. 6.

Thallus foliicolous, epi- to hyposubstratic, thin to very thin, up to c. 200 µm high, pale gray to pale tannish-gray. Surface slightly shiny, smooth, continuous to slightly verrucose, unfissured. True cortex present, ±continuous, up to c. 30 µm thick, consisting of periclinal hyphae. Algal layer ±continuous, weakly developed, calcium oxalate crystals absent. Vegetative propagules not seen. Ascomata conspicuous, large, up to c. 1.5 mm in diam., roundish, apothecioid to indistinctly chroodiscoid in older stages, sessile, solitary to marginally fused, regenerating, becoming distinctly emergent, flattened-subglobose to (flattened-)urceolate. Disc usually partly visible from surface, pale brownish, becoming dark-gray with age, epruinose. Proper exciple usually not visible from surface, sometimes apically becoming somewhat visible as brownish line, thalline rim margin small to gaping, irregular to star-shaped, thalline rim becoming distinctly layered, radially split and ±lobed, concolorous with thallus or slightly darker, internally incurved to rarely slightly erect, outer layers becoming erect to more rarely recurved. Proper exciple predominantly fused, rarely apically exposed, thin, hyaline internally to pale brownish or grayish marginally, sometimes dark-brown apically, non-amyloid. Hymenium up to c. 150 µm high, non-inspersed, moderately conglutinated, paraphyses moderately thick, ±parallel, unbranched, tips moderately thick, lateral paraphyses inconspicuous, up to 30 µm long, hypothecium conspicuous and thick, hyaline, strongly gelatinous and slightly amyloid. Epihymenium thin, hyaline, in older ascomata becoming distinctly brownish, rarely with few grayish granules. Asci 4-6(8)-spored, tholus thin, not visible at maturity. Ascospores moderately small to moderately large, (sub-)muriform, cell walls and endospore moderately thick, with thin to moderately thick halo, hyaline, weakly amyloid, oblong to roundish-fusiform with roundish to narrowed-roundish ends, loci large, predominantly irregular-roundish to slightly angular, subglobose to often elongate, transverse septae distinct and thick, ±regular, 30-60 x 10-15 µm with 8-16 x 1-4 loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish-brown, C-, PD+ orange-red; containing succin-protocetraric (major), protocetraric and fumarprotocetraric acids (traces).

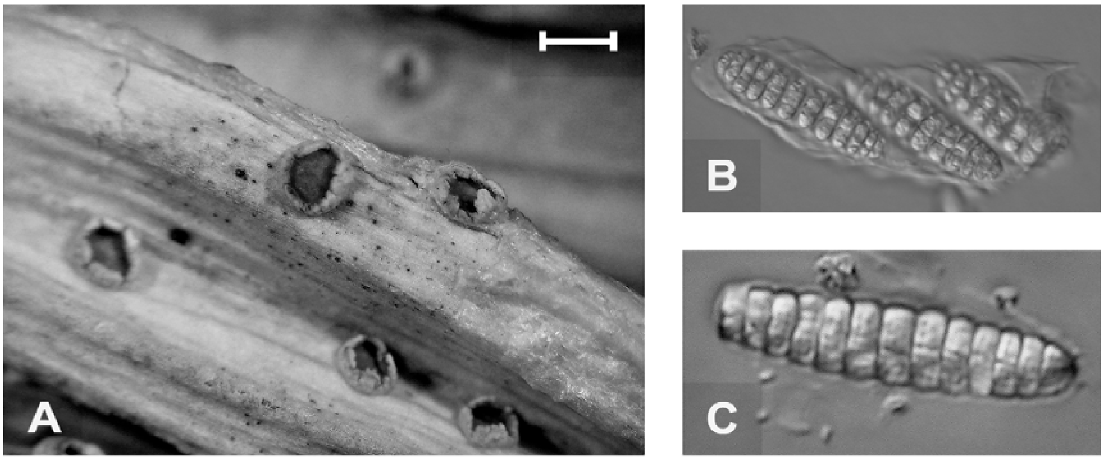

Fig. 6. *Chapsa asteliae*: ascomata (**A**) and ascospores (**B, C**). A.-C.: BM-isotype. Bar= A: 1.2 mm; B: 20 µm; C: 10 µm.

ECOLOGY AND DISTRIBUTION – *Chapsa asteliae* grows on dead leaves of *Astelia alpina* in (sub-) alpine heathlands in altitudes ranging from 900 to 1080 m. It is common in Tasmania and was previously only known from there.

NOTES – This taxon is characterized by a thin, corticate bright thallus and flattened, subglobose to urceolate ascomata with (at least in older ascomata) distinctly layered margins and an often dark disc, moderately large, hyaline, muriform, amyloid, thick-walled and halonate ascospores with only a few longitudinal septae. Further it contains the protocetraric acid chemosyndrome. *Chapsa lamellifera* is similar, for differences see under this taxon. *Chapsa asteliae* has similarities to *Topeliopsis*, it differs from that genus, however, in having a thin exciple and thickened paraphyses tips.

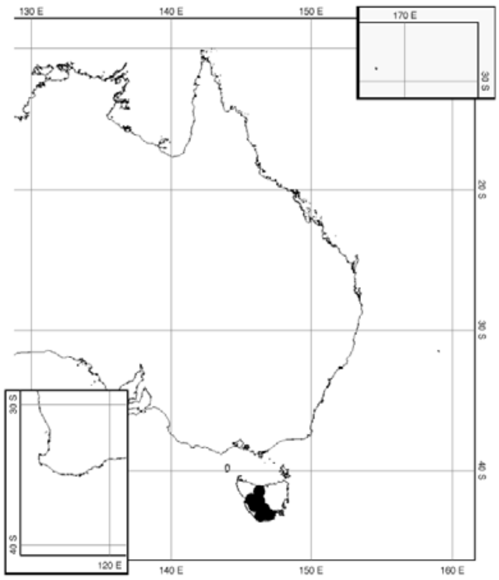

Fig. 7. Australian distribution of *C. asteliae*.

SPECIMENS EXAMINED – Australia, Tasmania, Hartz Mnt. NP., nr. Lady's Tarn, *Mayrhofer 9643* (GZU).

Chapsa astroidea (Berk. & Broome) Caceres & Lücking

In Caceres, Libri Botanici 22: 51 (2007). Bas.: *Platygrapha astroidea* Berk. & Broome, J. Linn. Soc. (Bot.) 14: 109 (1875). *Ocellularia astroidea* (Berk. & Broome) Hale, Mycotaxon 7: 377 (1978). *Thelotrema astoideum* (Berk. & Broome) Hale, Mycotaxon 11: 131 (1980). Type: Sri Lanka, *Thwaites* 629 (K!-lectotype, selected by Hale [1978: 377]).

Ocellularia alba (Fée) Müll.Arg. *var. caesiascens* Räs., Arch. Soc. Zool. Bot. Fenn. Vanamo 3: 185 (1949). Type: Australia, North Queensland, Korunda, Aug.1893, *Wilson* s.n. (H-Räs.!-holotype, NSW!-isotype).

Thelotrema platycarpellum Vain., Proc. Amer. Acad. Arts Sci. . 58: 138 (1923). *Ocellularia platycarpella* (Vain.) Zahlbr., Cat. Lich. Univ. II: 598 (1923). *Chapsa platycarpella* (Vain.) Frisch, Bibl. Lichenol. 92: 118 (2006). Type: Trinidad & Tobago – Trinidad, Arima, Verdant Vale, *Thaxter* 57 (TUR-Vain. 26791-holotype).

ILLUSTRATION – Fig. 8.

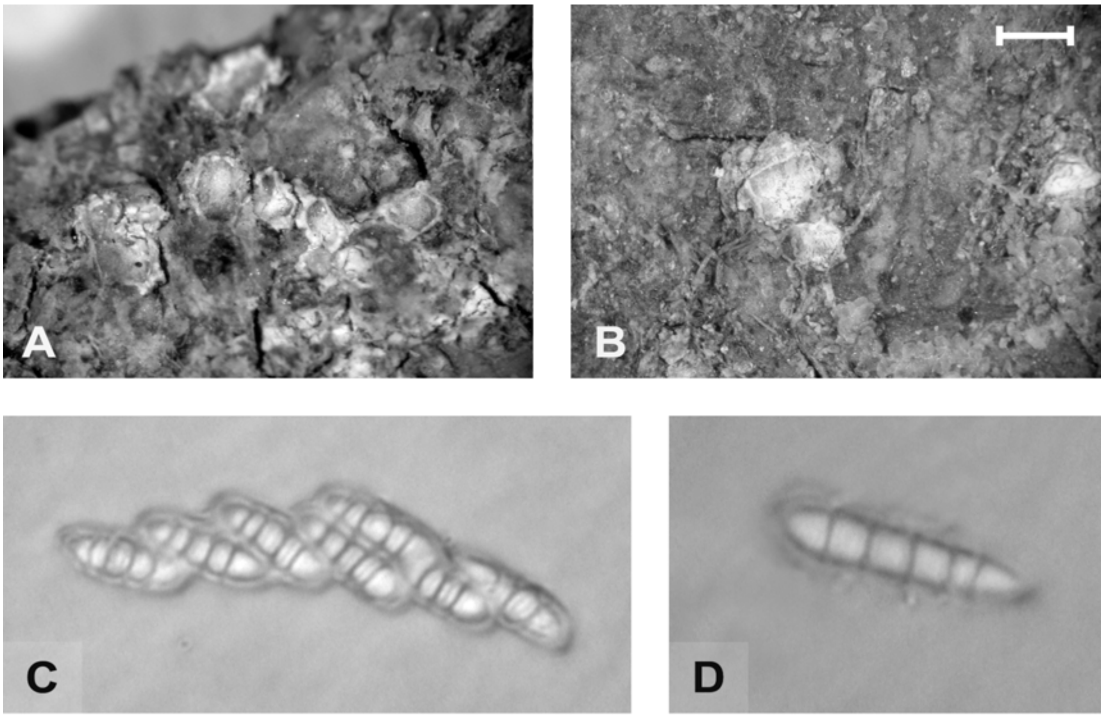

Fig. 8. *Chapsa astroidea*: ascomata (A, B) and ascospores (C, D). A., C.: H-holotype of *O. alba var. caesiascens*; B., D.: *Hale 830623*. Bar= A, B: 1 mm; C: 10 µm; D: 5 µm.

Thallus epi- to hypophloedal, thin, up to c. 200 µm high, dark olive or olive-brown to pale yellowish-brown. Surface ±waxy, smooth, continuous, unfissured. True cortex present, ±incontinuous, up to c. 30 µm thick, pale yellowish, consisting of periclinal to irregular hyphae. Algal layer continuous to incontinuous and poorly developed, calcium oxalate crystals abundant, predominantly clustered, sometimes forming layers within the medulla and the substratum. Vegetative propagules not seen. Ascomata conspicuous, large, up to c. 2.3 mm in diam., roundish to slightly irregular to distinctly irregular in fused ascomata, distinctly chroodiscoid, erumpent, solitary to fused, sometimes clustered in small groups, sometimes regenerating, immersed. Disc usually entirely visible from surface, grayish, distinctly pruinose, often glittering. Proper exciple not visible from surface, thalline rim split, distinctly lobed to more rarely slightly eroded, rarely layered, internally pruinose, whitish, concolorous with thallus outside, erect to recurved. Exciple fused, thin to evanescent, colorless internally to pale yellowish-brown marginally, apically often covered with grayish granules, non-amyloid. Hymenium up to c. 80 µm high, non-inspersed, strongly conglutinated, paraphyses

±straight, parallel to slightly interwoven, unbranched, tips not thickened to slightly thickened, lateral paraphyses present, often inconspicuous, up to c. 30 µm long, subhymenium often conspicuously dark-brown to slightly carbonized. Epihymenium (moderately) thick, hyaline, with grayish granules and often ±large calcium oxalate crystals. Asci 8-spored, tholus thin, not visible at maturity. Ascospores (very) small, transversely septate, cell walls (moderately) thin, ±distinctly halonate, hyaline, non-amyloid, fusi- to claviform, often conspicuously narrow, with (sub-)acute ends, loci predominantly angular, often ±longitudinal elongated, end cells conical, septae thin, regular, 9-20(23) x 3-5µm, with 3-7(8) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Chapsa astroidea* was collected in Australia on tree bark in tropical rainforests in altitudes ranging from 30 to 900 m. It is regionally common in Australia, occurring in northern Queensland. Outside of Australia it is known from Trinidad-Tobago, Africa (as *C. platycarpella* [Frisch, 2006]) and Sri Lanka (Hale, 1978, 1981) indicating a pantropical distribution.

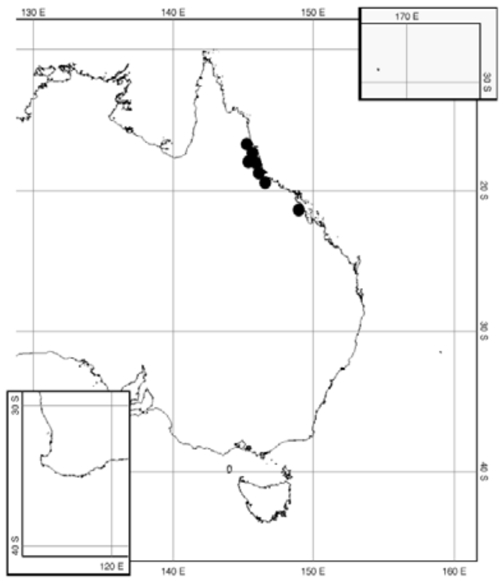

Fig. 9. Australian distribution of *C. astroidea*.

NOTES – This taxon is characterized by a corticate, dark thallus that gives a conspicuous contrast to the bright ascomata. Further it has a characteristic, usually dark subhymenial layer, small, narrow, transversely septate, hyaline, non-amyloid ascospores with thin cell walls. *Chapsa lassae* is a similar corticate species in Australia, it can be readily distinguished by the less distinctly pruinose, brownish discs, the off-white to reddish-brown, epruinose thalline margins and smaller ascospores (up to 15 µm, with up to 5 loci). Other similar Australian species include *C. alborosella* and *C. halei*, both differing by a dull, ecorticate thallus and *C. megaphlyctidioides*, which contains stictic acid. *Thelotrema platycarpella* is included as a synonym although the type material could not be studied, since the detailed description and illustrations provided by Frisch (2006) agree with the material studied here.

SPECIMENS EXAMINED – Australia, Queensland: Cape Tribulation, 3 km NE of Daintree River Crossing, *Hale 831668* (US). Atherton Tablelands: Junrum Environmental Park, nr. Kuranda, *Hale 831433* (US); Palmerston NP., 7 km E of the west boundary, *Hale 831435* (US); Mt. Hypipamee NP., S of Atherton, *Hale 831922* (US); Ellingea Falls, 10 km E of Millaa Millaa, *Lumbsch & Mangold 19144 b* (F); Off Palmerston Hwy, 11 km from main hwy and c. 2 km N of S Johnstons Forestry Camp, SE of Millaa Millaa, *Hale 832386* (US). Stallion Pocket logging area, 14 km from Gillies Hwy. and 1 km E from Mulgrave River Forestry rd., S of Gordonvale, *Hale 832388* (US). About 5 km NW of Babinda at the bridge crossing of the Russell River, *Hale 831173* (US). Francis Range, Woopen Creek Rd, NW of Innisfail, *Hale 830623, 830948, 832224* (US). 12.5 km E of Cardstone on Tully River Rd. to Kareeya Power Station, W of Tully, *Hale 830959, 831726* (US). 11.5 km on the Kirrama Forest Rd., W of Kennedy, *Hale 831341* (US). About 7.5 km E of Wallaman Falls, W of Ingham, *Hale 832387* (US). Eungella NP., Finch Hatton Gorge, *Lumbsch & Mangold 19116 n* (F). Sri Lanka, *Hale 51157* (US).

Chapsa halei Mangold spec. nov. ined.

Type: Australia, Queensland, Mt. Lewis Rd. 12km N from Kennedy Hwy., W of Mossman, *Hale 831320* (US-holotype).

ETYMOLOGY – This species is named in honor of Mason E. Hale who vastly contributed to the knowledge of Thelotremataceae and who left behind a large collection of this family from Australia.

ILLUSTRATION – Fig. 10.

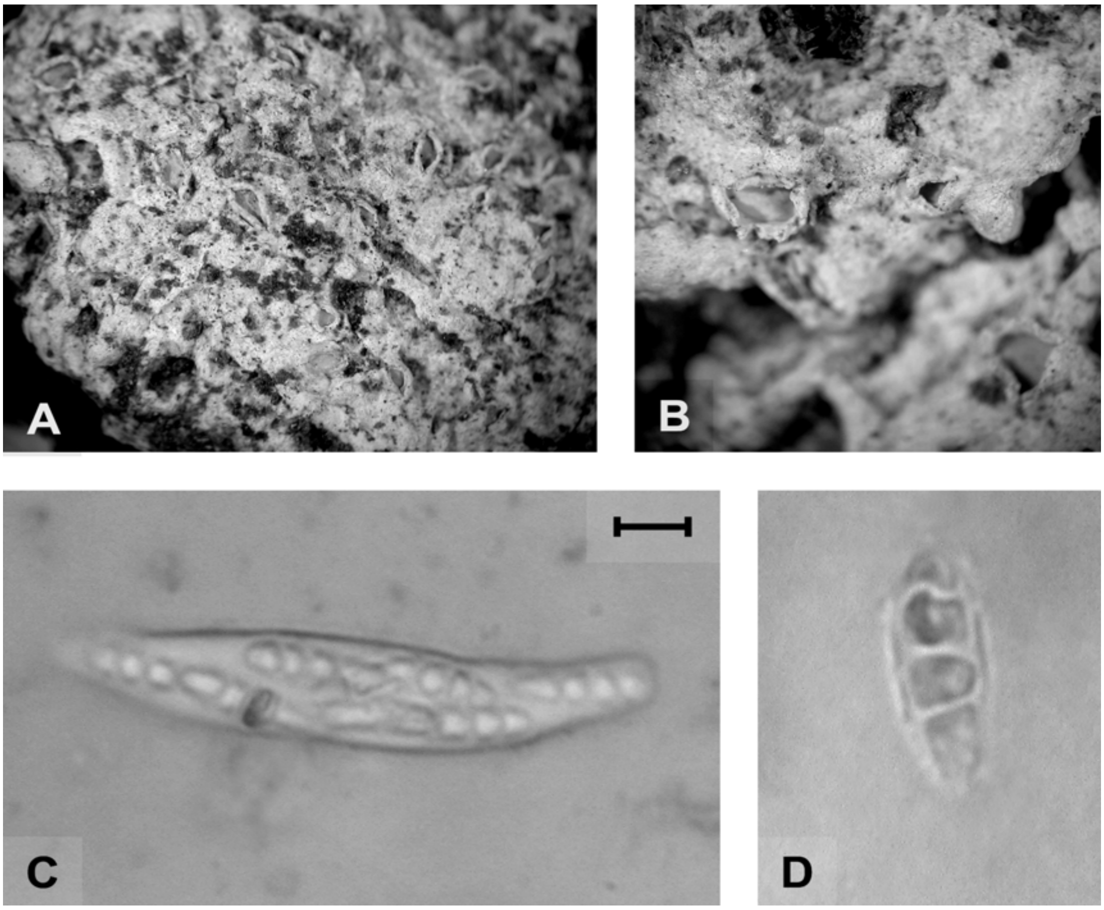

Fig. 10. *Chapsa halei*: growth habit (**A**), ascomata (**B**) and ascospores (**C, D**). A.-D.: US-holotype. Bar= A: 1 mm; B: 0.7 mm; C: 5 µm; D: 3 µm.

Thallus hypo- to epiphloedal, (moderately) thin, up to c. 150 µm high, pale gray. Surface dull, porous to roughened, continuous to rugose, predominantly unfissured. True cortex absent, thallus covered by a thin, incontinuous protocortex, up to c. 10 µm thick. Algal layer ±continuous, moderately well developed, calcium oxalate crystals abundant, usually small and scattered to more rarely clustered. Vegetative propagules not seen. Ascomata inconspicuous, large, up to c. 800 µm in diam., roundish to more often irregular to somewhat elongated, apothecioid when young, becoming chroodiscoid at maturity, erumpent, predominantly solitary, immersed. Disc partly to rarely entirely visible from surface, off-white to pale brownish, epruinose to indistinctly pruinose. Proper exciple not visible from surface, thalline rim margin irregular, coarsely split, usually with 2-4 large, thick, irregular lobes, rarely somewhat eroded, concolorous with thallus, becoming erect to recurved. Exciple fused, thin, often with substrate layers and crystals incorporated, hyaline internally to pale yellowish or yellowish-brown marginally, non-amyloid. Hymenium up to c. 70 µm high, non-inspersed, weakly conglutinated, paraphyses thick, straight, parallel, unbranched, tips not thickened to slightly thickened, lateral paraphyses present, conspicuous, up to c. 20 µm long, thick and adspersed with fine granules. Epihymenium thin to indistinct, hyaline, sometimes with fine grayish-brown granules. Asci 8-spored, tholus moderately thin, mostly not visible at maturity. Ascospores very small, transversely septate, cell walls moderately thick, non-halonate, hyaline, non-amyloid, predominantly fusi- to claviform, with roundish to subacute ends, loci roundish, subglobose to oblong to irregular, end cells cone-shaped, divided by regular, moderately thin to moderately thick septae, 10-13 x 2-3 µm with 3-6 loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Chapsa halei* was collected in Australia on tree bark in a tropical rainforest at 800 m. It is only known from the type collection in Northern Queensland.

Fig. 11. Australian distribution of *C. halei*.

NOTES – This taxon is characterized by a thin, gray thallus containing numerous crystals, simple, coarsely lobed ascoma margins, epruinose to weakly pruinose, and bright apothecial discs. Anatomical characters of the taxon include thick paraphyses and lateral paraphyses, the latter with fine granules, and small, narrow, transversely septate, hyaline, non-amyloid ascospores with moderately thickened parts. The species lacks secondary metabolites. A similar Australian species is *C. lassae*, see under this species for differences. Another similar Australian species with a thin, ecorticate thallus, lacking secondary compounds is *C. alborosella*. This species can be readily distinguished by larger ascospores (up to 25 µm long, with up to 9 loci). An additional similar taxon is *C. dissuta*[1] from Panama that differs in ascospore morphology. The ascospores in *C. dissuta* have angular loci that become fused centrally but otherwise have thick septae and endospore. This type of ascospores is reminiscent to ascospores in the *O. clandestina*-group (Frisch, 2006: 334).

SPECIMENS EXAMINED – See type collection.

Chapsa indica Massal.

Atti Reale Ist. Veneto Sci. Lett. Arti, ser. 3, 5: 257 (1860). Type: Sri Lanka, sine loco (VER-holotype).

Thelotrema pycnophragmium Nyl., Sertum lichenum tropicale Labuan et Singapore: 5 (1891). *Ocellularia pycnophragmia* (Nyl.) Zahlbr., Cat. Lich. Univ. II: 599 (1923). Type: Malaysia, Labuan, 1879, *Almquist* s.n. (H-Nyl.22679!-lectotype, selected by Frisch [2006: 100]).

[1] ***Chapsa dissuta*** (Hale) Mangold comb. nov. ined. – Bas.: *Ocellularia dissuta* Hale, Smithson. Contrib. Bot. 38: 20 (1978) – *Thelotrema dissutum* (Hale) Hale, Mycotaxon 11: 131 (1980). Type: Panama, Colon, Santa Rita Ridge, *Hale 43520* (US!-holotype).

Thelotrema albescens Vain., Boletim Soc. Broteriana, sér. 2, 6: 152 (1929). *Ocellularia albescens* (Vain.) Zahlbr., Cat. Lich. Univ. X: 211 (1939). Type: Mozambique, Palma, 1916, *A. Pires de Lima 524*, (TUR-Vain.34793-lectotype, selected by Salisbury [1971a: 273]).

ILLUSTRATION – Fig. 12.

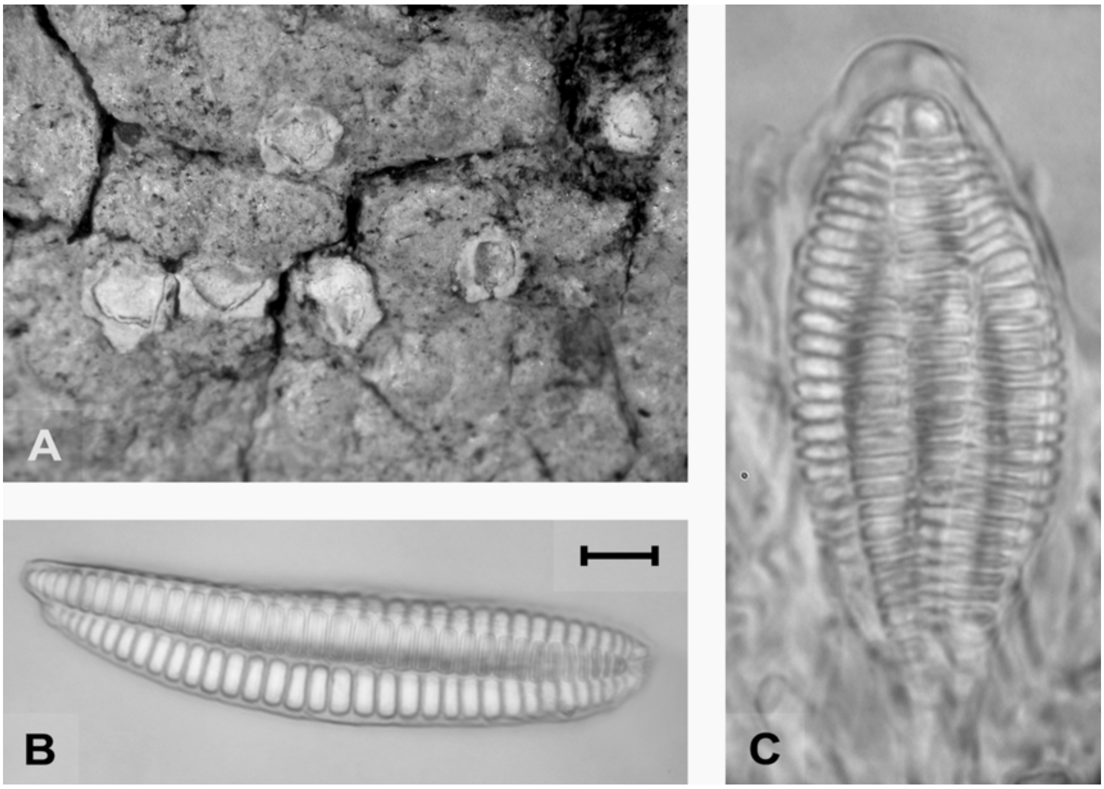

Fig. 12. *Chapsa indica*: ascomata (**A**), ascus (**C**) and ascospores (**B**). A.: *Lumbsch & Streimann 27576*; B., C.: H-lectotype. Bar= A: 1 mm; B: 12.5 µm; C: 10 µm.

Thallus predominantly hypophloedal, very thin, up to c. 50 µm high, pale gray to pale grayish-green. Surface dull to slightly shiny, smooth to roughened, often due to protuberant substrate, continuous, predominantly unfissured, sometimes appearing fissured due to substrate structure. Cortex structures absent to rarely covered by a thin, incontinuous protocortex up to c. 10 µm thick. Algal layer poorly to moderately well developed, continuous to incontinuous, calcium oxalate usually sparse, small to moderately large, scattered to more rarely clustered. Vegetative propagules not seen. Ascomata variable, conspicuous to inconspicuous, (moderately) large, up to c. 1.3 mm in diam., roundish to irregular, fused ascomata sometimes appear slightly branched, chroodiscoid at mature stages, erumpent, solitary to fused, immersed. Disc partly to entirely visible from surface, grayish, usually distinctly pruinose, sometimes glittering. Proper exciple not visible from surface to partly visible when becoming free, thalline rim split, distinctly lobed to more rarely somewhat eroded, lobes large and thick, internally ±pruinose, whitish to somewhat brownish from protuberant substrate, concolorous with thallus outside, erect to recurved. Exciple fused to partly free, thin to evanescent, colorless internally to yellowish or pale orange and often with substrate layers incorporated marginally, apically often covered with grayish granules, non-amyloid. Hymenium up to c. 150 µm high, non-inspersed, weakly conglutinated, paraphyses ±straight, parallel to slightly interwoven, unbranched, tips moderately to distinctly thickened, lateral paraphyses present, inconspicuous, up to c. 20 µm long. Epihymenium (moderately) thick, with grayish granules, sometimes with small crystals. Asci 6 to 8-spored, tholus thick, remaining thickened at maturity. Ascospores (moderately) large, transversely septate, cell walls (moderately) thick, endospore moderately thin to moderately thick, non-halonate, hyaline, non-amyloid, oblong-fusiform, with narrowed-roundish to subacute ends, loci roundish to slightly angular, rarely subglobose to lentiform towards the ends to predominantly oblong, end cells hemispherical to conical, septae (moderately) thin, regular, 50-110 x 6-12 µm with 20-35 loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Chapsa indica* was collected in Australia on the bark of an undetermined tree in a tropical rainforest in an altitude of 60 m. It is an extremely rare species in Australia, only known from north-western Northern Territory. This is the first report for Australia and the Philippines. It has been recorded from Africa, India, Sri Lanka, Andaman Islands and Malaysia (for references see Frisch, 2006) indicating a paleotropical distribution.

Fig. 13. Australian distribution of *C. indica*.

NOTES – This species is characterized by the very thin, ecorticate thallus, the whitish-pruinose ascomata, the large, transversely septate, hyaline, non-amyloid, oblong-fusiform ascospores with thickened cell-walls and the lack of lichen substances. The most similar species in Australia is *C. pulchra,* which differs by its ascospore morphology. It has smaller (up to 70 µm long, with up to 24 loci), thin-walled, predominantly cylindrical ascospores that are fragile and easily break apart.

SPECIMENS EXAMINED – Australia, Northern Territory: Curtain Falls, Litchfield Park, 38km WSW of Batchelor, *Elix, Lumbsch & Streimann 27576* (CANB). Philippines, Mindanao, Agusan, Nasipit Lumber Co., Florida logging area, c. 30 km SE of Butuan, *Hale & Banaag 25426* (US).

Chapsa lamellifera (Kantvilas & Vezda) Mangold comb. nov. ined.

Bas.: *Chroodiscus lamelliferus* Kantv. & Vezda, Lichenologist 32: 336 (2000). Type: Australia, Tasmania, Ben Ridge, *Kantvilas 105/81* (HO!-holotype; hb.Vezda-isotype).

ILLUSTRATION – Fig. 14.

Thallus epi- to hypophloedal, thin to very thin, up to c. 100 µm high, grayish-green to pale gray. Surface dull to slightly shiny, smooth, continuous, unfissured. Thallus covered by an incontinuous protocortex up to c. 20 µm thick. Algal layer ±continuous, moderately well developed, calcium oxalate crystals sparse, small, scattered. Vegetative propagules not seen. Ascomata variable throughout development, conspicuous, (very) large, up to c. 3 mm in diam., predominantly roundish, chroodiscoid at maturity, first erumpent to sessile in older stages, solitary to fused, becoming ±distinctly emergent, predominantly depressed-urceolate. Disc partly to more rarely entirely visible from surface, grayish-brown to flesh colored, indistinctly pruinose. Proper exciple not visible from surface, thalline rim characteristic, ±regularly radially split, lobed, becoming strongly layered, off-white to pale reddish-brown, inner layer(s) predominantly incurved, often gradually exfoliating, becoming erect to recurved towards the outer layers. Proper exciple fused, moderately thin to somewhat evanescent, hyaline internally to pale brownish marginally, non-amyloid. Hymenium up to c. 180 µm high, non-inspersed, strongly conglutinated, paraphyses straight to slightly bent, parallel, unbranched, tips unthickened to slightly thickened, lateral paraphyses present, predominantly inconspicuous, up to c. 25 µm long. Epihymenium thin, hyaline with grayish-brown granules. Asci 8-spored, tholus absent. Ascospores moderately small to moderately large, eumuriform, cell walls thin, with thin halo, hyaline to slightly yellowish in older ascospores, non-amyloid, oblong to (irregularly-)ellipsoid to reniform, with rounded to narrowed-rounded ends, loci small, roundish to angular, irregular, transverse septae only distinct in younger ascospores, irregular, vanishing with age, 30-60 x 10-20 µm with 12-18 x 2-5 loci. Pycnidia not seen.

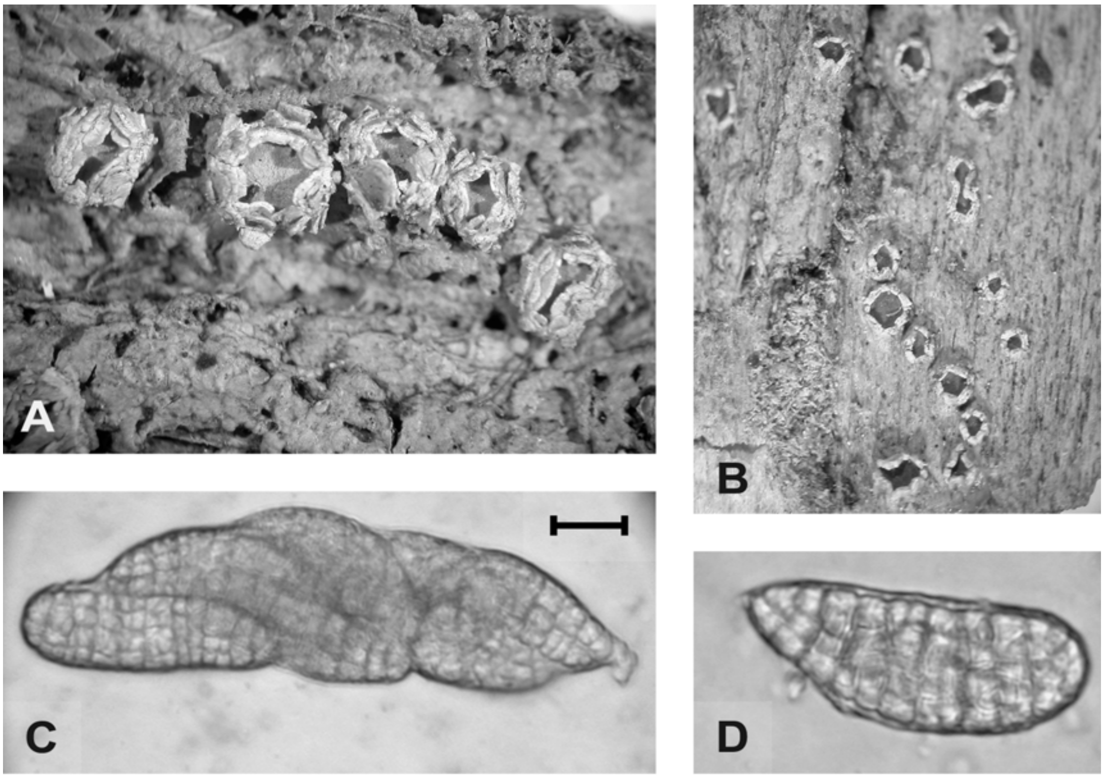

Fig. 14. *Chapsa lamellifera*: ascomata (**A, B)** and ascospores (**C, D**). A.-D.: HO-holotype. Bar= A: 1.5 mm; B: 3 mm; C: 15 µm; D: 10 µm.

CHEMISTRY – Thallus K+ yellowish, C-, PD+ reddish; containing protocetraric, fumarprotocetraric (majors to minors) and succinprotocetraric (minor) acids.

ECOLOGY AND DISTRIBUTION – *Chapsa lamellifera* was collected on the bark of trees, dead wood and more rarely on soil, debris or moss in moist, cool temperate rainforests in altitudes ranging from sea level to 900 m. It is common in Tasmania and currently only known from there and from New Zealand (Kantvilas & Vezda, 2000).

NOTES – This species can be readily identified by the large, distinctly layered ascomata, the moderately large, muriform, hyaline, thin walled, non-amyloid ascospores and the presence of the protocetraric acid chemosyndrome. A very close species is *C. asteliae*, which is also known from Tasmania. It can be distinguished by the different ecology (on *Astelia* in [sub-]alpine heathlands), smaller ascomata with grayish-pruinose discs and narrower ascospores with fewer longitudinal septae that show a faint amyloid reaction. Also similar, but readily distinguished by the transversely septate ascospores is *C. minor*, see also under this species. *Topeliopsis macrocarpa* and *T. tasmanica* could be also confused with *C. lamellifera*, but can be easily differentiated by the larger ascospores and the presence of the stictic acid chemosydrome. Vezda erroneously distributed *C. lamellifera* as an exsiccate of *C. megalophthalma* (as *Chroodiscus megalophthalmus* / Lich. Rar. Exsicc. n. 25). The latter taxon is another similar species, for differences see under this species. Many of the examined collections were sterile, however, they could be identified by their characteristic habitus and chemistry.

Fig. 15. Australian distribution of *C. lamellifera*.

SPECIMENS EXAMINED – Australia, Tasmania: King William Saddle, 14 km SW of Derwent Bridge, *Elix 26939* (CANB, B). Elliot Range, (Vezda: Lich. Rar. Exsicc. n. 25, C. megalophthalmus), *Kantvilas & Jarman* s.n., (BM, F, GZU, H, UPS). Southwest Conservation Area, along Scotts Peak Rd., 2.5 km from Gordon River Rd. turnoff, at Rainforest Nature Walk, *Wedin 3048* (UPS). Lake Pedder, SW Tasmania, *Bratt 2777* (BM). Uncertain locality: "On a stunted (Notho-)Fagus in an exposed situation alt. 2000 ft.", *Gunn 1763* (NSW).

Chapsa lassae Mangold spec. nov. ined.

Type: Australia, Queensland, Daintree NP., Mossman Gorge Section, near Rex Creek Swing Bridge, *Mangold 35 zq* (CANB-holotype, BRI-, F-isotypes).

ETYMOLOGY – This species is named after Anne Lass who was not only of great help on the second field trip to Australia, but also supported me throughout the whole project.

ILLUSTRATION – Fig. 16.

Thallus hypo- to mainly epiphloedal, in parts bulging and flaking away from the substrate, (moderately) thin, up to c. 100 µm high, pale olive. Surface shiny, smooth, continuous, unfissured. True cortex present, predominantly thin, ±continuous, consisting of irregular to more rarely periclinal hyphae, up to c. 20 µm thick. Algal layer well developed, continuous, calcium oxalate crystals lacking. Vegetative propagules not seen. Ascomata conspicuous, moderately large, up to c. 600 µm in diam., roundish to more often irregular, apothecioid to chroodiscoid in mature ascomata, erumpent, solitary to fused, often somewhat clustered, regenerating, immersed. Disc partly to rarely entirely visible from surface, grayish-brown, indistinctly pruinose. Proper exciple not visible from surface, thalline rim margin irregular, coarsely split, ±irregularly lobed, becoming distinctly layered in subsequent ascomata generations, off-white to pale reddish-brown, incurved to erect, outer layers becoming recurved. Exciple fused, (moderately) thin, with substrate layers incorporated, hyaline

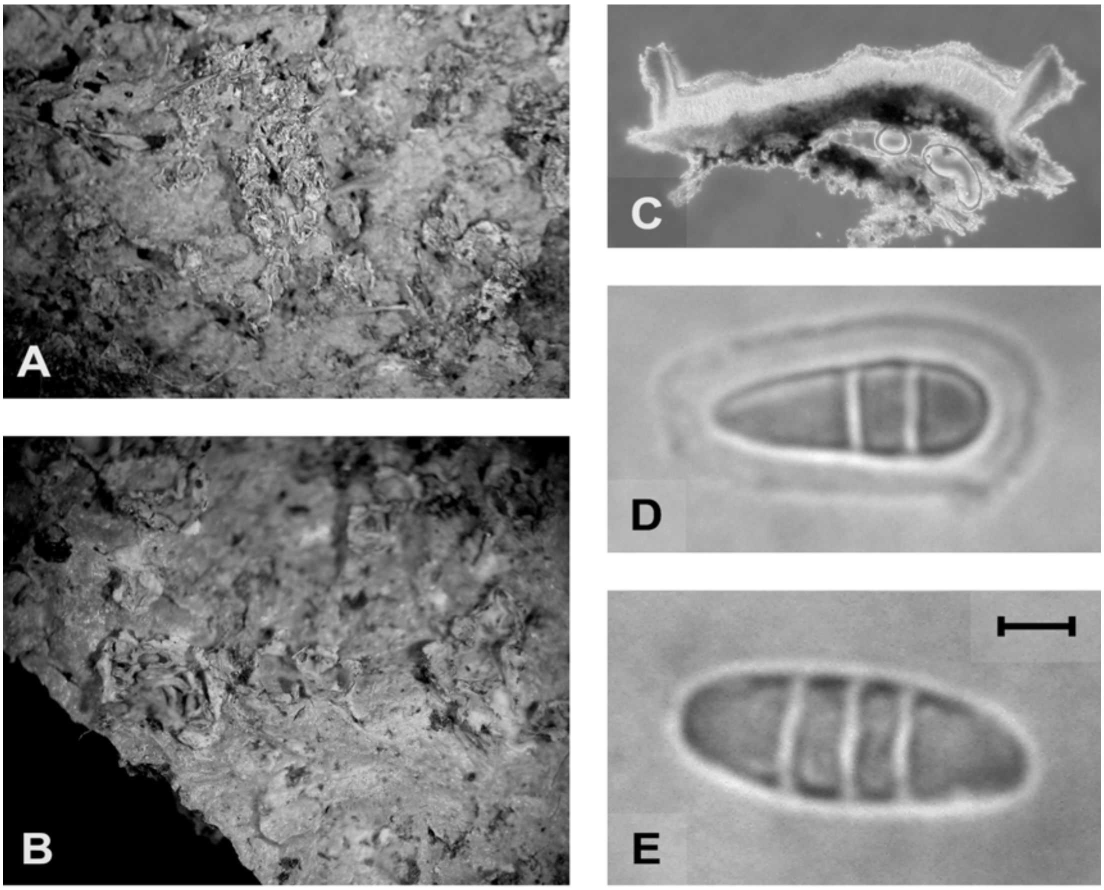

Fig. 16. *Chapsa lassae*: growth habit (**A**), ascomata (**B**), ascoma section (**C**) and ascospores (**D, E**). A.-E.: CANB-holotype. Bar= A: 1 mm; B: 0.5 mm; C: 100 µm; D, E: 3 µm.

internally to pale yellowish or yellowish-brown marginally, non-amyloid. Hymenium up to c. 80 µm high, non-inspersed, weakly conglutinated, paraphyses ±straight, moderately interwoven, unbranched, tips slightly to distinctly thickened, irregular, lateral paraphyses present, inconspicuous, up to c. 25 µm long. Epihymenium thin, hyaline, with fine grayish-brown granules. Asci 8-spored, tholus moderately thick, becoming (moderately) thin at maturity. Ascospores typical, very small, transversely septate, cell walls and endospore thin, with distinct, thick halo, hyaline, non-amyloid, predominantly fusi- to claviform, with roundish to subacute ends, loci large, angular, end cells hemispherical to conical, divided by ±regular, thin septae, 10-15 x 4-6 µm with 3-5 loci. Pycnidia not seen.

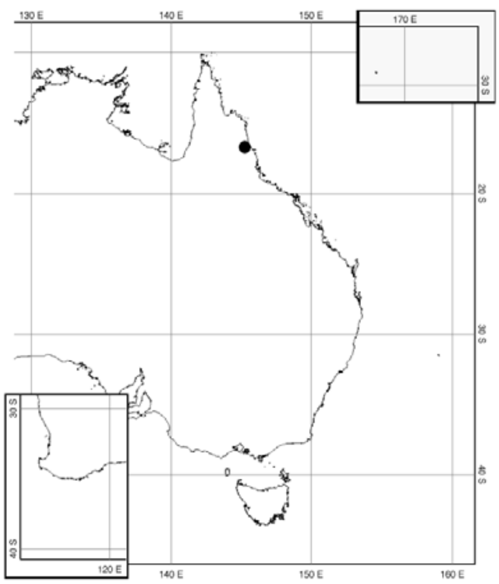

Fig. 17. Australian distribution of *C. lassae*.

CHEMISTRY – Thallus K-, C-, PD-; no compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – This species was collected on tree bark in a tropical rainforest at 100 m altitude. It is only known from the type collection in northern Queensland.

NOTES – *Chapsa lassae* is a characteristic species with a shiny, thin, but mainly epiphloedal thallus, regenerating ascomata with reddish-brown, layered margins, slightly pruinose, grayish-brown discs, and small, transversely septate, hyaline, non-amyloid ascospores with thin call walls and septae and a distinct, thick halo. Similar species in Australia include *C. alborosella*, *C. astroidea* and *C. halei*. The latter species, as well as the also similar *C. dissuta* from Panama can be distinguished be the absence of layered ascomata margins and the non-halonate ascospores with distinctly thickened parts. For differences to *C. alborosella* and *C. astroidea* see under this species.

SPECIMENS EXAMINED – See type collection.

Chapsa leprieurii (Mont.) A. Frisch

Bibl. Lich. 92: 105 (2006). Bas.: *Stictis leprieurii* Mont., Ann. Sci. Nat., Bot., sér. 4, 3: 97 (1855). *Phaeotrema leprieurii* (Mont.) Sherwood, Mycotaxon 5: 203 (1977). *Thelotrema leprieurii* (Mont.) Hale, Mycotaxon 11: 131 (1980). Type: French Guiana, Cayenne, *Leprieur 804* (PC-lectotype, selected by Hale [1981: 258]; G-isolectotype)

Thelotrema leucastrum Tuck., Proc. Amer. Acad. Arts Sci. 6: 269 (1864). *Phaeotrema leucastrum* (Tuck.) Zahlbr., Cat. Lich. Univ. II: 608 (1923). Type: Cuba, *Wright*, Lichenes Cubae 158 (FH-Tuck.-lectotype, selected by Frisch [2006: 105]; H-Nyl. 22662!-, L-, M!-isolectotypes).

Thelotrema leucastrum var. *difforme* Tuck., Proc. Amer. Acad. Arts Sci. . 6: 269 (1864). *Thelotrema difforme* (Tuck.) Vain., Ann. Acad. Sci. Fenn. A 15(6): 194 (1921a). *Phaeotrema leucastrum* var. *difforme* (Tuck.) Zahlbr., Cat. Lich. Univ. II: 608 (1923).Type: Cuba, *Wright*, Lichenes Cubae 159 (FH-Tuck.-holotype; H-Nyl. 22664-, L-, M!- isotypes).

Graphis subnivescens Nyl., Boletim. Soc. Broteriana 4: 211 (1886a); Flora 69: 174 (1886b). *Phaeotrema subnivescens* (Nyl.) Zahlbr., Cat. Lich. Univ. II: 387 (1923). Type: São Thomé, 1885, *Moller* s.n. (H-Nyl. 7507-holotype).

Graphis phlyctidea Vain., Ann. Acad. Sci. Fenn. A 15(6): 137 (1921a). *Phaeographis phlyctidea* (Vain.) Zahlbr., Cat. Lich. Univ. II: 383 (1923). Type: Philippines, Luzon, Irosin, *Elmer 14646* (TUR-Vain. 27523-holotype; FH-isotype).

Thelotrema confluens Vain., Ann. Acad. Sci. Fenn. A 15(6): 193 (1921a) nom. illegit. [non *Thelotrema confluens* Kremp.]. *Ocellularia confluentula* Zahlbr., Cat. Lich. Univ. II: 587 (1923) nom. nov. pro *Thelotrema confluens* Vain. Type: Philippines, Luzon, Irosin, *Elmer 14641* (pr. p.)/*14623* (TUR-Vain.-26908!-holotype).

ILLUSTRATION – Fig. 18.

Thallus hypo- to epiphloedal, (moderately) thin, up to c. 300 µm high, dark olive to olive-brown or pale yellowish-brown. Surface dull to wax-like, smooth, continuous to slightly verrucose, unfissured. True cortex present, ±continuous, up to c. 30 µm thick, pale yellowish, consisting of periclinal to irregular hyphae. Algal layer continuous to incontinuous and moderately well developed, calcium oxalate crystals usually abundant, mostly small and scattered, sometimes clustered. Vegetative propagules not seen. Ascomata very conspicuous, (moderately) large to rarely very large, up to c. 1.7(2) mm in diam., roundish to irregular, particularly in fused ascomata, apothecioid to chroodiscoid in older ascomata, erumpent, solitary to fused, often clustered in groups of two to several ascomata, immersed. Disc sometimes not visible to more often partly or rarely entirely visible from surface, grayish, distinctly pruinose, sometimes covered with same whitish-cottony substance as thalline rim. Proper exciple not visible from surface to more rarely becoming visible when partly detached, whitish, thalline rim (moderately) thick, indistinctly split to entire, often appearing somewhat eroded, with a ±thick whitish, cottony surface with sometimes visible tiny crystal needles, predominantly erect to recurved. Exciple fused to apically partly free, thin, colorless to pale yellowish internally to (pale) orange or brownish marginally, usually apically densely covered by grayish granules. Hymenium up to 110 µm high, non-inspersed, moderately conglutinated, paraphyses straight to slightly bent, parallel to slightly interwoven, unbranched, tips ±distinctly thickened, slightly irregular, lateral paraphyses present, conspicuous, up to 35 µm long. Epihymenium (moderately) thick, hyaline, with grayish granules. Asci 8-spored, tholus moderately thick, becoming thin or not visible at maturity. Ascospores (very) small, transversely septate, rarely with a singular longitudinal septum, cell walls and endospore (moderately) thick, non-halonate, brown, distinctly amyloid, oblong to ellipsoid to somewhat clavate with rounded to narrowed-rounded to rarely subacute ends, loci roundish, subglobular to more often lentiform or oblong, end cells hemispherical to more rarely conical, septae moderately thin to moderately thick, regular at maturity, 9-25(28) x 6-8(11) µm with 4-7(8)x(2) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no compounds detectable by TLC.

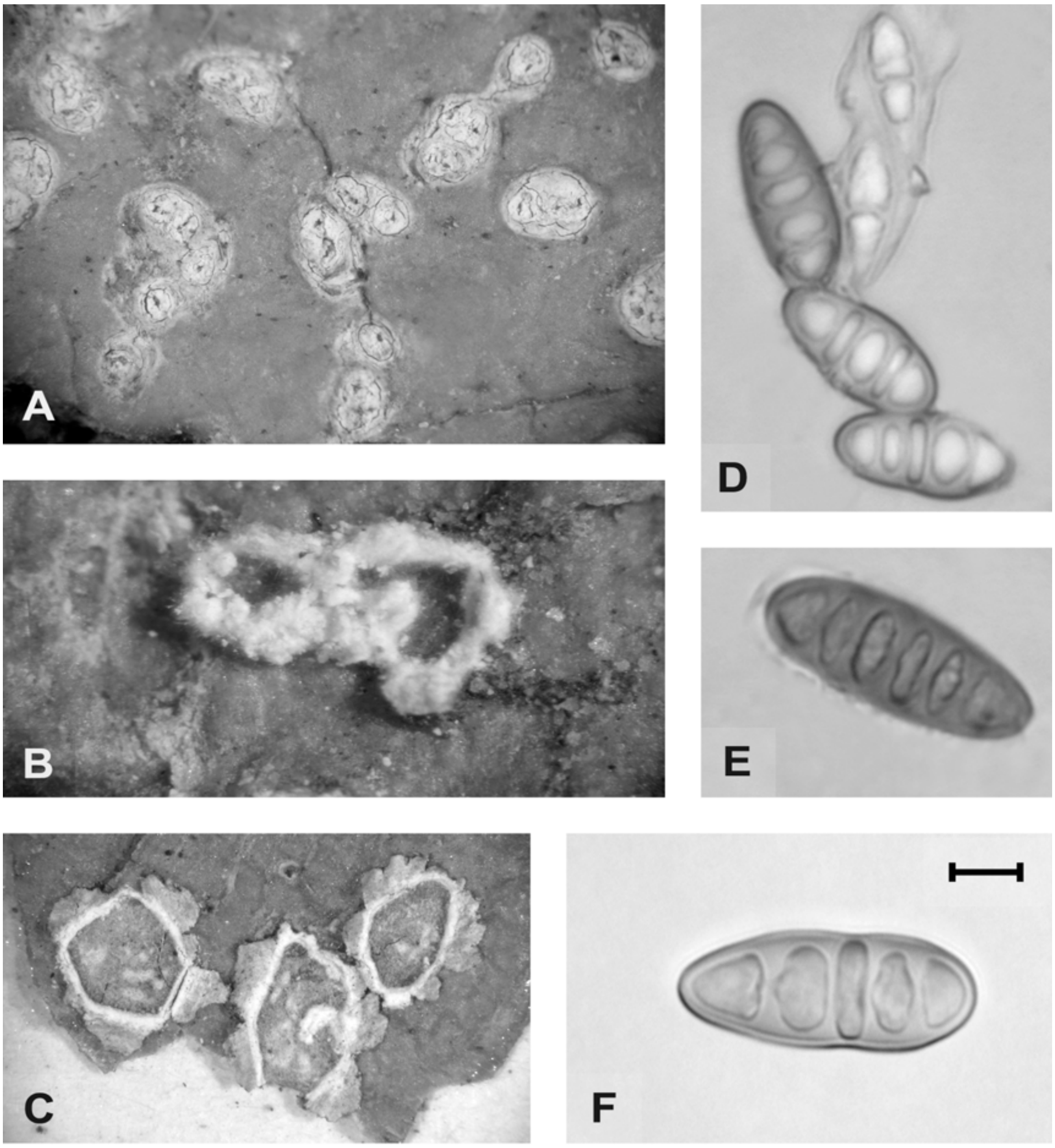

Fig. 18. *Chapsa leprieurii*: growth habit (**A**), ascomata (**B, C**) and ascospores (**D-F**). A., D.-F.: *Hale 830708*; B.: *Lumbsch & Mangold 19127 h*; C.: H-isolectotype of *T. leucastrum*. Bar= A: 1.2 mm; B: 0.5 mm; C: 0.8 mm; D: 6 µm; E: 5 µm; F: 4 µm.

ECOLOGY AND DISTRIBUTION – *Chapsa leprieurii* was collected in Australia on tree bark in tropical rainforests in altitudes ranging from 50 to 1000 m. It is regionally common in northern Queensland. This is the first report for Australia, outside of Australia it is known from the Neotropics (Hale, 1981; Frisch, 2006), Africa (Hale, 1981; Frisch, 2006), India (Awasthi, 1991), Sri Lanka Sumatra and Philippines (Hale, 1981), indicating a pantropical distribution.

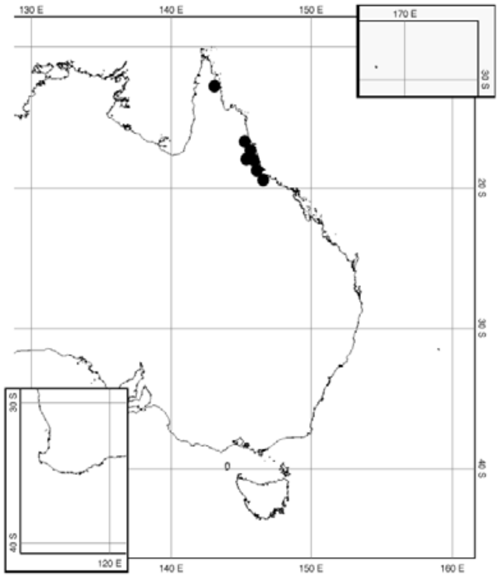

Fig. 19. Australian distribution of *C. leprieurii*.

NOTES – This species is characterized by a thin, corticate, dark thallus that gives a conspicuous contrast to the bright ascomata that have a typical cottony surface structure, at least in freshly collected material. Further it has small, transversely septate (a single longitudinal septum may rarely occur), brown, amyloid ascospores with distinctly thickened parts, and it lacks secondary compounds. In the examined specimens the size of the ascomata varied remarkably. Whereas most of the apothecia are indistinctly chroodiscoid and do not exceed 1 to 1.5 mm in diameter, a few ascomata in the type material of *T. leucastrum* show a typical chroodiscoid habitus and are up to 2 mm in diameter (see also Fig. 18., B and C). In Australia, a similar species is the stictic acid containing *C. platycarpa*, which further differs in slightly smaller (up to 20 µm long, with up to 6 loci), never distinctly amyloid ascospores and a distinctly free proper exciple. Another similar species that lacks lichen substances is *C. aggregatum*, known from Dominica and Sri Lanka. It differs by the distinctly free proper exciple, the usually apothecioid ascomata and smaller ascospores (up to 18 µm long, with up to 6 loci).

SPECIMENS EXAMINED – Australia, Queensland: Iron Range NP., 29 km from western boundary on track to Portland Rds., *Hale 830058* (US). Cape Tribulation, 2 km W of main rd. between Oil Palms and Coopers Creek, N of Daintree, *Hale 832163* (US). Thornton Range, CREB rd. (to Cooktown), about 5 km in from Daintree River crossing, NW of Mossman, *Hale 831398* (US). 15 km along Mulgrave River Rd. from intersection with the Gordonvale Rd., SW of Gordonvale, *Hale 830725, 830683, 830686* (US). Stallion Pocket logging area, 14 km from Gillies Hwy and 1 km E from Mulgrave River Forestry rd., S of Gordonvale, *Hale 832752, 832706* (US). Atherton Tablelands: Crystal Cascades, *Lumbsch & Mangold 19117p* (F); Lake Tinaroo, *Lumbsch & Mangold 19127h, Mangold 38i* (F). The Boulders, NW of Babinda, S of Cairns, *Hale 831350* (US). Bellenden Ker NP., Boulders area, 6 km W of Babinda, 50 km S of Cairns, *A. & M. Aptroot 22412* (ABL). Francis Range, Woopen Creek Rd., 25 km in from Bruce Hwy., NW of Innisfail, *Hale 832156, 832384, 832793* (US). Mt. Chalmynia logging area, 15 km from Bruce Hwy., W of Innisfail, *Hale 832071, 832367, 832385* (US). Josephine Falls, W of Bartle Frere and Bruce Hwy., S of Innisfail, *Hale 830706* (US). Mt. Spec NP., Ridge on the Loop, on the Paluma Rd., WNW of Townsville, *Hale 830708* (US).

Chapsa leprocarpa (Nyl.) A. Frisch

Bibl. Lich. 92: 108 (2006). Bas.: *Graphis leprocarpa* Nyl., Acta Soc. Sci. Fenn. 7: 472 (1863a). *Thelotrema leprocarpum* (Nyl.) Tuck., Genera lichenum: 139 (1872). *Graphina leprocarpa* (Nyl.) Zahlbr., Cat. Lich. Univ. II: 412 (1923). Type: U.S.A., Louisiana, 1853, *Hale 111* (FH-Tuck.-holotype; H-Nyl. 6839!-isotype).

Thelotrema colobicum Nyl., Bull. Soc. Linn. Normandie, sér. 2, 7: 169 (1874 ['1873']). Type: Andaman Islands, 1867, *Kurz 43* (M-holotype; H-Nyl.22493!-isotype).

ILLUSTRATION – Fig. 20.

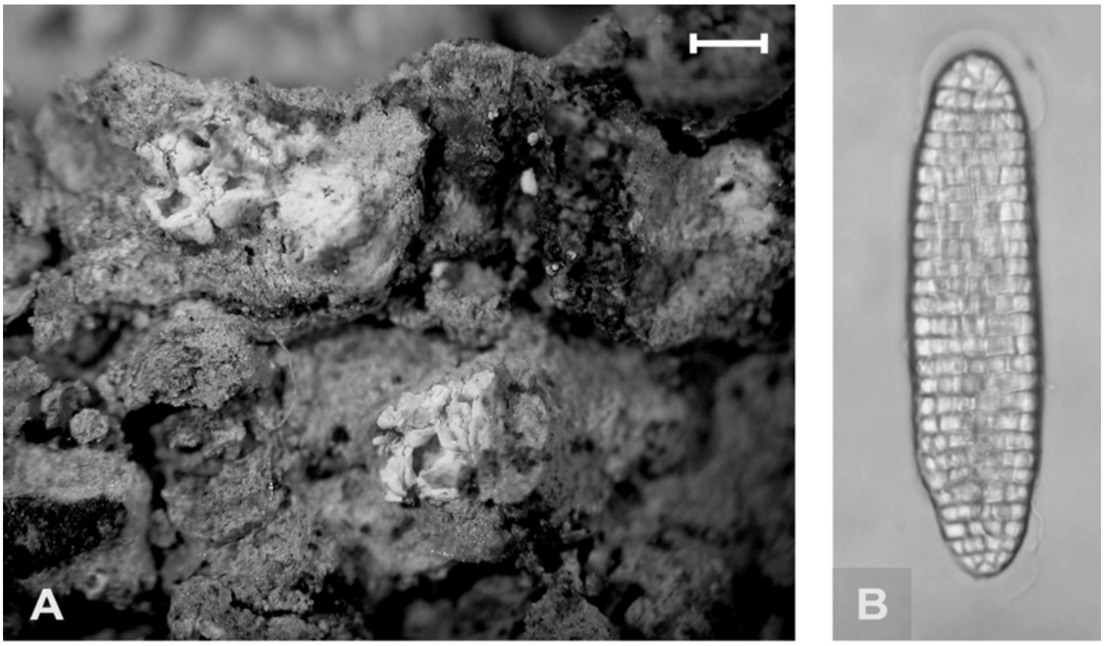

Fig. 20. *Chapsa leprocarpa*: growth habit (**A**) and ascospore (**B**). A., B.: *Mangold 37 h*. Bar= A: 0.75 mm; B: 17 µm.

Thallus predominantly hypophloedal, very thin to thin, up to c. 70 µm high, pale gray to pale grayish-green, on dark substrate accordingly darker. Surface dull, rough to somewhat pruinose, often with protuberant substrate structure, continuous, unfissured. Cortex structures absent. Algal layer poorly developed, predominantly incontinuous, calcium oxalate crystals lacking to moderately abundant, usually small, clustered or scattered. Vegetative propagules not seen. Ascomata conspicuous, (moderately) large, up to c. 1.7 mm in diam., but more often not larger than c. 700 µm in diam., roundish to slightly irregular, particularly in fused ascomata, apothecioid to chroodiscoid in older ascomata, erumpent, solitary to fused, sometimes regenerating, immersed. Disc partly to entirely visible from surface, grayish, usually distinctly pruinose. Proper exciple not visible from surface to visible when becoming partly detached, whitish, thalline rim margin irregular, usually coarsely split with large lobes, sometimes eroded, slightly to more rarely distinctly layered, whitish-pruinose internally, concolorous with thallus marginally, becoming erect to ±recurved. Proper exciple thin to somewhat evanescent, hyaline internally to pale yellowish to pale orange marginally, usually with substrate layers incorporated, apical parts covered by grayish granules, slightly to distinctly amyloid at the base. Hymenium up to c. 140 µm high, non-inspersed, weakly conglutinated, paraphyses straight to slightly bent, parallel to slightly interwoven, unbranched, tips distinctly thickened, lateral paraphyses present, conspicuous, up to c. 30 µm long, adspersed with fine granules. Epihymenium predominantly thick, hyaline, with coarse grayish-brown granules. Asci 1- to more rarely 2-spored, tholus thin, not visible at maturity. Ascospores (moderately) large, densely eumuriform, cell walls and endospore thin, with a thin and indistinct to a thick, distinct halo, then strongly thickened at the ascospore ends, hyaline, non-amyloid, oblong to slightly fusiform, with roundish to narrowed-roundish ends, loci small, angular to slightly roundish, transverse septae distinct, thin, regular, 60-130 x 20-40 µm µm with multiple loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Chapsa leprocarpa* was collected in Australia from tree bark in (sub)tropical rainforests in altitudes ranging from sea level to 1100 m. It is a common species, occurring in northern Queensland and in the wider Queensland/ New South Wales border region. This is the first report for Australia, otherwise it is known from the Neotropics (Frisch, 2006; Tuckerman, 1872), Africa (Frisch, 2006), India (Patwardhan & Nagarkar, 1980), Sri Lanka (Hale, 1981) and Borneo (Sipman, 1993) indicating a pan(sub)tropical distribution.

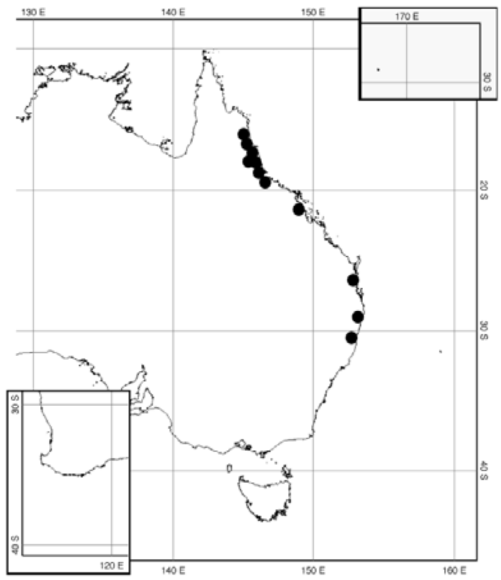

Fig. 21. Australian distribution of *C. leprocarpa*.

NOTES – This taxon is characterized by a thin, ecorticate thallus, often indistinctly chroodiscoid ascomata with a whitish-pruinose surface, conspicuous lateral paraphyses with fine granules, large, densely eumuriform, hyaline, non-amyloid ascospores with thin cell walls that occur singular ore rarely by two per ascus and the lack of lichen substances. In Australia, *C. niveocarpa* is a similar species see under this species for differences. On the world level, there are two species that can be confused with *C. leprocarpa*, the very similar *C. patens* that can be distinguished by larger ascospores (up to 160 µm long), and *C. grossomarginata*[2] that has smaller ascospores (up to 80 µm long) with less numerous, larger loci, and lateral paraphyses without granular structures.

SPECIMENS EXAMINED – Australia, Queensland: Big Tableland, 26 km S of Cooktown, *Streimann 30901* (CBG). 14 km SW of Mossman, Mt. Lewis, *Tibell 14598* (UPS). Near end of Black Mountain Rd., 33 km WNW of Kuranda, *Hale 832079* (US). Fresh Water Gorge, outside of Cairns, *Hale 832487* (US). Rd. from Gordonvale to Yarrabah, c. 10 km E of Cairns, *Lumbsch & Guderley 11158 u* (F). Atherton Tablelands: Danbulla Forest Drive, 4 km E of Tinaroo, *Hale 831212* (US); Lake Tinaroo, Downfall Creek Camping Area, *Lumbsch & Mangold 19125 k* (F); Bunbulla Forest Drive, near Lake Euramoo, *Mangold 37 h* (F); Lake Eacham NP., *Mangold 29 c, be* (F); 20 km SE of Yungburra, 1 km NW of Bonjes, *Tibell 15343* (UPS); Area below crater, Mt. Hypipamee NP., S of Atherton, *Hale 831924* (US); Malanda Falls, just N of Malanda, *Lumbsch & Mangold 19132 m* (F); SW of K-1 tree rd. off Palmerston Hwy., 11 km from main hwy. and 2 km N of S. Johnstone Forestry Camp, SE of Millaa Millaa, *Hale 832182* (US); Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Lumbsch & Mangold 19133 u, 19136 g, 19151 q, Mangold 30 zi, zm* (F); Just S of hwy., 13 km E of jct. Kennedy Hwy. and Palmerston Hwy., E of Ravenshoe, *Hale 831420,* 832131 (US). State Forest area on Tully Rd., 1 km from jct. with S. Mission Beach Rd., S of Mission Beach, *Hale 831540* (US). Mt. Spec NP., Ridge on the Loop, on the Paluma Rd., WNW of Townsville, *Hale 831856, 832322, 832390* (US). Eungella NP.: NP. side rd. near Pease's Lookout, off Darymple Rd., *Hale 831413* (US); Finch Hatton Gorge, *Lumbsch & Mangold 19113 u* (F); Trail at Broken River Picnic Area, *Hale 831679* (US). Noosa NP.: Palm Grove Track, *Hale 831452* (US); c.1 km from the sea near rd. to the Lookout, *Thor 4902/II* (S). Noosa Heads, *K. & A. Kalb 34277* (hb. Kalb). Wooroi State Forest Park, W of Teewantin, *Hale 832756* (US). Sunshine Coast Hinterland, Kenilworth SF., *Lumbsch & Mangold 19085 e* (F). New South Wales: Nightcap Forest Drive: Gibbergunyah Roadside Reserve, Whian Whian SF., W of Mullumbimby, *Hale 831505* (US); 1 km W of Minyon Falls, N of Lismore, *Hale 832215* (US). Tweed Range, Mebbin NP., *Mangold 21 f, i* (F). Dorrigo NP., Sassafras Creek Track, *Mangold 25 d, p* (F).

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[2] ***Chapsa grossomarginata*** (Matsum.) Mangold comb. nov. ined. Bas.: *Thelotrema grossomarginatum* Matsum., J. Hattori Bot. Lab. 88: 20 (2000). Type: Japan, Honshu, *Matsumoto 2492* (HIRO!-holotype).

Chapsa lordhowensis Mangold spec. nov. ined.

Type: Australia, New South Wales, Lord Howe Island, Goat House Cave, *Elix 42259* (CANB-holotype).

ETYMOLOGY – The epithet refers to the type location Lord Howe Island.

ILLUSTRATION – Fig. 22.

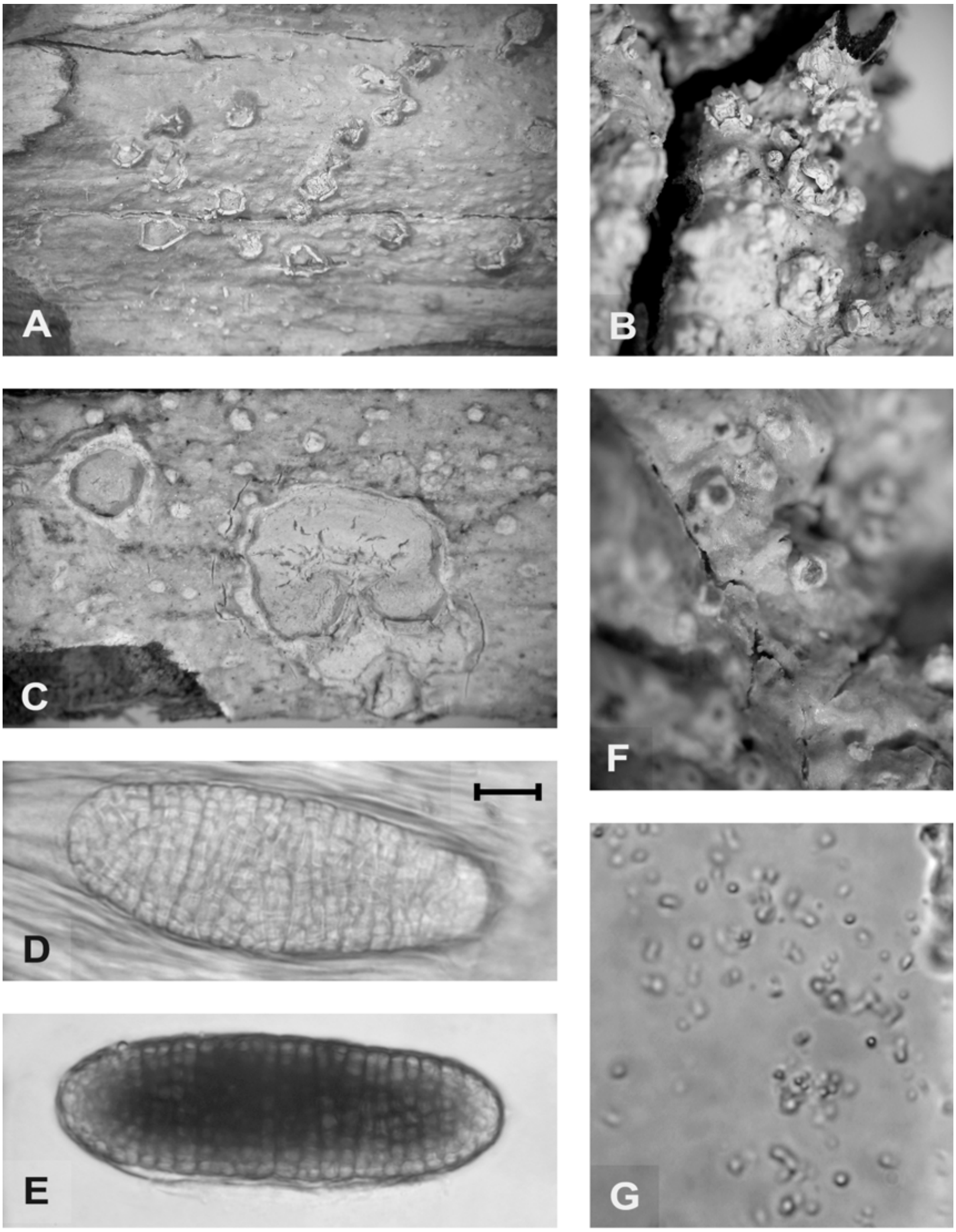

Fig. 22. *Chapsa lordhowensis*: growth habit (**A**), ascomata (**B, C**), ascospore (**D**), ascospore with amyloid reaction (**E**), pycnidia (**F**) and conidia (**G**). A., D., E.: *Elix 42267*; B., F., G.: CANB-holotype; C.: *Elix 42259*. Bar= A: 2.5 mm; B: 2 mm; C: 1 mm; D: 12.5 µm; E: 14 µm; F: 300 µm; G: 5 µm.

Thallus predominantly epiphloedal, moderately thick, up to c. 300 µm high, rarely pale yellowish-brown to usually pale olive. Surface ±shiny, smooth, continuous, unfissured. True cortex present, thick, continuous, up to c. 50 µm thick, hyaline to slightly yellowish, consisting of periclinal to irregular hyphae. Algal layer continuous and well developed, calcium oxalate crystals sparse, sometimes clusters of small crystals are found in lower thallus. Vegetative propagules not seen. Ascomata variable, conspicuous, moderately large to very large, up to c. 3 mm in diam., roundish to more rarely somewhat irregular, sometimes appearing slightly branched in fused ascomata, apo- to chroodiscoid, erumpent, solitary to rarely fused, typically regenerating, ±emergent, hemispherical to urceolate in younger ascomata, depressed-urceolate to cupular in older stages. Disc variable, partly to entirely visible from surface, pale to distinctly flesh-colored, epruinose to slightly pruinose, in deceasing ascomata disc becoming overgrown by a off-white to pale yellowish-brown layer. True exciple not visible from surface, thalline rim margin variable throughout ontogeny, in newly developing ascomata split to rugged or lobed, ±concolorous with thallus or brighter, becoming erect to more rarely recurved, in subsequent ascomata generations, margin developing out of layer covering the disc, splitting and opening irregularly, breaking away in large parts, marginally parts finally forming the new thalline rim, becoming erect to rarely recurved, layered with age, off-white to pale yellowish-brown. Exciple fused, moderately thick, hyaline internally to pale yellowish or yellowish-orange marginally, usually exciple extending into a distinct hyaline internal exciple moderately to strongly amyloid. Hymenium up to c. 180 µm high, non-inspersed, moderately conglutinated, paraphyses slightly bent, parallel, unbranched, tips predominantly unthickened, lateral paraphyses present, inconspicuous, up to c. 25 µm long. Epihymenium thick, hyaline to pale yellowish, with grayish- to yellowish-brown granules. Asci 1- to rarely 2-spored, tholus moderately thick, not visible at maturity. Ascospores (moderately) large, densely eumuriform, cell walls (moderately) thin, endospore thin, non-halonate, hyaline, distinctly amyloid, oblong to ellipsoid with rounded to narrowed-rounded ends, loci roundish to angular, predominantly irregular, distinctly transversely divided only in younger stages, in older stages septae becoming irregular and finally vanish, 65-120 x 22-35 µm with multiple loci. Pycnidia present, conspicuous, variable, predominantly in strongly raised verrucae with unconstricted to strongly constricted to somewhat stalked base and usually with bright tip becoming blackish when mature, Conidia small, irregular-roundish to irregular-oblong, up to c. 2 x 1 µm in size.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing stictic, constictic (majors), α-acetyloconstictic, cryptostictic, α-acetylhypoconstictic (minors), hypoconstictic and hypostictic (traces) acids.

ECOLOGY AND DISTRIBUTION – *Chapsa lordhowensis* was collected in Australia on tree bark in subtropical rainforests in mid-range altitudes of 380-420 m. It is only known from the type-collection on Lord Howe Island and from north of Sydney in continental New South Wales.

NOTES – The taxon is characterized by a shiny, distinctly corticate thallus, regenerating ascomata with rugged, layered margins, flesh-colored discs that become covered by a bright layer, large,

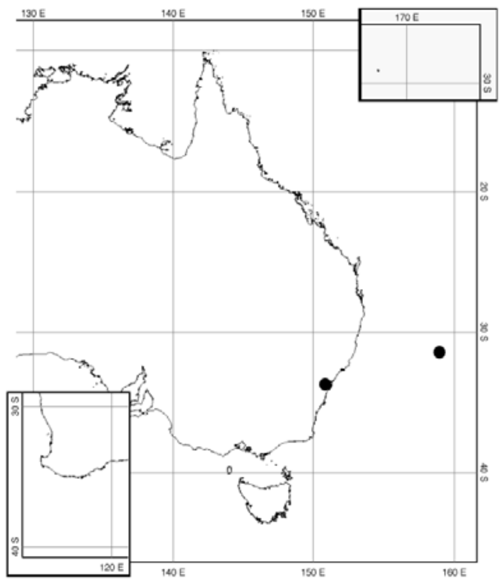

Fig. 23. Australian distribution of *C. lordhowensis*.

hyaline, densely eumuriform, thin-walled, amyloid ascospores that occur mostly singular per ascus and the stictic acid chemosydrome. *Chapsa megalophthalma* is a similar, stictic acid containing species which can be readily distinguished by 8-spored asci, smaller ascospores (up to 45 µm long), and more distinctly *Geaster*-like ascomata with a less distinctly layered margin. *Chapsa lamellifera* is another similar species that also differs in 8-spored asci with smaller, non-amyloid ascospores (up to 55 µm long) and a different chemistry (protocetraric acid). This is the first report of pycnidia in *Chapsa*, the conidia resemble the type found in *Thelotrema*, *Acanthotrema* and *Leucodecton*.

SPECIMENS EXAMINED – Australia, New South Wales: Benowie Walking Track (NNW of Sydney), *Archer 418415* (NSW). Lord Howe Island, Track to Goat House Cave, *Elix 42267* (B), *42144, 42146, 42259, 42267* pr.p. (CANB).

Chapsa megalophthalma (Müll. Arg.) Mangold comb. nov. ined.

Bas.: *Thelotrema megalophthalmum* Müll. Arg., Flora 65: 500 (1882). *Chroodiscus megalophthalmus* (Müll. Arg.) Vezda & Kantv. in Vezda, Lich. Rar. Crit. Exsicc. 3: 2 (1992). Type: Australia, Queensland, Toowoomba, *Hartmann* s.n. (BM!-lectotype, selected by Hale [1972, in herb.]).

Thelotrema leucophthalmum Nyl. var. *lacerata* Räs., Suom. Elain-ja Kasvit. Seuran Van. Tiedon. Pöytäkirjat 3: 184 (1949). Type: Australia, New South Wales, Katoomba, 1889, *Wilson* s.n. (H!-holotype).

ILLUSTRATION – Fig. 24.

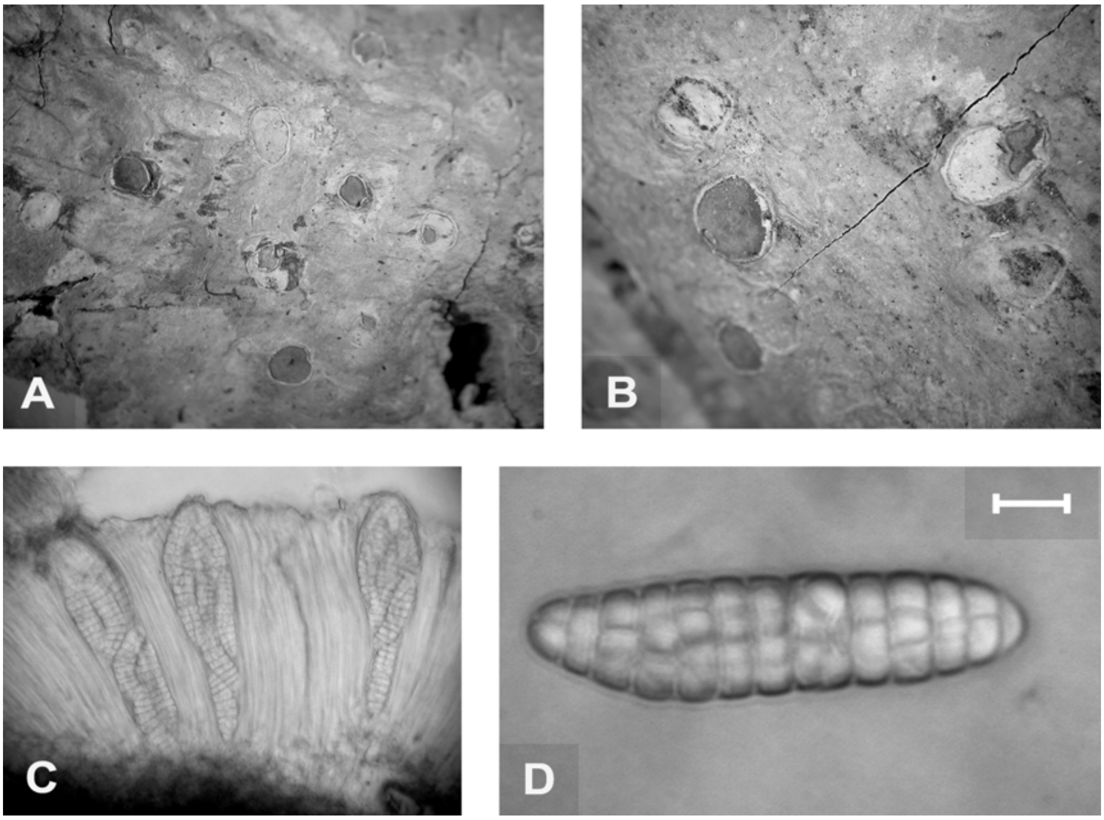

Fig. 24. *Chapsa megalophthalma*: growth habit (**A**), ascomata (**B**), hymenium and asci (**C**) and ascospore (**D**). A.-D.: *Mangold 19 zb*. Bar= A: 2.5 mm; B: 1.5 mm; C: 50 µm; D: 6 µm.

Thallus corticolous to rarely saxicolous, predominantly episubstratic, moderately thick, up to c. 200 µm high, rarely pale gray to usually pale grayish-green or (pale) olive. Surface rarely dull to ±shiny, smooth, continuous to moderately verrucose or verruculose, unfissured. Thallus covered by an incontinuous to continuous protocortex, sometimes becoming somewhat conglutinated forming a true cortex of irregular to more rarely periclinal hyphae, up to c. 30 µm thick. Algal layer continuous and well developed, calcium oxalate crystals lacking. Vegetative propagules not seen. Ascomata conspicuous, (very) large, up to c. 3 mm in diam., round to slightly irregular, sometimes appearing slightly branched in fused ascomata, chroodiscoid, erumpent, solitary to fused, regenerating, immersed. Disc partly to more often entirely visible from surface, variable, dark grayish-brown to brownish to pale or distinctly flesh-colored, epruinose to slightly pruinose, in deceasing ascomata disc becoming overgrown by a off-white to pale yellowish-brown covering tissue. True exciple superficially not distinguishable, thalline rim margin structure variable throughout ontogeny, in newly developing ascomata split, rugged to lobed, ±concolorous with thallus or brighter, becoming erect to recurved, in subsequent ascomata generations, margin developing out of a tissue covering the disc, the tissue splitting and opening irregularly, breaking away in large parts, marginal parts finally forming the new thalline rim, off-white to pale yellowish-brown, becoming erect to recurved, layered with age (non-regenerating, deceased ascomata sometimes also becoming entirely covered by thallus, with remnants of the margin often remaining visible). Exciple fused, thin, hyaline internally to pale yellowish or yellowish-orange marginally, usually lower exciple extending into a distinct hyaline, moderately to strongly amyloid lateral hypothecium. Hymenium up to c. 180 µm high, non-inspersed, moderately conglutinated, paraphyses ±straight, ±parallel, unbranched, tips unthickened to slightly thickened, lateral paraphyses present, inconspicuous, up to c. 20 µm long. Epihymenium moderately thin, (pale) brownish, with yellowish-brown to brownish granules. Asci 8-spored, tholus thin, not visible at maturity. Ascospores moderately small, eumuriform, cell walls (moderately) thin, endospore very thin, non-halonate, hyaline, non-amyloid, oblong to ellipsoid to reniform with rounded to more rarely narrowed-rounded ends, loci large, roundish to angular, ±rectangular to irregular, transverse septae thin, regular, 25-45(50) x 8-12 µm with 8-13(15) x 1-6 loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing stictic (major), constictic (major to minor), α-acetylhypoconstictic, cryptostictic, α-acetylconstictic, hyposalazinic and hypostictic (traces) acids.

ECOLOGY AND DISTRIBUTION – *Chapsa megalophthalma* was collected in Australia on tree bark and on rocks in shaded habitats in temperate rainforests and more rarely wet sclerophyll forests in predominantly higher altitudes ranging from 400 to 1250 m. It is a moderately common species occurring throughout New South Wales (except the type collection from Queensland near the New South Wales border). Besides Australia it was so far only reported from New Zealand (Kantvilas & Vezda, 2000).

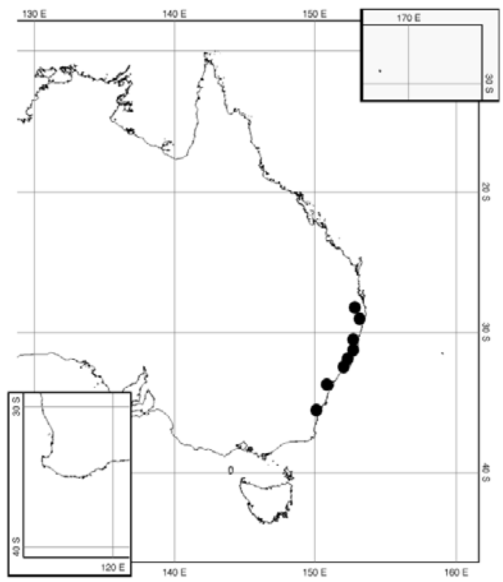

Fig. 25. Australian distribution of *C. megalophthalma*.

NOTES – The species is quite unique by having a smooth, often distinctly green thallus, large, regenerating ascomata with bright, off-white rimmed, flesh-colored discs. Two similar, Australian species are *C. lamellifera* and *C. lordhowensis*. Both species can be distinguished by a stronger layered ascoma margin and larger ascospores (up to 120 µm long in *C. lordhowensis* / up to 60 µm long in *C. lamellifera*). *Chapsa lamellifera* also differs in containing the protocetraric acid chemosyndrome. One collection from Cairns (Trinity Bay) made by Sayer in 1886 (MEL-26236), determined as *T. magalophthalmum* is sterile and could not be verified. It contains the stictic acid chemosyndrome. However, its identification is doubtful since it has large calcium oxalate crystals and strongly thickened paraphyse tips. *Chapsa recurva* from Philippines and India is a similar stictic acid containing species, which differs by a distinctly pruinose disc, larger ascospores (up to 68 µm long) and 2-4-spored asci.

SPECIMENS EXAMINED – Australia, New South Wales: Mt. Warning NP., track from summit to parking lot, *Mangold 19 zb* (F). Wilson Primitive Reserve, c. 55 km NW of Wauchope, *Hale 59237* (US). New England NP., *Hale 58790, 58794* (US). Mars Rd., Mt. Hyland Nature Reserve, 33 km NW of Dorrigo, *Streimann 60628* (CANB). 15 km W of Dorrigo, on the Armidale Rd., *Elix 2332* (CANB). C. 1 km W of Mt. Banda Banda, *Kantvilas 479/88* (NSW). Mt. Boss SF., 60 km WSW Port Macquarie, Mt. Banda Banda Flora Reserve, at the crossing of Banda Rd., and Loop Rd., *Wedin 3536* (UPS). Gloucester Tops, *Kantvilas 399/88* (NSW). Allyn River Forest Park, start of track to Burraga, *Kantvilas* s.n. (NSW). Blue Mountains NP., Mt. Wilson, Chimney Cottage, *K. & A. Kalb 20457* (hb. Kalb). Near Blackheath, Blue Mnts., below Bridal Veil Falls, *Hale 58679, 58683* (US). Below Katoomba Falls-trail to Giant Stairway, Katoomba, *Hale 58717, 58733* (US). Moreton NP., Yurnga Lookout, 35 km NE of Braidwood, *Curnow 64* (CANB). SE of Clyde Summit, 37 km from Bateman's Bay on main rd. to Braidwood, *Hale 69202* (US). Braidwood District, south side of Monga Mt., above Mongarlowe River SW of Monga sawmill, 21.07.1968, *Weber & Adams* s.n. (CANB, COLO, H). Monga NP./SF.: 18 km SE Braidwood, along Milo Rd. after turnoff from River Rd., *Wedin 3274* (UPS); 27 km SE of Braidwood, *Mangold 11 k, s* (F); Mongarlowe River Area, 4-6 km S of Monga: *Elix 11722, 11745, 22679, 30220, 30241, 30243, Lumbsch 5649 b, Verdon 1317* (CANB); *Streimann 15695* (B, CANB). Budawang Range, The Vines, near Vine Creek, 12 km from Sassafras, 14 km SE of Nerriga, *Verdon 2559* (CANB).

Chapsa megaphlyctidioides Mangold spec. nov. ined.

Type: Australia, Queensland, Cape Tribulation, 5 km on Buchanan Creek Rd., *Hale 831619* (US-holotype).

ETYMOLOGY – The epithet refers to the conspicuous, large and distinctly *Geaster*-like ascomata (from gk.: megas =large, great) which distinguishes this species from the otherwise similar species *C. phlyctidoides*.

ILLUSTRATION – Fig. 26.

Thallus epi- to hypophloedal, (moderately) thin, up to c. 150 µm high, olive to yellowish-green. Surface moderately shiny to waxy, smooth, continuous to slightly verrucose, unfissured. True cortex present, continuous, up to c. 50 µm thick, hyaline to pale yellowish, consisting of periclinal to rarely irregular hyphae. Algal layer continuous, well developed, calcium oxalate crystals variable, rare to lacking in main thallus, abundant near ascomata, small to moderately large, clustered. Vegetative propagules not seen. Ascomata conspicuous, large, up to c. 2 mm in diam., roundish to slightly irregular, often appearing irregular or slightly branched in fused ascomata, distinctly chroodiscoid, erumpent, solitary to fused, sometimes regenerating, immersed to slightly raised. Disc usually entirely visible from surface, pale flesh-colored to pale grayish, pruinose. Proper exciple not visible from surface (inner thalline rim layer may be confused with proper exciple!), thalline rim margin split and ±lobed, in older ascomata becoming moderately layered, whitish, finely pruinose, ±brownish towards the outside, becoming erect to recurved. Exciple fused, thin, hyaline internally, yellowish-brown marginally, apically with pale grayish-brown granules, non-amyloid.

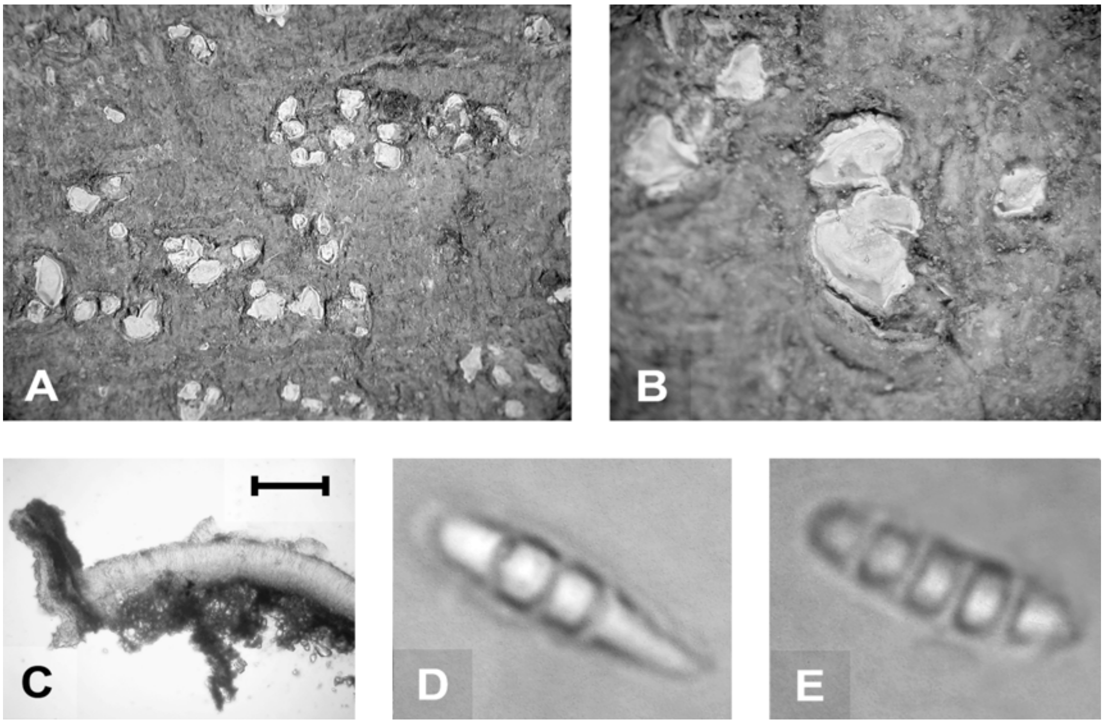

Fig. 26. *Chapsa magaphlyctidioides*: growth habit (**A**), ascomata (**B**), ascoma section (**C**) and ascospores (**D, E**). A.-E.: US-holotype. Bar= A: 2.5 mm; B: 1.25 mm; C: 100 µm; D: 3 µm; E: 4 µm.

Hymenium up to c. 70 µm high, non-inspersed, weakly conglutinated, paraphyses slightly bent, parallel to slightly interwoven, unbranched, tips unthickened to moderately thickened and somewhat irregular, lateral paraphyses present, conspicuous, up to c. 20 µm long. Epihymenium moderately thick, hyaline, with grayish granules and sometimes with small crystals. Asci 8-spored, tholus (moderately) thin, not visible at maturity. Ascospores (very) small, transversely septate, cell walls and endospore thin, halo moderately thick, hyaline, non-amyloid, fusiform to clavate, ends subacute to acute, loci angular to slightly roundish, predominantly ±rectangular, end cells predominantly conical, septae (moderately) thin, irregular, 10-18 x 3-5 µm with 4-6(8) loci. Pycnidia not seen.

Fig. 27. Australian distribution of *C. megaphlyctidioides*.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing stictic, constictic (majors), hypoconstictic, cryptostictic, α-acetyl-hypoconstictic and hypostictic (traces) acids.

ECOLOGY AND DISTRIBUTION – *Chapsa megaphlyctidioides* was collected in Australia on tree bark in a tropical rainforest at sea level. It is only known from the type collection in Northern Queensland.

NOTES – This taxon is characterized by the smooth, ±shiny to waxy, corticate thallus, large, conspicuous ascomata, small, transversely septate, hyaline, non-amyloid ascospores without thickened parts and the stictic acid chemosydrome. It is similar to *C. phlyctidioides*, which differs by a dull, ecorticate thallus, smaller, less distinctly *Geaster*-like ascomata with less layered margins, and larger (up to 24 µm long, with up to 8 loci) ascospores, that are non-halonate and have thickened cell walls and endospore.

SPECIMENS EXAMINED – See type collection.

Chapsa minor (Kantvilas & Vezda) Mangold comb. nov. ined.

Bas.: *Chroodiscus minor* Kantv. & Vezda, Lichenologist 32: 341 (2000). Type: Australia, Tasmania, Weindorfers Forest, *Kantvilas 16/88* (HO!-holotype; hb.Vezda-isotype).

ILLUSTRATION – Fig. 28.

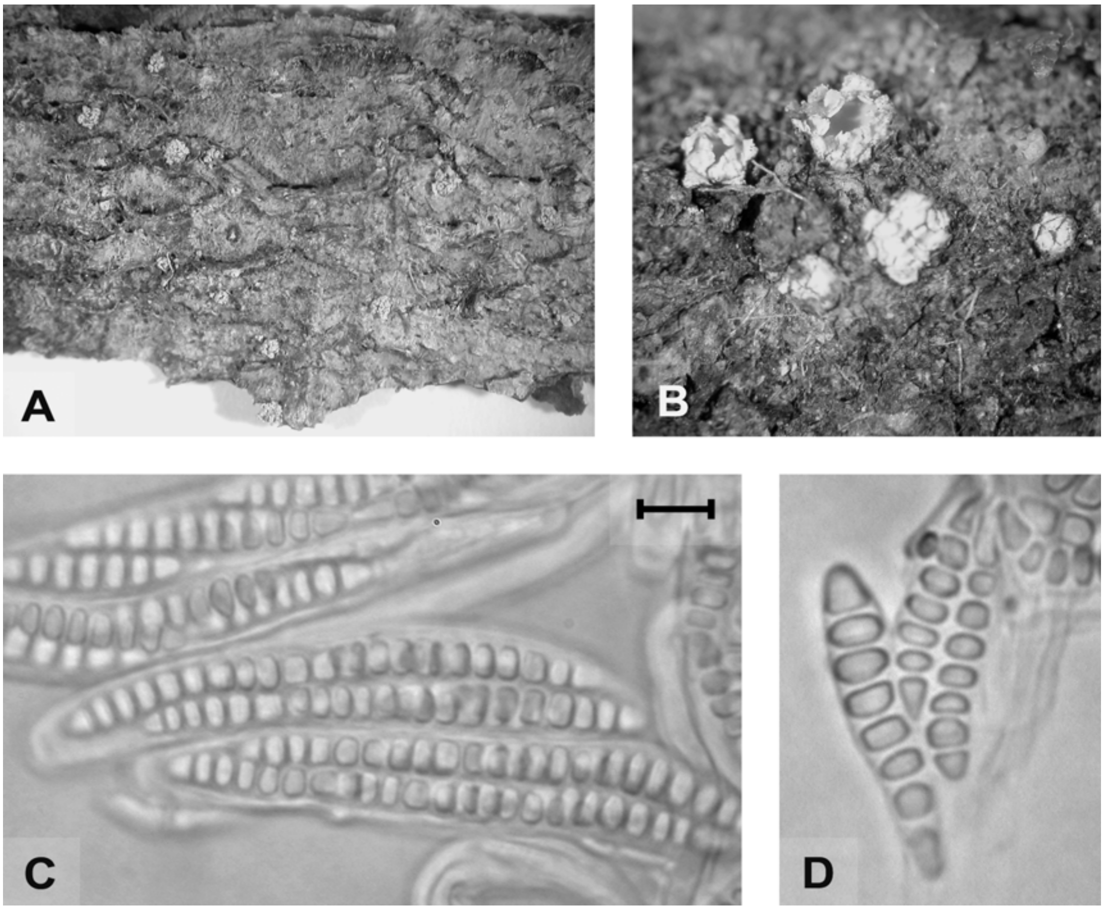

Fig. 28. *Chapsa minor*: growth habit (**A**), ascomata (**B**), asci (**C**) and ascospores (**D**). A.-D.: HO-holotype. Bar= A: 5 mm; B: 0.8 mm; C: 9 µm; D: 5 µm.

Thallus endo- to hypophloedal, thin to very thin, up to c. 80 µm high, grayish-green. Surface dull to slightly shiny, smooth, continuous, unfissured to slightly cracked. Thallus covered by a continuous to incontinuous protocortex, sometimes becoming distinctly conglutinated, forming an incontinuous true cortex consisting of periclinal hyphae, up to c. 10 µm high. Algal layer discontinuous and poorly developed, calcium oxalate crystals absent. Vegetative propagules not seen. Ascomata conspicuous, (moderately) large, up to c. 1 mm in diam., roundish to slightly irregular, apothecioid to chroodiscoid, sessile, solitary to rarely slightly fused, becoming emergent, depressed-urceolate to cupular. Disc partly to rarely entirely visible from surface, pale flesh-colored, epruinose. Proper exciple not visible from surface, thalline rim margin characteristic, up to 0.5 µm in diam., radially split, rugged and lobed, becoming distinctly layered, off-white, predominantly incurved, only outer layers becoming erect to recurved. Exciple fused, hyaline internally to yellowish-brown marginally, amyloid in basal parts. Hymenium up to c. 80 µm high, non-inspersed, strongly conglutinated, paraphyses slightly bent, parallel to slightly interwoven, unbranched, tips unthickened to slightly thickened, lateral paraphyses present, inconspicuous, up to c. 20 µm long. Epihymenium thin, hyaline to pale yellowish, without granules, often with small crystals. Asci 8-spored, tholus moderately thick, not visible at maturity. Ascospores small, transversely septate, cell walls (moderately) thin, endospore moderately thin to slightly thickened, with thin halo only in young stages, hyaline, non-amyloid to faintly amyloid ellipsoid to more often fusiform to clavate with narrowed-rounded to usually (sub)acute ends, loci roundish to angular, subglobose to rectangular or irregular, end cells hemispherical to conical, septae thick, regular, 20-28 x 4-6 µm with 6 to 9 loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing stictic, hypostictic (majors to minors), constictic (minor to trace), and cryptostictic (traces) acids.

ECOLOGY AND DISTRIBUTION – *Chapsa minor* was collected in Australia on tree bark in cool temperate rainforests in altitudes ranging from 300 to 1000m. It is a rare species occurring in Tasmania and southern Victoria, not yet reported from outside Australia.

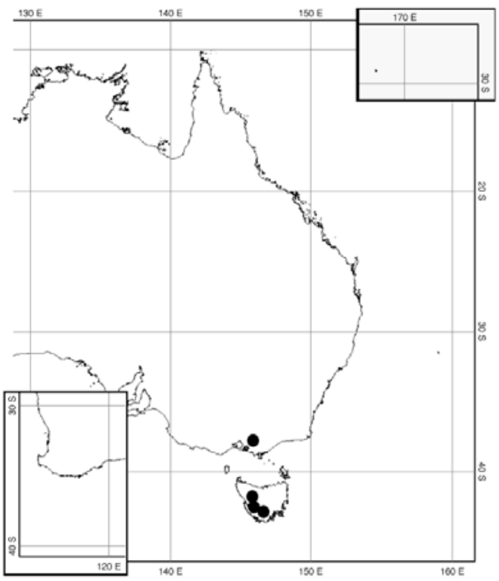

Fig. 29. Australian distribution of *C. minor*.

NOTES – This taxon is characterized by the thin thallus and the bright, apothecioid to indistinctly *Geaster*-like ascomata with layered margins and epruinose discs, the moderately small, transversely septate, hyaline, non- to faintly amyloid ascospores with thin cell walls and thickened endospore and septae and the presence of the stictic acid chemosyndrome. A similar, and probably closely related species is *C. lamellifera*, which agrees in having layered ascomata and containing the stictic acid chemosyndrome. It can be readily distinguished, however, by larger, muriform ascospores. For differences to *C. phlyctidioides* see under this species.

SPECIMENS EXAMINED – Australia, Victoria: Warburton, Feb. 1902, *Wilson* s.n. (MEL n. 26169).

Chapsa niveocarpa Mangold spec. nov. ined.

Type: Australia, Queensland, Atherton Tablelands, Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Lumbsch & Mangold 19151 p* (CANB-holotype; BRI-isotype).

ETYMOLOGY – The epithet refers to the inspersed hymenium and the whitish-pruinose surface of the ascomata (from lat.: *niveus* =snowy and gk. -*carpus* =fruit).

ILLUSTRATION – Fig. 30.

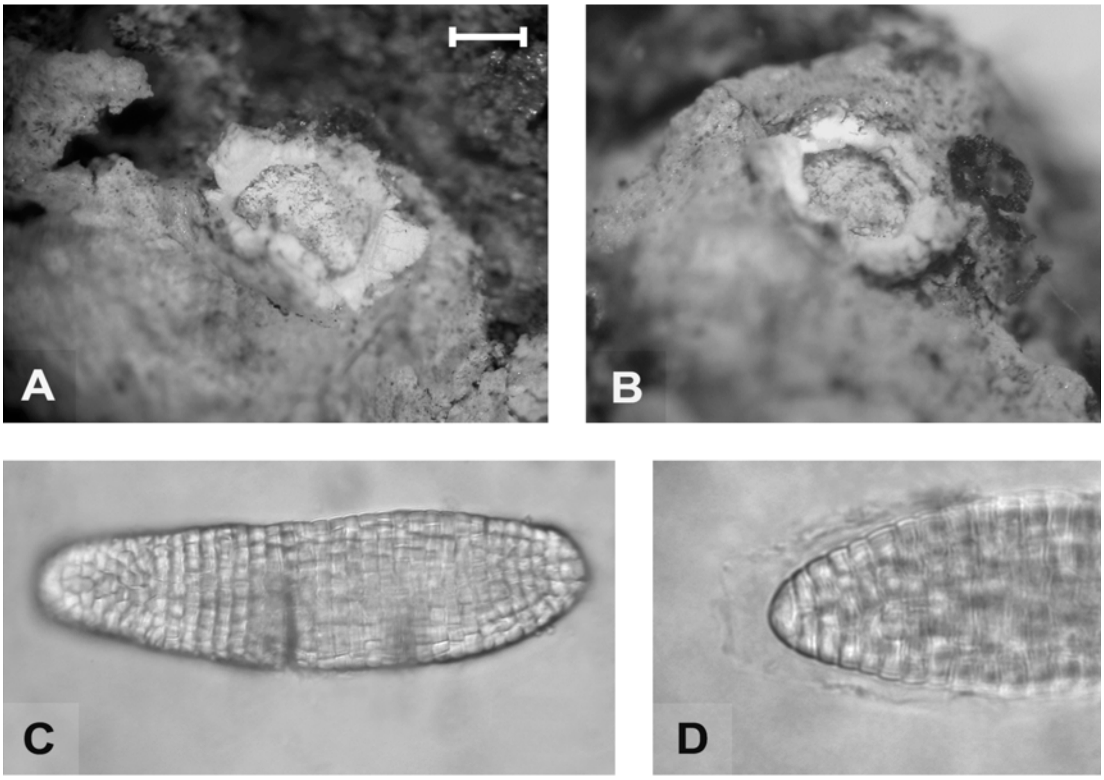

Fig. 30. *Chapsa niveocarpa*: ascomata (**A**, **B**), ascospore (**C**) and ascospore detail (**D**). A.-D.: CANB-holotype. Bar= A, B: 0.7 mm; C: 20 µm; D: 15 µm.

Thallus predominantly hypo- to somewhat epiphloedal, (moderately) thin, up to c. 200 µm high, pale gray to pale grayish-green. Surface dull, rough to somewhat pruinose, often with protuberant substrate structure, continuous, unfissured. Cortex structures predominantly absent, thallus rarely covered by a thin, incontinuous protocortex up to 20 µm. Algal layer poorly to moderately well developed, predominantly incontinuous, calcium oxalate crystals moderately abundant, usually small, clustered to more often scattered. Vegetative propagules not seen. Ascomata conspicuous, (moderately) large, up to c. 2 mm in diam., roundish to slightly irregular, particularly in fused ascomata, apothecioid to chroodiscoid in older ascomata, erumpent, solitary to fused, sometimes regenerating, immersed. Disc partly to entirely visible from surface, pale grayish to whitish, strongly pruinose. Proper exciple not visble from surface to sometimes visible when becoming partly detached, whitish, thalline rim margin irregular, usually coarsely split and lobed, sometimes eroded, slightly to distinctly layered, distinctly whitish-pruinose on the insides, becoming erect to ±recurved. Proper exciple thin to evanescent, hyaline internally to pale yellowish to pale orange marginally, with substrate layers incorporated, apically covered by a usually thick layer of grayish granules, non-amyloid. Hymenium up to c. 200 µm high, interspersed by granules (see below), weakly conglutinated, paraphyses distinctly adspersed by fine, hyaline granules, straight to slightly bent, parallel to slightly interwoven, unbranched, tips distinctly thickened, lateral paraphyses present, conspicuous (but often obscured by granule inclusions), up to c. 45 µm long, adspersed with fine granules. Epihymenium thick to very thick, hyaline with coarse grayish granules. Asci 1- to very rarely 2-spored, tholus thin, not visible at maturity. Ascospores (moderately) large, densely eumuriform, cell walls and endospore thin, with thin to moderately thick, then irregular halo, hyaline, becoming somewhat yellowish to grayish at late maturity, non-amyloid, oblong to slightly fusiform, with roundish to narrowed-roundish ends, loci small, angular to slightly roundish, with distinct, regular, thin, transverse septae in younger ascomata, becoming somewhat irregular in older ascospores, 80-190 x 20-50 µm with multiple loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Chapsa niveocarpa* was collected in Australia on tree bark in tropical rainforests in altitudes ranging from 500 to 1100 m. It is a rare species occurring to Northern Queensland.

Fig. 31. Australian distribution of *C. niveocarpa*.

NOTES – The interspersed hymenium, caused by the adspersion of the paraphyses with fine granules is the most characteristic feature of this species, a character that is also occurring in *C. leprocarpa* and *C. patens*, where granules can be found restricted to the lateral paraphyses. *Chapsa niveocarpa* is further characterized by a thin, ecorticate thallus, strongly pruinose, whitish ascomata, large, densely eumuriform, hyaline, non-amyloid ascospores without thickened parts and the lack of secondary metabolites. Of those taxa only *C. leprocarpa* occurs in Australia. It can be distinguished by a thinner thallus, less strongly pruinose ascomata with a lower hymenium (up to 140 µm high) and smaller ascospores (up to 130 µm long) that more often occur by two per ascus. *C. patens* is morphologically similar, but lacks granular paraphyses and has slightly smaller ascospores (up to 160 µm long). It does not occur in Australia.

SPECIMENS EXAMINED – Australia, Queensland: Mt. Lewis Rd., W of Mossman, *Hale 832394* (US). Atherton Tablelands: Lake Eacham NP., track around lake, *Hale 831188* (US); Palmerston NP., 6 km E of the west boundary, *Hale 831721* (US); Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Mangold 30 p* (F); 13 km S of Ravenshoe on Tully Falls Rd., *Hale 831974* (US). Dawson logging area, WSW of Tully, *Hale 832138* (US).

Chapsa phlyctidioides (Müll.Arg.) Mangold comb. nov. ined.

Bas.: *Ocellularia phlyctidioides* Müll.Arg., Hedwigia 32: 130 (1893). *Thelotrema phlyctidioides* (Müll.Arg.) Hale, Mycotaxon 11: 132 (1980). Type: Australia, Queensland, Brisbane, *Bailey 354* (G!-holotype).

ILLUSTRATION – Fig. 32.

Thallus epi- to hypophloedal, thin, up to c. 150 µm high, pale gray to greenish-gray. Surface dull, smooth to slightly roughened, continuous to verrucose or verruculose, often fissured. True cortex absent, thallus covered by an indistinct, incontinuous protocortex up to c. 10 µm thick. Algal layer ±continuous but poorly developed, calcium oxalate crystals variable, sparse to abundant, small to large, singular or clustered. Vegetative propagules not seen. Ascomata conspicuous, predominantly moderately large, up to c. 0.8 mm in diam., roundish to slightly irregular, often appearing slightly branched or irregular in fused ascomata, apothecioid to indistinctly chroodiscoid, erumpent, solitary to fused, regenerating, immersed to slightly emergent. Disc partly visible from surface, pale flesh-colored, pruinose, in deceased ascomata disc becoming exposed, turning into a whitish-pruinose layer which resembles the thalline rim of subsequent ascomata. Proper exciple not visible from surface (inner thalline rim layer may be confused with proper exciple!), thalline rim margin structure variable throughout ontogeny, in newly developing ascomata split, rugged to lobed, ±concolorous with thallus or brighter, incurved to erect, in subsequent ascomata generations margin layered, splitting and opening irregularly, breaking away in some parts, remaining parts finally forming the new inner thalline rim, whitish-pruinose, incurved to erect, slightly recurved only in outer layers. Proper exciple fused, thin to evanescent, hyaline internally to pale yellowish marginally, distinctly amyloid in marginal parts, amyloidity extending towards lateral subhymenial margins. Hymenium up to c. 80 µm high, non-inspersed, in older ascomata often with crystal inclusions, moderately conglutinated, paraphyses slightly bent, parallel to slightly interwoven, unbranched, tips slightly thickened, somewhat irregular, lateral paraphyses present, inconspicuous, up to c. 20 µm long. Epihymenium moderately thin to moderately thick, hyaline with yellowish-gray granules and crystals. Asci 8-spored, tholus moderately thick, not visible at maturity. Ascospores small, transversely septate, very rarely with a single longitudinal septum, cell walls and endospore moderately thick, non-halonate, hyaline, non-amyloid to faintly amyloid, ellipsoid to fusiform to clavate, ends roundish to subacute, loci roundish to slightly angular, subglobose to more often lentiform or acute-lentiform with hemispherical to conical end cells, septae thin to moderately thick, regular, 15-24 x 5-7µm with 4-8 (x2) loci. Pycnidia not seen.

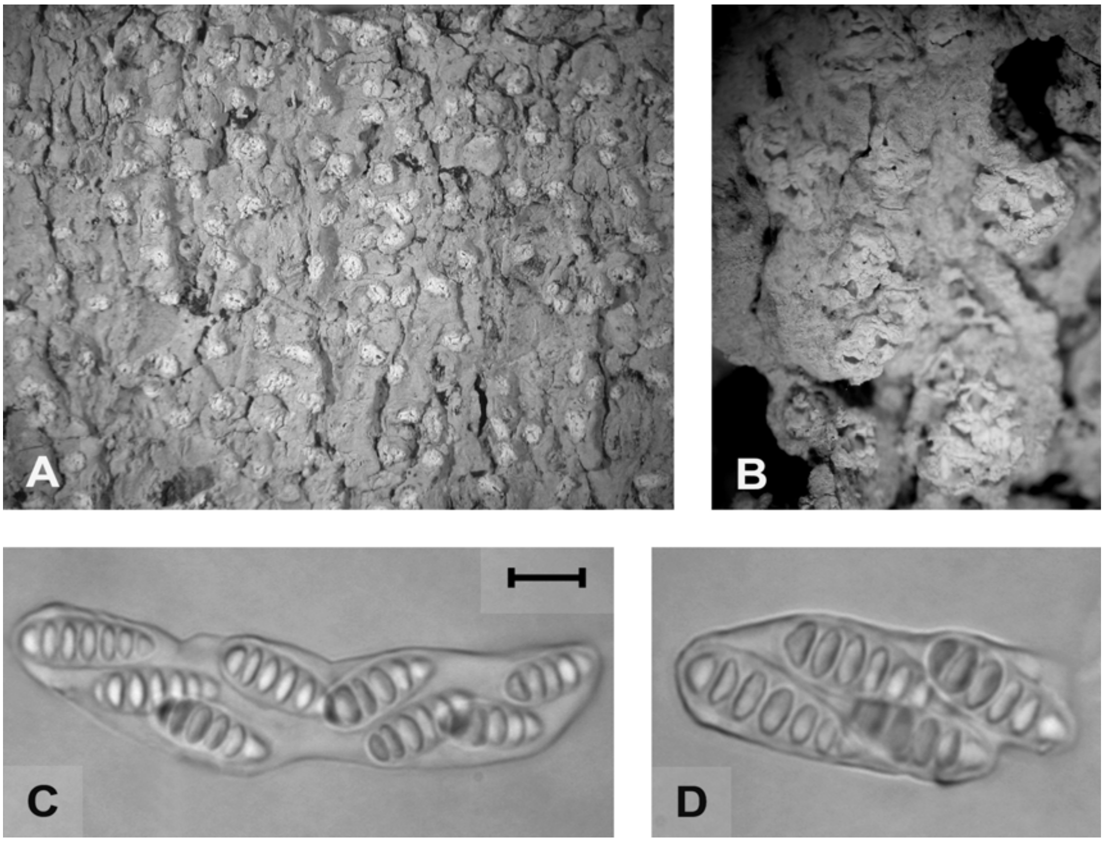

Fig. 32. *Chapsa phlyctidioides*: growth habit (**A**), ascomata (**B**) and ascospores (**C, D**). A., D.: *Hale 831193*; B., C.: *Elix 18609*. Bar= A: 2 mm; B: 1 mm; C: 10 µm; D: 8 µm.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing stictic (major), constictic, hypostictic (majors to minors), cryptostictic and α-acetylhypoconstictic (traces) acids.

ECOLOGY AND DISTRIBUTION – *Chapsa phlyctidioides* was collected in Australia on tree bark in (sub)tropical rainforests in altitudes ranging from 10 to 800 m. It is a moderately common species occurring in northern Queensland, the Queensland/New South Wales border region and on Norfolk Island. Besides Australia the species was reported from Dominica, Central America and Sri Lanka (Hale, 1981) indicating a pan(sub)-tropical distribution.

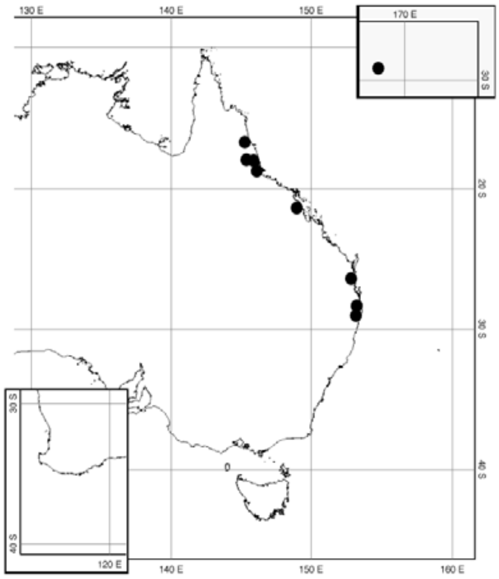

Fig. 33. Australian distribution of *C. phlyctidioides*.

NOTES – This taxon is characterized by the thin, dull, ecorticate thallus, almost closed, regenerating ascomata, small, transversely septate, hyaline ascospores and the presence of the stictic acid chemosydrome. *Chapsa minor* is similar, containing stictic acid, but having raised, regular, solitary and epruinose ascomata. *Chapsa esslingeri* (Hale) Mangold comb. nov. ined.[3] from Panama is similar, but has distinctly emergent, solitary ascomata, an inspersed hymenium and strongly amyloid ascospores that tend to turn slightly brownish with age.

SPECIMENS EXAMINED – Australia, Queensland: S of Noah's Beach on the Cape Tribulation Rd., *Hale 832275* (US). Atherton Tablelands: Malanda Falls, *Lumbsch & Mangold 19129 s* (F); Curtain Fig Tree S.F.P., 3 km S of Yungaburra, *Hale 831624* (US); Souita Falls, *Lumbsch & Mangold 19155 u* (F). Babinda Boulders, *Mangold 39 l, v, x, ze* (F). State Forest on Tully Rd., 1 km from jct. with S. Mission Beach Rd., S of Mission Beach, *Hale 831725* (US). Eungella NP., along Broken River, *Lumbsch & Mangold 19100 f* (F). Noosa NP., E of Noosa Heads, *Hafellner 16694* (GZU). Kenilworth SF., SW of Kenilworth, *Hale 831193* (US). Lamington NP.: Main Border Track out of O'Reillys, *Hale 831729, 832269* (US); Python Rock Track, *Hale 830863* (US). New South Wales: Lions Tourist Rd. near Queensland border, N of Wiangaree, *Hale 832712* (US). Mt. Warning NP., W of Murwillumbah, *Hale 832115* (US). Norfolk Island: Mt. Pitt Reserve, Red Road Track to Mt. Bates, *Elix 18609* (CANB).

Chapsa platycarpa (Tuck.) A. Frisch

Bibl. Lichenol. 92: 113 (2006). Bas.: *Thelotrema platycarpum* Tuck., Proc. Amer. Acad. Arts Sci. . 5: 406 (1862). *Phaeotrema platycarpum* (Tuck.) Zahlbr., Cat. Lich. Univ. II: 609 (1923). Type: Cuba, *Wright*, Lichenes Cubae no. 139 (FH-Tuck.-holotype; BM!-, H-Nyl. 22667-, G-, L-, M-, PC-, UPS-, US!-, W-isotypes).

Thelotrema platycarpoides Tuck., Proc. Amer. Acad. Arts Sci. . 6: 270 (1864). *Phaeotrema platycarpoides* (Tuck.) Müll. Arg., Flora 69: 311 (1886). Type: Cuba, *Wright*, Lichenes Cubae no. 157 (FH-Tuck.-lectotype, selected by Frisch [2006: 116 - 'piece 6']; BM-, FH-Tuck.-, G-, H-Nyl. 22671-, L-, M!-, PC-, UPS-, US!-, W-isolectotypes).

Phaeotrema apertum C. W. Dodge, Nova Hedwigia, Beiheft 12: 98 (1964). Type: Uganda, *Dummer 4293* (BM!-holotype; FH-Dodge-isotype).

[For additional synonymy see Frisch (2006).]

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[3] ***Chapsa esslingeri*** (Hale) Mangold comb. nov. ined. Bas.: *Ocellularia esslingeri* Hale, Smithson. Contrib. Bot. 38: 20 (1978). *Thelotrema esslingeri* (Hale) Hale, Mycotaxon 11: 131 (1980). Type: Panama, Veraguas, *T. L. Esslinger 4626* (US!-holotype). [Hale (1978: 20) reports an unidentified PD negative compound in this taxon, however, the chemical test of the type material resulted in stictic and constictic acids as major compounds.]

Illustration – Fig. 34.

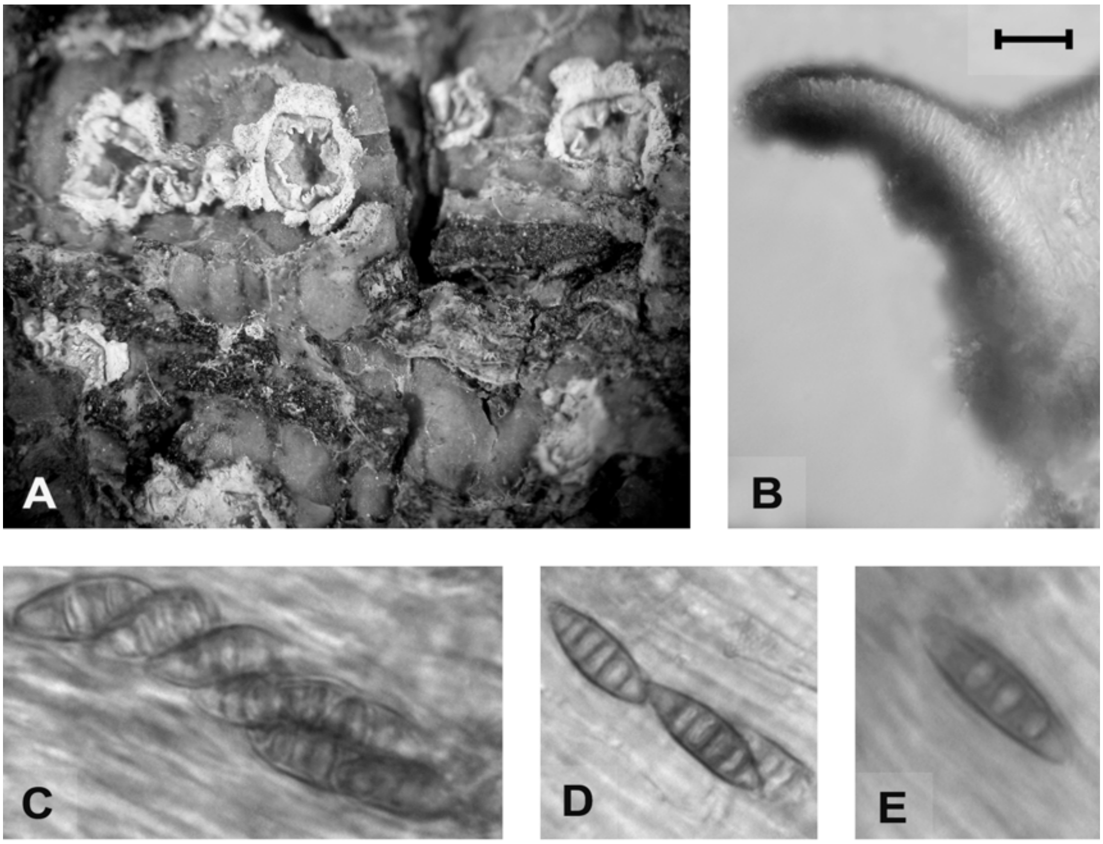

Fig. 34. *Chapsa platycarpa*: ascomata (**A**), section of ascoma margin (**B**) and ascospores (**C-E**). A., E.: *Hale 830990;* B.: BM-isotype; C., D.: US-isolectotype of *T. platycarpoides*. Bar= A: 1.25 mm; B: 20 µm; C, E: 7 µm; D: 10 µm.

Thallus hypo- to epiphloedal, (moderately) thin, up to c. 300 µm high, dark olive to olive-brown or pale yellowish-brown. Surface dull to wax-like, smooth, continuous to verrucose, unfissured. True cortex present, up to 50 µm thick, continuous, yellowish, formed by periclinal to irregular hyphae, sometimes with crystal inclusions. Algal layer continuous and well developed, calcium oxalate crystals abundant, mostly small, and scattered, sometimes clustered. Vegetative propagules not seen. Ascomata conspicuous, (moderately) large, up to c. 2 mm in diam., roundish to slightly irregular, apothecioid to chroodiscoid in older ascomata, erumpent, solitary to fused, often clustered in groups of c. 2-6 ascomata, immersed. Disc partly to rarely entirely visible from surface, grayish, distinctly pruinose. Proper exciple usually almost entirely visible from surface, forming an inner margin/pore, slightly split to ridged, free, irregular, wide to gaping, whitish to off-white, often ±shrunken, predominantly incurved to rarely somewhat erect. Thalline rim margin split and coarsely lobed or eroded, off-white to whitish on the insides, concolorous with thallus on the outside, erect to recurved. Proper exciple free, (moderately) thin, hyaline internally to pale yellowish-brown or brownish marginally, non-amyloid. Hymenium up to c. 100 µm high, non-inspersed, moderately conglutinated, paraphyses straight to slightly bent, parallel to slightly interwoven, unbranched, tips distinctly thickened and somewhat irregular, lateral paraphyses present, conspicuous, up to 20 µm long. Epihymenium (moderately) thick, hyaline, with grayish to brownish granules and small crystals. Asci 8-spored, tholus moderately thick to moderately thin, not visible at maturity. Ascospores (very) small, transversely septate, cell walls and endospore moderately thick, non-halonate, brown, weakly to moderately amyloid, ellipsoid to fusiform with roundish-narrowed to subacute ends, loci roundish to angular, roundish-lentiform to oblong or irregular, end cells conical, septae (moderately) thick, regular, 10-20 x 4-6 µm with 4-6(7) loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellow, C-, PD+ orange; containing constictic and stictic (majors) and α-acetylconstictic (trace) acids.

ECOLOGY AND DISTRIBUTION – *Chapsa platycarpa* was collected in Australia on tree bark in (sub)tropical rainforests and monsoon forests in low altitudes ranging from sea level to 100 m. It is a rare species, known from north-western Northern Territory (Frisch, 2006), northern and central Queensland. Besides Australia it was reported from the Neotropics, Africa, India, Sri Lanka and SE Asia (for references see Frisch, 2006) indicating a pan(sub)tropical distribution.

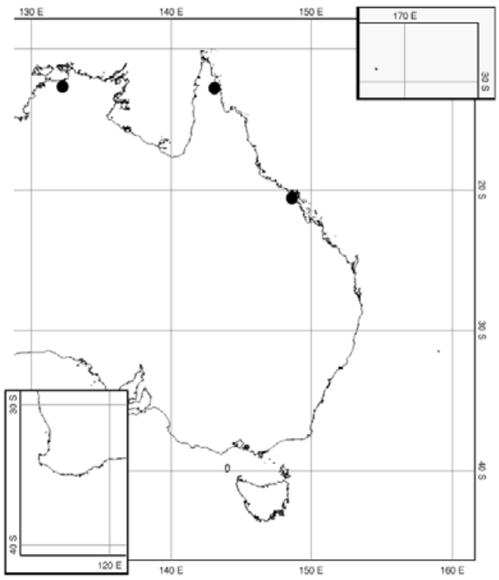

Fig. 35. Australian distribution of *C. platycarpa*.

NOTES – This taxon in characterized by a dark, corticate thallus, chroodiscoid ascomata with an incurved, free proper exciple, small, transversely septate, brown, indistinctly amyloid ascospores with thickened parts and the stictic acid chemosyndrome compounds. The only similar Australian species is *C. leprieurii*, see there for differences. Another similar species is *Thelotrema neei* from Panama, which differs by a hypophloedal thallus, ascomata with epruinose, reddish-brown discs and smaller (up to 14 µm long, with up to 4 loci), non-amyloid ascospores. Although this taxon has chroodiscoid ascomata and thereby could be combined to *Chapsa*, I prefer to keep it tentatively in *Thelotrema* since it has a distinctly free proper exciple and it is uncertain if *Chapsa* s. str. is characterized by a fused to only indistinctly free proper exciple (see also notes of the genus description).

SPECIMENS EXAMINED – Australia, Queensland: Iron Range NP., 3.5 km from western boundary on track to Portland Rds., *Hale 830077* (US). Conway Range NP., near Shute Harbour-Airlie Beach, *Hale 830990* (US).

Chapsa pulchra (Müll.Arg.) Mangold comb. nov. ined.

Bas.: *Ocellularia pulchra* Müll.Arg., Nuovo Giorn. Bot. Ital. 23: 395 (1891). Type: Australia, Queensland, *Bailey 583* (G!-holotype; BRI-'Shirley Book', p. 21, n. 34 [BRI-AQ721219]!-isotype).

ILLUSTRATION – Fig. 36.

Thallus epi- to predominantly hypophloedal, thin, up to 100 µm high, pale gray to pale grayish-green. Surface dull, rarely smooth to usually rough with protuberant substrate surface, continuous, unfissured, sometimes appearing fissured due to substrate structure. Cortex structures absent. Algal layer continuous to incontinuous, moderately well to poorly developed, calcium oxalate crystals sparse to abundant, small to large, scattered or clustered. Vegetative propagules not seen. Ascomata variable, conspicuous, moderately large to very large, up to c. 2 mm in diam., roundish to irregular, particularly in fused ascomata, apo- to chroodiscoid in older stages, erumpent, solitary to fused, often clustered in groups of few to many ascomata, then usually smaller, immersed. Disc partly to entirely visible from surface, pale flesh-colored to grayish, usually with distinct pruina and ±glittering. Proper exciple not visible from surface, thalline rim margin (moderately) thick, split to somewhat lacerate, lobed to eroded, rarely slightly layered, ±distinctly pruinose, whitish, becoming erect to ±recurved. Exciple fused, thin to evanescent, hyaline internally to yellowish or pale orange marginally, often with incorporated substrate particles, apically usually covered in grayish to brownish-gray granules, non-amyloid. Hymenium up to c. 130 µm high, non-inspersed, highly conglutinated, paraphyses straight, parallel to slightly interwoven, unbranched, tips slightly thickened and somewhat irregular, lateral paraphyses present, conspicuous, up to c. 30 µm long. Epihymenium (moderately) thick, hyaline, with coarse grayish to brownish-gray granules and crystals. Asci 6 to 8-spored, tholus (moderately) thick, thin when mature. Ascospores moderately small to moderately large, transversely septate, fragile, often breaking apart in microscopic slide, cell walls (moderately) thin, endospore thin to very thin, in earlier stages with indistinct but thick to very thick, often irregular halo, hyaline, non-amyloid, bacillar to bacillar-fusiform, often ±bent, loci roundish to slightly angular, predominantly roundish-rectangular to depressed-rectangular with usually hemispherical end cells, septae thin, distinctly regular, 30-60(70) x 5-8 µm with 12-22(24) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no compounds detectable by TLC.

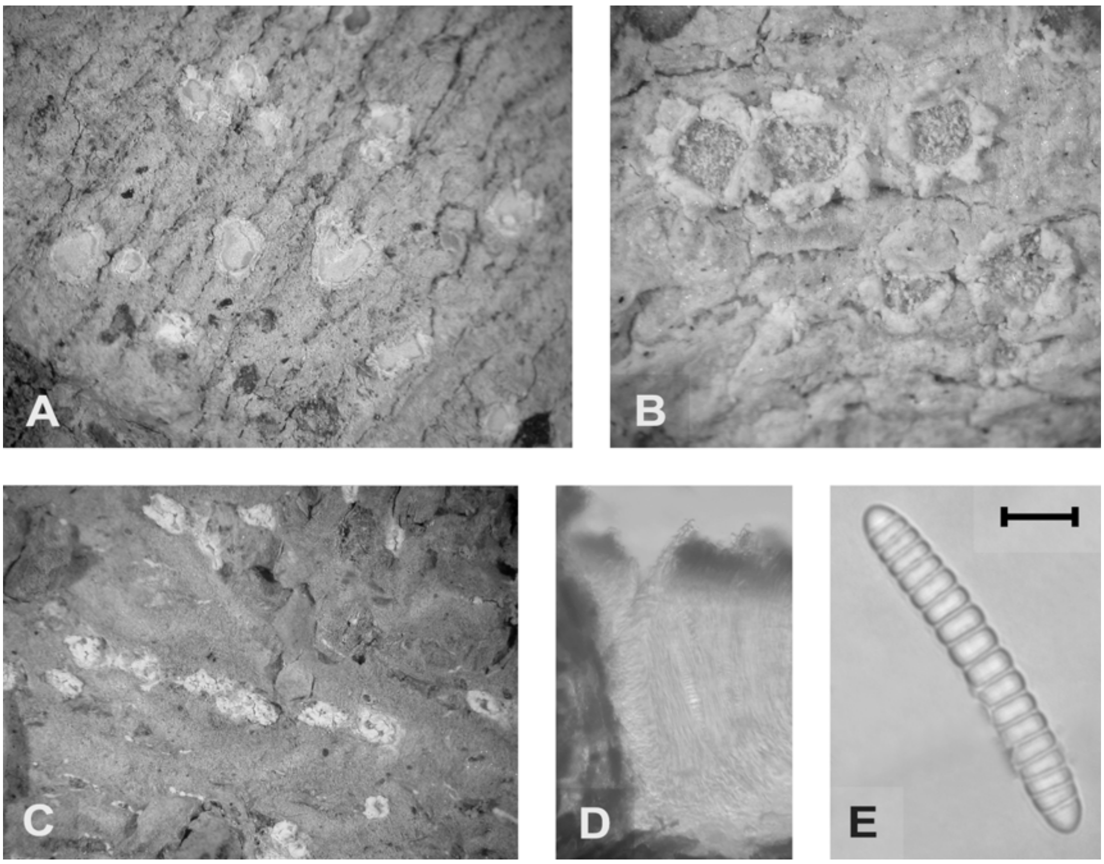

Fig. 36. *Chapsa pulchra*: growth habit (**A, C**), ascomata (**B**), section of ascoma margin (**D**) and ascospore (**E**). A.: Mangold 23 u; B., E.: Lumbsch & Mangold 19129 t; C.: Lumbsch & Mangold 19151 za; D.: G-holotype. Bar= A: 1.75 mm; B: 1 mm; C: 2 mm; D: 30 µm; E: 10 µm.

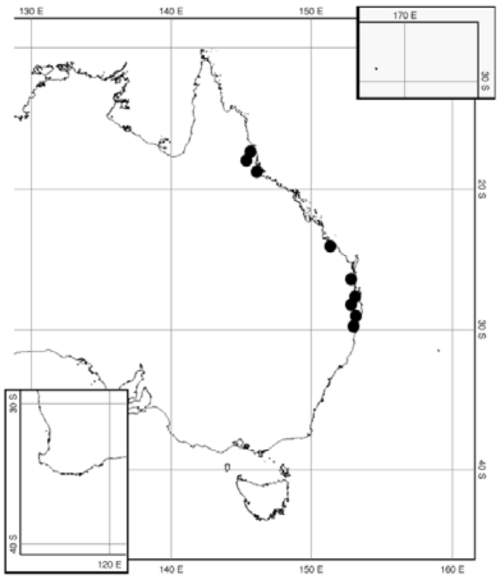

Fig. 37. Australian distribution of *C. pulchra*.

ECOLOGY AND DISTRIBUTION – *Chapsa pulchra* was collected in Australia on tree bark of several trees in predominantly open sites of (sub)tropical wet sclerophyll forests and rainforests in altitudes ranging from 10 to 1130 m. It is a common species, known from Queensland and the Queensland-New South Wales border region. So far not reported from outside Australia.

NOTES – It is a quite uniform species and it can even be identified in the field by its conspicuous whitish ascomata and the endophloedal, bright thallus. Only the ascomata are somewhat variable regarding their size and arrangement. Older, solitary ascomata are usually very large, in groups of clustered ascomata they can be found to be considerably smaller (see fig. 36, B and C). It is further characterized by the large, transversely septate, hyaline, non-amyloid, thin-walled, ±bacillar and fragile ascospores and the lack of secondary compounds. In Australia, the closest taxa is *C. indica*, for differences see there. Morphologically similar is *C. colobicus*, which can be readily distinguished by mono- to bisporic asci with densely eumuriform ascospores.

SPECIMENS EXAMINED – Australia, Queensland: Fitzroy Island on Great Barrier Reef, 25 km E of Cairns, *A. & M. Aptroot 22334/I* (ABL). Atherton Tablelands: Lake Tinaroo, Downfall Creek Camping Area, *Lumbsch & Mangold 19123 j, 19125 h* (F); Dunbulla Forest Drive, near Lake Durango parking lot, *Mangold 37 j* (F); W side of Lake Eacham NP., 3 km in from W boundary on rd. from Yungaburra, *Hale 832154* (US); Lake Eacham NP., *Mangold 29 ag* (F); Plath Rd. logging head, 9 km W of Plath Rd., off Kennedy Hwy., Herberton Range, S of Atherton, *Hale 832165* (US); Malanda Falls, *Lumbsch & Mangold 19129 t* (F); Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Lumbsch & Mangold 19133 d, I, 19148 a, d, 19151e, k, za* (F). Dawson logging area, 24 km S of Koombooloomba turnoff, WSW of Tully, *Hale 830695* (US). Blencoe Creek, Cardwell Range, 48 km NW of Cardwell, *Elix & Streimann 20144* (CANB). Dawes Range, Kroombit SF., 53 km E of Biloela, *Elix 34751* (CANB). Kalpowar Forest Drive, 40 km NE of Monto, SW of Gladstone, *Hale 831272, 831666, 832515* (US). Imbil SF., 6 km NW of Imbil, *Rogers 2525* (BRI). Imbil Forest Drive, between stop #4 and #5 on rd. from Borumba Dam to Imbil, SW of Glympie, *Hale 831366* (US). 31 km S of Gympie, 5 km W of Imbil, *Tibell 12606, 12618* (UPS). Booloumba Creek SF., SW of Kenilworth, *Hale 831715* (US). 6 km N of Jimna, *Tibell 12783* (UPS). Sunshine Coast Hinterland, N side of Lake Baroon Pocket, W of Montville, *Lumbsch & Mangold 19082 e* (F). Mt. Mee SF.: near Mt. Mee, N of Brisbane, *Hale 58561, 58633* (US); 6 km NW of Forestry Office, NW of Mt. Mee, *Hale 830286, 832116, 832389* (US). Goodna (E of Ipswich, nr. Brisbane): *Wilson "1457"* (as *T. megalophthalmum*) (NSW-539388); *Wilson* s.n., Aug. 1889 (NSW-539347). Cunninghams Gap, N of Cunningham Hwy., *A. & K. Kalb 34260* (hb. Kalb). New South Wales: Tweed Range, Mebbin NP., 25 km SW of Murwillumbah, *Mangold 21 r, s* (F). Nightcap Forest Drive: 1 km W of Minyon Falls, N of Lismore *Hale 832364* (US); Big Shrub Flora Reserve, W of Mullumbimby, *Hale 831698, 832040* (US). 'Woolongbar' (=?Wollongbar, nr. Lismore), *Wilson "1457"* (as *T. megalophthalmum*), Jul.1984 (NSW-539369). Iluka Nature Reserve, 50 km NE of Grafton, *Mangold 23 u* (F).

Chapsa subpatens (Hale) Mangold comb. nov. ined.

Bas.: *Thelotrema subpatens* Hale, Bull. Br. Mus. nat. Hist. (Bot.) 8: 269 (1981). Type: Sri Lanka, Southern Province, Galle, *Hale 46208* (US-holotype, BM!-isotype).

ILLUSTRATION – Fig. 38.

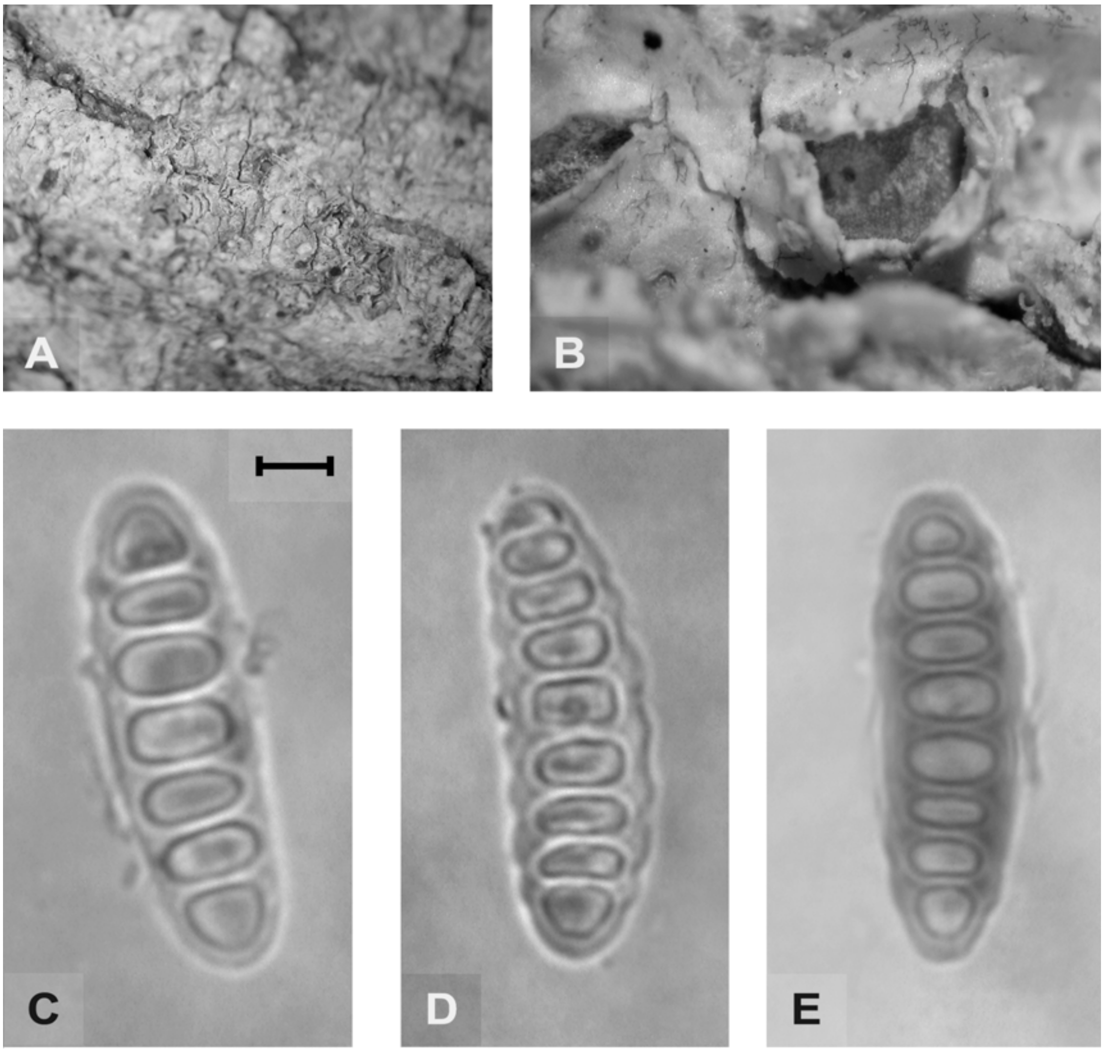

Fig. 38. *Chapsa subpatens*: growth habit (**A**), ascoma (**B**), ascospores (**C, D**) and ascospore with amyloid reaction (**E**). A.: BM-isotype; B.-E.: *Hale 68794*. Bar= A: 2.5 mm; B: 0.4 mm; C: 3 µm; D, E: 3.5 µm.

Thallus predominantly hypophloedal, very thin, up to c. 50 µm high, (pale) grayish. Surface dull to slightly shiny, smooth, continuous, predominantly unfissured, sometimes appearing fissured due to substrate structure. Cortex structures predominantly absent, rarely thallus covered by a thin, incontinuous protocortex up to c. 10 µm thick. Algal layer poorly developed, incontinuous, calcium oxalate crystals absent. Vegetative propagules not seen. Ascomata inconspicuous, large, up to c. 1.5 mm in diam., roundish to slightly irregular, particularly in fused ascomata, apothecioid to chroodiscoid in older ascomata, erumpent, solitary to fused, immersed. Disc partly to rarely entirely visible from surface, (pale) brownish to grayish-brown, becoming slightly pruinose with age. Proper exciple often visible from surface, usually appearing free, but always fused with substrate/thalline rim layers, whitish, thalline rim margin irregular, rugged and lobed, lobes large and thin, sometimes eroded, often appearing layered due to exfoliating substrate, concolorous with thallus or brownish due to protuberant substrate layers, becoming erect to recurved in older stages. Exciple (moderately) thick, hyaline internally to pale yellowish marginally, often with substrate layers incorporated, apically usually covered by grayish granules, often slightly amyloid (reddish) to distinctly amyloid at the base (purple). Hymenium up to c. 80 µm high, non-inspersed, weakly conglutinated, paraphyses straight to slightly bent, parallel, unbranched, tips unthickened to slightly thickened, lateral paraphyses present, inconspicuous in younger ascomata, up to c. 20 µm long, not clearly separated from exciple. Epihymenium moderately thick, brownish, with fine to coarse grayish-brown granules. Asci 6 to 8-spored, tholus moderately thin, thinning or not visible at maturity. Ascospores small, transversely septate, cell walls and endospore (moderately) thick, often with distinctly crenate surface, non-halonate, hyaline, distinctly to strongly amyloid, predominantly ellipsoid to oblong-fusiform, rarely fusiform, with roundish to narrowed-roundish ends, loci roundish to slightly angular, predominantly subglobose to oblong, end cells hemispherical to conical, septae (moderately) thick, regular, 20-30 x 6-7 µm with 7-10 loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Chapsa subpatens* is known in Australia from one collection on tree bark in a cool-temperate *Nothofagus* forest at 800 m altitude. It is an extremely rare species in Australia, only known from Tasmania. This is the first report for Australia, so far it was only reported from Sri Lanka.

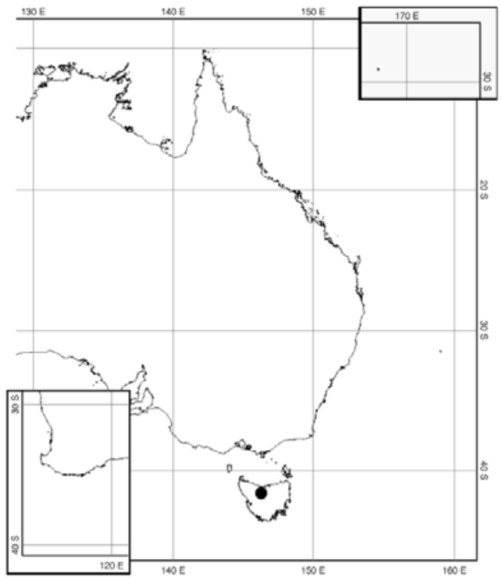

Fig. 39. Australian distribution of *C. subpatens*.

NOTES – *Chapsa subpatens* is an inconspicuous species, mainly characterized by the very thin, ecorticate thallus, the brownish discs, the small, transversely septate, hyaline, amyloid ascospores with thickened parts and the lack of lichen substances. In the type collection (besides the present material from Tasmania the only existing collection of this species), the ascomata are small and almost apothecioid, somewhat resembling a member of *Thelotrema*. The Tasmanian specimen however, is probably fully mature or better developed and has large, *Geaster*-like ascomata. The only known similar *Chapsa* in Australia is *C. tibellii* from northern Queensland, which can be readily distinguished by the thicker, corticate thallus and the larger (up to 45 µm long), fusiform ascospores. Further, *C. crispata* from Brazil is the most closely affiliated species, it also differs by a distinctly epiphloedal thallus and has thick margins which are, as well as the disc, distinctly whitish-pruinose.

SPECIMENS EXAMINED – Australia, Tasmania: Murchinson Hwy., 57 km S of Bass Hwy., S of Hellyer Gorge, *Hale 68794* (US).

Chapsa tibellii Mangold spec. nov. ined.

Type: Australia, Queensland, Atherton Tablelands, Mt. Haig, 22 km NE of Atherton, *Tibell 15314* (UPS-holotype).

ETYMOLOGY – This species in named after the Swedish lichenologist Leif Tibell who collected the type specimen.

ILLUSTRATION – Fig. 40.

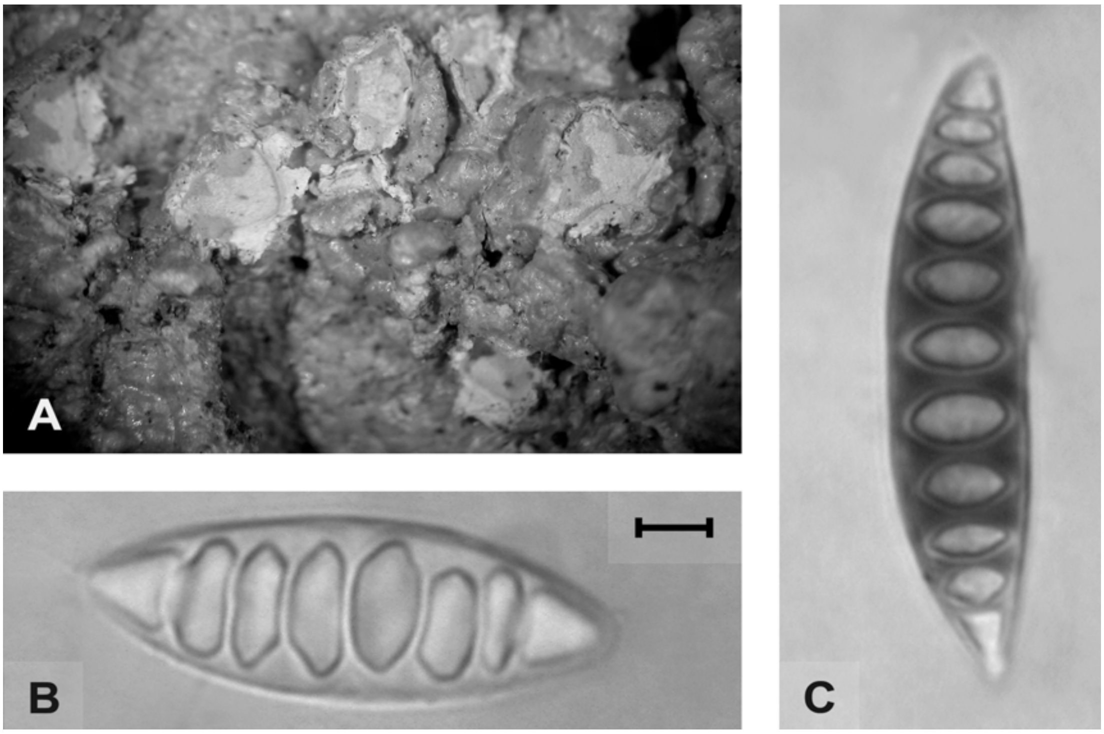

Fig. 40. *Chapsa tibellii*: ascomata (**A**), ascospore (**B**) and ascospore with amyloid reaction (**C**). A.-C.: UPS-holotype. Bar= A: 1.5 mm; B: 4 µm; C: 5 µm.

Thallus epi- to somewhat hypophloedal, thin to usually (moderately) thick, up to c. 400 µm high, pale yellowish-gray to (pale) greenish-gray. Surface shiny, smooth, predominantly distinctly verrucose to verruculose, unfissured, sometimes coarsely cracked. True cortex present, thick, up to c. 50 µm thick, continuous, consisting of periclinal to irregular hyphae. Algal layer continuous and well developed, calcium oxalate crystals usually abundant, large to more rarely small, clustered. Vegetative propagules not seen. Ascomata very conspicuous, (very) large, up to c. 5 mm in diam., roundish to irregular, in fused ascomata sometimes slightly branched, chroodiscoid, erumpent, solitary to sometimes fused, immersed to somewhat emergent, sometimes with a ±constricted base. Disc predominantly entirely visible from surface, whitish-gray to gray, distinctly pruinose, with fine pruina. Inner proper exciple not visible from surface to sometimes visible, in particular in older ascomata with recurved thalline margins, predominantly fused, sometimes partly becoming slightly detached, whitish, thalline rim margin thick, split to rugged or coarsely lobed, becoming erect to recurved, in older ascomata sometimes eroded, often slightly pruinose internally, ±whitish or brighter than thallus, concolorous with thallus marginally. Exciple fused to apically slightly free, moderately thin to moderately thick, pale yellowish internally to yellowish-brown or (dark-)brown marginally, apically often dark brown and covered with grayish granules, sometimes slightly amyloid at the base. Hymenium up to c. 120 µm high, non-inspersed, moderately conglutinated, paraphyses ±straight, parallel, with unthickened to slightly thickened, regular to slightly irregular tips, lateral paraphyses present, conspicuous, up to c. 25 µm long, subhymenium conspicuous, dark-brown to slightly carbonized. Epihymenium moderately thick, hyaline, with ±coarse grayish granules. Asci 8-spored, tholus thick, thin when mature. Ascospores typical, (moderately) small, transversely septate, cell walls and endospore thick, non-halonate, hyaline, distinctly amyloid in mature ascospores, rarely ellipsoid to predominantly fusiform with narrowed-roundish to acute ends, loci roundish to somewhat angular, predominantly lentiform to irregular-lentiform with predominantly cone-shaped endcells, septae (moderately) thick, often becoming irregular, 25-45 x 7-10 µm with 8-12(14) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Chapsa tibellii* was collected in Australia on tree bark in tropical rainforests and a wet sclerophyll forest in elevations ranging from 800 - 1200 m. It is a rare species only known from the Atherton Tablelands region in Northern Queensland.

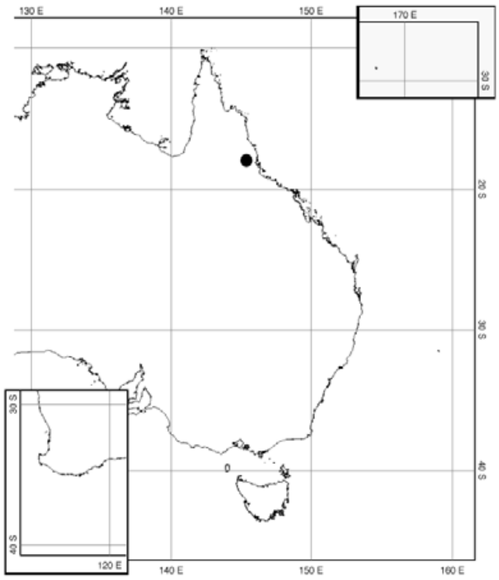

Fig. 41. Australian distribution of *C. tibellii*.

NOTES – It is a very characteristic species with a shiny, corticate, usually thick, verrucose to verruculose thallus with abundant crystal inclusions, conspicuous, large, distinctly chroodiscoid ascomata with bright-gray, pruinose discs and thick thallus margins, a dark subhymenium and moderately large, hyaline, transversely septate, amyloid, fusiform ascospores with thickened cell walls. *Chapsa dilatata* from the Neotropics[4] is a similar species that differs in chemistry (stictic acid chemosydrome) and in having smaller ascospores (up to 33 µm long, with up to 10 loci). Two species from Brazil are similar, both lacking secondary compounds and having ±similar sized, hyaline, transversely septate ascospores, *C. crispata*[5] and *C. elabens*[6]. *Chapsa crispata* has smaller ascospores (up to 25 µm long, up to 8 loci) and smaller, less distinctly chroodiscoid ascomata with a partly free exciple and a thinner thallus. *C. elabens* can by readily distinguished by the ecorticate, thin thallus, the inspersed hymenium and the larger ascospores (up to 50 µm long, up to 20 loci).

SPECIMENS EXAMINED – Australia, Queensland, Atherton Tablelands: Davies Creek Rd. 17 km S of Kennedy Hwy., S of Davies Creek Falls NP., E of Mareeba, *Hale 830916* (US); Plath Rd. logging head, 9 km W of Plath Rd., off Kennedy Hwy, Herberton Range, S of Atherton, *Hale 832395, 832679* (US); 10 km S of Ravenshoe on Tully Falls Rd., *Hale 831443* (US); Culpa logging area, 13 km from Koombooloomba rd. turnoff, SE of Tully Falls, *Hale 832705* (US); Dawson logging area, State Forest Reserve 605, 24 km S of Koombooloomba turnoff, WSW of Tully, *Hale 830881, 831654, 832392* (US).

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[4] Hale (1981) reports this taxa from Sri Lanka. However, Hale's collection found in US has large, densely eumuriform, non-amyloid ascospores and is an undetermined species of *Chapsa* close to *C. recurva/C. zahlbruckneri* (both types not seen).

[5] ***Chapsa crispata*** (Müll. Arg.) Mangold comb. nov. ined. Bas.: *Ocellularia crispata* Müll. Arg., Journ. Linn. Soc. London, Bot., 30: 452 (1895). Type: Brazil, Rio de Janeiro, (ex hb. Kew 1894), *Portella* s.n. (G!-lectotype, here selected).

[6] ***Chapsa elabens*** (Müll. Arg.) Mangold comb. nov. ined. Bas.: *Ocellularia elabens* Müll. Arg., J. Linn. Soc. London, Bot. 30: 452 (1895). Type: Brazil, (ex hb. Kew 1894), s.c. (G!-lectotype, selected by Hale [1972, in hb.]).

2. 9. 2. ***Chroodiscus*** (Müll.Arg.) Müll.Arg., Lichenes epiphylli novi: 18 (1890). Type species: *Platygrapha coccinea* Leight. [= *C. coccineus* (Leight.) Müll.Arg.]. Type: Brazil, *Spruce 443* (BM-lectotype).

Ocellularia sect. *Chroodiscus* Müll.Arg., Flora 66: 352 (1883a). *Phyllophthalmaria* sect. *Chroodiscus* (Müll. Arg.) Zahlbr., in Engler-Prantl, Die natürlichen Pflanzenfamilien I, 1: 120 (1905).

Phyllobrassia Vain., Ann. Acad. Sci. Fenn., ser. A 15(6): 173 (1921a). Type species: *Platygrapha mirifica* Kremp. [= *C. mirificus* (Kremp.) R. Sant.]. Type: Borneo, *Beccari 229 b* (M-holotype).

THALLUS – Crustose, foliicolous, thin, epiphyllous, up to c. 40-50 µm high, pale greenish to pale grayish-green. Surface dull to shiny, smooth, continuous to slightly verruculose, unfissured. Prothallus absent. True cortex absent, covered by a thin, discontinuous protocortex up to c. 10 µm thick. Algal layer well developed, continuous, crystals abundant, small to moderately large, forming a ±continuous layer beneath the algal layer. Distinct medulla layer absent. Vegetative propagules not known from the Australian taxa, discoid isidia known from *C. mirificus*.

ASCOMATA – Conspicuous, moderately small to moderately large, up to c. 300-600 µm in diam., roundish to rarely slightly elongated or irregular in fused ascomata, chroodiscoid from early stages on, non-regenerating, solitary to fused, immersed to slightly raised. Disc visible from surface, bright orange to reddish-orange or (pale) grayish to (pale) grayish-brown epruinose or pruinose. Proper exciple not visible from surface, thalline rim margin moderately thin to moderately thick, rarely entire, otherwise slightly to distinctly split, ±distinctly lobed, ±eroded, particularly in older stages, slightly incurved to more often erect to distinctly recurved. Proper exciple fused, thin to evanescent or moderately thick, non-amyloid. Subhymenium indistinct, evanescent, hyaline to slightly grayish. Hymenium non-amyloid, discoid, up to c. 50-60 µm high, non-inspersed, clear, moderately to distinctly conglutinated, paraphyses thin, straight, parallel to slightly interwoven, unbranched, tips not thickened to slightly thickened, lateral paraphyses absent. True columella or columellar structures absent. Epihymenium thin to moderately thick, hyaline or pale orange to rust-red, granulose.

Asci 8-spored, tholus moderately thin to thin or moderately thick, non-amyloid, clavate. Ascospores uni- to biseriate, small, 7-15 x 2-4 µm, transversely septate, cell walls moderately thin, smooth, non-halonate, hyaline, non-amyloid, ellipsoid to fusiform, straight, with 2-6 loci, end cells hemispherical to more often conical, loci large, ±angular, cuboid, septae moderately thin to thin, regular to irregular.

PYCNIDIA – Not known.

CHEMISTRY – Secondary compounds present, containing the stictic acid chemosyndrome and unknown anthraquinones.

ECOLOGY AND DISTRIBUTION – The *Chroodiscus* species in Australia occur on living leaves in altitudes ranging between 20 and 800 m. The distribution is restricted to tropical rainforests of the eastern coast of northern Queensland. Both taxa occurring in Australia are pantropical.

NOTES – Besides Hales' inclusion in *Thelotrema* (1981), this comparably well-known and well separated taxonomic group of Thelotrematacae has been treated as a distinct genus ever since Müller's introduction as an independent genus in 1890. Several authors recently (Kalb, 1991; Kantvilas & Vezda, 2000; Staiger, 2002; Vezda, 1992) included corticolous and temperate foliicolous taxa with lateral paraphyses which are now grouped in *Acanthotrema*, *Chapsa* and *Topeliopsis*.

The genus is readily characterized by small, foliicolous thalli, distinctly chroodiscoid ascomata without lateral paraphyses, small, hyaline, non-amyloid ascospores and a distribution strictly restricted to tropical rainforests. Similar genera include *Acanthotrema*, *Chapsa* and *Reimnitzia*, all well distinguished by a different ecology, larger thalli and (except the latter, see below) lateral paraphyses. The presence of lateral paraphyses in *Reimnitzia* is uncertain (see also there), however, this monotypic genus is further distinguished from *Chroodiscus* by a thick and bulging thallus, slightly branched hymenia and brown ascospores.

The report of *C. mirificus* for Australia (Lumbsch & Vezda, 1990) was based on a misidentification of *C. parvisporus*.

Species descriptions:

Chroodiscus australiensis Vezda & Lumbsch

Nova Hedwigia 50: 246 (1990). Type: Australia, Queensland, Atherton Tableland, Souita waterfalls, *Lumbsch 5437/17 ei*, (F!-holotype, hb. Vezda-isotype).

ILLUSTRATION – Fig. 42.

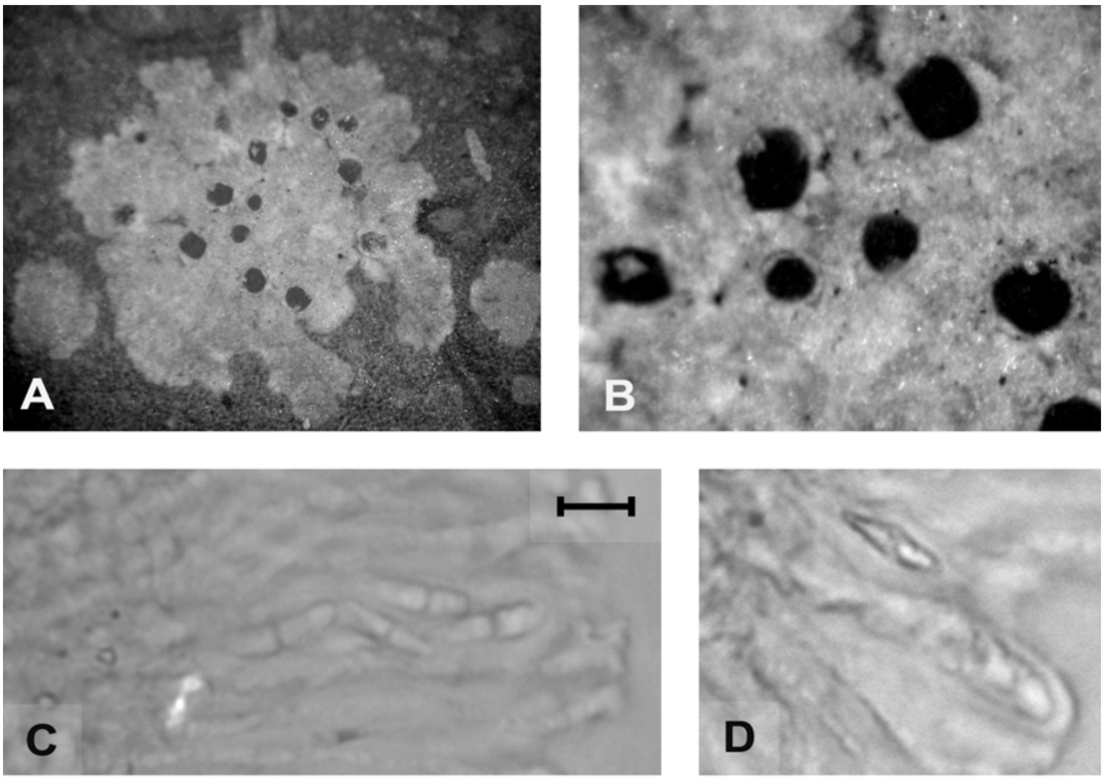

Fig. 42. *Chroodiscus australiensis*: growth habit (**A**), ascomata (**B**) and asci and ascospores (**C, D**). A.-D.: F-holotype. Bar= A: 1 mm; B: 275 µm; C: 7.5 µm; D: 5 µm.

Thallus epiphyllous, thin, up to c. 40 µm high, pale greenish. Surface dull to shiny, smooth, continuous, unfissured. True cortex absent, covered by a thin, incontinuous protocortex up to c. 10 µm thick. Algal layer well developed, continuous, crystals abundant, small to moderately large, forming a ±continuous layer beneath the algal layer. Vegetative propagules not seen. Ascomata conspicuous, moderately small, up to c. 300 µm in diam., roundish, chroodiscoid, solitary to marginally slightly fused, immersed to slightly raised. Disc predominantly entirely visible from surface, bright orange to reddish-orange, epruinose. Proper exciple not visible from surface, thalline rim margin moderately thin, entire to slightly split, ±distinctly lobed only in younger ascomata, in older stages becoming eroded, predominantly pale orange, slightly incurved to erect to more rarely recurved. Proper exciple fused, thin to evanescent, pale orange, non-amyloid. Hymenium up to c. 50 µm high, non-inspersed, pale orange, moderately conglutinated, paraphyses straight, parallel to slightly interwoven, unbranched, tips unthickened to slightly thickened, lateral paraphyses absent. Epihymenium moderately thick, pale orange to rust-red, with rust-red, moderately small crystals. Asci 8-spored, tholus (moderately) thin, not visible at maturity. Ascospores very small, transversely septate, cell walls moderately thin, endospore lacking, non-halonate, hyaline, non-amyloid, ellipsoid to more often fusiform with narrowed roundish to subacute ends, loci predominantly conical, in 3-locular ascospores internal locus angular, septae (moderately) thin, 7-10 x 2-3 µm with 2(3) loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing stictic and hypostictic (majors) acids, ascomata K+ purplish, containing an unknown orange to rust-red anthraquinone.

ECOLOGY AND DISTRIBUTION – *Chroodiscus australiensis* was collected in Australia on living leaves in tropical rainforests in altitudes ranging between 50 and 700 m. It is a rare species occurring in northern Queensland. Besides Australia it was reported from the Neotropics, Africa and South-East Asia (for references see Frisch, 2006), indicating a pantropical distribution.

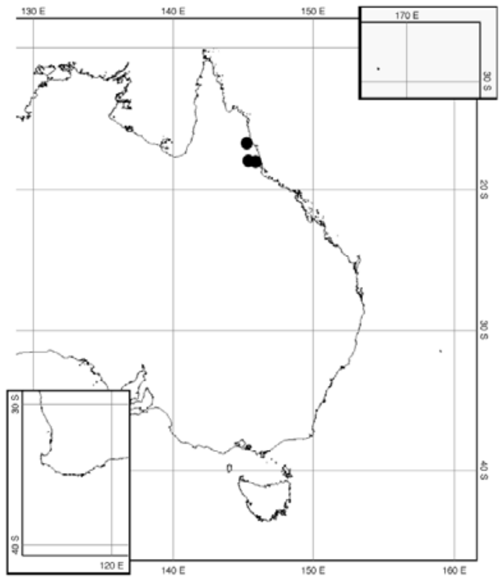

Fig. 43. Australian distribution of *C. australiensis*.

NOTES – This taxa is a conspicuous foliicolous lichen that is readily characterized by the reddish-orange ascomata and the 2(3)-celled ascospores. For differences to *C. parvisporus*, the only other member of *Chroodiscus* in Australia, see under that species. On the world level the pantropical *C. coccineus* is morphologically similar, it can be distinguished by a distinctly verruculose thallus surface and larger ascomata (up to c. 500 µm in diam.) and ascospores (up to 12 µm long, with up to 4 loci).

SPECIMENS EXAMINED – Australia, Queensland: Daintree NP., W of Mossman, *A. & K. Kalb 25376* (F). Atherton Tablelands, Souita waterfalls, *Lumbsch 5437 zc, zg, ep, zh* (F). Bellenden Ker NP., Boulders area, *Aptroot 22443, 22458* (B), *22431* (ABL). Palmerston NP., near Tchupala Falls, *Aptroot 22580* (ABL). Daintree NP., W of Mossman, *A. & K. Kalb 25376* (F).

Chroodiscus parvisporus Kalb & Lücking

Stapfia 80: 271 (2002). Type: Australia, Queensland, surroundings of Daintree Village, Daintree River, *A. & K. Kalb* s.n. (hb. Kalb-holotype, not seen).

ILLUSTRATION – Fig. 44.

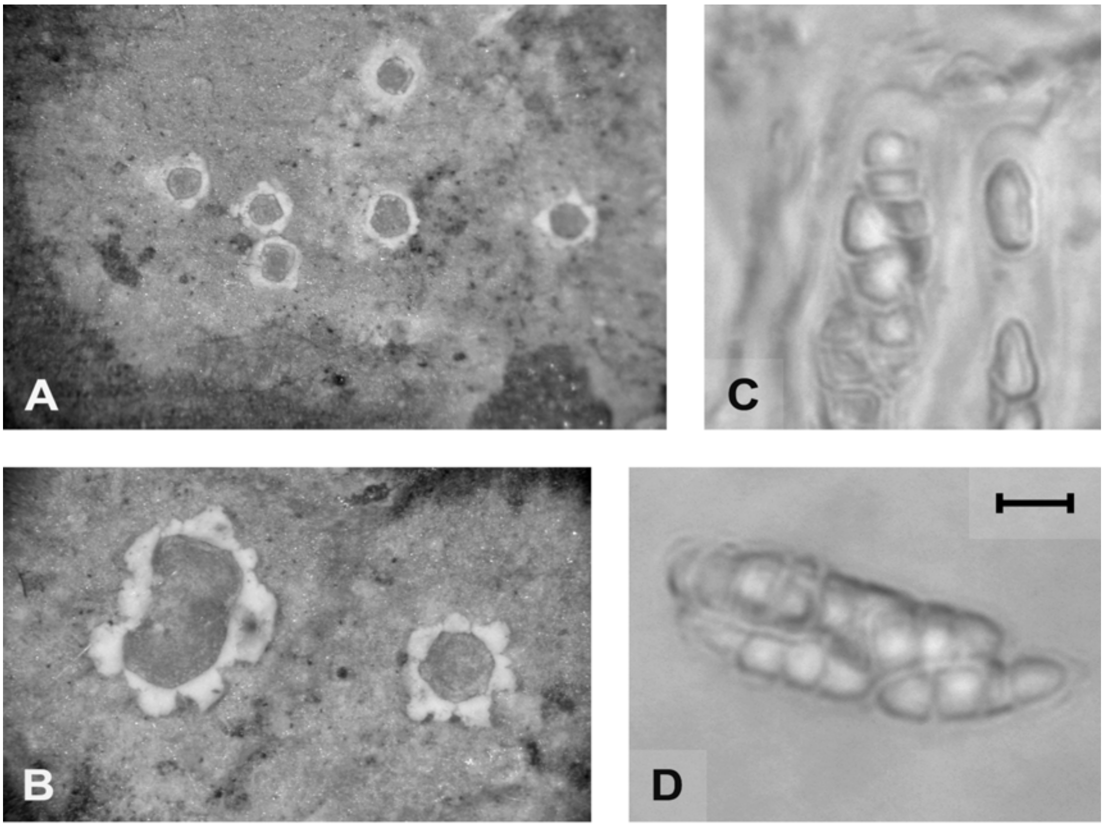

Fig. 44. *Chroodiscus parvisporus*: growth habit (**A**), ascomata (**B**), asci (**C**) and ascospores (**D**). A., B.: *A. & K. Kalb s.n.*; C., D.: *Lumbsch & Mangold 19126 a*. Bar= A: 0.8 mm; B: 250 µm; C, D: 5 µm.

Thallus epiphyllous, thin, up to c. 50 µm high, pale grayish-green. Surface dull to slightly shiny, smooth, continuous to slightly verruculose, unfissured. True cortex absent, covered by a thin, incontinuous protocortex up to 10 µm thick. Algal layer well developed, continuous, crystals abundant, small, forming a ±continuous layer beneath the algal layer. Vegetative propagules not seen. Ascomata conspicuous, moderately large, up to c. 600 µm in diam., predominantly roundish to more rarely slightly elongated, irregular in fused ascomata, chroodiscoid, solitary to fused, usually slightly raised. Disc predominantly entirely visible from surface, (pale) grayish to (pale) grayish-brown, epruinose to slightly pruinose. Proper exciple not visible from surface, thalline rim margin thick, split and ±distinctly lobed, often somewhat eroded, off-white, erect to predominantly recurved. Proper exciple fused, moderately thick, pale brownish to pale grayish-brown, non-amyloid. Hymenium up to c. 60 µm high, non-inspersed, distinctly conglutinated, paraphyses straight, parallel to slightly interwoven, unbranched, tips unthickened to slightly thickened, lateral paraphyses absent. Epihymenium thin to indistinct, hyaline, with a few fine ±colorless granules and small crystals. Asci 8-spored, tholus moderately thick throughout development, lateral walls moderately thick, thin when mature. Ascospores very small, transversely septate, cell walls moderately thin, endospore lacking, non-halonate, hyaline, non-amyloid, oblong to ellipsoid with roundish to slightly narrowed roundish ends, loci predominantly angular with conical to hemispherical end cells, septae (moderately) thin, irregular, 10-15 x 3-4 µm with 3-6 loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing stictic, constictic (majors), hypoconstictic, hypostictic (minors) and α-acetylconstictic (trace) acids.

ECOLOGY AND DISTRIBUTION – *Chroodiscus parvisporus* was collected in Australia on living leaves in tropical rainforests in altitudes ranging between 20 and 800 m. It is a rare species occurring in northern Queensland. Besides Australia it was reported from the Neotropics and Indomalaysia (Lücking & Grube, 2002), indi-cating a pantropical distribution.

NOTES – This taxon is characterized by the grayish to brownish discs, transversely septate, relatively large ascospores and the stictic acid chemosydrome compounds. *Chroodiscus australiensis* differs in smaller ascospores (up to 10 µm with up to 3 loci) and reddish, K+ purple discs, containing an unknown anthraquinone.

Fig. 45. Australian distribution of *C. parvisporus*.

SPECIMENS EXAMINED – Australia, Queensland: Surroundings of Daintree Village, *A. & K. Kalb* s.n. (F). Atherton Tablelands: Curtain Fig Tree, *Lumbsch 5427/8-zh* (F); Souita Falls, *Lumbsch 5437/10-zii, 5437/17-eh* (F); Lake Euranoo, *Lumbsch & Mangold 19126 a* (F).

2. 9. 3. ***Fibrillithecis*** Frisch, Bibl. Lichenol. 92: 135 (2006). Type species*: Thelotrema vernicosum* Zahlbr. [=*F. halei* (Tuck. & Mont.) Mangold comb. nov. ined.]. Type: U.S.A., Hawaii, Oahu, *Rock 101* (W-lectotype).

Thelotrema sect. *Tremotyliopsis* Zahlbr., Denkschr. Kaiserl. Akad. Wiss. Wien, math.-naturw. Klasse 83: 120 (1909). Type species: *Thelotrema insigne* Zahlbr., Denkschr. Kaiserl. Akad. Wiss. Wien, math.-naturw. Klasse 83: 120 (1909). Type: Brazil, São Paulo. *Wettstein & Schiffner* s.n. (W-holotype).

Fibrillithecis halei is the only known species in Australia, for a description see there.

NOTES – This recently described new genus was introduced to accommodate three taxa (*F. insignis*, *F. platyspora*, *F. vernicosa*) predominantly characterized by a distinctly fibrous proper exciple. Only two species are accepted here, viz. *F. halei* and *F. insignis* which are distinguished by the occurrence of isidia. In *F. halei* isidia are absent, in *F. insignis*, which is not known from Australia, distinct cylindrical, branched isidia are present. *Fibrillithecis platyspora* and *F. vernicosa* are considered synonymous to *F. halei*, see notes in the description of this species.

The taxonomic uncertainties in this group are reflected in the combination of *Fibrillithecis* taxa in Hale's exciple structure-based classification (1980, 1981). The two species where either treated as *Thelotrema* (e.g. as *T. piluliferum* or *T. platysporum* [=*T. halei*]) based on the interpretation of the apical excipular fibrils as lateral paraphyses, or *Myriotrema* (as *M. insigne* [=*F. insignis*]) due to a stronger emphasis of characters as the perithecioid ascomata and the fused proper exciple. *Myriotrema* is the most similar genus to *Fibrillithecis*, which is also supported by molecular data (Frisch & al., 2006). The two genera are distinguished by the structure of the apical proper exciple, in *Myriotrema* distinct fibrils are absent. Frisch (2006: 137) further gives a different structure of the cortex as a separating character.

Species description:

Fibrillithecis halei (Tuck. & Mont.) Mangold comb. nov. ined.

Bas.: *Porina halei* Tuck. & Mont., Annal. Scienc. Nat. Bot. 4(8): 295 (1857). *Thelotrema halei* (Tuck. & Mont.) Nyl., Annal. Scienc. Nat. Bot. 4(11): 221 (1859). Type: Venezuela, Dec. 1838, *Fendler* s.n. (FH-Tuck.!-lectotype, selected by Hale [1972 in hb.]; H-Nyl.-isolectotype).

Thelotrema argenteum Müll.Arg., Hedwigia 30: 50 (1891). Type: Australia, Queensland, Bellenden Ker, *Bailey 547* (G-holotype; BM!-, BRI!-, C!-, NSW!-, NY!-, TNS!-, WIS!-isotypes).

Thelotrema pachystomum ssp. *piluliferum* Tuck., Proc. Amer. Acad. Arts Sci. 7: 227 (1866). Type: U.S.A., Hawaii, Oahu, Waiahu Mtns., *Mann s.n.* (FH-Tuck.!-lectotype, re-selected by Frisch [2006: 140]; G-, W-isolectotypes).

Thelotrema vernicosum Zahlbr., Ann. Mycol. 10: 370 (1912). *Fibrillithecis vernicosa* (Zahlbr.) Frisch, Bibl. Lichenol. 92: 140 (2006). Type: U.S.A., Hawaii, Oahu, Koolau Mnts., *Rock 101* (W-lectotype, selected by Hale [1981: 264]; FH!-isolectotype).

Thelotrema platysporum Harm., Bull. Soc. Sci. Nancy, 3(13): 41 (1912). *Fibrillithecis platyspora* (Harm.) Frisch, Bibl. Lichenol. 92: 137 (2006). Type: ?New Caledonia/Australia ("pro maxima parte in Nova Caledonia, pro minima vero in Australia collecti"), *Pionniero 38* (DUKE-lectotype, selected by Hale [1981: 266]; FH!-, W-isolectotypes).

Thelotrema gibbosum H. Magn., in Magnusson & Zahlbruckner, Ark. Bot. 31 A(1): 53 (1943). Type: Hawaii, W. Maui, Haelaau, *Selling 5836* (UPS-lectotype, selected by Hale [1981: 264]; S-isolectotype).

Thelotrema diminitum Hale, Phytologia 27: 494 (1974). Type: Sarawak, Bako National Park, *Hale 30536* (US!-holotype).

ILLUSTRATION – Fig. 46.

Thallus corticolous to rarely muscicolous, epi- to hyposubstratic, moderately thin to moderately thick, up to c. 400 µm high, pale greenish- to yellowish-gray, dark olive-gray or off-white. Surface ±shiny, smooth to rarely partly somewhat pruinose, predominantly ±verrucose, usually fissured to more rarely somewhat areolate. True cortex present, continuous to sometimes discontinuous, up to c. 30 µm thick, consisting of irregular to periclinal hyphae. Algal layer ±well developed, continuous, with ±abundant, small to large calcium oxalate crystals, in (very) large clusters. Vegetative propagules not seen. Ascomata variable, usually conspicuous, (moderately) large, up to c. 1(1.5) mm in diam., roundish, somewhat irregular in fused ascomata, predominantly perithecioid to rarely apothecioid, solitary to fused, rarely somewhat clustered in groups, immersed to strongly emergent, then (flattened-)cylindrical to (flattened-)urceolate with continuous surface. Disc usually not visible from surface, in open to gaping ascomata partly visible, pale flesh-colored, with whitish pruina. Pores (very) small and opening at late maturity, sometimes wide to rarely gaping, up to c. 200 µm in diameter, usually not larger than c. 80 µm in diam., roundish to slightly irregular, pore margin rarely entire to fibrous and formed by the apical proper exciple, then usually ±sunken, fused proper exciple often becoming apically visible from surface due to evanescent thalline rim margin, concolorous with thalline rim to somewhat grayish or brownish, in some specimen proper exciple becomes partly to entirely detached, then visible from surface in its main upper parts, with whitish-pruinose surface. Thalline rim margin moderately thin to thick, roundish, entire to often ±eroded, small to moderately wide to rarely wide or gaping, incurved, predominantly concolorous with thallus. Proper exciple conspicuous, predominantly fused, rarely becoming ±free, thick to very thick, forming lateral paraphyses-like structures by apically distinctly radiating hyphae, hyaline internally to yellowish-brown or orange-reddish marginally, apically sometimes grayish-brown to dark-brown, non-amyloid. Hymenium up to c. 180 µm high, non-inspersed, highly conglutinated, paraphyses unbranched, parallel, ±bent, irregular and often distinctly multicellular, tips thickened, lateral paraphyses and columellar structures lacking. Epihymenium thin, hyaline, with fine grayish granules. Asci 8-spored, tholus moderately thick, thin when mature.

Ascospores (very) small, (sub-)muriform, cell walls moderately thin to moderately thick, endospore thick, in younger ascospores sometimes with thin halo, hyaline, distinctly amyloid, sub-globular to oblong with rounded ends, loci predominantly roundish, subglobular to oblong with same shaped end cells, transverse septae moderately thick, irregular, 10-30 x 7-15(18) µm with 4-6(8) x 1-4(6) loci. Pycnidia present, immersed or in thallus warts, conidia bacilliform, c. 2-4 x 0.5 µm.

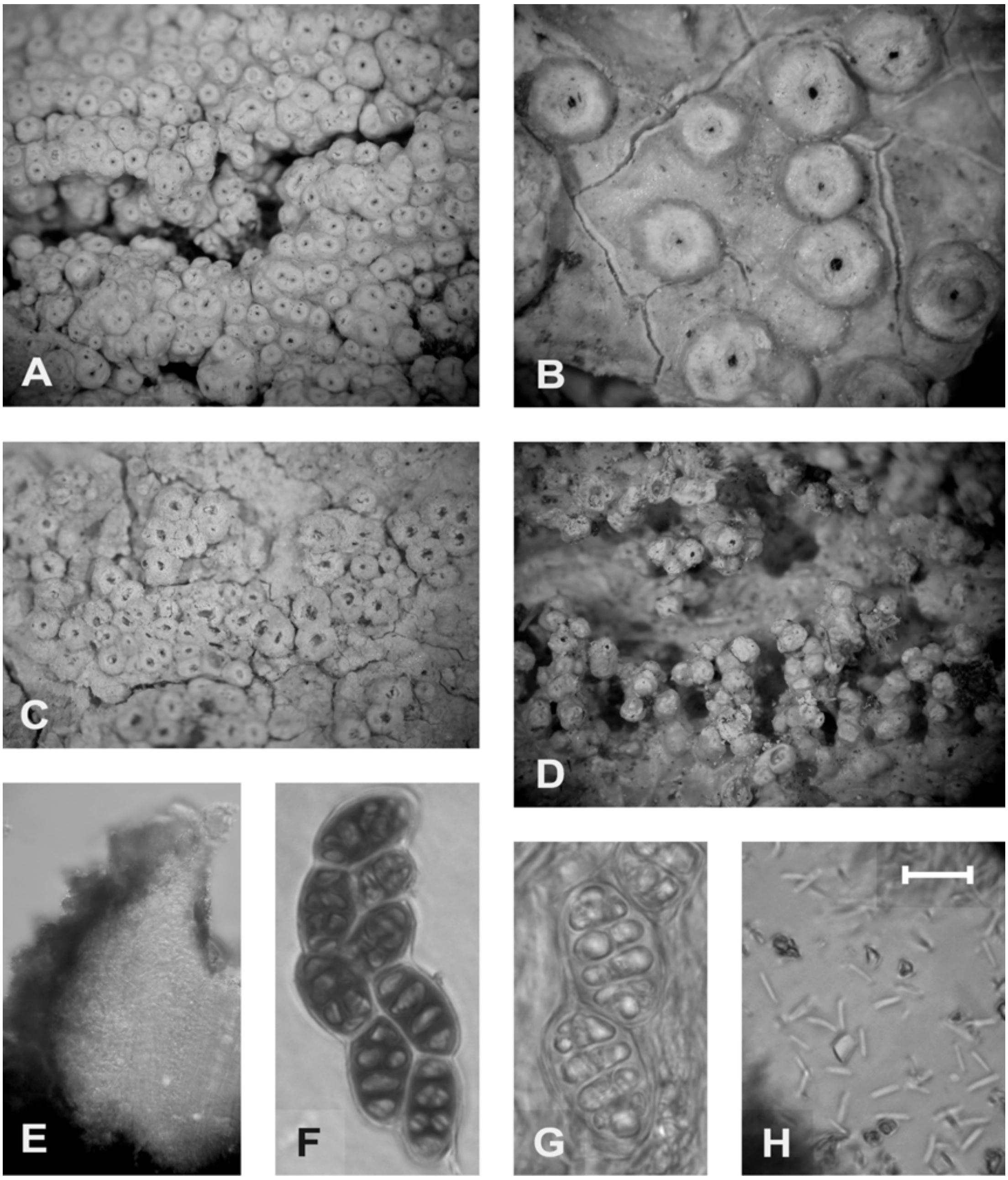

Fig. 46. *Fibrillithecis halei*: growth habit (**A, C, D**), ascomata (**B**), section of ascoma margin (**E**), ascospores showing amyloid reaction (**F**), ascospores (**G**) and conidia (**H**). A.: *Streimann 61845*; B., E., G.: FH-lectotype of *T. piluliferum*; C., F.: FH-lectotype; D.: *Weber & McVean* s.n.; H.: *Mangold 36 v*. Bar= A: 1.75 mm; B: 0.6 mm; C, D: 1.5 mm; E: 50 µm; F:15 µm; G: 10 µm; H: 6 µm.

CHEMISTRY – Thallus K-, C-, PD+/- yellow; containing an unknown sterol ['platysporum unknown': Rf 57 in B', (dark-)brown after charring with yellowish to greenish aurora in UV] (major to minor or lacking), psoromic (major to trace or lacking), 2'-0-demethylpsoromic (minor to trace or lacking) acid, and sometimes traces of other unknown substances of the psoromic acid chemosyndrome.

ECOLOGY AND DISTRIBUTION – *Fibrillithecis halei* grows on tree bark and bryophytes in (sub-) tropical rainforests and mangroves in altitudes ranging from sea level to 1350 m. It is common and wide-spread in northern Queensland and New South Wales. This pantropical species was reported from Hawaii, U.S.A. (Harris, 1990), Venezuela, Africa (Frisch, 2006), Réunion (Kalb, 2001), India (Nagarkar & al., 1985), Sri Lanka (Hale, 1981), Borneo (Hale, 1974, 1981; Sipman, 1993), New Caledonia (Hale, 1981).

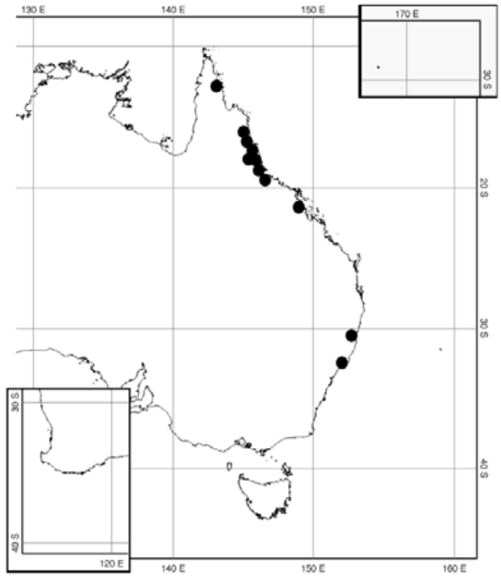

Fig. 47. Australian distribution of *F. halei*.

NOTES – This taxon is characterized by the corticate thallus, large, usually perithecioid, ±emergent ascomata, the thick, fibrous proper exciple, moderately small, muriform, thick-walled, hyaline, amyloid ascospores and the presence of the psoromic acid chemosydrome and/or 'platysporum unknown'. It is variable in morphology and chemistry, while its ascospore and ascomata anatomy is homogenous. In his treatment, which includes the introduction of the new genus *Fibrillithecis*, Frisch (2006) separated three different taxa, the isidiate *F. insignis* and two non-isidiate species: *F. vernicosa* (containing psoromic acid) and *F. platystoma* (containing 'platystoma unknown'). Since chemically intermediate forms, containing both compounds, were found in the Australian collections, the latter two names are regarded as conspecific. The type collection of *Porina halei* from Venezuela in FH agrees well with the paleotropic material despite ascomata with distinctly free proper exciple and a strongly verrucose thallus surface. The latter feature, interpreted as isidia by Harris (1990), can be found in less distinct form in several other specimen of *F. halei* and do not confirm with the 'true' isidia found in *F. insignis*. The detached proper exciple, however, is most likely due to depauperisation of the collection.

SPECIMENS EXAMINED – Australia, Queensland: Lockhart River Settlement road, 36 km SW of Cape Weymouth, *Streimann 56621* (B, CANB, H). Cooktown, trail from Grassy Hill to Cherry Tree Bay, *Lumbsch & Guderley 11173i* (F). Annan River, Grass Tree Pocket Rd., 38 km S of Cooktown, *Streimann 46374* (B, CANB). Mt. Windsor, 5 km W of new Forestry Camp, NW of Mossman, *Hale 830644, 831876, 831950, 832644* (US). Mossman River Gorge, (Hale exsic. as *T. diminitum*, distrib. Univ. of Colorado Museum, no. 453), *Weber & McVean* s.n. (BM, CANB, COLO, H, MEL, NSW, S, US); *Mangold 36 v* (F). Fresh Water Gorge, outside of city of Cairns, *Hale 830746* (US). Fitzroy Island on Great Barrier Reef, 25 km E of Cairns, *Aptroot 22280* (ABL). Atherton Tablelands: Davies Creek Rd. 17 km S of Kennedy Hwy., S of Davies Creek Falls NP., E of Mareeba, *Hale 832125* (US); SW of K-1 tree rd. off Palmerston Hwy., 11 km from main hwy. and 2 km N of S.Johnstone Forestry Camp, SE of Millaa Millaa, *Hale 832413, 832684, 832729* (US); 23 km E of jct. Kennedy Hwy and Palmerston Hwy, E of Ravenshoe, *Hale 832098* (US). The Boulders, NW of Babinda, S of Cairns, *Hale 831371* (US). 3 km N of Garradunga, Graham Range, N of Innisfail, *Hale 831208* (US). State Forest area on Tully Rd., 1 km from jct. with S. Mission Beach Rd., S of Mission Beach, *Hale 831122, 831226, 831754* (US). Dawson logging area, State Forest Reserve 605, 24 km S of Koombooloomba turnoff, WSW of Tully, *Hale 830607, 830613* (US). Culpa logging area, 13 km from Koombooloomba rd. turnoff, SE of Tully Falls, *Hale 832211* (US). Edmund Kennedy NP.: On Clift Rd., NW of Cardwell, *Hale 832818, 832819* (US); Few km N of

Cardwell, *A. & K. Kalb 34285* (hb. Kalb). Kennedy North district, near Meunga Creek, 4 km N of Cardwell, *Streimann 61845* (B, CANB). Hinchinbrook Isld., northern end, *Gilbert 75/797* (HOB). 7.5 km E of Wallaman Falls, W of Ingham, *Hale 69167, 69171, 832250* (US). Little Crystal Creek Falls, Mt.Spec NP., the falls on Paluma Rd., *Hale 831204* (US). Cape Hillsborough NP., NW of Mackay, *Hale 831705, 832470* (US). New South Wales: New England NP., along Tree Fern Gully, *Wedin 3591* (UPS). Werrikimbe NP., Beech Plateau, 80 km NW of Port Macquarie, *Streimann 63965* (B, CANB). Burraga Swamp, Allyn River Forest Park, *Kantvilas* s.n. (NSW). Gloucester Tops, *Kantvilas* s.n. (NSW). Malaysia, Borneo, Sabah, *Hale 28344* (US).

2. 9. 4. ***Leptotrema*** Mont. & Bosch, in Miquel, F.A.W., Plantae Junghuhnianae. 4: 483 (1855). Type species*: Leptotrema zollingeri* Mont. & Bosch. Type: Java, *Zollinger 738* (L-holotype).

Leptotrema wightii is the only known species in Australia, for a description see there.

NOTES – This recently resurrected genus (Frisch, 2006) traditionally included taxa with brown, muriform ascospores according to Müller's (1887c) ascospore-based classification. In Hale's revised generic concept (1980, 1981) it was synonymized with *Myriotrema* based on the absence of lateral paraphyses and carbonization. Frisch (2006) only accepts one species, *L. wightii*. In contrast, I accept an additional taxon. The type species *L. zollingeri* was considered conspecific with *L. wightii* by Frisch (ibid.) but is considered here a distinct species based on a different chemistry (see also notes under *L. wightii*).

The genus is accepted here tentatively and needs evaluation by molecular data. It is distinguished from the similar genus *Leucodecton* by two characters, the 'sac-like' asci without a tholus, and ascospores with an early thick-walled stage. *Reimnitzia* has similar ascospores but differs by its *Geaster*-like ascomata and asci with a ±distinct tholus. The differences in exciple morphology (*Thelotrema*-type proper exciple in *Reimnitzia*) stated by Frisch (ibid.) could not be confirmed, since no lateral paraphyses where found in the *Reimnitzia* specimen examined. *Myriotrema* is another similar genus, readily distinguished by its excipular structure with ±radiating apical hyphae, further also differing in asci with a ±distinct tholus and ascospores with comparably thin walls in immature stages. *Leptotrema*-like asci and ascospores with thick walls from early stages on can also be found in species belonging to genera which are otherwise well separated: These include *Chapsa lamellifera* that has 'Leptotrema-type' asci and *Ocellularia bahiana* with similar ascospores. Other specific characters for *Leptotrema* include a basal thallus layer of conglutinated hyphae, which also occurs in *R. santensis*, and the columnar arrangement of calcium oxalate crystals that occurs in several other species (e.g. *R. santensis, Myriotrema phaeosporum, Thelotrema myriocarpum, Leucodecton compunctellum*).

Species description:

Leptotrema wightii (Tayl.) Müll. Arg.

Flora 65: 499 (1882). Bas.: *Endocarpon wightii* Tayl., Lond. J. Bot. 6: 155 (1847). *Thelotrema wightii* (Tayl.) Nyl., Mém. Soc. Sci. Cherbourg 5: 118 (1857). *Phaeotrema wightii* (Tayl.) Zahlbr., Ark. Bot. 31A(1): 48 (1944). *Myriotrema wightii* (Tayl.) Hale, Mycotaxon 11: 135 (1980). Type: India, Madras, *Wight* s.n. (FH-Tayl.!-lectotype, selected by Hale [1974b: 43]; BM!-, G-isolectotypes).

Endocarpon baileyi Stirt., Trans. Proc. Roy. Soc. Vict. 17: 74 (1881). - *Leptotrema baileyi* (Stirt.) Shirl., Proc. Roy. Soc. Queensl. 6: 194 (1889). Type: Australia, Queensland, Brisbane, 1878, *Bailey 249* (GLAM-holotype; BRI!-isotype).

Thelotrema ravenelii Tuck., Amer. J. Arts and Sci, ser. 2, 25: 426 (1858). *Leptotrema ravenelii* (Tuck.) Fink, Lichen Flora U.S.: 133 (1935). Type: U.S.A., South Carolina, *Ravenel 151* (FH-Tuck.-lectotype, selected by Salisbury [1971b: 35]; NY!-, US!-isolectotypes).

Thelotrema subconcretum Leight., Trans. Linn. Soc. London 27: 169 (1869). *Phaeotrema subconcretum* (Leight.) Müll. Arg.: Mém. Soc. Phys. Hist. Nat. Genève 29(8): 10 (1887c). *Leptotrema subconcretum* (Leight.) Müll. Arg., Nuov. Giorn. Bot. Ital. 23: 277 (1891a). Type: Sri Lanka, Central Province, *Thwaites 89* (BM!-lectotype, selected by Hale [1974b: 43]).

[For additional synonymy see Frisch (2006), see also Mangold & al. (2006) regarding the synonymy of *Thelotrema leiospodium* Nyl. and the note below regarding *L. zollingeri* Mont. & Bosch.]

ILLUSTRATION – Fig. 48.

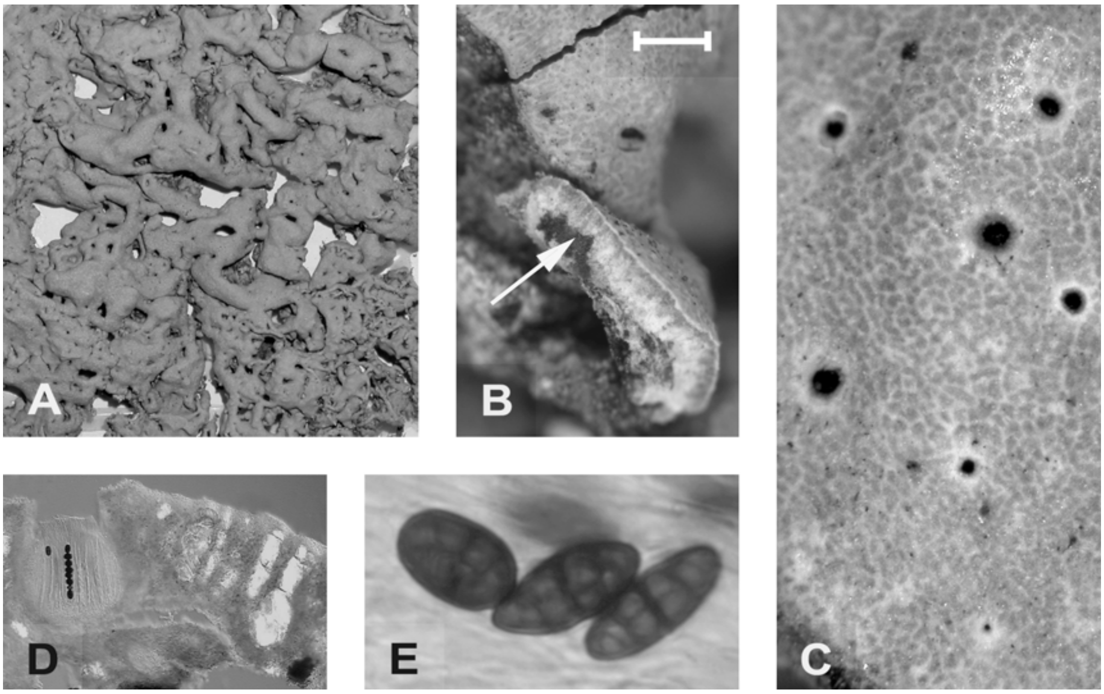

Fig. 48. *Leptotrema wightii*: growth habit (**A**), thallus section showing anthraquinone crystal cluster (arrow) (**B**), ascomata (**C**), ascoma and thallus section (**D**) and ascospores (**E**). A.: BRI–isotype of *E. baileyi*; B., E.: *Elix 35434*; C., D.: *Hale 831324*. Bar= A: 8 mm; B: 1.3 mm; C: 1 mm; D: 200 µm; E: 14 µm.

Thallus epiphloedal, thick to very thick, usually bulging and flaking away from the substrate, up to c. 1000 µm high, pale greenish gray. Surface dull, smooth, continuous to rarely rimose, with a bright reticulate structure, forming a grainy-speckled pattern, unfissured, sometimes coarsely cracked. True cortex absent, thallus covered by a ±continuous protocortex up to c. 20 µm thick. Algal layer well developed and continuous, becoming incontinuous due to crystal inclusions, calcium oxalate crystals abundant, large, clustered, forming columnar structures, medulla with conspicuous, frequent or rarely infrequent bright red anthraquinone crystals. Basal thallus sometimes formed of strongly conglutinated hyphae, forming a lower cortex-like structure. Vegetative propagules not seen. Ascomata inconspicuous, small to moderately large, up to c. 600 µm in diam., ±roundish, peri- to apothecioid, predominantly solitary, immersed. Disc usually not visible from surface, rarely becoming partly visible, pale to dark brown, epruinose. Pores small to wide to rarely gaping, up to c. 400 µm in diam., in mature ascomata formed by proper exciple, roundish to rarely slightly irregular, with entire margin, apical proper exciple becoming ±visible from the outside, forming a fused to somewhat (rarely distinctly) free inner pore margin, incurved and usually ±sunken, bright-translucent to off-white. Thalline rim margin thick, entire, with same form as pore margin, often brighter than thallus. Proper exciple predominantly fused to slightly detached, only in old, gaping ascomata becoming distinctly free, (moderately) thick, hyaline internally to yellowish or orange-brown marginally, sometimes with grayish granules incorporated, non-amyloid. Hymenium up to c. 250 µm high, non-inspersed, strongly conglutinated, paraphyses straight to slightly bent, parallel to somewhat interwoven, slightly branched towards the apical hymenium, with distinctly thickened tips, lateral paraphyses and columellar structures absent. Epihymenium moderately thin, hyaline, sometimes with fine grayish granules. Asci 8-spored, tholus or distinctly thickened parts absent. Ascospores (very) small, (sub-)muriform, cell walls thick in younger stages, in mature ascospores cell walls moderately thick to moderately thin, endospore (moderately) thin, non-halonate, becoming brown at early maturity, non-amyloid to faintly amyloid, subglobose to oblong to more rarely ellipsoid, with predominantly rounded ends, loci roundish to (slightly) angular, predominantly irregular, septae becoming (moderately) thin, irregular or often with one central, more distinct septum, 10-30 x 8-15 µm, with 3-6 x 1-4 loci. Pycnidia not seen, fide Frisch (2006) immersed or in thallus warts, conidia bacilliform, 5-7 x 1-1.2 µm.

CHEMISTRY – Thallus K- with K+ purple crystals, C-, PD-; containing an unknown anthraquinone (RF-values 33/14/14 in solvent systems A/B'/C).

ECOLOGY AND DISTRIBUTION – *Leptotrema wightii* was collected in Australia on bark of trees or shrubs, often overgrowing adjacent mosses. It was most frequently found in seasonally wet areas such as dry monsoon shrubs and forests mainly at river flats; rarely in rainforests. It occurs in tropical to warm-temperate climates in altitudes ranging from sea level to 1000 m. It is a common and wide-spread species, occurring throughout Queensland, northern and southern-central New South Wales. In Queensland it often extends somewhat into the hinterland. Besides Australia it was reported from Hawaii (Magnusson & Zahlbruckner, 1944), the Neo-tropics (Harris, 1990; Hale, 1974; Redinger, 1936), Africa (Frisch, 2006), India, Sri Lanka, Philippines (Hale, 1981), Sarawak (as *T. forminulosum*, Krempelhuber, 1875), indicating a pan(sub)-tropical distribution that extends into warm-temperate climates.

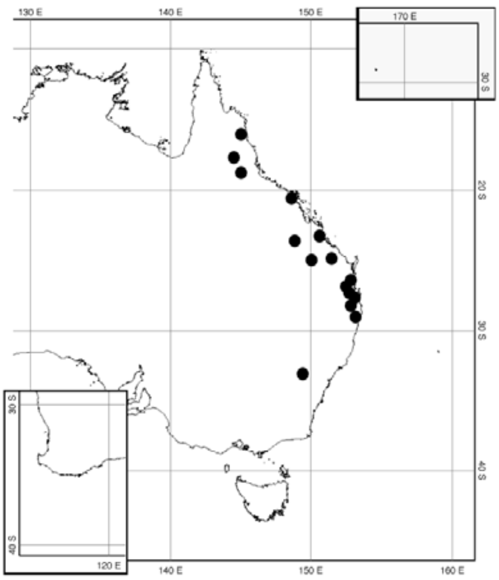

Fig. 49. Australian distribution of *L. wightii*.

NOTES – This taxon can be easily identified by the thick, bulging thallus with reticulate surface and conspicuous red anthraquinone crystals, immersed ascomata and small, (sub-) muriform, roundish, brown, non-amyloid ascospores with an irregular loci arrangement. A very similar species in Australia is *M. phaeosporum*, for differences see under that species. *Thelotrema leiospodium*, known from Europe and Macaronesia, was long treated as a synonym (Salisbury, 1971) but can be readily distinguished by the absence of anthraquinone crystals, the distinct lateral paraphyses and larger (up to 40 µm long, with up to 10 x 5 loci), fusiform ascospores. [See Mangold & al. (2006) for a more detailed discussion, see also there (ibid.) for a discussion of the taxonomic treatment of the similar *Leptotrema lithophila* Oxner described from far-east Asia.] The examined isotype of *L. zollingeri* in US (Java, *Zollinger 738* - holotype in L) contains the hypoprotocetraric acid chemosyndrome and lacks anthraquinone crystals. This taxon, listed as a synonym of *L. wightii* by Frisch (2006), is thus here regarded as a distinct species.

SPECIMENS EXAMINED – Uncertain location: Woolston (?New Zealand), *Wilson* s.n. (NSW-539379). Australia, Queensland: Bloomfield River, 55 km SSE of Cooktown, *Streimann 57282* (B, CANB). Royal Arch Caves NP., 5 km SW of Chillagoe, *Streimann 46481* (CANB). Forty Mile Shrub NP., 53 km E of Mount Surprise, *Streimann 46720* (CANB). Conway Range NP., near Shute Harbour-Airlie Beach, *Hale 831935* (US). Bunya Mountains NP.: 2 km E of Munro's Camp, *Scott 705* (BRI); Track from Dandabah to Pine George Lookout via Festoon Falls, *Lumbsch 10998i* (F); Just before leaving NP. on the N, *Hale 831324* (US). Port Curtis, Rockhampton, *Thozet 755* (G, M, MEL). Goodnight Shrub near Gympie, *Ryan* s.n. (BRI-689506). Moreton, Rosewood Shrub, *Bailey* s.n. (BRI-689507, MEL-5792). Booloumba Creek SF., SW of Kenilworth, *Hale 831285* (US). Maroochy, *Bailey 811* (BRI). 14 km WSW of Monto, *Streimann 9864* (CANB). Kalpowar Forest Drive, c. 40 km NE of Monto, *Hale 831183* (US). Mt. Mee SF., 6 km NW of Forestry Office, *Hale* 830853 (US). Hurdle Gully, Coominglah SF., *Elix 35434* (CANB). Isla Gorge NP., 27 km NNE of Taroom, *Elix 35133* (CANB). Pine Mountain SF., near Flutter Creek, *Elix 34790* (B, CANB). Between Springsure and Emerald, *McVean 6396* (COLO). Mt. Glorious near Brisbane, *Rogers* s.n. (BRI-689027). Mt. Beppo, near Esk, *Rogers* s.n. (BRI-689502). Lowood, *Wilson* s.n. (NSW-539381). 10.5 km SE of Toogoolawah, 2 km SE of Mt. Beppo, *Tibell 12530* (UPS). Brisbane, *Bailey* s.n. (G-10194/29-31). Lingalonga, Flagstone Creek near Toowoomba, *Swarbrick 694630* (BRI). Darling Downs, Toowoomba, *Hartmann* s.n. (G, MEL-26203). Cunninghams Gap NP., c. 40 km NW of Warwick, *A. & K. Kalb 21409* (hb. Kalb). Killarney, *Wilson* s.n. (NSW-539383). New South Wales: Wollongbar, *Wilson* s.n. (NSW-539382.A). Hillend, *Wilson* s.n. (NSW-539385). Uncertain location, 'Shirley book', p. 23, s.c. (BRI-AQ721246); 'Shirley book', p. 'D', s.c. (BRI-AQ721713).

2. 9. 5. ***Leucodecton*** Massal., Atti I. Reale Istit. Veneto, ser. 3, 5: 325 (1860). Type species: *Leucodecton compunctum* (Ach.) Massal. Type: India Occidentalis, on *Cinchona angustifolia*, s.c. (H-Ach.734!-lectotype, selected by Frisch [2006: 148]; UPS-isolectotype).

Enterostigma Müll. Arg., Flora 68: 254 (1885) [nom. superfl. pro *Leucodecton* Massal.]. *Chiodecton* subgen. *Enterostigma* (Müll. Arg.) Vain., Ètude Lich. Brésil 2: 138 (1890). *Enterostigmatomyces* Cif. & Thomas., Atti Ist. Bot. Lab. Crittog. Univ. Pavia, ser. 5, vol. 10: 73 (1953). Type species: *Enterostigma compunctum* (Ach.) Müll. Arg. [=*Leucodecton compunctum* (Ach.) Massal].

THALLUS – Crustose, corticolous, epi- to hypophloedal, moderately thin to moderately thick, up to c. 400-500 µm high, rarely up to 1 mm high. Mostly pale, in shades of gray or green with olive, yellowish or whitish tones, sometimes with grainy-speckled pattern. Surface dull to slightly shiny, smooth to ±farinose or rough, continuous to rugose or verrucose to verruculose, unfissured to fissured or more rarely rimose to areolate. Prothallus thin to indistinct, brown. Predominantly ecorticate, sometimes without cortical structures to usually without distinct true cortex and covered by a up to c. 10-30 µm thick, continuous to discontinuous protocortex, very rarely with distinctly conglutinated parts forming a partial true cortex consisting of irregular to rarely periclinal hyphae. Algal layer continuous and well developed to more rarely discontinuous and poorly developed, calcium oxalate crystals predominantly abundant, small to large, scattered to clustered, sometimes forming columnar structures, rarely forming layers in lower thallus (*L. subcompunctum*). Distinct medulla layer mostly absent, rarely present (*L. glaucescens)*. Vegetative propagules not seen, soralia occurring in *L. sorediiferum* (not known from Australia).

ASCOMATA – Predominantly inconspicuous to rarely conspicuous, small to moderately large, c. up to 400-600 µm in diam., usually roundish to slightly irregular, sometimes distinctly irregular or angular . Predominantly apothecioid to rarely perithecioid, solitary to marginally fused, sometimes also distinctly fused and clustered, forming stroma-like structures, non-regenerating, predominantly immersed to more rarely slightly raised to very rarely distinctly emergent, then hemispherical with same surface as thallus. Disc rarely not visible to more often partly or sometimes entirely visible from surface, grayish, distinctly pruinose. Pores small or moderately wide, rarely wide to gaping, c. up to 50-550 µm in diam., formed by proper exciple, roundish to irregular or angular, pore margin predominantly entire to more rarely slightly split or dentate. Proper exciple apically or in upper parts becoming visible from surface, usually distinctly free to rarely somewhat fused, particularly in younger stages, often conspicuously short, mostly whitish to off-white, more rarely grayish or brownish, sometimes shrunken, incurved to erect to more rarely somewhat recurved. Thalline rim margin moderately thin to moderately thick, roundish to slightly irregular, more rarely distinctly irregular or angular, predominantly wide to gaping, rarely small, entire to rarely slightly eroded, concolorous to ±brighter than thallus, in emergent ascomata incurved. Proper exciple usually apically or in upper parts free, at least in older stages, rarely thin to moderately thick, hyaline to pale yellowish or rarely pale brownish internally, yellowish or brownish, more rarely with orange or grayish tones marginally, apically sometimes darkish-brown to slightly carbonized, non-amyloid to more rarely faintly amyloid at the base. Subhymenium indistinct, thin and with same color as basal exciple. Hymenium non-amyloid, moderately to distinctly cupular, up to c. 120-200 µm high, non-inspersed, clear, moderately to strongly conglutinated. Paraphyses straight to ±bent, sometimes distinctly curly in apical parts, distinctly interwoven, predominantly slightly branched towards the margins, tips slightly to rarely distinctly thickened, rarely somewhat irregular. Lateral paraphyses and true columella absent, in fused ascomata sometimes columella-like structures present. Epihymenium hyaline, predominantly moderately thin to thick with grayish to brownish granules and often small crystals.

Asci predominantly 8-spored, rarely 1-4-spored, non-amyloid, clavate, ascus walls mostly not thickened and with moderately thin to thick, in mature asci thin to invisible tholus, sometimes younger asci without distinct tholus and with thickened ascus walls throughout, at maturity evenly thinning or thinning in lower parts only (*L. compunctellum* and *L. occultum*). Ascospores uni- to biseriate, very small to large, 7-130 x 5-35 µm, predominantly submuriform, more rarely eumuriform or transversely septate. Cell walls mostly moderately thick to thick, predominantly smooth to rarely crenate or irregular at late maturity, endospore in muriform ascospores thin to moderately thick, non-halonate, predominantly brown and non-amyloid to faintly amyloid, in *L. compunctum* (not known from Australia) hyaline to yellowish in depauperate ascospores and strongly amyloid (see also notes). Predominantly oblong to ellipsoid, more rarely subglobose or fusiform, transversely septate ascospores fusi- to claviform, with roundish to narrowed-roundish to more rarely subacute, very rarely distinctly acute ends; with 4-45 x 0-12 loci, loci roundish to angular, subglobose to lentiform or ±irregular, with same shaped to rarely hemispherical or conical end cells, transverse septae thin to moderately thick.

PYCNIDIA – Found in several species immersed with dark pore area, conidia variable, obovate to fusi- or bacilliform, up to c. 3-6 x 1 µm.

CHEMISTRY – Secondary compounds present to rarely absent (*L. compunctum*), predominantly of the stictic acid, rarely norstictic acid chemosyndrome.

ECOLOGY AND DISTRIBUTION – In Australia, *Leucodecton* species grow on tree bark predominantly in (sub)tropical to rarely warm-temperate rainforests and wet sclerophyll forests, more rarely in tropical mangroves, in altitudes ranging between sea level and 1500 m. They occur in north-western Northern Territory, and in Queensland to central New South Wales and Lord Howe Island. Four of the five currently known *Leucodecton* species occurring in Australia are pantropical, ±extending into subtropical or warm-temperate zones; *L. albidulum* is thus far only known in Australasia.

NOTES –This neglected genus was described by Massalongo (1860) and recently resurrected (Frisch, 2006).

The species in *Leucodecton* are mainly characterized by a predominantly ecorticate thallus, apothecioid ascomata with ±free proper exciple that consists of distinctly paraplectenchymatous hyphae without a parallel (basally) or radiating (apically) orientation and no distinct carbonization ("*Leucodecton*-type"), distinctly interwoven, often slightly branched paraphyses, and absence of lateral paraphyses. Further, most of the *Leucodecton* taxa have ±distinctly muriform, brown, non- to faintly amyloid ascospores and contain stictic or norstictic acid. Exceptions are *L. albidulum* with transversely septate ascospores and *L. compunctum* with hyaline, distinctly amyloid ascospores and no secondary metabolites.

The most similar genus is *Leptotrema*, for differences see under that genus. Also similar are members of *Myriotrema,* this genus is mainly distinguished by a different exciple type with parallel hyphae and radiating tips ('*Ocellularia*-type'). In particular *Myriotrema* species with brown ascospores and the stictic acid chemosyndrome are difficult to distinguish, see at *Myriotrema*.

Leucodecton forms a well supported clade in the molecular analysis of Frisch & al. (2006) and its distinction from *Myriotrema* (see above) is supported.

Species descriptions:

Leucodecton albidulum (Nyl.) Mangold comb. nov. ined.

Bas.: *Thelotrema albidulum* Nyl., Annal. Scienc. Nat. Bot. 4(15): 46 (1861). *Myriotrema albidulum* (Nyl.) Hale, Mycotaxon 11: 132 (1980). Type: Nova Caledonia, Balade, 1867, *Vieillard* s.n. (H-Nyl. 22767!-holotype; H-Nyl. 22770!-, PC-isotypes).

ILLUSTRATION – Fig. 50.

Thallus hypo- to predominantly epiphloedal, moderately thick, up to c. 500 µm high, off-white to (pale) grayish-green. Surface dull, smooth to more often finely pruinose, continuous to sometimes verrucose, ±distinctly fissured. Cortex structures absent. Algal layer well to sometimes poorly developed, continuous to incontinuous, calcium oxalate crystals abundant to more rarely sparse, scattered or clustered. Vegetative propagules not seen. Ascomata inconspicuous, moderately small to sometimes moderately large, up to c. 600 µm in diam., roundish to more often ±irregular, apothecioid, solitary to fused and clustered, sometimes forming stroma-like structures, predominantly immersed. Disc predominantly entirely visible from surface, grayish, pruinose. Pores wide to gaping, up to c. 550 µm in diam., formed by proper exciple, proper exciple apically visible from surface, free, rarely roundish to more often ±irregular or angular, predominantly entire, very short, whitish to off-white, often ±shrunken, erect to slightly incurved. Thalline rim margin moderately thin to moderately thick, roundish to roundish-irregular or angular, gaping, entire to slightly eroded, brighter than thallus or concolorous with thallus. Exciple becoming entirely free, thin, pale yellowish internally to yellowish-brown or brownish marginally, non-amyloid. Hymenium up to c. 120 µm high, non-inspersed, moderately conglutinated, paraphyses straight to slightly bent, distinctly interwoven, slightly branched towards the margins, lateral paraphyses and true columella absent, in fused ascomata sometimes with columella-like structures. Epihymenium (moderately) thick, with grayish-brown granules. Asci 8-spored, tholus (moderately) thick, thin when mature. Ascospores (moderately) small, transversely septate, cell walls moderately thin to moderately thick, becoming ±distinctly crenate to irregular at late maturity, endospore becoming (moderately) thick, non-halonate, brown, ±faintly amyloid, predominantly fusi- to claviform, sometimes slightly bent, with roundish to more often (sub)acute ends, loci angular in immature ascospores, becoming roundish and subglobose to slightly lentiform with maturity, end cells hemispherical to more often conical, septae moderately thin to moderately thick, regular, 25-45 x 5-7 µm with 8-12 loci. Pycnidia present, immersed with darkened pore area, conidia bacilliform, up to c. 6 x 1 µm.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing stictic (major), constictic, hypostictic (major to minor), α-acetyl-constictic, hypoconstictic and cryptostictic (traces) acids.

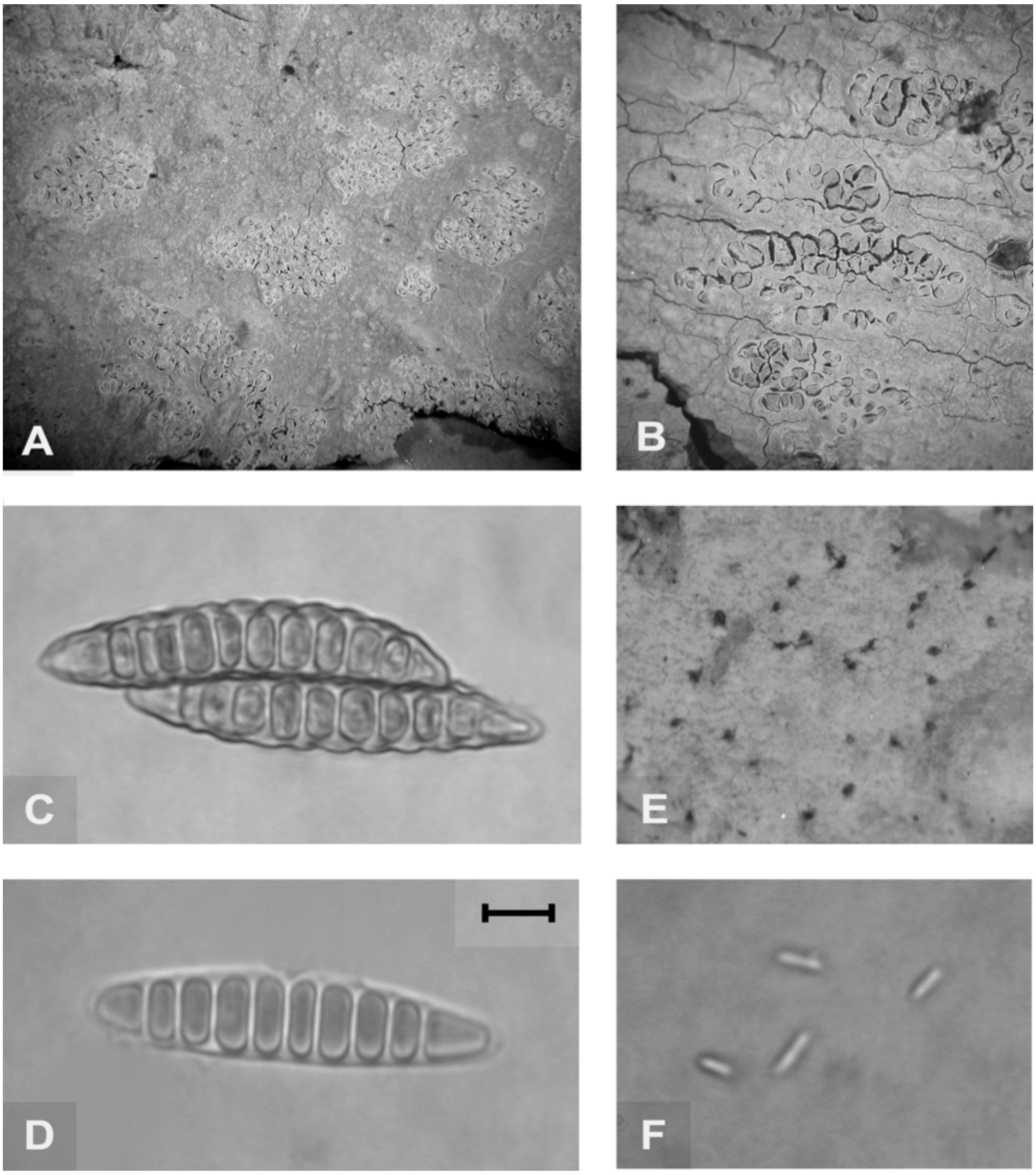

Fig. 50. *Leucodecton albidulum*: growth habit (**A**), ascomata (**B**), mature ascospores (**C**), immature ascospore (**D**), pycnidia (**E**) and conidia (**F**). A.: *Wilson* s.n. (NSW); B., D.: *Lumbsch & Mangold 19116 p*; C.: H-lectotype; E., F.: *Mangold 35 e*. Bar= A: 2 mm; B: 1 mm; C: 7.5 µm; D: 5 µm. E: 200 µm, F: 6 µm.

ECOLOGY AND DISTRIBUTION – *Leucodecton albidulum* was collected in Australia on tree bark in (sub)tropical rainforests in altitudes ranging from 200 to 900 m. It is a rare but widely distributed species occurring in northern and northern-central Queensland and in the Queensland/New South Wales border region. This is the first report for Australia, otherwise it is only known from the type location New Caledonia.

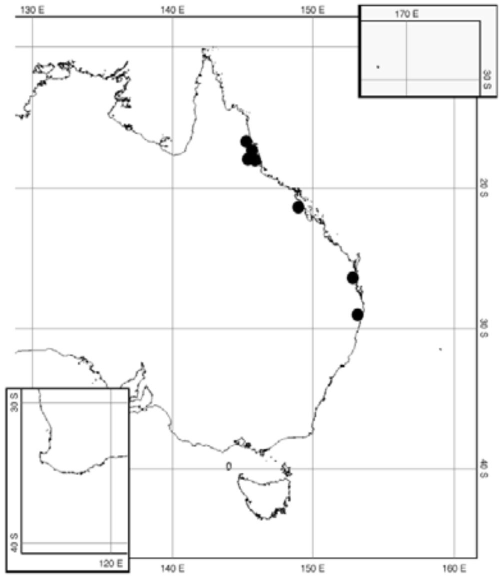

Fig. 51. Australian distribution of *L. albidulum.*

NOTES – This taxon is readily characterized by the thick, ecorticate thallus, the ±distinctly angular, clustered ascomata with stroma-like arrangement, the branched and interwoven hymenium the transversely septate, brown, narrow ascospores with (sub-)acute ends and the presence of the stictic acid chemosydrome. *Leucodecton samaranum* (Vain.) Mangold comb. nov. ined.[7] from the Philippines is morphologically almost identical with *L. albidulum*, and agrees in containing the stictic acid chemosydrome but has distinctly smaller ascospores (15-20 x 4-6 µm with 4-5 loci). A similar species from Australia is *L. glaucescens*, which can be readily distinguished by smaller, submuriform ascospores. This is the first known member of *Leucodecton* with transversely septate ascospores and bacilliform conidia. However, regarding the thallus and ascoma anatomy, as well as the chemistry, the taxon is in full accordance with other members in this genus.

SPECIMENS EXAMINED – Australia, Queensland: Daintree NP., Mossman Gorge Section, near Rex Creek Swing Bridge, *Mangold 35 e* (F). Atherton Tablelands: Davies Creek Rd. 17 km S of Kennedy Hwy., E of Mareeba, *Hale 832335* (US); Lake Euranoo, *Hale 831742* (US), *Mangold 38 e* (F); Danbullah Forest Drive, 1 km W of Cathedral Fig Tree, *Hale 831570* (US); Along west boundary of Lake Eacham NP., *Hale 831229* (US); SW of K-1 tree rd. off Palmerston Hwy., 2 km N of S.Johnstone Forestry Camp, SE of Millaa Millaa, *Hale 831228* (US). Eungella NP.: "Palm Walk", 2.5 km SE of Eungella, *A. & K. Kalb 34249, 34264* (hb. Kalb); Near Pease's Lookout, *Hale 831548* (US); Finch Hatton Gorge, *Lumbsch & Mangold 19116 p* (F). Mary Cairncross Park, SE of Maleny, *Hale 831224, 831578, 831728* (US). New South Wales: Mount Warning NP., track from parking lot to Lyrebird Lookout, *Mangold 17 g* (F). Big Shrub Flora Reserve, Night Cap Forest Drive, W of Mullumbimby, *Hale 831396* (US). Big Shrub, Richmond River, Jun. 1894, *Wilson* s.n. (MEL, NSW, US).

Leucodecton compunctellum (Nyl.) A. Frisch

Bibl. Lichenol. 92: 155 (2006). Bas.: *Thelotrema compunctellum* Nyl., Bull. Soc. Linn. Normand ser. 2, 2: 77 (1868). *Leptotrema compunctellum* (Nyl.) Zahlbr., Cat. Lich. Univ. II: 632 (1923). Type: New Caledonia, Loyalty, 1864, *Thiébault* s.n. (H-Nyl. 22703!-lectotype, selected by Hale [1972 in herb.]).

Thelotrema monosporum var. *subgemium* Nyl., Bull. Soc. Linn. Normand. 2, 2: 77 (1868). *Thelotrema subgemium* Nyl., Sertum Lichen. Tropic. Labuan et Signapore, p. 5 (1891). Type: New Caledonia, Lifu (Loyalty), 1864, *Thiebaut* s.n. (H-Nyl. 22702!-lectotype, selected by Hale [1972 in herb.]).

Thelotrema elachistoteron Leight., Trans. Linn. Soc. Lond. 27: 169 (1870). *Leptotrema elachistoteron* (Leight.) Patw. & Kulk., Norw. J. Bot., 24: 128 (1977). *Myriotrema elachistoteron* (Leight.) Hale, Mycotaxon 11: 133 (1980). *Leucodecton elachistoteron* (Leight.) Frisch, Bibl. Lichen. 92: 155 (2006). Type: Sri Lanka, Central Province, *Thwaites C.L. 132* (BM!–lectotype, selected by Hale [1981: 278]).

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[7] ***Leucodecton samaranum*** (Vain.) Mangold comb. nov. ined., Bas.: *Thelotrema samaranum* Vain., Annal. Acad. Scient. Fennic. ser. A 15(6): 185 (1921). *Phaeotrema samaranum* (Vain.) Zahlbr., Cat. Lich. Univ. II: 610 (1923). Type: Philippines, Samar, Catubig River, Bur. Sci. 24931 pr.p., Feb.-Mar. 1916, *Edano s.n.* (TUR-Vain. 31266!-holotype).

Thelotrema reclusum Kremp. in Nyl., Bull. Soc. Linn. Normand., 7(2): 168 (1873). *Leptotrema reclusum* (Kremp.) Zahlbr., Cat. Lich. Univ. II: 639 (1923). *Myriotrema reclusum* (Kremp.) Hale, Mycotaxon 11: 135 (1980). Type: Andaman Islands, *Kurz 21* (M–lectotype, selected by Hale [1978: 54]; BM!-, FH-Tuck.-, H-Nyl.-, UPS-, W-, ZT–isolectotypes).

Anthracothecium oligosporum Müll.Arg., Flora 71: 48 (1888). *Leptotrema oligosporum* (Müll. Arg.) Patw. & Makhija, Bryologist 83: 368 (1980). Type: Australia, Queensland, Lower Herbert River (near Ingham), *Wickham* s.n. (G!–lectotype, selected by Patwardhan & Makhija [1980: 368]).

Thelotrema microglaenoides Vain., J. Bot. 34: 206 (1896) [non *Thelotrema microglaenoides* Vain., Ann. Univ. fenn. åbo, ser. A, 2(3): 32 (1926) = nom. illegit.! {=*Diploschistes diploschistoides* (Vain.) Salisb. fide Guderley & Lumbsch (1996)}]. *Leptotrema microglaenoides* (Vain.) Zahlbr., Cat. Lich. Univ. II: 637 (1923). Type: St. Vincent, *Elliott 266* (TUR-Vain.!–holotype, BM–isotype).

Leptotrema deceptum Hale, Sm. Contr. Bot. 16: 39 (1974). *Myriotrema deceptum* (Hale) Hale, Mycotaxon 11: 133 (1980). Type: Dominica, Dec.1971, *Hale 37860* (US!–holotype).

Myriotrema nuwarense Hale, Bull. Br. Mus. Nat. Hist. (Bot.) 8(3): 289 (1981). *Leptotrema nuwarense* (Hale) Nagark., Sethy & Patwardhan, Mycotaxon 27: 74 (1986). *Leucodecton nuwarense* (Hale) Frisch, Bibl. Lichen. 92: 155 (2006). Type: Sri Lanka, Central Province, Nuwara Eliya District, *Hale 50272* (US!–holotype, BM–isotype).

Leucodecton biokense A. Frisch, Bibl. Lichen. 92: 152 (2006). Type: Equatorial Guinea, Bioko, *Mann* s.n. (BM-holotype, BM!-isotype).

ILLUSTRATION – Fig. 52.

Thallus epi- to hypophloedal, variable in thickness, thin to moderately thick, up to c. 500 µm high, pale gray to greenish gray or pale yellowish-brown, often with grainy-speckled pattern. Surface dull to slightly shiny, smooth, continuous to rugose and/or minutely verruculose, unfissured to fissured. True cortex absent, thallus predominantly covered by an ±continuous protocortex up to c. 20 µm thick. Algal layer poorly to well developed, predominantly continuous, calcium oxalate crystals usually abundant, large and clustered, sometimes forming columnar structures. Vegetative propagules not seen. Ascomata predominantly inconspicuous, small to moderately large, up to c. 400 µm in diam., roundish, peri- to rarely somewhat apothecioid, solitary, immersed to slightly emergent, then hemispherical with same surface as thallus. Disc not visible from surface. Pores tiny to more rarely small, up to c. 50(100) µm in diam., roundish with entire margin, apical proper exciple becoming visible from the outside, forming a fused to ±free inner pore margin, incurved, bright-translucent to pale brownish, in older ascomata often thinning, then appearing more dark. Thalline rim margin moderately thick, roundish, entire, (moderately) small, incurved, concolorous to sometimes brighter than thallus. Proper exciple fused to apically free in older ascomata, moderately thin to moderately thick, hyaline to pale yellowish internally, (pale)orange- to yellowish-brown or brownish marginally, non-amyloid or slightly amyloid at the base. Hymenium up to c. 200 µm high, non-inspersed, strongly conglutinated, paraphyses ±bent to often distinctly curly in apical parts, distinctly interwoven, unbranched to slightly branched towards the margins, with slightly thickened tips, lateral paraphyses and columellar structures absent. Epihymenium indistinct or lacking, hyaline and without granules in perithecioid ascomata, in apothecioid ascomata thin and with grayish-brown granules and small crystals. Asci 1-4-spored, distinct tholus usually not developed or thin, in younger asci often with moderately thickened walls throughout, thinning in all parts at maturity. Ascospores (moderately) large, eumuriform, cell walls and endospore moderately thick, non-halonate, becoming distinctly brown at late stage of maturity, non-amyloid to faintly amyloid, predominantly only in younger ascospores, oblong to oblong-ellipsoid with rounded to narrowed-rounded ends, loci roundish to angular, predominantly irregular, transverse septae thin but distinct, regular, 35-80 x 10-35 µm in 2- to 4-spored asci, 60-130 x 10-35 µm in single-spored asci, with 10-45 x 3-12 loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellow, C-, PD+ orange; containing constictic and stictic (majors), cryptostictic, hypoconstictic and hypostictic (minors to traces) acids.

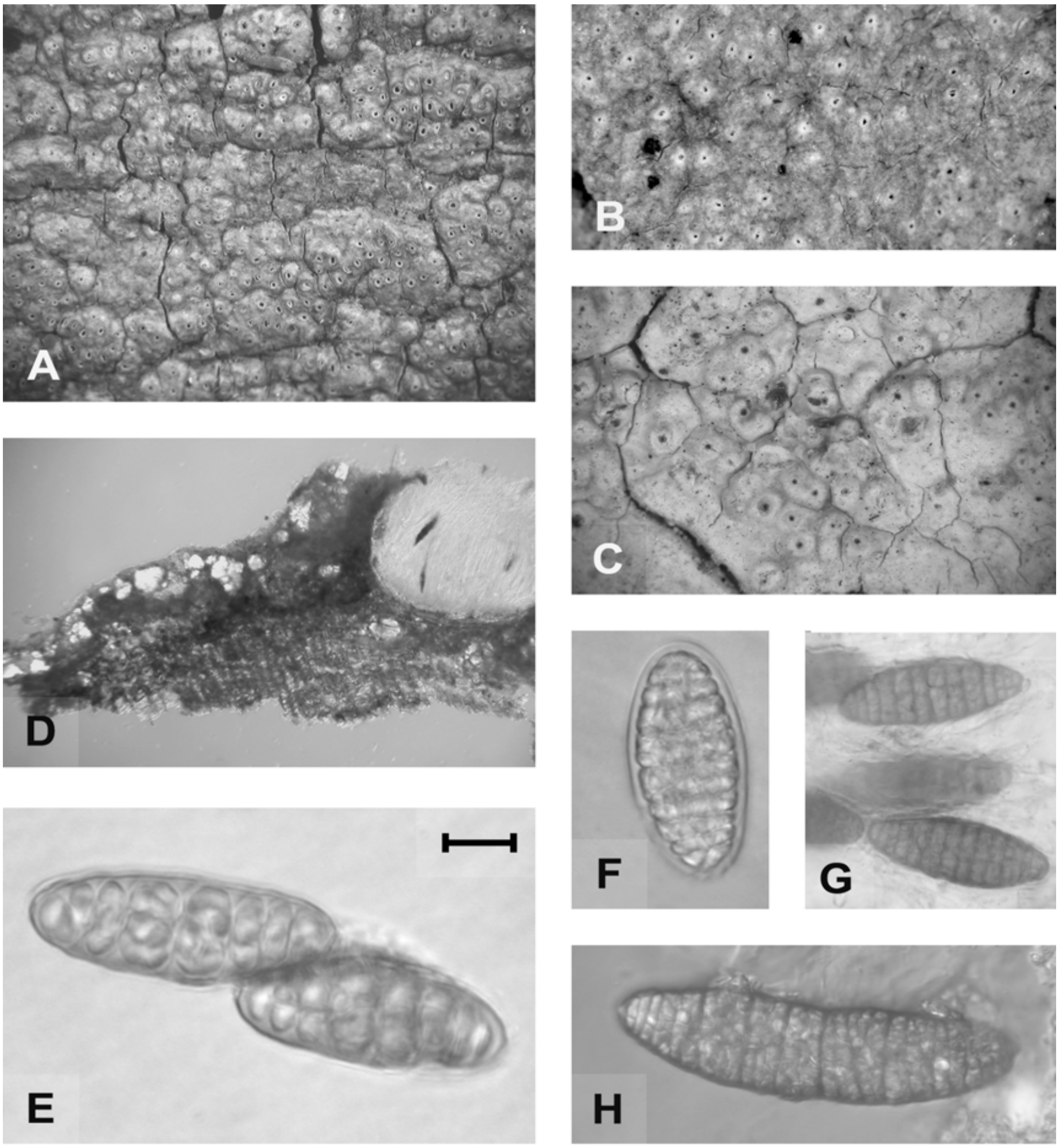

Fig. 52. *Leucodecton compunctelum*: growth habit (**A**), ascomata (**B, C**), ascoma and thallus section (**D**) mature ascospores (**E, G, H**) and immature ascospore (**F**). A.: US–holotype of *M. nuwarense*; B.: *Hale 831086*; C., E.: *Hale 830870*; D., H.: BM-lectotype of *T. elachistoteron*; F.: US-holotype of *L. deceptum*; G.: H-lectotype of *T. monosporum* var. *subgemium*. Bar= A: 2 mm; B, C: 1 mm; D: 100 µm; E, F: 15 µm; G: 30 µm; H: 20 µm.

ECOLOGY AND DISTRIBUTION – *Leucodecton compunctellum* occurs on tree bark, predominantly in moist lowland habitats such as tropical mangroves and (sub)tropical coastal rainforests, more rarely in (sub)tropical montane rainforests, in altitudes ranging from sea level to 1100 m. It is common and wide-spread in the north-western Northern Territory and Queensland. The pantropical species is also known from the Neotropics (Hale, 1974, 1978; Harris, 1995), Africa, India (Patw. & Kulkarni, 1977), Sri Lanka, Andaman Islands and New Caledonia.

NOTES – This taxon is characterized by the the (moderately) large, eumuriform, brown, thick-walled ascospores and the presence of the stictic acid chemosyndrome. It is variable, however, intermediate stages of all characters, such as thickness and coloration of the thallus, size of ascospores and number per ascus were found (see also Mangold & al., 2006). Several similar, stictic acid containing species are known from Australia, which all differ in smaller ascospores including *L. subcompunctum, M. desquamans*, *M. phaeosporum* and *M. trypaneoides*. *Leucodecton bisporum* (Nyl.) Mangold comb. nov. ined.[8] from Guadeloupe is another similar species, however, the observed type material in H-Nyl. differs in having a distinctly inspersed hymenium and larger ascospores (up to 180 µm long).

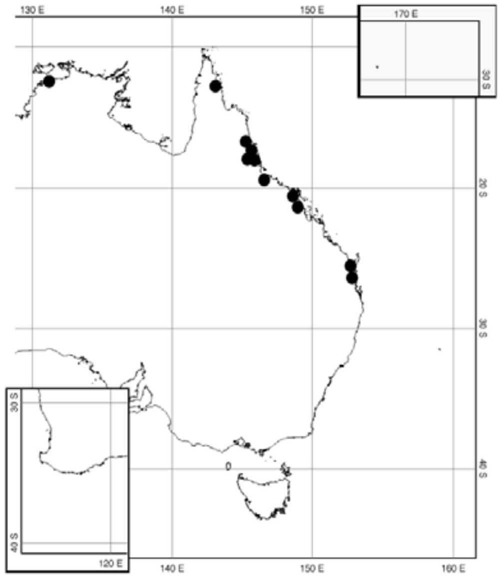

Fig. 53. Australian distribution of *L. compunctellum.*

SPECIMENS EXAMINED – Australia, Northern Territory: Palmerston, 20 km SE of Darwin, *A. & K. Kalb 30748, 30754* (hb. Kalb). Queensland: Cape York Peninsula, Tozers Gap, Iron Range NP., *Streimann 56352* (CANB). Cape Tribulation Area: C. 15 km E of Daintree, *Lumbsch & Mangold 19166 n, 19167 f* (F); Between Pilgrim Sands and Thornton Beach, *Lumbsch & Mangold 19160 e, j, r, t, z, 19161 a, c, e, g, y, hb, va, 19162 l, ob* (F); Myall Beach, *Mangold 31 i, n* (F); Walking track from Myall Beach to Cape Tribulation Beach, *Mangold 32 e, l, q* (F); N of Daintree, *Hale 831086* (US); Cape Tribulation Beach, *Hale 832776* (US). Mt. Windsor, NW of Mossman, *Hale 830870, 830874, 830989, 832113, 832226* (US). Daintree NP., Mossman Gorge Sct., 26 km NNE of Mossman, *Streimann 46018* (CANB). Upper Mossman River, *Mangold 35 x* (F). Cooga Beach, c. 5 km E of Mossman, *Lumbsch & Mangold 19169 g, h, i* (F). W of Palm Cove, c. 25 km N of Cairns, *A. & K. Kalb 19942* (hb. Kalb). Machans Beach, N of Cairns, *A. & K. Kalb 21155, 21161, 21185* (hb. Kalb). Atherton Tablelands: Kuranda Range, SE of Kuranda, *A. & K. Kalb 19902* (hb. Kalb); Stallion Pocket logging area, S of Gordonvale, *Hale 832435* (US); 15 km along Mulgrave River Rd. from intersection with the Gordonvale Rd., SW of Gordonvale, *Hale 830726, 831088* (US); Mt. Chalmynia logging area, 15 km from Bruce Hwy, *Hale 830993, 832209* (US). Babinda Boulders, *Mangold 39 o* (F). Francis Range, Woopen Creek Rd., *Hale 832770* (US). Edmund Kennedy NP., NW of Cardwell, *Hale 832170, 832717* (US). Conway Peninsula, E of Proserpine, *Scott 618* (BRI). Conway Range NP., near Shute Harbour-Airlie Beach, *Hale 831258, 832112, 832264* (US). Cape Hillsborough NP., NW of Mackay, *Hale 830278, 831468* (US). Fraser Coast, River Heads, *Lumbsch & Mangold 19092 q* (F). Blackall Ranges (Nambour area), *Wilson 2041* pr.p. (NSW). Guadeloupe, Chemin des Mamelles, *Hale 31382* [as *T. bisporum*] (US). Dominica, *Hale 38139* (US). Sri Lanka, *Hale 50170* (US).

Leucodecton glaucescens (Nyl.) A. Frisch

Bibl. Lichenol. 92: 164 (2006). Bas.: *Thelotrema glaucescens* Nyl., Ann. Sci. Nat. Bot. 4(19): 332 (1863b). *Leptotrema glaucescens* (Nyl.) Müll.Arg., Flora 65: 499 (1882). *Myriotrema glaucescens* (Nyl.) Hale, Mycotaxon 11: 133 (1980). Type: U.S.A., Louisiana, *Dr. Hale* s.n. (FH-Tuck.-lectotype, selected by Hale [1981: 282]; H-Nyl.-isolectotype).

ILLUSTRATION – Fig. 54.

[8] ***Leucodecton bisporum*** (Nyl.) Mangold comb. nov. ined. Bas.: *Thelotrema bisporum* Nyl. apud Hue, Nouv. Archiv. du Museum, 3(3): 96 (1891) [ex nomen nudum: *Thelotrema bisporum* Nyl., Mem. Soc. Sci. Nat. Cherbourg 5: 118 (1857)]. Type: Guadeloupe, *L'Herminier s.n.* (H-Nyl. 22489!-lectotype, selected by Hale [1972, in herb.]).

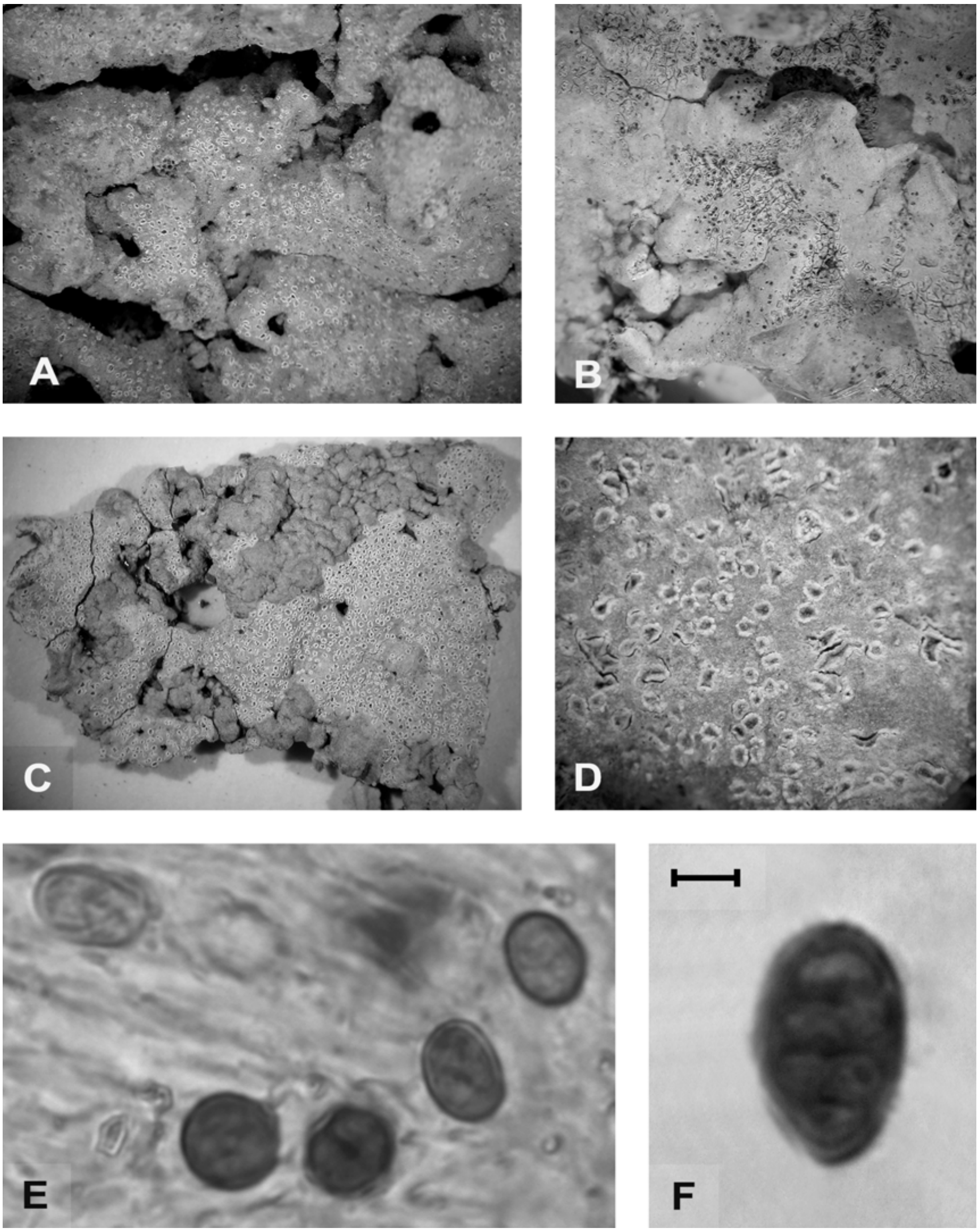

Fig. 54. *Leucodecton glaucescens*: growth habit (**A-C**), ascomata (**D**) and ascospores (**E, F**). A., D., E., F.: *Lumbsch & Mangold 19117 g*; B.: *Hale 58568*; C.: *Hale 832559*. Bar= A: 2 mm; B: 1.5 mm; C: 2.5 mm; D: 500 µm; E: 6 µm; F: 3.5 µm.

Thallus epiphloedal, thick to very thick, up to c. 1 mm high, bulging and partly flaking away from substratum, grayish to grayish-green or pale yellowish. Surface dull to rarely slightly shiny, smooth to somewhat mealy, often with speckled pattern, continuous to verruculose, unfissured to fissured or rimose. True cortex absent, thallus covered by ±continuous protocortex up to c. 25 µm thick. Algal layer usually continuous and well developed, sometimes becoming incontinuous due to crystal inclusions, calcium oxalate crystals abundant, small to large, scattered or clustered, sometimes forming column-like structures, distinct, well developed medulla layer present. Vegetative propagules not seen.

Ascomata abundant, conspicuous, moderately small to moderately large, up to c. 400 µm in diam., roundish to more often ±irregular or angular, apothecioid, solitary to fused and clustered, often forming stroma-like structures, immersed. Disc predominantly entirely visible from surface, grayish, pruinose. Pores wide, up to c. 350 µm in diam., formed by proper exciple, proper exciple apically or in upper parts becoming visible from surface, roundish to ±irregular or angular, predominantly entire, free, short, whitish to off-white, often ±shrunken, erect to slightly recurved. Thalline rim margin gaping, moderately thin to moderately thick, roundish to ±irregular or angular, entire to slightly eroded, brighter than thallus or concolorous with thallus. Proper exciple becoming partly to entirely free, moderately thin, hyaline to pale yellowish internally, orange to pale brownish marginally, non-amyloid, often with old and deceased ascospores in transitional zone between hymenium and proper exciple. Hymenium up to c. 120 µm high, non-inspersed, moderately conglutinated, paraphyses straight to slightly bent, interwoven, slightly branched towards the margins and the apical hymenium, with distinctly thickened tips, lateral paraphyses and true columella absent, in fused ascomata sometimes columella-like structures present. Epihymenium moderately thick, hyaline, with grayish to pale brown granules. Asci 8-spored, tholus (moderately) thick, thin when mature. Ascospores (very) small, submuriform, cell walls moderately thick, endospore thickened, non-halonate, brown, non-amyloid to rarely very faintly amyloid, subglobose to oblong to ellipsoid, with roundish to narrowed-roundish ends, loci roundish, subglobose to oblong, with same shaped end cells, transverse septae (moderately) thin, regular, 7-17 x 5-9 µm with 4-6 x 1-3 loci. Pycnidia present, immersed with darkened pore area, conidia variable, roundish to oval or fusiform, up to c. 3 x 1 µm.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing constictic, stictic, hypostictic (majors), α-acetylconstictic, hypoconstictic and cryptostictic (traces) acids.

ECOLOGY AND DISTRIBUTION – *Leucodecton glaucescens* was collected in Australia on tree bark in (sub)tropical rainforests in altitudes ranging from sea level to 900 m. It is rare but wide-spread, occurring in northern and southern Queensland. This is the first report for Australia. Previously this pantropical species has been recorded from the Neotropics, India and Sri Lanka (Hale, 1981).

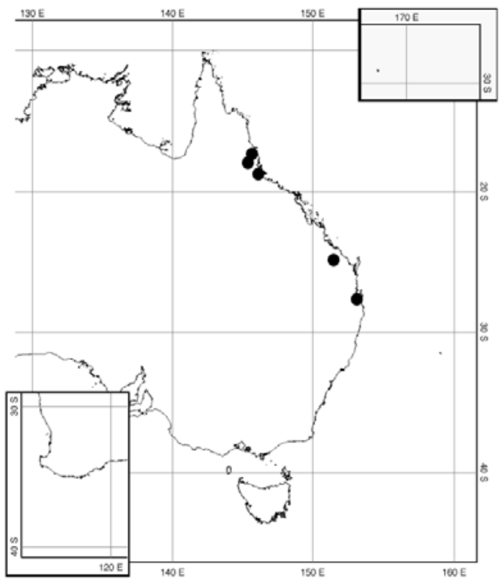

Fig. 55. Australian distribution of *L. glaucescens*.

NOTES – This taxon is characterized by the thick, bulging thallus with many crystal in-clusions, the immersed, irregular/angular ascomata with free exciple that usually are clustered and forming stroma-like arrangements, the small, ±roundish, submuriform, brown ascospores with distinctly thickened parts and the stictic acid chemo-syndrome. Some specimens, in particular *Lumbsch & Mangold 19117 g* have almost chroodiscoid apothecia and thus remind of *Reimnitzia santensis* (see fig. 55, D). Besides the chemical differences (*R. santensis* lacks secondary substances), the ascospore and ascomata size is different (ascomata up to 2 mm in diam., ascospores up to 25 x 12 µm). *Leucodecton albidulum* is another similar species, but differs in having larger, transversely septate ascospores.

SPECIMENS EXAMINED – Australia, Queensland: Crystal Cascades, 5 km W of Cairns, Lumbsch & Mangold *19117 g* (F). Atherton Tablelands: Along west boundary of Lake Eacham NP., *Hale 830700, 831003* (US);

Wongabel SF., S of Atherton on the Kennedy Hwy., *Hale 832559* (US). Edmund Kennedy NP.: Few km N of Cardwell, *A. & K. Kalb 34283* (hb. Kalb); On Clift Rd., *Hale 832716* (US). Kalpowar Forest Drive. c. 40 km NE of Monto, SW of Gladstone, *Hale 831385, 831427* (US). Upper Coomera, *Wilson* s.n. (NSW n. 539384 pr. p.). Mt.Mee SF., near Mt.Mee, N of Brisbane, *Hale 58568* (US).

Leucodecton occultum (Eschw.) A. Frisch

Bibl. Lichenol. 92: 157 (2006). Bas.: *Thelotrema occultum* Eschw., in Martius, Eschweiler & Nees ab Esenbeck: Flora Brasiliensis I, 1: 174 (1833). Type: Brazil, Caitété (Bahia), s.c., pr.p. (M-lectotype, selected by Hale [1974a; 40]; G-isolectotype).

Urceolaria compuncta Ach., Meth. Lich.: 143 (1803) [non *Porina compuncta* Ach., Syn. Lich.: 112 (1814)]. *Thelotrema compunctum* (Ach.) Nyl., Mém. Soc. Sci. Nat. Cherbourg 5: 118 (1858). *Leptotrema compunctum* (Ach.) Müll. Arg., Flora 71: 527 (1888c). *Leptotrema compactum* (Ach.) Müll. Arg., Flora 70: 400 (1887b) [erroneous]. *Myriotrema compunctum* (Ach.) Hale, Mycotaxon 11: 133 (1980). Type: Indonesia, *Chr. Smith* s.n. (LINN-Sm. 1692.7-lectotype, selected by Hale [1981: 276]; H-Nyl. 22447!-, G!-isolectotypes).

Leptotrema compunctum var. *purpuratum* Müll. Arg., Bull. Soc. Roy. Bot. Belgique 30: 75 (1891d). Type: Costa Rica, 1890, *Pittier 5218* (G-holotype, US!-isotype).

Thelotrema loandense Vain., in Hiern, W. P. (edit.): Catalogue of the African plants collected by Dr. Friedrich Welwitsch in 1853-1861 2(2): 429 (1901). *Leptotrema loandense* (Vain.) Zahlbr., Cat. Lich. Univ. II: 636 (1923). Type: Angola, Mar. 1854, *Welwitsch 441* (TUR-Vain. 26793-holotype, BM!-isotype).

Thelotrema compunctum var. *antillarum* Vain., Ann. Acad. Sci. Fenn., ser. A 6(7): 134 (1915). *Leptotrema compunctum* var. *antillarum* (Vain.) Zahlbr., Cat. Lich. Univ. II: 633 (1923). Type: Virgin Islands, 14.02.1906, *Raunkiaer 553* (TUR-Vain. 26798-lectotype, selected by Salisbury [1971a: 276]; C!-isolectotype).

Thelotrema compunctum var. *praiense* Vain., Boletim Soc. Broteriana, sér. 2, 6: 149 (1929). Type: Mozambique, 1917, *Pires de Lima 383* (TUR-Vain. 34802 lectotype, selected by Salisbury [1971a: 276]).

Thelotrema compunctum f. *portoricensis* Vain., Mycologia 21: 38 (1929). *Leptotrema compunctum* f. *portoricense* (Vain.) Zahlbr., Catal. Lich. Univ. II: 632 (1923). Type: Porto Rico, 01.03.1916, *Fink 1749* (W-holotype, NY!-isotype).

ILLUSTRATION – Fig. 56.

Thallus epi- to hypophloedal, variable in thickness, thin to moderately thick, up to c. 500 µm high, pale grayish to pale greenish- or yellowish-gray. Surface dull to slightly shiny or somewhat glittering, smooth to more often ±roughened to porous, continuous to rugose to rarely somewhat verrucose, distinctly fissured. True cortex absent, cortex-structures absent or rarely covered by an incontinuous protocortex up to c. 10 µm thick. Algal layer poorly developed, incontinuous, calcium oxalate crystals usually abundant, small to more rarely large, scattered to clustered. Vegetative propagules not seen. Ascomata moderately conspicuous, small to moderately large, up to c. 600 µm in diam., roundish, apothecioid, solitary, immersed to slightly emergent, then hemispherical with same surface as thallus. Disc partly visible from surface, grayish, coarsely pruinose. Pores small to moderately wide, up to c. 200 µm in diam., predominantly formed by proper exciple, proper exciple usually apically or in upper parts becoming visible from surface, roundish to irregular with entire to indistinctly split or slightly dentate margin, whitish, sometimes shrunken, incurved to erect to rarely somewhat recurved. Thalline rim margin wide to gaping, moderately thin to moderately thick, roundish to slightly elongate or irregular, entire, incurved, thalline rim concolorous with thallus, sometimes circularly fissured along the ascoma outline, forming a ring-like structure. Proper exciple free in the upper parts, moderately thin to moderately thick, hyaline to pale yellowish or pale brownish internally, yellowish- to reddish-brown or brownish marginally, sometimes slightly carbonized or dark-brown apically, non-amyloid. Hymenium up to c. 170 µm high, non-inspersed, strongly conglutinated, paraphyses ±straight, somewhat irregular and with ±distinct septation, distinctly interwoven, parallel to slightly branched, particularly towards the margins and the epihymenium, with slightly thickened, sometimes ±irregular tips, lateral paraphyses and columellar structures absent. Epihymenium moderately thick, hyaline, with grayish-brown granules and small crystals. Asci 8-spored, distinct tholus usually not developed, in younger asci with moderately thickened walls throughout, at maturity distinctly thinning only in lower parts. Ascospores (moderately) small, (sub-)muriform, cell walls thick, endospore (moderately) thin, non-halonate, becoming distinctly brown at early maturity, non-amyloid to faintly amyloid only in younger ascospores, oblong to predominantly ellipsoid with rounded to narrowed-rounded to rarely slightly subacute ends, loci roundish to slightly angular, predominantly subglobular to somewhat irregular, with same shaped end cells, transverse septae moderately thin to moderately thick, predominantly regular, 20-35(40) x 10-17 µm with 6-8(10) x 1-5(6) loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ orange-red, C-, PD-; containing norstictic (major), stictic (minor to absent), α-acetylconstictic (minor to absent) and connorstictic (minor to absent) acids.

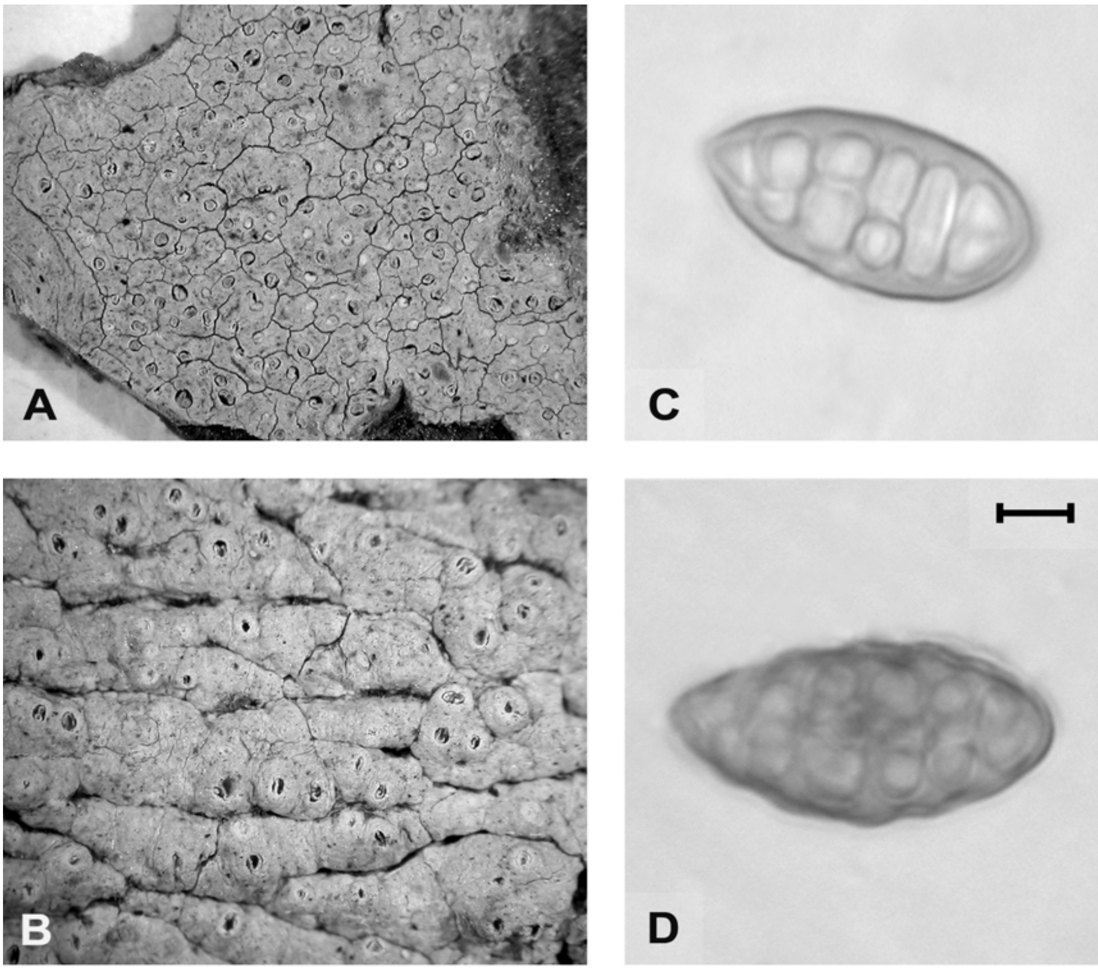

Fig. 56. *Leucodecton occultum*: growth habit (**A**), ascomata (**B**), younger ascospore (**C**) and older ascospore (**D**). A.: NY-isotype of *T. compunctum* f. *portoricensis*; B.-D.: *Streimann 48587*. Bar= A: 2 mm; B: 1.25 mm; C: 5 µm; D: 6 µm.

ECOLOGY AND DISTRIBUTION – *Leucodecton occultum* occurs on tree bark in tropical mangroves, more rarely in (sub)tropical rainforests in altitudes ranging from sea level to 900 m. It is common and wide-spread in the north-western Northern Territory and Queensland. The pantropical species is also known from the Neotropics, Africa, India (Sethy & al., 1987), Sri Lanka (Hale, 1981), Philippines (ibd.) and New Caledonia.

NOTES – It is a common taxon that is characterized by the ecorticate, fissured thallus, immersed to slightly emergent ascomata with free proper exciple, small, (sub-)muriform, brown, thick-walled ascospores and the norstictic acid chemosyndrome. It is similar to *L. subcompuntum*, which lacks norstictic acid, has more distinctly developed cortex structures and has slightly larger ascospores (up to 45 x 20 µm in size).

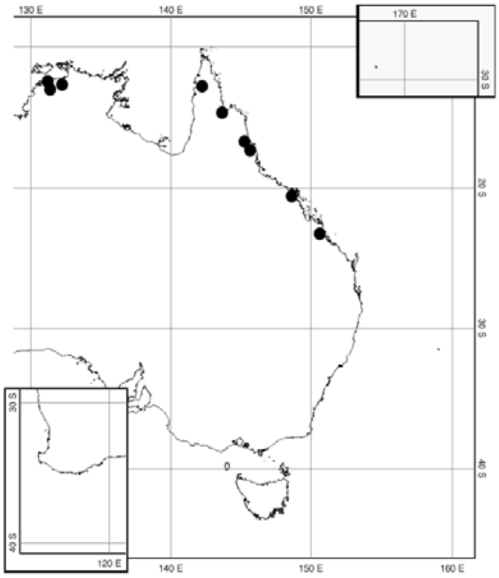

Fig. 57. Australian distribution of *L. occultum.*

SPECIMENS EXAMINED – Australia, Northern Territory: Darwin area, *Stevens 4171, 4173* (BRI). Darwin and Gulf District, *Thompson 492* (CANB). 8 km E of Darwin, N of Landing Quarantine station, *Thor 5918, 5927* (S). Meckitt creek landing, 18 km NE of Darwin, *Thor 5828* (S). Kakadu NP., *A. & K. Kalb 29583*, *30472, 30509, 30576, 30593, 30596, 30778* (hb. Kalb). Daly River Rd. at Adelaide River Crossing, 27 km S of Adelaide River Settlement, *Lumbsch & Elix 8841* (F). Greenant Creek, 35 km SSE of Adelaide River Settlement, *Streimann 48587* (B). Stuart Hwy., 11 km NW of Pine Creek, *Streimann 42110* (CANB). 116 km SSW of Darwin, Adelaide river near the road, *Thor 5995d* (S). Green Ant Creek, 35 km SSE of Adelaide River Settlement, *Elix 28188, Streimann 48587* (CANB). Queensland: Uncertain locality, *Knight* s.n. (G-10194/8). Cape York Peninsula: Cook, Pennefather River, *Morton 1033305* (MEL); Weipa, *Specht 689029* (BRI); At Musgrave, on Peninsula Developmental Rd., *Hale 831171* (US). Mt. Lewis Road, W of Mossman, *Hale 831932* (US). Cairns, 5 km N of the city near the airport, *A. & M. Aptroot 22170, 22191* (ABL). Conway Range NP., near Shute Harbour-Airlie Beach, *Hale 831738, 830884* (US). Mt. Archer Environmental Park, 7 km NE of Rockhampton, *Elix 34542* (CANB). Ross Creek, Yeppoon, *Elix 34599, 34619* (CANB, B). Uncertain locality, 'Bailey Book', p. 2, s.c. (BRI-AQ720155).

Leucodecton subcompunctum (Nyl.) A. Frisch

Bibl. Lichenol. 92: 162 (2006). Bas.: *Thelotrema subcompunctum* Nyl., Bull. Soc. Linn. Normandie, sér. 2, 2: 76 (1868). *Leptotrema subcompunctum* (Nyl.) Zahlbr., Cat. Lich. Univ. II: 640 (1923). *Myriotrema subcompunctum* (Nyl.) Hale, Mycotaxon 11: 135 (1980). Type: New Caledonia, Lifu, Loyalty, 1864, *Thiébaut* s.n. (H-Nyl.22440!-lectotype, selected by Hale [1974b: 42]; G!-, PC-isolectotypes).

Leptotrema diffractum Müll. Arg., Hedwigia 30: 50 (1891c). Type: Australia, Queensland, Bellenden Ker, *Bailey 527* (G!-holotype, BRI!-isotype).

Leptotrema polycarpum Müll.Arg., Bull. Herb. Boissier 3: 315 (1895). Type: Australia, Queensland, 1887, *Knight 80* (G!-holotype, G!-isolectotypes [6 samples]).

Leptotrema inclusum Zahlbr., Bot. Mag. Tokyo 41: 317 (1927). Type: Japan, Kinkuwasan, June 1902, *Faurie 5147* (W-holotype).

Myriotrema decorticatum Hale, Bull. Br. Mus. Nat. Hist. (Bot.) 8(3): 277 (1981). Type: Sri Lanka, Matara District, *Hale 46259* (US!-holotype, AMH-, PDA-isotypes).

ILLUSTRATION – Fig. 58.

Thallus epi- to hypophloedal, moderately thin to moderately thick, up to c. 400 µm high, variably colored, pale grayish- to yellowish-green or (pale) olive. Surface variable, dull to somewhat shiny, smooth to roughened or porous, continuous to verrucose or verruculose, unfissured to distinctly fissured to areolate. Thalline cover variable, in younger specimens thallus sometimes without cortex structures, otherwise covered by a ±continuous protocortex up to c. 30 µm high, sometimes becoming conglutinated, forming a true cortex of irregular to

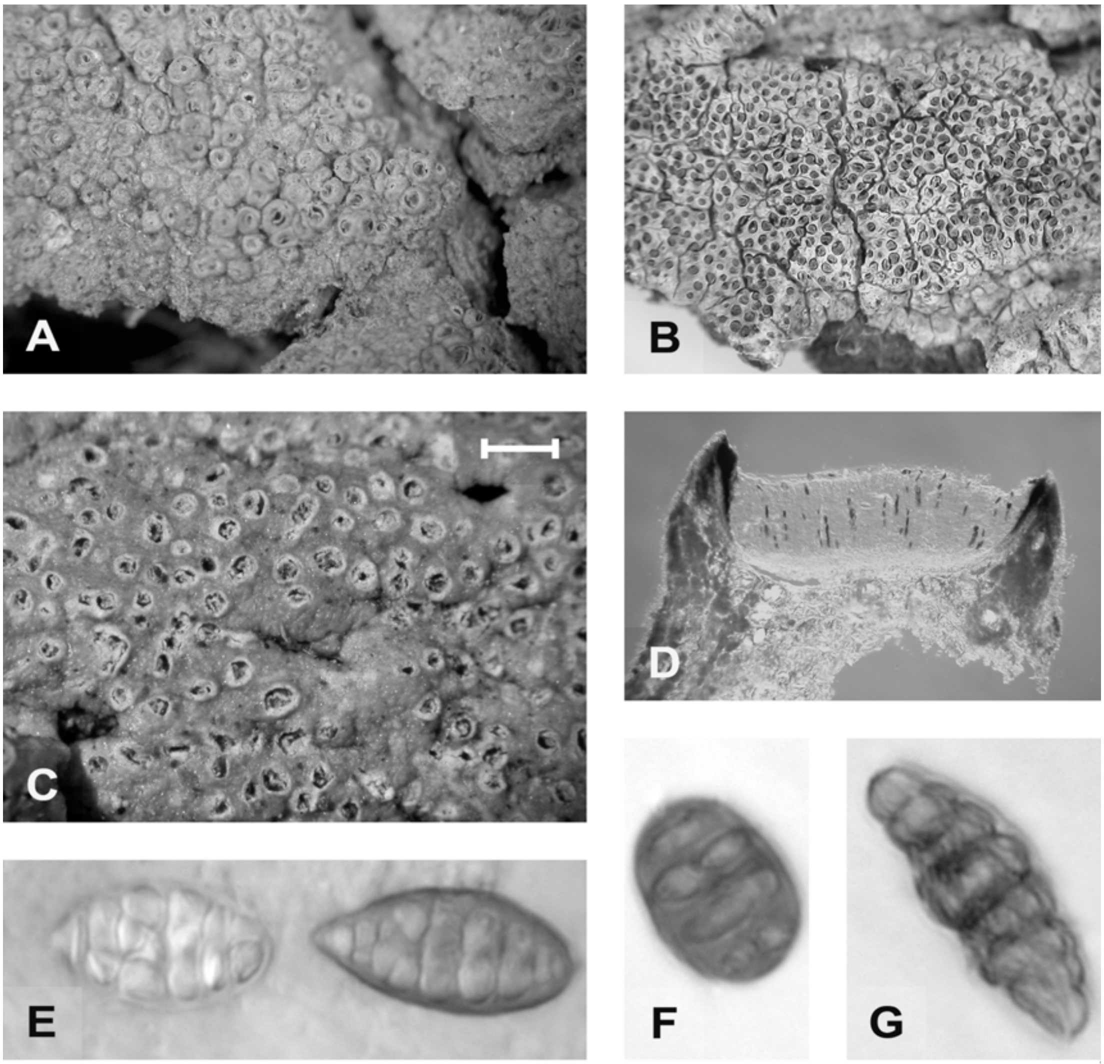

Fig. 58. *Leucodecton subcompunctum*: growth habit and ascomata (**A-C**), ascoma section (**D**) and young, mature and over-mature ascospores (**E-G**). A.: *Lumbsch & Mangold 19116 o;* B.: *Hale 830876*; C., F.: H-lectotype; D., E.: US-holotype of *M. decorticatum*; G.: G-holotype of *L. diffractum*. Bar= A: 1 mm; B: 1.5 mm; C: 0.8 mm; D: 100 µm; E: 12 µm; F, G: 20 µm.

rarely periclinal hyphae. Algal layer well developed and continuous, calcium oxalate crystals small to large, scattered to clustered, often forming a continuous layer in the lower medulla. Vegetative propagules not seen. Ascomata inconspicuous to moderately conspicuous, (moderately) small, up to c. 400 µm in diam., predominantly roundish to slightly irregular, becoming apothecioid, solitary to marginally fused, sometimes clustered, predominantly immersed to slightly raised to rarely distinctly emergent, then hemispherical to slightly subglobose and with same surface as thallus. Disc often becoming partly visible from surface, grayish, slightly to distinctly pruinose. Pores small to moderately wide, up to c. 300 µm in diam., predominantly formed by proper exciple, proper exciple apically or in upper parts usually becoming visible from surface, becoming predominantly free in mature stages, short, whitish to grayish or brownish, sometimes shrunken, incurved to erect to rarely somewhat recurved. Thalline rim margin wide to gaping, moderately thin to moderately thick, roundish to slightly elongate or irregular, entire, incurved, thalline rim concolorous with thallus or somewhat brighter. Proper exciple usually becoming free apically or in upper parts, moderately thin to moderately thick, hyaline to pale yellowish or pale brownish internally, yellowish- to grayish-brown or brownish marginally, sometimes slightly carbonized or dark-brown apically, non-amyloid to faintly amyloid at the base. Hymenium up to c. 150 µm high, non-inspersed, strongly conglutinated, paraphyses ±bent to often distinctly curly in apical parts, distinctly interwoven, unbranched to slightly branched towards the margins, with slightly thickened tips, lateral paraphyses and columellar structures absent. Epihymenium thin to moderately thick, hyaline, with grayish-brown granules and small crystals. Asci 8-spored, tholus (moderately) thin, not visible at maturity. Ascospores variable, very to moderately small, (sub-)muriform, cell walls (moderately) thick, endospore moderately thin to moderately thick, non-halonate, becoming brown usually at late stage of maturity, non-amyloid to faintly amyloid in younger ascospores, oblong to ellipsoid to fusiform, with rounded to subacute ends, loci roundish to slightly angular, subglobular to oblong to somewhat irregular, with same shaped end cells, transverse septae moderately thin to moderately thick, predominantly regular, 10-45(50) x 7-20 µm with (4)6-10(12) x 1-6 loci. Pycnidia not seen, fide Frisch (2006: 164) immersed with blackish and sometimes detached pore area, conidia irregular, narrow elliptical to obovate, up to 5 x 1.2 µm.

CHEMISTRY – Thallus K+ yellow, C-, PD+ orange; containing constictic and stictic (majors), cryptostictic, hypoconstictic and hypostictic (minors to traces) acids.

ECOLOGY AND DISTRIBUTION – *Leucodecton subcompunctum* was collected in Australia on tree bark in (sub)tropical to warm-temperate wet sclerophyll forests and rainforests in an altitude ranging from sea level to 1500 m. It is common and wide-spread from northern Queensland to central New South Wales and also occurs in Lord Howe Island. The pantropical species is also known from North America (Harris, 1995), Africa (Frisch, 2006), Sri Lanka (Hale, 1981), Japan (Zahlbruckner, 1927) and New Caledonia. Hale (1974b) reports *L. subcompunctum* from Dominica and describes the species with 1-2 spores per ascus and ascospores up to 55 µm long, which indicates that this collections probably belongs to *L. compunctellum*.

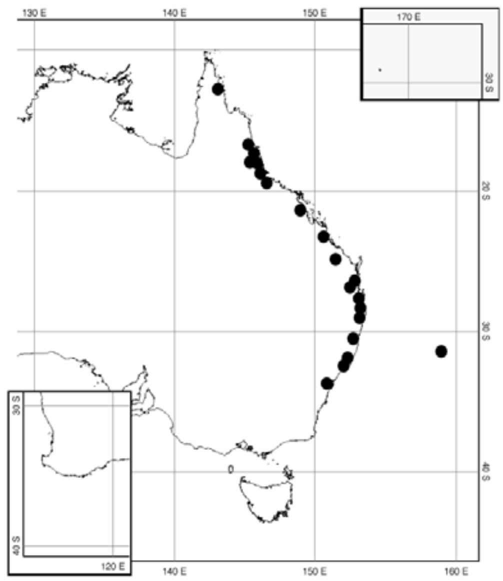

Fig. 59. Australian distribution of *L. subcompunctum.*

NOTES – It is a highly variable species, however, in the examined material all of the morphotypes are linked by intermediate stages. It is characterized by the absence of a distinct true cortex, the numerous, small, predominantly immersed ascomata with partly to entirely free exciples, the moderately small, muriform, brown, thick-walled ascospores and the stictic acid chemosyndrome. *Myriotrema phaeosporum* is similar, but distinguished by a less distinct, weakly fissured thallus with a speckled surface pattern and the narrow-pored, perithecioid mature ascomata with a fused to indistinctly free proper exciple of the *Myriotrema*-type. For differences to *L. occultum*, see under that species. *Leucodecton compunctellum* differs by larger ascospores (up to 140 µm long) in1-4-spored asci. *Myriotrema desquamans* and *M. trypaneoides* have a shiny, distinctly corticate thallus and ascoma with smaller pores and fused proper exciple. *Leucodecton oxysporum*[9] from Brazil is another similar species that can be distinguished by ascomata with wider pores, a predominantly fused exciple and an inspersed hymenium. *Leucodecton fissurinum* known

[9] ***Leucodecton oxysporum*** (Redgr.) Mangold comb. nov. ined., Bas.: *Leptotrema oxysporum* Redgr., Hedwigia 73: 63 (1933). Type: Brazil, Taperinha, Santarem, Jul. 1927, *Ginzberger* s.n. (B!-lectotype, here selected).

from Sri Lanka and Africa is another close taxon and probably conspecific with *L. subcompunctum* (Hale, 1981: 279f.; Frisch, 2006: 156f). Unfortunately no type material was available for this study. However, a collection determined by Hale as '*Myriotrema*' *fissurinum* from the type locality (*Hale 46221*) belongs to *L. subcompunctum*.

SPECIMENS EXAMINED – Australia, Queensland: Iron Range NP., 11 km SW of Cape Weymouth, *Streimann 56377* (B, CANB). Cape Tribulation area, track to Cape Tribulation Beach, *Mangold 32 i* (F). Km 45 on Mt.Windsor Rd., NW of Mossman, *Hale 830759, 831481* (US). Mt. Windsor, NW of Mossman, *Hale 830281, 830843, 830989, 831879, 832062, 832204, 832257, 832330, 832695* (US). Mt.Lewis Rd., W of Mossman, *Hale 830289, 831022, 832779* (US). Near end of Black Mountain Rd., 33 km WNW of Kuranda, *Hale 832766* (US). End of Clohesy River Rd., W of Cairns, *Hale 831053* (US). Atherton Tablelands: Davies Creek Rd., E of Mareeba, *Hale 830973, 830991, 832623* (US); Danbullah Drive, E of Tinaroo, *Hale 832484* (US); Lake Tinaroo, Downfall Creek Camping Area, *Lumbsch & Mangold 19125 i* (F); Lake Euranoo, *Lumbsch & Mangold 19127 e, f, zd* (F); Just S of Tolga on Kennedy Hwy., *Hale 831423, 832478* (US); Lake Barrine NP., *Hale 830944, 832415* (US), *Filson 515536* (MEL); Lake Eacham NP., *Hale 830904, 832730* (US), *Mangold 29 ai, p, q, r, u, al, bb* (F); Plath Rd. logging head, S of Atherton, *Hale 831019, 832308, 832453* (US); Palmerston NP., *Hale 831907, 832494, 832522* (US); Souita Falls, *Lumbsch & Mangold 19153 p* (F); Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Mangold 30 p, zf, zr* (F); 13 km S of Ravenshoe on Tully Falls Rd., *Hale 832141* (US). Bellenden Ker: *Bailey* s.n. (NSW-539376); 7 km W of Bellenden Ker, *A. & M. Aptroot 22485* (ABL). Francis Range, NW of Innisfail *Hale 831021, 832114* (US). Culpa logging area, SE of Tully Falls *Hale 830850, 831923, 832662, 832713* (US). Dawson logging area, WSW of Tully, *Hale 830290, 831002, 831203* (US). State Forest area on Tully Rd., S of Mission Beach, *Hale 831355* (US). 7.5 km E of Wallaman Falls, W of Ingham, *Hale 830982, 831020* (US). About 7.5 km E of Wallaman Falls, W of Ingham, *Hale 832675, 832328* (US). Paluma Range, between Townsville und Ingham, *A. & K. Kalb 25781, 25788* (hb.Kalb). Mt. Spec NP., WNW of Townsville, *Hale 831873, 832205, 832640* (US). Cape Hillsborough NP., NW of Mackay, *Hale 830259, 831719* (US). Eungella NP.: Near Peases Lookout, *Hale 831407* (US); 2 km S of Eungella, *Tibell 14711/II* (UPS); Finch Hatton Gorge, *Lumbsch & Mangold 19116 o* (F). Waterpark State Forest Park, N of Yeppoon, *Hale 69146, 831441* (US). Kalpowar Forest Drive., SW of Gladstone *Hale 831437* (US). Kroombit SF., 53 km E of Biloela, *Elix 34733* (B, CANB). Bunya Mnts. NP., *Hale 831504* (US). Noosa NP.: Palm Grove Track, *Hale 831295, 831297, 831298, 831334, 831417, 831447, 831453, 831497, 831606, 831661, 831672, 831689* (US); Near lookout, *Thor 4902/I* (S); Tanglewood Track, *Elix 10366* (CANB). Wooroi State Forest Park, W of Teewantin, *Hale 830275* (US). Kenilworth SF., SW of Kenilworth, *Hale 830758* (US). Upper Coomera, *Wilson* s.n. (NSW-603826). Lamington NP., *Hale 830876, 831203, 831572* (US). New South Wales: McPherson Range, Border Ranges NP., NE of Wiangaree, *Hafellner 16644* (GZU). NW part of Wiangaree Forest Drive, N of Kyogle, *Hale 832556* (US). South Toonumbar SF., 22 km WNW of Kyogle, *Streimann 60813A* (CANB, B). Whian Whian SF., W of Mullumbimby, *Hale 831642* (US). Nightcap Forest Drive, N of Lismore, *Hale 830968, 832425* (US). Nightcap NP., Mnt. Nardi/Mnt. Matheson Track, *Mangold 22 zl* (F). Dorrigo SF., near Dorrigo, *Hale 58740* (US). Dorrigo NP.: Never Never Picnic Area and Rosewood Creek Track, *Mangold 24 a* (F); Sassafras Creek Track, *Mangold 25 r* (F). Styx River SF., 68 km E of Armidale, *Kalb & Williams 20602* (hb. Kalb). Doyles River SF., 95 km SE Walcha, *Hale 58634* (US). Chicester SF., 21 km SW of Gloucester, *Elix 24993* (CANB). Barrington Tops NP., *Lumbsch & Filson 8668 c* (CANB, F). Wallingat SF., 16 km SW of Forster: *Elix 42631* (CANB); *Streimann 44242 a* (B, CANB). Katoomba: *Kalb 20597* (hb. Kalb); Sep.1889, *Wilson '3'* (G, H). Lord Howe Island: Track from Smoking Tree Ridge to Rocky Run, *Elix 42458* (CANB); Soldiers Creek, *Elix 42403* (CANB). Uncertain locality: 'Shirley Book', p. 23, s.c. (BRI-AQ721253). Sri Lanka, *Hale 46221, 46303* (US).

2. 9. 6. ***Melanotopelia*** Lumbsch & Mangold, gen. nov. ined. Type species: *Topeliopsis toensbergii* Vezda & Kantvilas [=*M. toensbergii* (Vezda & Kantvilas) Lumbsch & Mangold comb. nov. ined.]. Type: U.S.A., Washington, *Tønsberg 25545* (BG!-holotype).

Melanotopelia rugosa is the only known species in Australia, for a description see there.

NOTES – This new genus includes two species formerly placed in *Topeliopsis.* They are distinguished from the latter by a distinctly dark to carbonized marginal proper exciple and non-amyloid ascospores (a few species in *Topeliopsis* s. lat. have I- ascospores), which was confirmed by molecular data (part 3). A similar exciple structure, viz. dark to carbonized marginally, hyaline with lateral paraphyses internally, can be found in *Diploschistes* (readily distinguished by a different photobiont and ecology) and in the '*Leptotrema schizoloma*-

group'. The members of the latter group, however, are distinguished by regenerating ascomata with a ±distinctly layered margin.

Species description:

Melanotopelia rugosa (Kantvilas & Vezda) Lumbsch & Mangold comb. nov. ined.

Bas.: *Topeliopsis rugosa* Kantvilas & Vezda, Lichenologist 32: 351 (2000). Type: Tasmania, Reservoir lakes, *Kantvilas 177/86* (HO!-holotype, hb. Vezda-isotype).

ILLUSTRATION – Fig. 60.

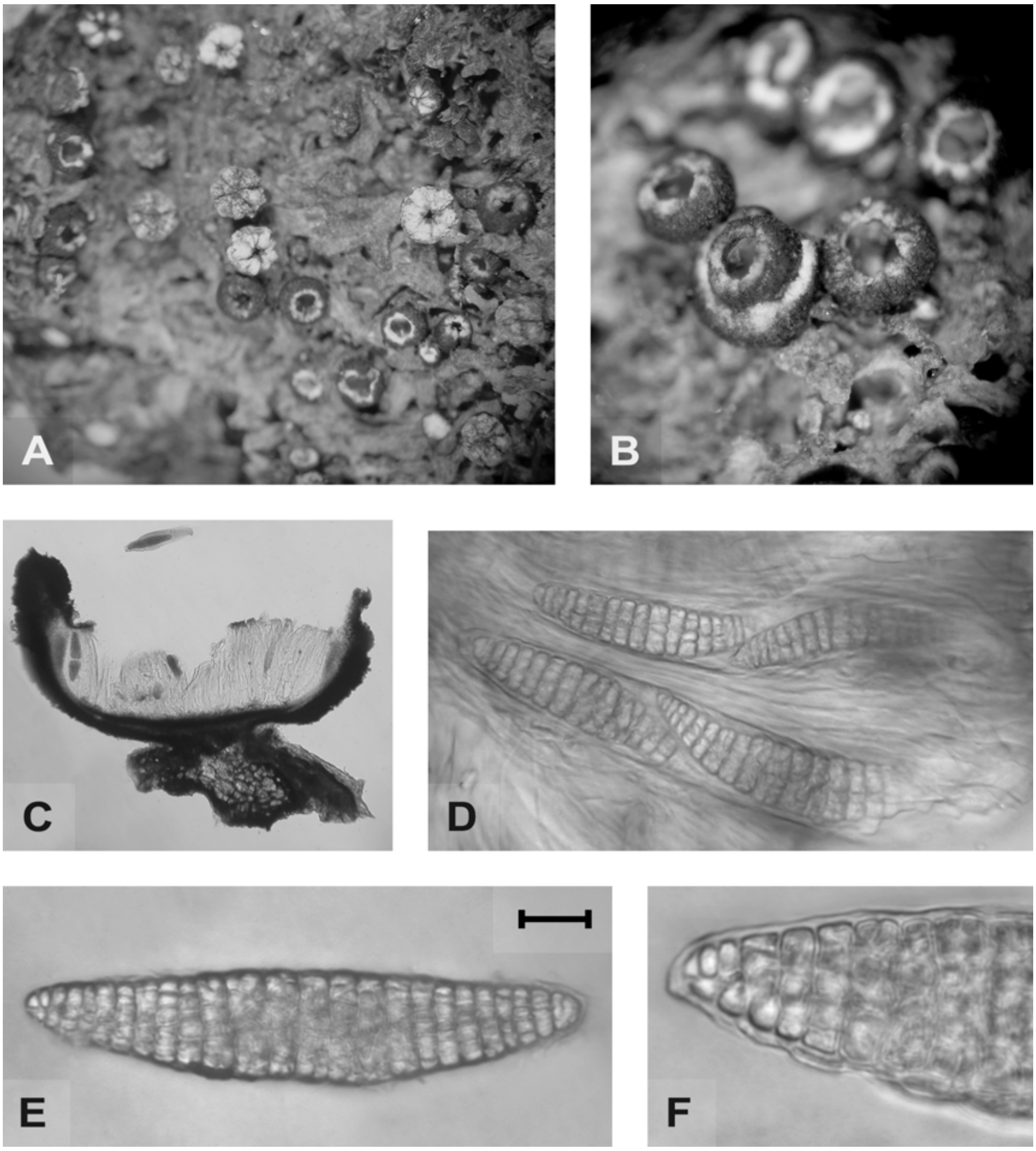

Fig. 60. *Melanotopelia rugosa*: growth habit (**A**), ascomata (**B**), ascoma section (**C**), asci (**D**), ascospore (**E**) and ascospore detail (**F**). A.-F.: HO-holotype. Bar= A: 1 mm; B: 0.6 mm; C: 200 µm; D: 30 µm; E: 25 µm; F: 12.5 µm.

Thallus muscicolous to partly corticolous, epi- to hyposubstratic, thin, up to c. 80 µm high, pale off-white. Surface dull to shiny or glittering, smooth, continuous, unfissured. True cortex present, continuous to incontinuous, formed of periclinal hyphae, up to c. 30 µm thick. Algae layer poorly developed, incontinuous, calcium oxalate crystals absent. Vegetative propagules not seen. Ascomata typical, conspicuous, (moderately) large, up to c. 1 mm in diam., roundish, perithecioid first, becoming apothecioid with maturity, sessile, solitary to marginally slightly fused, often growing successively, distinctly emergent, subglobular in younger stages, becoming urceolate. Disc often becoming partly visible from surface, whitish to pale brownish, epruinose, often distinctly cracked or eroded with age. Proper exciple not visible from surface, pores small to gaping, up to c. 600 µm in diam., in younger ascomata irregular star-shaped, becoming roundish in older ascomata, pore margin entire to slightly split. Thalline rim in young ascomata concentrically rugose at the apex, whitish to pale grayish, in older ascomata thalline rim margin only slightly rugose to finally entire, remaining whitish to pale grayish, forming a conspicuous contrast to the otherwise dark-gray to blackish thalline rim, incurved. Proper exciple fused, thick, hyaline internally, dark-brown to carbonized marginally, often amyloid towards the base and the subhymenium. Hymenium up to c. 350 µm high, non-inspersed, moderately conglutinated, paraphyses straight, distinctly parallel, unbranched, with slightly thickened tips, lateral paraphyses present, conspicuous, not clearly separated from proper exciple, up to c. 50 µm long, columellar structures lacking. Epihymenium indistinct and hyaline in younger ascomata, becoming (moderately) thick, reddish to dark brown with age, granules or crystals absent. Asci 1-4-spored, tholus (moderately) thick, thin when mature. Ascospores moderately to very large, densely eumuriform, cell walls distinctly thickened in younger ascospores, becoming thin in later stages, endospore (moderately) thin, sometimes with thin halo, hyaline, yellowish to pale brownish in old or decayed ascospores, non-amyloid to very faintly amyloid, predominantly fusiform to irregular-fusiform with narrowed-roundish ends, loci roundish to somewhat angular, predominantly irregular, transverse septae distinct and regular in younger ascospores, becoming indistinct or lacking at late maturity, 80-230 x 20-45 µm with multiple loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing constictic, stictic (majors), and cryptostictic (minor) acids. [Fide Kantvilas & Vezda (2000) some specimen lacking secondary metabolites.]

ECOLOGY AND DISTRIBUTION – *Melanotopelia rugosa* was collected in Australia predominantly on bryophytes in subalpine moorland in altitudes ranging from 750-1050 m. One specimen was collected on tree bark in a tropical rainforest at 1500 m. It is a rare, disjunct species, occurring in south-west Tasmania and in high altitudes in Queensland. It is also known from New Zealand and subantarctic islands (Lumbsch & al., 2008), indicating a subantarctic distribution extending to high altitudes in the tropics.

Fig. 61. Australian distribution of *M. rugosa.*

NOTES – This taxon can be easily recognized by the thin, corticate thallus, the urceolate ascomata with bright margins and a dark thalline rim, a distinctly carbonized exciple, large, hyaline, densely eumuriform ascospores and the stictic acid chemosydrome. The only Australian species, which could be confused with *M. rugosa*, is *T. muscigena* with similar ascospores that differ in being strongly amyloid. Moreover, it contains no secondary compounds and lacks carbonization. *Melanotopelia toensbergii* from north-Pacific U.S.A., the only other thus far known member of *Melanotopelia*, differs in having smaller ascomata with smaller pores, smaller ascospores (up to 110 µm long) and containing the protocetraric acid chemosyndrome.

SPECIMENS EXAMINED – Australia, Queensland: Bellenden Ker NP., centre peak, 40 km S of Cairns, *A. & M. Aptroot 22535* (ABL).

2. 9. 7. ***Myriotrema*** Fée, Méthode lichénographique et genera. Paris: 34 (1824). Type species: *Myriotrema olivaceum* Fée.

Coscinedia Massal., Atti Reale Ist. Veneto Sci. Lett. Arti, ser. 3, 5: 256 (1860). Type species: *Coscinedia micropora* (Mont.) Massal. Type: Indonesia, Java, *Junghuhn 143* (PC-holotype).

Ocellis Clements, The genera of fungi: 80 (1909). Type species: *Ocellis myriopora* (Tuck.) Clements. Type: Cuba, Monte Verde, *Wright 129* (FH-Tuck.-holotype, H-Nyl. 22646-isotype).

THALLUS – Crustose, rarely bulging and flaking away from substrate, corticolous, thin to thick, epi- to hypophloedal, up to c. 100-1000 µm high, mostly in shades of olive or gray, with greenish to yellowish or whitish tones, sometimes with pale patches due to a partly absent algal layer or with a grainy-speckled pattern. Surface shiny to dull, smooth, usually continuous to rugose or slightly verrucose, rarely verrucose or verruculose, unfissured to fissured or rarely distinctly areolate or rimose. Prothallus thin to indistinct, pale to darkish brown. Corticate to rarely ecorticate, either with a ±distinct, continuous true cortex at least in younger thalli, hyaline to slightly yellowish, up to c. 20-60 µm thick, sometimes with distinct internal splitting, consisting of periclinal to more rarely irregular hyphae; or covered by a continuous to discontinuous protocortex up to c. 30 µm thick. Algal layer well-developed, rarely poorly developed, continuous to discontinuous, calcium oxalate crystals abundant to lacking, small to more often large, scattered to more often clustered, sometimes forming columnar structures. Often with distinct medulla layer. Vegetative propagules present or absent, isidia occurring in two Australian species (*M. eminens*, *M. frustillatum*) for description see under these species.

ASCOMATA – Predominantly inconspicuous, rarely conspicuous, often small, up to c. 200-500 mm in diam., or large, up to c. 600-800 µm in diam., roundish to more rarely ±irregular, rarely elongate to distinctly lirelliform. Peri- to apothecioid, solitary to distinctly fused, sometimes clustered and forming patches of densely arranged ascomata, rarely forming stroma-like structures, non-regenerating, often distinctly immersed to slightly raised, or rarely distinctly emergent and sessile, then usually hemispherical to conical, rarely subglobose or urceolate. Disc often not visible from surface, sometimes partly visible and flesh colored, predominantly epruinose to pruinose. Pores mostly tiny to moderately small, up to c. 30-200 µm in diam., rarely wide or gaping, up to c. 300-600 µm in diam., roundish to ±irregular, rarely elongate. Proper exciple not visible from the surface, pore margin entire to slightly, rarely distinctly split, formed by thalline rim; or proper exciple becoming ±visible from surface, free to fused, off-white to whitish, entire to split, sometimes shrunken, incurved. Thalline rim margin small to wide, thin to thick, entire to slightly split, rarely distinctly split and/or lacerate to eroded, concolorous with thallus to more often ±brighter or distinctly whitish, off-white or pale brownish, incurved to rarely ±erect. Proper exciple fused to slightly detached or distinctly free, thin to moderately thick, hyaline to pale yellowish, rarely orange internally, yellowish to reddish or grayish to brownish marginally, apically often darkened or covered by granules, non-amyloid to amyloid basally. Subhymenium indistinct, thin and concolorous with basal exciple. Hymenium non-amyloid, moderately to distinctly cupular, up to c. 70-300 µm high, predominantly non-inspersed and clear, rarely inspersed or interspersed, usually moderately to strongly, rarely weakly conglutinated. Paraphyses often ±thickened, irregular and/or distinctly septate, rarely straight to usually ±bent, rarely distinctly curly in apical parts, parallel to more often ±distinctly interwoven, often ±distinctly branched, in particular towards the margins and tips, tips predominantly ±thickened, often ±irregular. Lateral paraphyses and true columella absent, in fused ascomata often columella-like structures present. Epihymenium mostly indistinct to thin, more rarely ±thick, hyaline, egranulose or granulose.

Asci 8-spored, rarely 1-2-spored, non-amyloid, clavate, ascus walls mostly not thickened, tholus predominantly present, ±thick in younger stages, ±thin to not visible at maturity, in *M. protoalbum* with a distinctly tapered ocular chamber; rarely with moderately thickened ascus walls and without distinct tholus. Ascospores uni- to biseriate, small to very large, 10-200 x 4-50 µm, transversely septate to submuriform or eumuriform. Cell walls predominantly ±thick, rarely (moderately) thin, smooth, endospore in muriform ascospores thin to thick, usually non-halonate to indistinctly halonate, rarely distinctly halonate, hyaline to sometimes distinctly brown, amyloid to non-amyloid, rarely subglobose or claviform to often oblong to ellipsoid or fusiform, with roundish to subacute, rarely acute ends, with 1-12 x 0-7 or multiple loci, loci roundish to slightly, rarely distinctly angular, subglobose to oblong or lentiform, more rarely ±irregular, with same shaped, hemispherical or conical end cells, transverse septae thin to moderately thick or rarely thick, distinct to sometimes indistinct with age in densely muriform ascospores, regular to irregular.

PYCNIDIA – Often present, immersed or in thallus warts with dark to brownish pore area, often surrounded by a brighter zone, conidia bacilliform, fusiform to very rarely irregular, up to c. 5-8 x 1-2 µm.

CHEMISTRY – β-Orcinol depsidones present or absent; *M. olivaceum* contains various hitherto unknown substances ('olivaceum unknowns').

ECOLOGY AND DISTRIBUTION – The *Myriotrema* species in Australia occur on tree bark, in altitudes ranging between sea level and 1500 m. The species were predominantly found in subtropical to tropical rainforests, more rarely also in wet sclerophyll forests, mangroves and monsoon forests of the (sub)tropics, in north-western Northern Territory, Queensland, Norfolk Island, northern New South Wales and Lord Howe Island. At present state of knowledge, amongst the 17 species known in Australia, two are endemic (*M. frustillatum, M. temperatum*), seven are paleotropical to paleosubtropical (*M. desquamans, M. eminens, M. microporum, M. phaeosporum, M. polytretum, M. protoalbum, M. subconforme*) and eight are pansubtropical to pantropical (*M. album, M. clandestinum, M. glaucophaenum, M. myrioporum, M. olivaceum, M. rugiferum, M. trypaneoides, M. viridialbum*).

NOTES – This genus was reintroduced by Hale (1980, 1981) to accommodate taxa lacking carbonization and lateral paraphyses (*Thelotrema* sect. *Myriotrema* in Salisbury [1971a, 1978]). Frisch (2006) excluded several taxa based on morphological differences and partially supported by molecular data, and assigned them to various other genera (e.g. *Fibrillithecis, Leptotrema, Leucodecton, Ocellularia, Stgeobolus*). In its present circumscription the genus is still considered heterogeneous, Frisch (ibid.) separates two major groups, the '*M. olivaceum*-group' and the '*M. viridialbum*-group'. In the present treatment, Frisch's classification is accepted in large parts, however, only the '*M. olivaceum*-group' is confirmed as a well separated sub-group as described by Frisch (ibid.). The distinguishing character of a reticulate columella in the '*M. viridialbum*-group', which, according to Frisch, sets the sub-group in close affinity to *Stegobolus*, remains dubious. Columella-like structures are found in many species, not only in *M. glaucophaenum* and *M. viridialbum* (the two Australian species grouped in the '*M. viridialbum*-group') but also in members that show strong similarities to the '*M. olivaceum*-group' (*M. album, M. rugiferum*), these structures do not represent a true columella as found in e.g. *Ocellularia* or *Stegobolus*, but are formed due to the fusion of individual ascomata (see also under *M. glaucophaenum*). Further, several taxa are included in *Myriotrema* which are deviant from both sub-groups, as *M. desquamans, M. phaeosporum* or *M. trypaneoides* with brown ascospores reminiscent to *Leucodeton*, or species with large, densely muriform ascospores (*M. eminens, M. frustillatum*). Hence, I accept here a *Myriotrema* s. str. group and *Myriotrema* s. lat., including all remaining species placed in the genus for the time being.

Myriotrema s. lat. is circumscribed by a ±pale proper exciple consisting of prosoplectenchymatous hyphae that are distinctly radiating towards the apical parts ('*Ocellularia*-type') without substrate inclusions, absence of lateral paraphyses, peri- to apothecioid ascomata and predominantly shiny, ±distinctly corticate thalli. *Myriotrema* s. str. is further characterized by small, immersed to slightly raised ascomata, and small, hyaline, amyloid transversely septate to submuriform ascospores. Similar genera include *Fibrillithecis, Leptotrema, Leucodecton* and *Ocellularia* (not treated here). Except for *Ocellularia* the genera are chiefly distinguished by the structure of the proper exciple (see also under this genera). The distinction of *Ocellularia* is more problematic and in certain cases poorly understood. The two genera are distinguished by the presence of a true columella and/or distinct carbonization. The placement of several taxa, particularly those with absent columella and indistinct carbonization, currently grouped in *Ocellularia* needs further study.

Species descriptions:

Myriotrema album Fée

Essai Crypt. Écorc.: 104 (1824). *Thelotrema album* (Fée) Nyl., Ann. Sci. Nat. Bot. 5(7): 315 (1867). *Ocellularia alba* (Fée) Müll. Arg., Mem. Soc. Phys. Geneve 29(8): 6 (1887). *Thelotrema myriotrema* Nyl., Memoir. Soc. Sienc. Nat. Cherbourg 5: 107 (1857) [nom. nov. pro *Myriotrema album* Fée]. Type: "America meridionali, ad corticem *Bonplandiae trifoliatae* (Wild.)", s.c. (G-Fée 249!-lectotype, selected by Hale [1978: 12]; H-Nyl. 22635-isolectotype).

ILLUSTRATION – Fig. 62.

Thallus epi- to hypophloedal, (moderately) thick, up to c. 500 µm high, (pale) olive to yellowish-olive, often with paler patches due to a partly absent algal layer. Surface ±shiny, smooth, continuous to rugose, unfissured. True cortex usually present, predominantly continuous, slightly yellowish, thickness variable, up to c. 40 µm thick, consisting of periclinal to irregular hyphae, sometimes partly not conglutinated forming a protocortex. Algal layer well developed, continuous but sometimes partly thinning or lacking (see above), presence of calcium oxalate crystals somewhat variable, predominantly abundant, small to large, clustered, sometimes forming short layers, more rarely sparse, then usually found in scattered (large) clusters, distinct medullar layer present. Vegetative propagules not seen. Ascomata usually inconspicuous, predominantly ±small, up to c. 350 µm in diam., roundish, apothecioid, solitary to marginally to rarely entirely fused, often clustered, forming patches of densely arranged ascomata, in some specimen ascomata sometimes becoming stroma-like fused, then often sharing the same thalline rim (Fig. 62, B), predominantly immersed to rarely

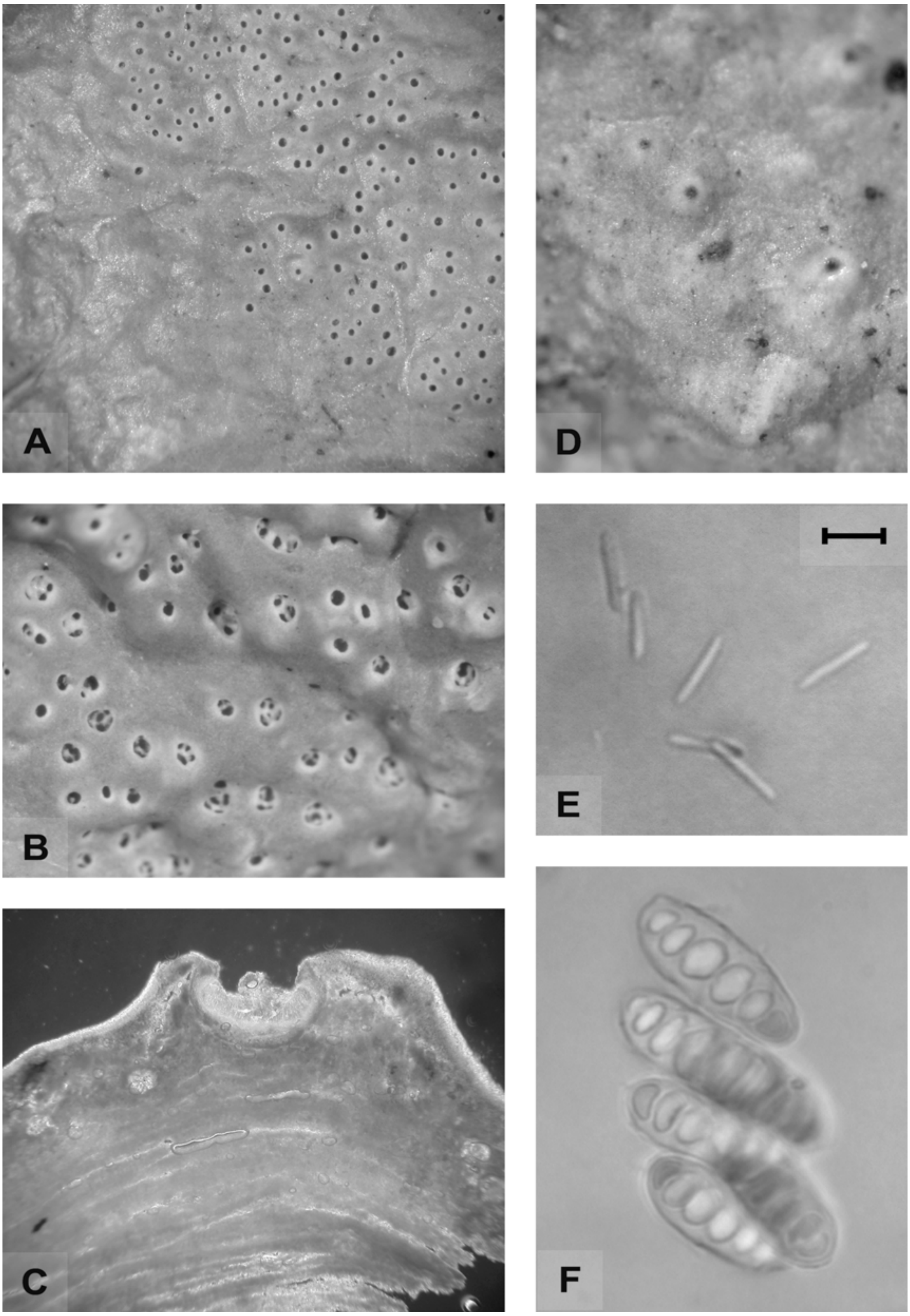

Fig. 62. *Myriotrema album*: growth habit (**A**), ascomata (**B**), ascomata section (**C**), pycnidia (**D**), conidia (**E**) and ascospores (**F**). A., F.: *Lumbsch & Mangold 19110 e*; B., C.: *Streimann 45850*; D., E.: *Mangold 30 r*. Bar= A, B: 1 mm; C, D: 100 µm; E: 5 µm; F: 7 µm.

somewhat emergent, then hemispherical. Disc often becoming partly visible from surface, pale flesh colored, epruinose to slightly pruinose. Pores (moderately) small to sometimes becoming wide, up to c. 200 µm in diam., predominantly roundish to somewhat irregular, entire to rarely slightly split, proper exciple usually not visible from surface, in distinctly fused ascomata (see above) becoming visible from surface, entire, erect, off-white. Thalline rim margin variably thick, usually ±thin to more rarely moderately thick, brighter than thallus, forming a narrow to moderately wide off-white ring-like area, level with thallus to often somewhat raised, rarely sunken, thalline rim predominantly incurved. Proper exciple fused, predominantly moderately thin, hyaline internally, pale yellowish to yellowish-brown marginally, non-amyloid. Hymenium up to c. (80)100 µm high, non-inspersed, strongly conglutinated, paraphyses straight to slightly branched, distinctly septate, slightly interwoven, with distinctly thickened, somewhat irregular tips, lateral paraphyses and true columella lacking, in fused ascomata columella-like structures present (see above). Epihymenium indistinct to thin, hyaline, sometimes with fine grayish granules. Asci 8-spored, tholus (moderately) thick, becoming moderately thin at maturity. Ascospores (very) small, transversely septate, often with a single longitudinal septum, cell walls (moderately) thick, endospore moderately thin to moderately thick, sometimes with thin halo, hyaline, predominantly distinctly to strongly amyloid, rarely with faint amyloid reaction, ellipsoid to fusi- or claviform, predominantly with narrowed-roundish or subacute to more rarely acute ends, loci roundish to somewhat acute, subglobose to lentiform or irregular, with same shaped to hemispherical or conical end cells, septae thin to moderately thick, often slightly to distinctly irregular, 10-25(28) x 4-9 µm with 3-8 (x2) loci. Pycnidia present, in thallus warts with brownish pore area surrounded by a bright zone, conidia bacilliform, up to c. 8 x 1 µm.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Myriotrema album* was collected in Australia on tree bark predominantly in (sub-)tropical rainforests in altitudes ranging from 10 - 1230 m. It is common and wide-spread from northern Queensland to northern New South Wales. Besides Australia it was reported from the Neotropics, Philippines and Solomon Islands indicating a pan(sub)tropical distribution.

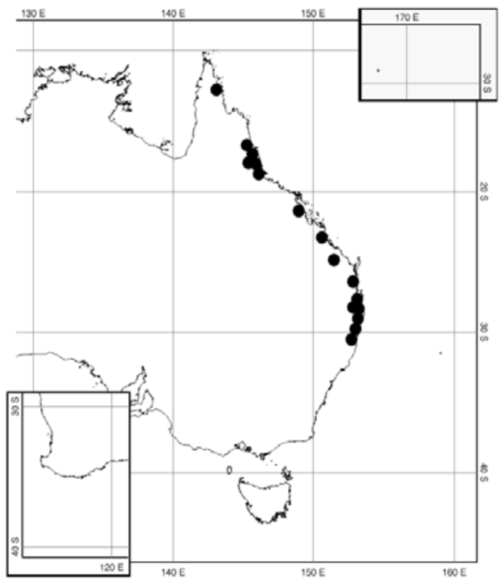

Fig. 63. Australian distribution of *M. album.*

NOTES – This taxon is characterized by the thick, unfissured, shiny, corticate thallus, small, predominantly immersed ascomata with fused proper exciple, transversely septate to indistinctly submuriform, hyaline, amyloid ascospores with thickened parts and the absence of secondary compounds. A morphologically similar species is *M. clandestinum,* which can be distinguished by less abundant calcium oxalate crystals and the presence of the psoromic acid chemosyndrome. Other similar Australian species with the same chemistry include *M. protoalbum* and *M. myrioporum*, for differences see under these species.

SPECIMENS EXAMINED – Australia, Queensland: Uncertain locality: 'Peachey's Shrub', Aug. 1889, *Wilson* s.n. (NSW 539375). Iron Range NP., 29 km from western boundary on track to Portland Rds., *Hale 830043, 832671* (US). Cape Tribulation area: Myall Beach, *Lumbsch & Mangold 19160 w* (F); 2 km W of main rd. between Oil

Palms and Coopers Creek, *Hale 830043, 832671* (US); Milky Pine Rd., 3 km NE of Daintree River Crossing, *Hale 832218* (US). Thornton Range: At tower turnoff on CREB rd. (to Cooktown), c.15 km N of the Daintree River crossing, *Hale, 830964, 831194, 831359, 831501, 832558* (US); CREB rd., about 5 km in from Daintree River crossing, *Hale 831472, 831655* (US); CREB track, *Stevens 19184* (GZU). Mt. Windsor logging area, NW of Mossman: 9 km from rd. to old Forestry Camp and the main rd., *Hale 832542*; E of old Forestry Camp, *Hale 832391* (US). Mt. Lewis Rd., 10.5 - 16 km N from Kennedy Hwy., W of Mossman, *Hale 69153, 831202, 832086 , 832337, 832342* (US). Rex Creek, Mossman Gorge, Daintree River NP., 6 km W of Mossman, *Streimann 45850* (B, CANB). 14 km SW of Mossman, Mt. Lewis, *Tibell 14615* (UPS). Cairns, Aug. 1893, *Wilson* s.n. (NSW 539368). Atherton Tablelands: Davies Creek Rd. 17 km S of Kennedy Hwy., S of Davies Creek Falls NP., E of Mareeba, *Hale 830724* (US); Lamb Range, near Mt. Haig, 20 km SE of Mareeba, *Streimann 57668* (B); Lake Eacham NP., *Mangold 29 aj* (F); Plath Rd. logging head, 9 km W of Plath Rd., off Kennedy Hwy, Herberton range, S of Atherton, *Hale 832554* (US); 13 km SW of Atherton, on summit of Great Dividing Range, *Weber & Moir 352* (C, CANB, COLO, G, H, MEL, NSW, S, US, WIS); Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Mangold 30 r* (F); 10-18 km S of Ravenshoe on Tully Falls Rd., *Hale 832065, 832798, 832805* (US); Culpa logging area, 13 km from Koombooloomba rd. turnoff, SE of Tully Falls, *Hale 830615* (US). Near TELECOM Cable Car bldg., at base of Bellenden Ker (off Bruce Hwy.), *Hale 831531* (US) Mt.Tyson, 2 km W of Tully, *Streimann 45557* (CANB). State Forest area on Tully Rd., 1 km from jct. with S. Mission Beach Rd., S of Mission Beach, *Hale 831467* (US). Eungella NP.: "Palm Walk", 2.5 km SE of Eungella, *A. & K. Kalb 34262, 34263, 34267* (hb. Kalb); NP. side rd. nr. Peases Lookout, off Darymple rd., *Hale 831412, 831598* (US); Rosser Rd. entry point off Darymple rd., near Peases Lookout, *Hale 832530* (US); Rd. to rainforest at NP. margin, *Lumbsch & Mangold 19110 e* (F). Waterpark Creek State Forest Park in Byfield SF., 24 km N of Yeppoon, *Hale 831741* (US). Kroombit Tops SF.: Munholme Creek, 47 km SW of Calliope, *Streimann 65062* (B, CANB); Dawes Range, 53 km E of Biloela, *Elix 34741, 34754* (B, CANB, H). Kalpowar Forest Drive, c.40 km NE of Monto, SW of Gladstone, *Hale 831756, 832173* (US). Wooroi State Forest Park, W of Teewantin, *Hale 832320, 832724* (US). Mapleton Falls, c. 13 km W of Nambour, *Hale 832820* (US). Blackall Ranges, 06. Aug. 1890, *Wilson* s.n. (NSW 539373). Mt. Mee SF., 6 km NW of Forestry Office, NW of Mt. Mee, *Hale 832790* (US). Mt. Glorious, Brisbane SF., c. 40 km WNW von Brisbane, *A. & K. Kalb 26573* (hb. Kalb). Brisbane, Aug. 1896, *Wilson s.n.* (NSW 539372). Upper Coomera, 1802, *Wilson* s.n. (NSW 539371). 'Lambourine' [Mnt. Tamborine], 1802, *Wilson* s.n. (NSW 539374). Carabeen Nature Refuge, 45 km E of Warwick, *Lumbsch & Mangold 19174 f* (F). Lamington NP.: Near lost world, *A. & M. Aptroot 21900* (ABL); O'Reillys Guesthouse, *A. & K. Kalb 21542* (hb. Kalb). New South Wales: Lions Tourist Rd. near Queensland border, N of Waingaree, *Hale 832764* (US). Nightcap NP., Mnt. Nardi/Mnt. Matheson Track, *Mangold 22 zd, zf, zg, zh* (F). Night Cap Forest Drive, W of Mullumbimby: Big Shrub Flora Reserve, *Hale 831375* (US); Gibbergunyah Roadside Reserve, Whian Whian SF., *Hale 831329, 831400, 831478* (US); 1 km W of Minyon Falls, N of Lismore, *Hale 832405* (US). Wollongbar, Jun. 1894, *Wilson* s.n. (NSW 539370). Richmond River, *Hodgkinson* s.n. (M 23370). Iluka Nature Reserve, 50 km NE of Grafton: *Mangold 23 r* (F); *Hale 58546* (US). Dorrigo SF., near Dorrigo, *Hale 58756* (US). Uncertain locality: 'Shirley Book', p. 23, s.c. (BRI-AQ721249).

Myriotrema clandestinum (Fée) Hale

Mycotaxon 11: 113 (1980). Bas.: *Thelotrema clandestinum* Fée, Ess. Crypt. Suppl. 84: 90 (1837). Type: "In america ad corticem Cinchonae lancifoliae Mutis", s.c. (G-Fée 244!-lectotype, selected by Hale [1974a: 32]).

Thelotrema terebratulum Nyl., Ann. Sci. Nat, Bot, sér. 5, 7: 315 (1867a). *Ocellularia terebratula* (Nyl.) Müll. Arg., Mém. Soc. Phys. Hist. Nat. Genève 29(8): 12 (1887c). *Myriotrema terebratulum* (Nyl.) Hale, Mycotaxon 11: 135 (1980). Type: Colombia ('Nova Granata'), Rio Negro, 1863, *Lindig 129* (H-Nyl. 22637-lectotype, selected by Hale [1978: 33]; FH-Tuck.!-, G!-, M-, PC-isolectotypes).

Thelotrema clandestinum f. *remanens* Nyl., Ann. Sci. Nat., Bot., sér. 5, 7: 317 (1867a) *Thelotrema remanens* (Nyl.) Müll. Arg., Mém. Soc. Phys. Hist. Nat. Genève 29(8): 7 (1887c). Type: Colombia, Monte del Morro, 1863, *Lindig 90* (H-Nyl.-holotype; BM-, G-, PC-isotypes).

ILLUSTRATION – Fig. 64.

Thallus epi- to hypophloedal, (moderately) thick, up to c. 700 µm high, (pale) olive to yellowish-olive, often with paler patches due to a partly absent algal layer. Surface ±shiny, smooth, continuous to rugose, unfissured. True cortex usually present, predominantly continuous, slightly yellowish, thickness variable, up to c. 50 µm thick, formed of periclinal to somewhat irregular hyphae, rarely partly not conglutinated forming a protocortex. Algal layer well developed, continuous but often partly thinning or lacking (see above), calcium

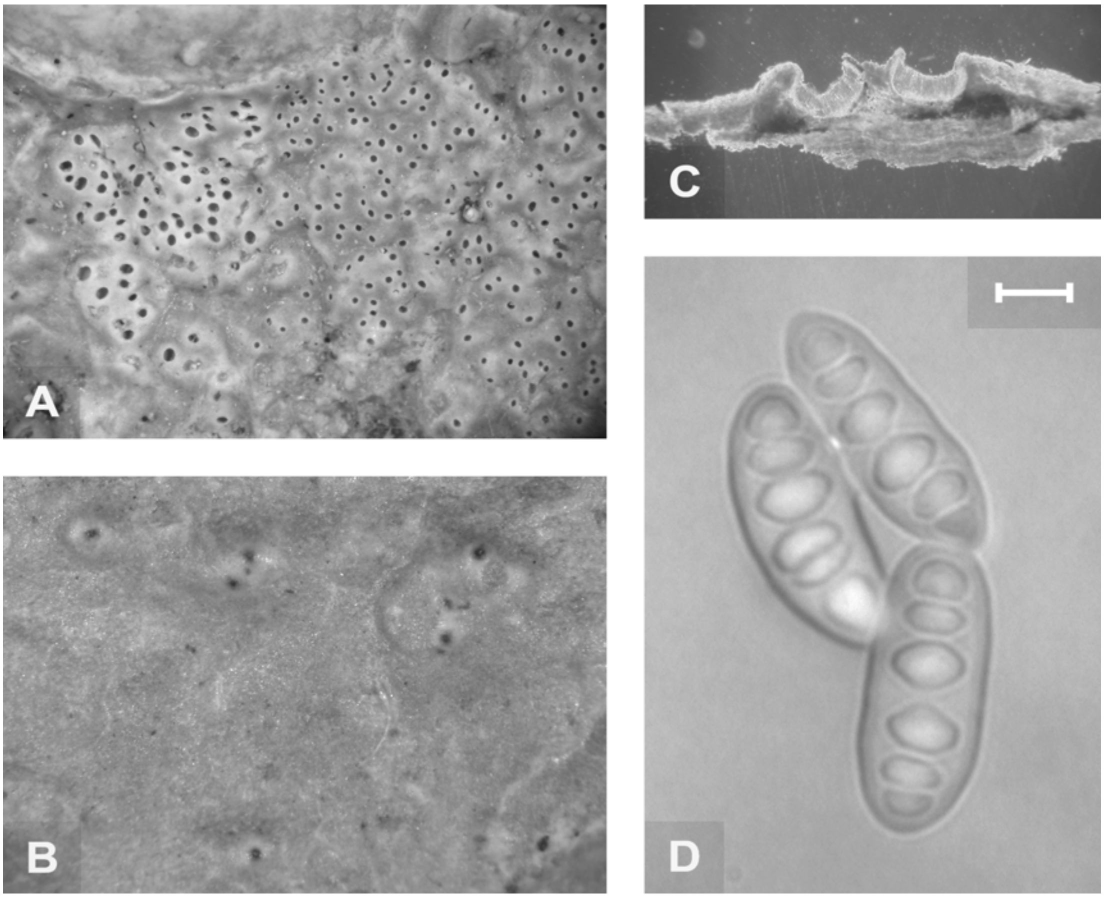

Fig. 64. *Myriotrema clandestinum*: growth habit (**A**), pycnidia (**B**), ascomata section (**C**) and ascospores (**D**). A.: *Lumbsch & Mangold 19132 z*; B., C.: *Lumbsch & Mangold 19132 s*; D.: *Lumbsch & Mangold 19132 v*. Bar= A: 1.5 mm; B: 0.25 mm; C: 250 µm; D: 5 µm.

oxalate crystals sparse or lacking, usually found in scattered (large) clusters, distinct medullar layer present. Vegetative propagules not seen. Ascomata usually inconspicuous, ±small, up to c. 300 µm in diam., roundish, apothecioid, solitary to marginally fused, often clustered, forming patches of densely arranged ascomata, predominantly immersed to rarely somewhat emergent, then hemispherical. Disc often becoming partly visible from surface, pale flesh colored, epruinose to slightly pruinose. Pores (moderately) small to sometimes becoming wide, up to c. 100(200) µm in diam., predominantly roundish to somewhat irregular, entire to rarely slightly split, proper exciple not visible from surface. Thalline rim margin variably thick, usually ±thin to more rarely moderately thick, brighter than thallus, forming a narrow pale brownish to off-white ring-like area, level with thallus to often somewhat raised, thalline rim incurved. Proper exciple fused, moderately thin to moderately thick, hyaline internally, pale yellowish to yellowish-gray marginally, non-amyloid. Hymenium up to c. 90(100) µm high, non-inspersed, strongly conglutinated, paraphyses straight to slightly branched, distinctly septate, slightly interwoven, with slightly to distinctly thickened tips, lateral paraphyses and columellar structures absent. Epihymenium indistinct to thin, hyaline, rarely with fine grayish granules. Asci 8-spored, tholus moderately thick, thin when mature. Ascospores (very) small, transversely septate, sometimes with a single longitudinal septum (see notes), cell walls (moderately) thick, endospore moderately thin to moderately thick, sometimes with thin halo, hyaline, distinctly to strongly amyloid, ellipsoid to fusiform, predominantly with narrowed-roundish to subacute ends, loci roundish to somewhat acute, subglobose to lentiform or irregular, with same shaped or hemispherical to conical end cells, septae moderately thin, sometimes slightly irregular, 10-25(27) x 6-8 µm with 3-6(7) (x2) loci. Pycnidia present, in thallus warts with brownish pore area surrounded by a bright zone, mature conidia not found, fide Frisch (2006) bacilliform, up to c. 8 x 1.5 µm.

CHEMISTRY – Thallus K+ yellowish, C-, PD+ yellow; containing psoromic (major) and subpsoromic (minor to trace) acids.

ECOLOGY AND DISTRIBUTION – *Myriotrema clandestinum* occurs in Australia on tree bark predominantly in tropical rainforests in altitudes ranging from 10 - 900 m. It is common in Queensland, occurring frequently in the northern part, rarely in northern-central or southern Queensland. It is a pantropical species being reported from the Neotropics (e.g., Hale, 1978b, 1981; Sipman, 1992a), Africa (Frisch, 2006), India (Nagarkar & al., 1988), Sri Lanka (Hale, 1981), Andman Islands (Sethy & al., 1987), Taiwan (Hale, 1981), Borneo (Sipman, 1993), Philippines (Hale, 1981), New Caledonia (Nylander, 1868) and Solomon Islands (Hale, 1981).

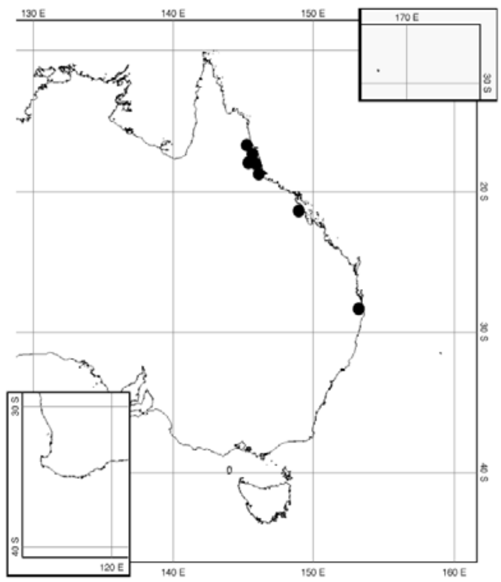

Fig. 65. Australian distribution of *M. clandestinum*.

NOTES – This taxon is characterized by an unfissured, thick, shiny thallus that is distinctly corticate, the immersed, small ascomata with fused exciple, small, hyaline, thick-walled, amyloid ascospores that are predominantly transversely septate, and the presence of the psoromic acid chemosyndrome. It is similar to *M. album* that mainly differs by the absence of secondary compounds (for further differences see under that species). *Myriotrema microporum* and *M. temperatum* are also close species, see there for differences. Another similar species is *M. glaucophaenum*, it can be distinguished by a thinner thallus, larger, often distinctly emergent ascomata with a free proper exciple and slightly smaller ascospores (up to 20 µm long). *Myriotrema terebratulum* was considered as a similar, but distinct species (e.g., Hale, 1974a: 32, 1978: 41; Patwardhan & Kulkarni, 1977: 12) distinguished by the strictly transversely septate ascospores. However, in the Fée type material of *M. clandestinum* no submuriform ascospores were found. However, several Australian collections have ascospores with an additional longitudinal septum. Hence, I follow Salisbury's (1978) opinion to regard the presence or absence of a vertical septum as of little taxonomic value. Salisbury (loc. cit.) discussed the contradictory statements of Nylander (1867: ascospores 'medio divisis') and Müller (1887: 'clare 4-loculares') for this species. Hence *T. terebratulum* is included as a synonym of *M. clandestinum* here.

One of Hale's collections from Atherton Tableland (*Hale 831933*) differs by the presence of 2-*0*-demethylsubpsormic acid (Elix, pers. comm.) but lacks psoromic and subpsoromic acids. It further differs in strongly aggregated and partly fused ascomata, very similar to some collections of *M. album*. The deviant specimen is tentatively included here for its chemotaxonomic relationship, until molecular data are available.

SPECIMENS EXAMINED – Australia, Queensland: Thornton Range: CREB rd. (to Cooktown), about 5 km in from Daintree River crossing, NW of Mossman, *Hale 831520* (US). Cape Tribulation Area, Cape Kimberley, *Lumbsch & Mangold 19166 f* (F). Km 45 on Mt. Windsor Rd., NW of Mossman, *Hale 831314* (US). Mt. Lewis Rd. 4-16 km N from Kennedy Hwy., W of Mossman, *Hale 830634, 832588* (US). Daintree NP., Mossman Gorge Section, near western border of National Park along Mossman creek, *Mangold 36 c* (F). Near end of

Black Mountain Rd., 33 km WNW of Kuranda, *Hale 832686* (US). Kuranda, *Wilson* s.n. (MEL 26171). End of Clohesy River Rd., 16 km SE Kennedy Hwy., W of Cairns, *Hale 832349* (US). Atherton Tablelands: Lake Barrine NP., *Hale 831577* (US); Lake Eacham NP., track around lake, *Hale 830267* (US); W side of Lake Eacham NP., 3 km in from W boundary on rd. from Yungaburra, *Hale 832353* (US); Area below crater, Mt. Hypipamee NP., S of Atherton, *Hale 832102*, *832129* (US); Malanda Falls, *Lumbsch & Mangold 19132 s, v, z* (F); Millaa Millaa falls, *Lumbsch & Mangold 19139 o* (F); SW of K-1 tree rd. off Palmerston Hwy, 11 km from main hwy and 2 km N of S.Johnstone Forestry Camp, SE of Millaa Millaa, *Hale 831933* (US); Palmerston NP., 6 km E of the West Boundary, *Hale 831646* (US); Culpa logging area, 13 km from Koombooloomba rd. turnoff, SE of Tully Falls, *Hale 832787* (US). Francis Range, Woopen Creek Rd., 25 km in from Bruce Hwy., NW of Innisfail, *Hale 832677* (US). Mt. Chalmynia logging area, 15 km from Bruce Hwy., W of Innisfail, *Hale 832258* (US). Dawson logging area, State Forest Reserve 605, 24 km S of Koombooloomba turnoff, WSW of Tully, *Hale 832689* (US). Dicks Tableland, "Rain Forest Discovery track" near Eungella, 60 km W of Mackay, *K. & A. Kalb 107* (CANB). Python Rock Track, Lamington NP., *Hale 830867* (US).

Myriotrema desquamans (Müll.Arg.) Hale

Mycotaxon 11: 133. 1980. Bas.: *Anthracothecium desquamans* Müll.Arg., Flora, Jena 71: 48 (1888). *Leptotrema desquamans* (Müll.Arg.) Patw. & Makhija, Bryologist 83: 368 (1980). Type: Australia, Queensland, Johnston River [Innisfail], *Berthoud* s.n. (G!–lectotype, selected by Patwardhan & Makhija [1980: 368]).

Thelotrema irosinum Vain., Suomal. Tiedeakat. Toim. A, 15: 174 (1921). *Leptotrema irosinum* (Vain.) Zahlbr., Cat. Lich. Univ. II: 635 (1923). Type: Philippines, Irosin, *Elmer 14749* (TUR-Vain.-lectotype, selected by Hale [1981: 278]; FH-, G-, L-, W-isolectotypes).

ILLUSTRATION – Fig. 66.

Thallus epiphloedal to partly hypophloedal, (moderately) thick, up to c. 800 µm high, pale olive to greenish gray. Surface shiny, smooth, continuous to slightly verrucose, unfissured. True cortex present, up to c. 40 µm thick, consisting of periclinal hyphae. Algal layer well developed, continuous but interrupted by calcium oxalate crystals, calcium oxalate crystals abundant, small to large, scattered or in clusters. Vegetative propagules not seen. Ascomata inconspicuous, small, up to c. 400 µm in diam., roundish, perithecioid, solitary, immersed to slightly emergent, then (flattened-)hemispherical. Disc not visible from surface. Pores tiny to very small, up to c. 30 µm in diam., roundish, entire, proper exciple apically visible from surface, forming the pore margin, fused, usually whitish-translucent, incurved, flush with thallus or slightly sunken. Thalline rim margin roundish, whitish or brighter than thallus. Proper exciple fused, ±thin, hyaline internally, yellowish- to reddish-brown marginally, often ±amyloid at the base. Hymenium up to c. 300 µm high, non-inspersed, highly conglutinated, paraphyses interwoven, slightly branched, tips thickened, lateral paraphyses and columellar structures absent. Epihymenium inconspicuous, hyaline, without granules. Asci 8-spored, tholus thick, thin when mature. Ascospores small, eumuriform, cell walls thick in younger stages becoming moderately thin at maturity, endospore slightly thickened, non-halonate, brown, non-amyloid to faintly amyloid, rarely (sub-)globular (morphotype II) to usually oblong, ends roundish to narrowed-roundish to rarely somewhat apiculate, loci roundish to slightly angular, (irregular-)subglobose to slightly lentiform, transverse septae thin, regular to irregular, 20-35 x 8-18µm, with 6-12 x 1-7 loci. Pycnidia not seen.

CHEMISTRY – Strain I: Thallus K+ yellowish to brown, C-, PD+ orange; containing constictic, stictic, (majors), hypoconstictic, cryptostictic and hypostictic (traces) acids. Strain II: Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Myriotrema desquamans* grows on tree bark in tropical rainforests in altitudes ranging from sea level to 800 m. It is moderately common in northern Queensland. This paleotropical species was previously reported from India and the Andman

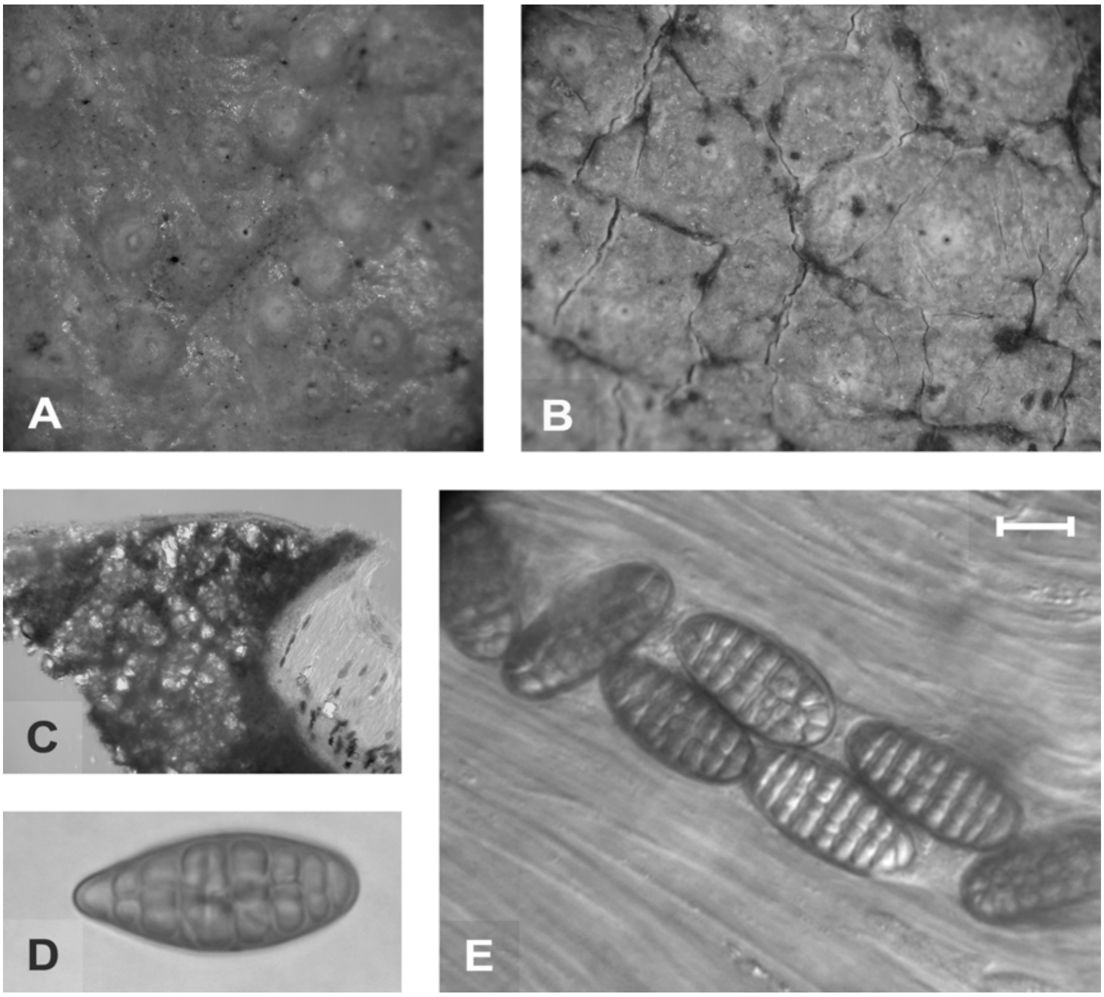

Fig. 66. *Myriotrema desquamans*: ascomata (**A, B**), ascoma and thallus section (**C**) and ascospores (**D, E**). A.: *Lumbsch & Mangold 19166 h*; B., C.: *Barnsley 1668*; D.: *Lumbsch & Mangold 19155 e*; E.: *Hale 831005*. Bar= A: 0.4 mm; B: 0.5 mm; C: 200 µm; D: 7.5 µm; E: 12 µm

Islands (as *L. irosinum*, Patwardhan & Kulkarni, 1977; Sethy & al., 1987), Sri Lanka (Hale, 1981), Philippines (as *T. irosinum*, Vainio, 1921) and Sabah (Patwardhan & Kulkarni, 1977).

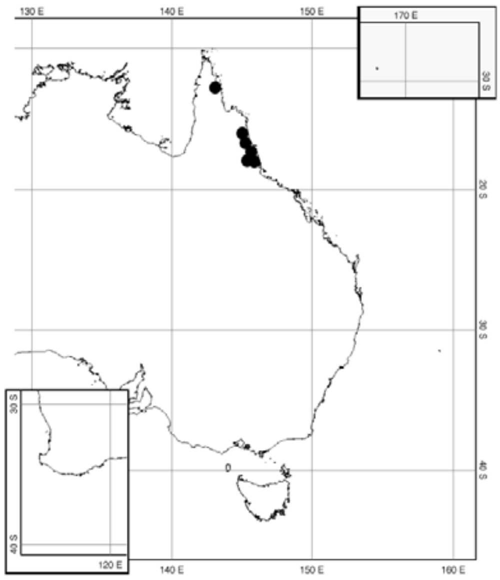

Fig. 67. Australian distribution of *M. desquamans.*

NOTES – This taxon is characterized by the shiny, corticate thallus, the immersed to slightly emergent perithecia with small pores, the moderately small, brown, muriform ascospores. A similar species is *M. trypaneoides*, see there for differences. Other Australian species with brown, muriform ascospores and the stictic acid chemosydrome (*L. glaucescens*, *L. subcompunctum* and *M. phaeosporum*) can be distinguished by wider pored ascomata and less distinctly shiny thallus surfaces. One collection from Cape Tribulation (*Mangold 32 zb*) differs in having globose to subglobose ascospores and is included only tentatively under this name until further collections become available. Further, one Hale collection (*Hale 830737*) lacks secondary compounds but otherwise agrees with the stictic acid containing specimens. Thus it is treated as a chemotype (strain II) of *M. desquamans*.

SPECIMENS EXAMINED – Strain I: Australia, Queensland: Iron Range NP.: 2-14 km from western boundary on track to Portland Roads, *Hale 830012, 830017, 830018, 830601, 832807, 832809* (US); Mt. Tozer, *Clarkson 2910* (BRI). Gordon Creek, near Lockhart River settlement, *Streimann 56537* (B, CANB). 'Home Rule' Track to Home Rule waterfall, S of Cooktown, *Barnsley 1668* (CANB). Near Cedar Bay NP., on road to Cooktown, *Mangold 34 m, p* (F). Cape Tribulation Area: Emmagen Creek, *Lumbsch & Guderley 11161 f* (F); Cape Tribulation NP., *Hale 831709* (US); Cape Tribulation Beach, *Hale 831975* (US); Myall Beach, *Mangold 32 b, zb* (F); Buchanan Creek Rd. (Cow Bay), *Hale 830260, 831234* (US); Cape Kimberley, *Lumbsch & Mangold 19166e, h, o, 19167b, k, q, r* (F). Daintree NP., Mossman Sct., Lower Mossman River, *Mangold 35 j, 36 e* (F); Mossman Gorge, *Hale 832207, 832259* (US). Machans Beach, N of Cairns, *K. & A. Kalb 21199* (hb. Kalb). Fitzroy Island, E of Cairns, *A. & M. Aptroot 22305* (ABL). Crystal Cascades, WSW of Cairns, *Lumbsch & Mangold 19120 d, n* (F). Atherton Tablelands: 27 km on Mulgrave River Rd., SW of Gordonvale, *Hale 830960* (US); Danbullah Forest Drive, *Hale 69170, 841488, 831515* (US); Curtain Fig Tree, *Lumbsch & Mangold 1928 q* (F); W side of Lake Eacham NP., *Hale 830938* (US); Souita Falls, *Lumbsch & Mangold 19155 e, i* (F); SW of K-1 tree rd. off Palmerston Hwy, *Hale 831005, 830865* (US); Just S of Hwy, 23 km E of jct Kennedy Hwy and Palmerston Hwy, *Hale 831052* (US); Wooroonooran NP., Palmerston Sct., *Lumbsch & Guderley 11108 h* (F); Kearney Falls, *Streimann 46560 b* (CANB); Josephine Falls, *Hale 831736* (US). 5 km NW of Babinda, near bridge crossing of the Russell River, *Hale 831115* (US). Babinda Boulders: *A. & M. Aptroot 22405* (ABL); *Hale 831594* (US); *Mangold 39 za* (F). 3 km N of Garradunga, Graham Range, *Hale 831605* (US). Francis Range, Woopen Creek Rd., *Hale 830272* (US). 12 km E of Cardstone on Tully River Rd. to Kareeya Power Station, *Hale 831970* (US).

Strain II: Australia, Queensland: Picnic area 2 km E of Cardstone on Tully River Rd. to Kareeya Power Station, *Hale 830737* (US).

Myriotrema eminens (Hale) Hale

Mycotaxon 11: 133 (1980). Bas.: *Thelotrema eminens* Hale, Mycotaxon 3: 177 (1975). Type: Malaysia, Pahang, *Hale 29947* (US-holotype, not seen).

ILLUSTRATION – Fig. 68.

Thallus epi- to hypophloedal, thin, up to c. 100 µm high, whitish-grayish to pale yellowish-gray. Surface ±shiny, smooth, continuous, unfissured to slightly fissured. True cortex usually present, ±continuous, up to c. 20 µm thick, moderately dense, formed of periclinal hyphae. Algal layer poorly developed but ±continuous, calcium oxalate crystals sparse to absent. Isidia often present, concolorous with thallus, cylindrical, slightly branched, up to c. 1.3 mm long and up to c. 200 µm thick. Ascomata conspicuous, moderately large, up to c. 800 µm in diam., predominantly ±roundish, perithecioid, marginally fused and clustered, forming groups of few to several ascomata, distinctly emergent, subglobose to urceolate. Disc not visible from surface. Pores small, up to c. 200 µm in diam., roundish to irregular, entire to slightly split, apical proper exciple usually not visible from surface, rarely becoming visible if partly detached, entire to slightly split, incurved, whitish, pore area sometimes sunken, concolorous with thalline rim or somewhat darkened. Thalline rim margin thick, entire to sometimes slightly cracked, flattened to sometimes slightly annular, concolorous with thallus or pale yellowish. Proper exciple fused, apically sometimes becoming free, (moderately) thick, color conspicuous, orange internally, reddish to reddish-brown marginally, non-amyloid. Hymenium up to c. 250 µm high, non-inspersed, strongly conglutinated, paraphyses thick, parallel, slightly branched towards the exciple, often distinctly curly in apical parts, tips thickened, lateral paraphyses and columellar structures absent. Asci 1(-2)-spored, tholus thin, not visible at maturity. Ascospores (very) large, densely eumuriform, cell walls and endospore thin, non-halonate, hyaline, distinctly to strongly amyloid, oblong to roundish-fusiform with roundish to narrowed-roundish ends, often somewhat irregular in outline, loci small, roundish to slightly angular, ±subglobose, transverse septae thin, irregular, vanishing with age, 150-200 x 25-50 µm with multiple loci. Pycnidia not seen.

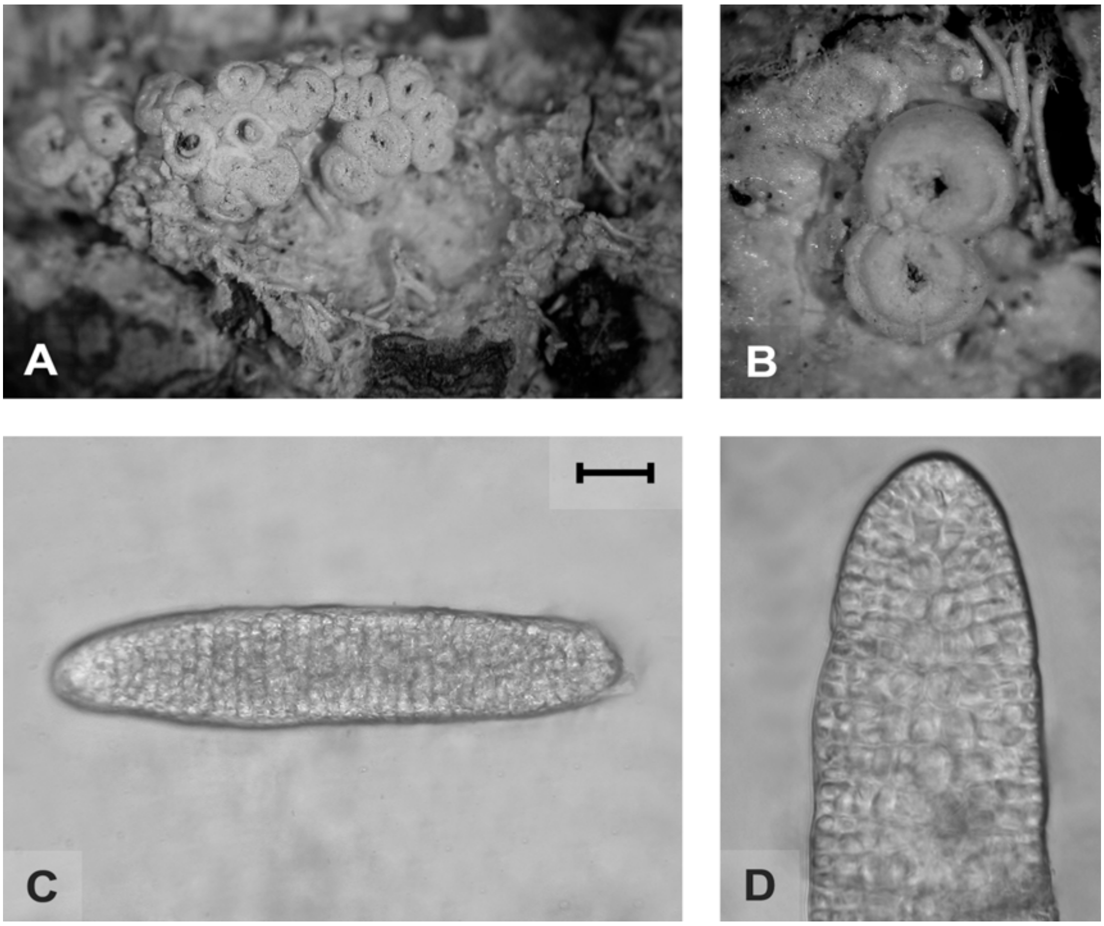

Fig. 68. *Myriotrema eminens*: growth habit (**A**), ascomata and isidia (**B**), ascospore (**C**) and ascospore detail (**D**). A.-D.: *Hale 831968*. Bar= A: 0.8 mm; B: 0.4 mm; C: 27.5 µm; D: 15 µm.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing constictic, stictic, (majors), hypostictic (minor), hypoconstictic and cryptostictic (traces) acids.

ECOLOGY AND DISTRIBUTION – The species was collected in Australia on tree bark in tropical rainforests in altitudes ranging from 530 to 1000 m. It is very rare in northern Queensland. This is the first report for Australia, it is known from Sri Lanka, Malaysia and the Philippines (Hale, 1981).

NOTES – *Myriotrema eminens* is characterized by the isidiate, corticate thallus, ±urceolate ascomata with a conspicuous, reddish exciple, large, eumuriform, thin-walled, hyaline, amyloid ascospores and the stictic acid chemosyndrome. The number of spores per ascus (one to rarely two)

Fig. 69. Australian distribution of *M. eminens.*

found in the Australian collections is somewhat different from Hale's (1981) description, who gave 2-4 spores per ascus. However, previously (Hale, 1975), he mentioned 1-2 spores per ascus for that species. The presence of isidia is variable, the specimen from Atherton Tablelands is abundantly isidiate, whereas the sample from Mt. Windsor is almost non-isidiate. Variation in isidia occurrence has been described earlier for *M. eminens* (Hale, 1981: 279).

SPECIMENS EXAMINED – Australia, Queensland: Mt. Windsor, 5 km W of new Forestry Camp, NW of Mossman, *Hale 831880* (US). Off Palmerston Hwy, 11 km from main hwy. and 2 km N of S. Johnstone Forestry Camp, SE of Millaa Millaa, *Hale 831968* (US).

Myriotrema frustillatum Mangold spec. nov. ined.

Type: Australia, New South Wales, Mt. Warning NP., track from summit to parking lot, *Mangold 19 f* (CANB-holotype; NSW-isotype).

ETYMOLOGY – The epithet refers to the characteristic form of the isidia (from lat. frustillum =a small piece, a scrap).

ILLUSTRATION – Fig. 70.

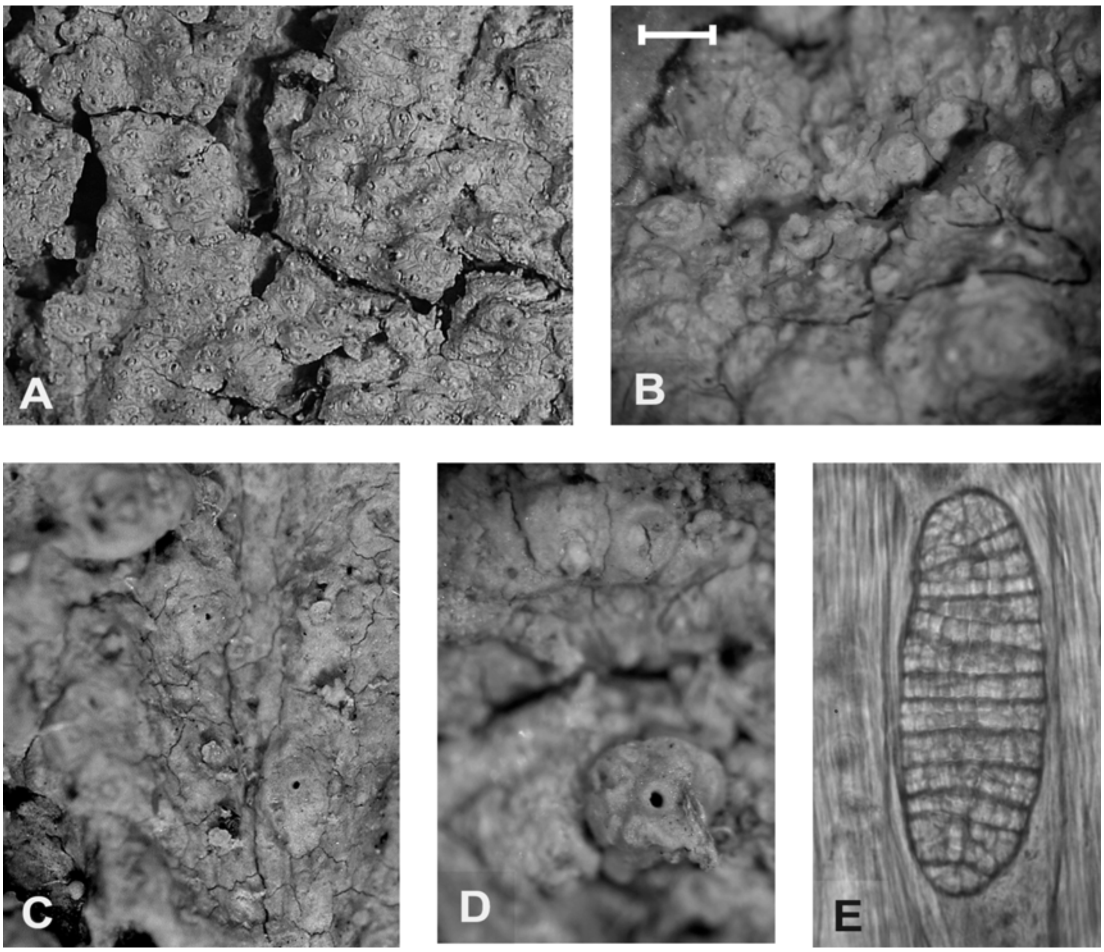

Fig. 70. *Myriotrema frustillatum*: growth habit (**A**), isidia (**B**), isidia and ascomata (**C, D**) and ascospore (**E**). A., C..: *Hale 831415*; B., E.: CANB-holotype; D.: *Hale 831681*. Bar= A: 2 mm; B: 1 mm; C: 0.7 mm; D: 0.45 mm; E: 18 µm.

Thallus epi- to hypophloedal, moderately thin to moderately thick, up to c. 300 µm high, (pale)greenish-gray to pale yellowish-gray. Surface dull to slightly shiny, smooth, ±rugose to verrucose, distinctly to strongly fissured. Thallus covered by an incontinuous to continuous protocortex, up to c. 35 µm thick. Algal layer moderately to well developed, ±continuous, calcium oxalate crystals abundant, small to large, usually clustered. Isidia present, very characteristic, concolorous with thallus, irregularly shaped, up to c. 300 µm in diameter, with a depressed to stalk-like base, usually developing out of a pit-like structure (see fig. 70, B-D). Ascomata inconspicuous, usually very sparse or absent, moderately large, up to c. 800 µm in diam., roundish, perithecioid, solitary, becoming distinctly emergent, (irregular-) hemispherical to irregular-urceolate in older ascomata. Discs not visible from surface. Pores tiny, up to c. 70 µm in diam., roundish, entire, proper exciple not visible from surface. Thalline rim margin moderately thick, concolorous with thallus, thalline rim incurved. Proper exciple fused, moderately thick, pale yellowish to pale orange internally, orange to yellowish-brown or brownish marginally, weakly to distinctly amyloid at the base. Hymenium up to c. 250 µm high, non-inspersed, strongly conglutinated, paraphyses thin, parallel, unbranched, straight to slightly bent in basal parts, distinctly curly in apical parts, tips slightly thickened, lateral paraphyses and columellar structures absent. Epihymenium indistinct, hyaline, without granules. Asci 1-2-spored, tholus and lateral walls evenly moderately thick in younger stages, thin when mature. Ascospores moderately to very large, densely eumuriform, cell walls and endospore thin, non-halonate, hyaline, non-amyloid, oblong to roundish-fusiform with roundish to narrowed-roundish ends, loci moderately small, ±angular, variably shaped, transverse septae thin, becoming somewhat irregular and indistinct with age, 80-200 x 20-38 µm with multiple loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ orange-red, C-, Pd-; containing norstictic (major), connorstictic, subnorstictic and hyposalazinic (traces) acids.

ECOLOGY AND DISTRIBUTION – *Myriotrema frustillatum* grows on tree bark in (sub)tropical rainforests in altitudes ranging from 300 to 1130 m. It is rare but wide-spread, occurring in northern Queensland and the Queensland/New South Wales border region and is currently only known from there.

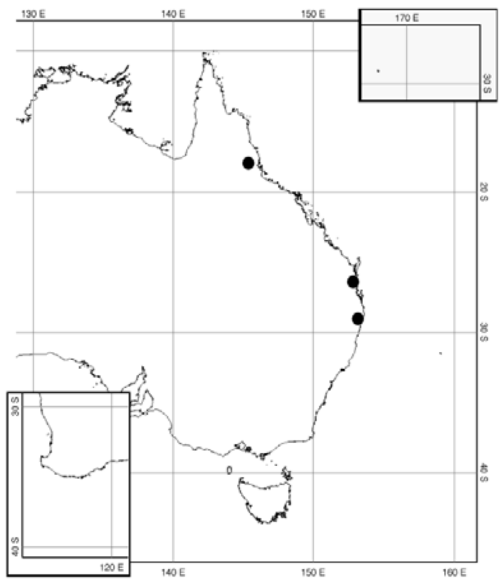

Fig. 71. Australian distribution of *M. frustillatum*.

NOTES – Although it is predominantly sterile or is found with only very few ascomata, the new species is readily characterized by the presence of isidia and the presence of the norstictic acid chemosydrome. Fertile specimen are further characterized by perithecioid ascomata and large, densely eumuriform, hyaline, non-amyloid ascospores without thickened parts. Except for *T. porinaceum*, which has lateral paraphyses and lacks isidia, there are no similar species in Australia. The generic position of this taxon is uncertain. The brown outer proper exciple is reminiscent of *Ocellularia*, however, substrate structures are always absent. For the time being the new species is placed in *Myriotrema* until future phylogenetic studies become available.

SPECIMENS EXAMINED – Australia, Queensland: Atherton Tablelands: Lake Eacham NP., *Mangold 29 j* (F); Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Mangold 30 y* pr.p. (F). Mapleton Falls, c.13 km W of Nambour, *Hale 832002* (US). New South Wales: Tweed Range, Mebbin NP., 25 km SW of Murwillumbah, *Mangold 21 p* (F). Nightcap NP., Mnt. Nardi/Mnt. Matheson Track, *Mangold 22 m, u* (F). NW part of Wiangaree Forest Drive, N of Kyogle, *Hale 831415* (US). Cambridge Plateau Forest Drive, 1-3 km N of picnic area, Richmond Range SF., 30 km W of Casino, *Hale 831681* (US).

Myriotrema glaucophaenum (Kremp.) Hale

Mycotaxon 11: 133 (1980). Bas.: *Thelotrema glaucophaenum* Kremp., Nuov. Giorn. Bot. Ital. 7: 19 (1875). *Ocellularia glaucophaena* (Kremp.) Zahlbr., Cat. Lich. Univ. II: 591 (1923). Type: Borneo, 1866, *Beccarii 92* (M!-holotype, G-isotype).

Ocellularia costaricensis Müll. Arg., Bull. Soc. Bot. Belgique 30: 75 (1891d). *Rhabdodiscus costaricensis* (Müll. Arg.) Vainio, Ann. Acad. Sci. Fenn. A 15(6): 184 (1921). *Ocellularia alba* f. *costaricensis* (Müll. Arg.) Redgr., Arkiv för Bot. 28A, 8: 18 (1936). *Myriotrema costaricense* (Müll. Arg.) Hale, Mycotaxon 11: 133 (1980). Type: Costa Rica, Baie de Salinas, 1892, *Pittier* s.n. (Plantae costaricenses exsiccatae no. 5320) (G-holotype, M!-isotype).

Thelotrema emergens Vain., Ann. Acad. Sci. Fenn., ser. A 15(6): 192 (1921a). *Ocellularia emergens* (Vain.) Zahlbr., Cat. Lich. Univ. II: 590 (1923). Type: Philippines, Mindanao, Butuan, *C. M. Weber 1416* (TUR-Vain. 26885!-holotype, NY!-isotype).

Myriotrema subcostaricense Sipman, Acta Bot. Fenn. 150: 168 (1994). Type: Guyana, Upper Mazaruni District, *Sipman & Aptroot 19424* (B-holotype, BRG-isotype).

ILLUSTRATION – Fig. 72.

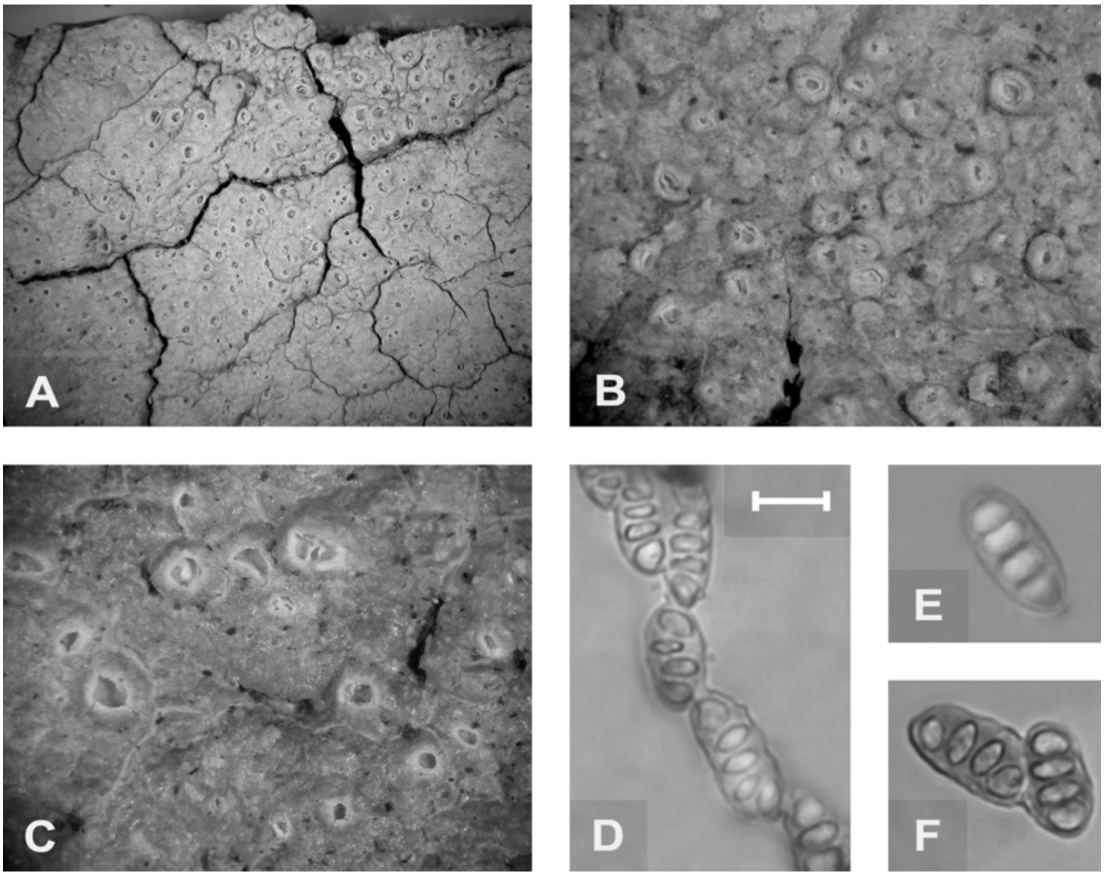

Fig. 72. *Myriotrema glaucophaenum*: growth habit (**A**), ascomata (**B, C**), ascospores **(D, E)** and ascospores showing amyloid reaction (**F**). A.: M-isotype of *O. costaricensis*; B.: *Hale 831201*; C.: *Hale 831434*; D., F.: *Hale 832616*; E.: TUR-holotype of *T. emergens*. Bar= A: 2 mm; B: 1 mm; C: 0.75 mm; D: 9 µm; E: 7 µm; F: 8 µm.

Thallus epi- to hypophloedal, (moderately) thin, up to c. 200 µm high, pale yellowish-green to (pale) olive. Surface ±shiny, smooth, continuous to rugose to verrucose, unfissured to slightly fissured. True cortex usually present, ±continuous, up to c. 25 µm thick, consisting of periclinal hyphae. Algal layer well to poorly developed, ±continuous, calcium oxalate crystals sparse to abundant, large and clustered, usually a distinct medulla layer present. Vegetative propagules not seen. Ascomata often conspicuous, becoming moderately large, up to c. 800 µm in diam., in fused ascomata often larger, roundish to irregular, in particular in fused ascoma, apothecioid to somewhat chroodiscoid, solitary to more often and fused, becoming slightly to distinctly emergent, predominantly (irregular-) urceolate. Disc usually becoming partly to rarely entirely visible from surface, pale flesh colored, pruinose. Pores wide to gaping, up to c. 600 µm in diam., roundish to irregular, entire to slightly ragged, proper exciple often becoming apically to more rarely entirely visible from surface, ±free, whitish, sometimes slightly shrunken, incurved to erect to rarely slightly recurved. Thalline rim margin wide to gaping, rarely roundish to more often irregular, (moderately) thick, rarely entire to usually split to lacerate or eroded, rarely concolorous to distinctly whitish and somewhat pruinose due to exposed medulla, thalline rim usually becoming erect to slightly recurved. Proper exciple fused to partly or entirely free, thick, hyaline internally, pale brownish or grayish marginally, sometimes with inclusions of substrate particles, non-amyloid. Hymenium up to c. 100 µm high, non-inspersed, strongly conglutinated, paraphyses thick, irregular and often dist. septate, ±interwoven, with thickened, irregular tips, lateral paraphyses and true columella absent, columella-like structures often present due to fused ascomata. Epihymenium (moderately) thick, hyaline, with coarse grayish granules and fine crystals. Asci 8-spored, tholus moderately thick, thin when mature. Ascospores (very) small, transversely septate, sometimes with a single longitudinal septum, cell walls moderately thin to moderately thick, endospore (moderately) thick, covered by a thin halo, hyaline, variably amyloid, non-amyloid in younger ascospores, usually distinctly amyloid at maturity, ±ellipsoid to oblong, with narrowed-roundish to subacute ends, loci ±roundish, subglobose to lentiform or oblong, end cells hemispherical to conical, septae moderately thin to moderately thick, often irregular, 10-18(20) x 5-8 µm with 2-6(8) (x2) loci. Pycnidia not seen, fide Frisch (2006) in thallus warts with brownish pore area, conidia fusiform, up to 6 x 1.5 µm.

CHEMISTRY – Thallus K+ yellowish, C-, PD+ yellow; containing psoromic (major), 2'-0-demethylpsoromic (minor to trace) and sub-psoromic (trace) acids.

ECOLOGY AND DISTRIBUTION – *Myriotrema glaucophaenum* was collected in Australia on tree bark predominantly in tropical rainforests in altitudes ranging from 50 - 1200 m. It is a common species in Queensland. This is the first report for Australia, it is also known from the Neotropics (Frisch, 2006), Africa (ibid.), Sri Lanka (Hale, 1981), Malaysia (ibid.) and the Philippines (ibid.) indicating a pantropical distribution.

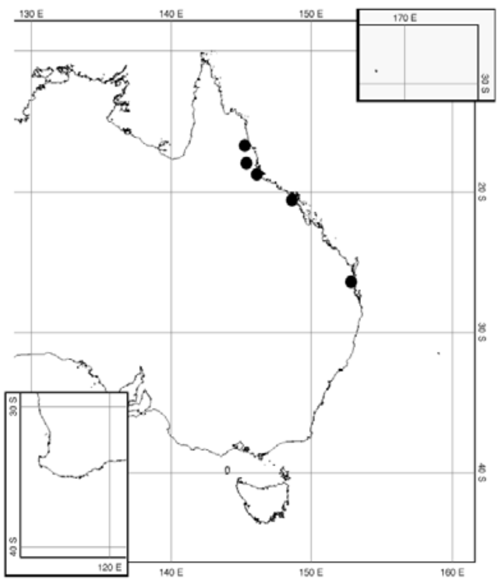

Fig. 73. Australian distribution of *M. glaucophaenum.*

NOTES – This taxon is characterized by a ±shiny, corticate thallus, emergent, wide-pored and fused ascomata irregular paraphyses and small, transversely septate, hyaline ascospores and the presence of the psoromic acid chemosyndrome.

Similar Australian species include *M. viridialbum, M. clandestinum* and *M. microporum*, for differences see under these species. *Myriotrema glaucophaenum* is unusual since its ascomata are *Thelotrema*-like but it lacks lateral paraphyses. Frisch (2006) included *M. glaucophaenum* in a sub-group of *Myriotrema*, the *M. viridialbum*-group, which is, amongst other characters, outlined by the presence of a "massive, ±reticulate columella" (ibid.). Although morphologically as well as microscopically in the ascoma sections, columella-like structures are frequently present, it is obvious that these structures are not derived from single apothecia but formed of excipular remnants of merged ascomata. Thus, often two or more ascomata can be found in various stages of fusion in a single, or in two (three) fused (irregular) thalline rim(s). A feature that is, for example, also found in *M. album* (see also under this species).

SPECIMENS EXAMINED – Australia, Queensland: Mt. Windsor logging area, just E of old Forestry Camp, NW of Mossman, *Hale 831872, 832440, 832616* (US). Mt. Windsor, 5 km W of new Forestry Camp, NW of Mossman, *Hale 830709* (US). Mt.Lewis Rd. 16 km N from Kennedy Hwy., W of Mossman, *Hale 832596* (US). Atherton Tableland: Lake Euramoo, *Lumbsch & Mangold 19127 e* (F); Danbulla Forest Drive, E of Tinaroo: Lake Euramoo State Forest Park, *Hale 831347* (US); Forest walk at Mobo Creek Crater, *Hale 831434* (US); 1 km W of Cathedral Fig Tree nr. Yungaburra, *Hale 831201* (US); Along west boundary of Lake Eacham NP., on rd. from Atherton, *Hale 831917* (US); Lake Eacham NP., track around lake, *Hale 830284* (US); 22 km NE of Atherton, Mt. Haig, *Tibell 15315* (UPS); Wongabel SF., S of Atherton on the Kennedy Hwy., *Hale 831751* (US); 13 km S of Ravenshoe on Tully Falls Rd., *Hale 832631* (US). Blencoe Creek, Cardwell Range, 48 km NW of Cardwell, *Streimann 36817* (B, CANB, US). About 7.5 km E of Wallaman Falls, W of Ingham, *Hale 831966* (US). Conway SF., 18 km E of Proserpine, *Elix 20770* (CANB). Noosa NP., Palm Grove Track, *Hale 830764* (US). Solomon Islands, Santa Isabal Isl., Tatamba, *Hill 11177* (US). French Guiana, Saül, *Sipman 31637* (as exsiccate of *M. subcostaricense* - Lichenotheca Latinoamericana no. 134) (US). Costa Rica, *Pitier 5321* (US).

Myriotrema microporum (Mont.) Hale

Mycotaxon 11: 134 (1980). Bas.: *Thelotrema microporum* Mont., Ann. Sci. Nat., Bot., sér. 3, 10: 130 (1848). *Coscinedia micropora* (Mont.) Massal., Atti I. R. Istit. Veneto, ser. 3, 5: 256 (1860). *Ocellularia micropora* (Mont.) Müll. Arg., Flora 74: 112 (1891e). Type: Indonesia, Java, *Junghuhn* s.n. (= Lichenes Javanicum no. 143) (PC-lectotype, selected by Hale [1981: 286]; FH-Tuck.!-, G-, H-Nyl.-, L-, M-, US!-isolectotypes).

Thelotrema crassulum Nyl., Ann. Sci. Nat., Bot., sér. 4, 11: 258 (1859). *Ocellularia crassula* (Nyl.) Zahlbr., Cat. Lich. Univ. II(4): 588 (1923). Type: Mauritius ('Bourbon'), *Boivin* s.n. (PC-lectotype, selected by Hale [1981: 286]; M-, G-, H-Nyl. 22652-, H-Nyl.22653-isolectotypes).

Ocellularia galactina Zahlbr., Ann. Crypt. Exot. 5: 216 (1932). Type: South Africa, Knysna, *v.d. Byl 673* (W-holotype; LD-, US!-isotypes).

ILLUSTRATION – Fig. 74.

Thallus predominantly epi- to somewhat hypophloedal, thick, up to c. 800 µm high, color variable, predominantly (pale) olive in younger thalli becoming grayish or greenish-gray to yellowish-brown with age, often with a (dark-) gray hue. Surface dull to shiny, smooth, continuous to rugose, becoming distinctly fissured to areolate in mature stages. Cortex structures variable, often and particularly in younger thalli true cortex present, ±continuous, hyaline, up to c. 50 µm thick, consisting of periclinal to somewhat irregular hyphae, sometimes lacking a true cortex, then covered by a thin and often incontinuous protocortex. Algal layer well developed, continuous, calcium oxalate crystals lacking or sparse, then small and scattered to more rarely clustered, distinct medullar layer often present. Vegetative propagules not seen. Ascomata abundant, small, up to c. 250 µm in diam., roundish, apothecioid, solitary to marginally fused, predominantly immersed. Disc usually not visible from surface, very rarely becoming partly visible, pale flesh colored, epruinose. Pores small to rarely mod small, up to c. 150 µm in diam., roundish to irregular, predominantly ±split, proper exciple usually becoming apically to rarely entirely visible from surface, off-white, usually shrunken, incurved. Thalline rim margin becoming moderately wide to wide, roundish

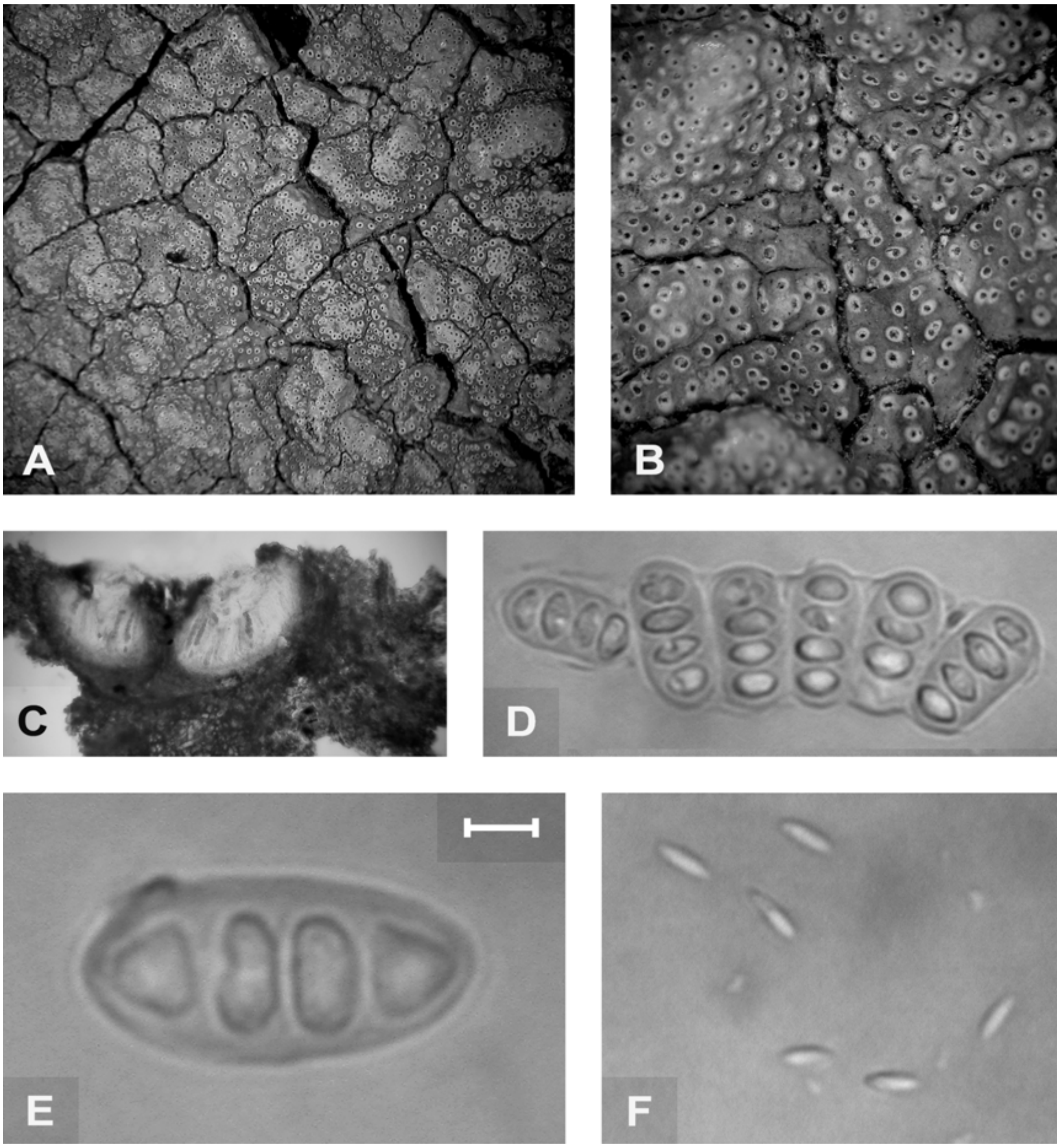

Fig. 74. *Myriotrema microporum*: growth habit (**A**), ascomata (**B**), ascomata section (**C**), ascospores (**D, E**) and conidia (**F**). A.-D.: FH-isolectotype; E., F.: *Lumbsch & Mangold 19174 a*. Bar= A: 2.5 mm; B: 1 mm; C: 125 µm; D: 7 µm; E: 2.5 µm; F: 3 µm.

to somewhat irregular, (moderately) thin, entire to more often ±split, often ±distinctly raised, whitish or brighter than thallus, thalline rim incurved. Proper exciple usually becoming free in upper parts, (moderately) thin, with thin or lacking hyaline to pale yellowish area internally, entirely or marginally grayish to pale grayish-brown, sometimes faintly amyloid in lower parts. Hymenium up to c. 100 µm high, non-inspersed, moderately conglutinated, paraphyses somewhat irregular, ±interwoven, with slightly thickened tips, lateral paraphyses lacking, apical exciple sometimes forming lateral paraphyses-like structures due to radiating hyphae, columellar structures absent. Epihymenium indistinct to thin, hyaline, sometimes with fine grayish granules. Asci 8-spored, tholus moderately thick, thinning or not visible at maturity. Ascospores (very) small, transversely septate, cell walls and endospore (moderately) thick, non-halonate, hyaline, distinctly to strongly amyloid, oblong to ellipsoid to somewhat fusiform with roundish to subacute ends, loci roundish, oblong to lentiform, with same shaped to hemispherical to rarely conical end cells, septae moderately thin, regular, 10-16(18) x 5-8 µm with 3-4(5) loci. Pycnidia present, immersed, with inconspicuous dark pore, conidia fusiform, up to c. 5 x 2 µm.

CHEMISTRY – Thallus K+ yellowish, C-, PD+ yellow; containing psoromic (major), 2'-0-demethylpsoromic (minor to trace) and subpsoromic (trace) acids.

ECOLOGY AND DISTRIBUTION – *Myriotrema microporum* occurs on tree bark in (sub)tropical rainforests, rarely in wet sclerophyll forests in altitudes ranging from sea level to 1200 m. It is common and wide spread in the north-western Northern Territory and Queensland. This paleotropical species was also recorded from Africa, Mauritius, India (Nagarkar & al., 1988), Sri Lanka (Hale, 1981), SE Asia (eg., Hale, 1981; Nagarkar & al., 1988; Sipman, 1993), Samoa (Zahlbruckner, 1907) and Solomon Islands (Hale, 1981). Records from the Neotropics are erroneous (Hale, 1981).

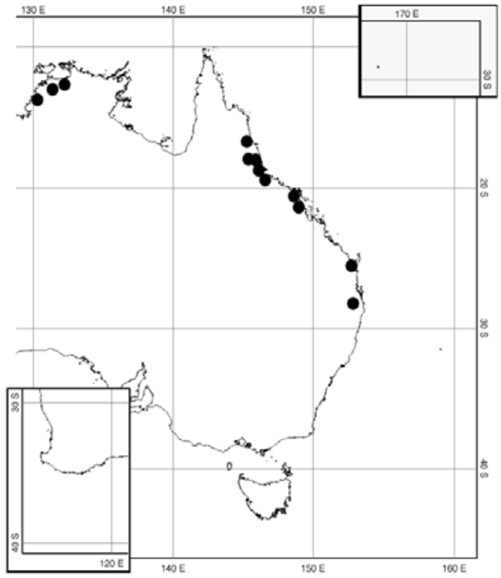

Fig. 75. Australian distribution of *M. microporum*.

NOTES – Mature and well developed specimen of *M. microporum* can be recognized morphologically by the thick, areolate thallus that becomes somewhat dull and (dark-)gray, and immersed ascomata with free exciple. It is further characterized by small, transversely septate, hyaline, amyloid ascospores with distinctly thickened parts and the psoromic acid chemosyndrome. In younger and poorly developed collections however, *M. microporum* can be easily confused with *M. clandestinum,* which differs by ascomata with fused exciple, an often exposed disc and slightly lager ascospores (up to 25 µm long) that sometimes have a single longitudinal septum. Other similar species include the psoromic acid containing *M. glaucophaenum* and *M. temperatum*, and *M. olivaceum* with different chemistry (for further differences to *M. microstoma* see under these species). The extratropical *M. temperatum* can be distinguished by a distinctly verruculose thallus with abundant calcium oxalate crystals and larger ascomata that have a fused proper exciple and an entire, thicker thalline rim margin. *Myriotrema glaucophaenum* differs by a thicker, never distinctly fissured or areolate thallus, larger, usually distinctly emergent ascomata with a thick, often distinctly split to lacerate thalline rim margin.

SPECIMENS EXAMINED – Australia, Northern Territory: Curtain Falls, Litchfield Park, 38 km WSW of Batchelor, *Elix 27577* (CANB). Kakadu NP., "Gungarre Monsoon Forest", *A. & K. Kalb 30597* (hb Kalb). Channell Point, 23 km NNW of Daly River, *Elix 27713* (CANB). Queensland: Uncertain locality, 1899, *Bailey* s.n. (BM-761745, -761745). Cape Tribulation Area, near the "Cape Tribulation Store", *Mangold 33 v* (F). Km 45 on Mt. Windsor Rd., NW of Mossman, *Hale 831418, 832300* (US). Mt. Windsor Tableland, 45 km NW of Mossman, *Elix 16457* (B, CANB). Mt. Windsor logging area, just E of old Forestry Camp, NW of Mossman, *Hale 831256, 831854, 832262* (US). Mt. Windsor, 5 km W of new Forestry Camp, NW of Mossman, *Hale 832719* (US). Mt. Windsor logging area, 9 km from rd. to old Forestry Camp and the main rd., *Hale 830611* (US). Mt.Lewis Rd., 10 km N from Kennedy Hwy., W of Mossman, *Hale 831245*, *831947, 832431* (US). Atherton Tablelands: Davies Creek Rd. 17 km S of Kennedy Hwy., S of Davies Creek Falls NP., E of Mareeba, *Elix 85* (CANB, US), *Hale 64024* (COLO, H, MEL) *831871, 832445, 832578, 832757* (US); Danbullah Drive, E of Tinaroo, forest walk at Mobo Creek Crater, *Hale 831489*, *832510* (US); 22 km NE of Atherton, Mt. Haig, *Tibell 15313* (UPS); Lake Eacham NP.: *Mangold 29 am* (F), *A. & M. Aptroot 22633* (ABL); Plath Rd. logging head, 9 km W of Plath Rd., off Kennedy Hwy, Herberton range, S of Atherton, *Hale 830274, 831861, 832192* (US); Malanda Falls, *Lumbsch & Mangold 19132 zc* (F); 15 km E of Malanda, close to Bora ground, *Tibell*

15369 (UPS); Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Mangold 30 k* (F); S of hwy., 13 km E of jct. Kennedy Hwy. and Palmerston Hwy., E of Ravenshoe, *Hale 831259*; Arthur Bailey Rd., 9 km SSE of Ravenshoe, *Streimann 46154* (B, CANB); Walter Hill Range, 26 km SE of Ravenshoe, *Elix 17090* (CANB); Ravenshoe SF., Culpha Ck. Catchment, Cardwell Range, 41 km SE of Ravenshoe, *Elix 16085, 16086* (CANB); Culpa logging area, 13 km from Koombooloomba rd. turnoff, SE of Tully Falls, *Hale 832305* (US). Francis Range, Woopen Creek Rd., 25 km in from Bruce Hwy, NW of Innisfail, *Hale 832085* (US). Dawson logging area, State Forest Reserve 605, 24 km S of Koombooloomba turnoff, WSW of Tully, *Hale 831216, 831280, 832110* (US). Cardwell Range: Blencoe Creek, 48 km NW of Cardwell, *Streimann 36870* (CANB, H, US); Yuccabine Creek, Kirrima Rd., 27 km WNW of Cardwell, *Elix 15745* (CANB); Kirrima SF., 24 km WNW of Cardwell, *Elix 15666*, *Streimann 28584* (CANB). North Wallaman Logging Area, 36 km WNW of Ingham, *Streimann 28799* (B, CANB). About 7.5 km E of Wallaman Falls, W of Ingham, *Hale 831009* (US). Mt. Spec SF.: Paluma Range, 6 km SW of Paluma, *Elix 20255* (B, CANB); Paluma to Hidden Valley Rd., 40 km S of Ingham, *Streimann 64262* (B, CANB). Mt. Spec NP., Ridge on the Loop, on the Paluma Rd., WNW of Townsville, *Hale 832419* (US). Conway Range NP., near Shute Harbour-Airlie Beach, *Hale 832698*, *832721* (US). Cape Hillsborough NP., NW of Mackay, *Hale 831292* (US). Eungella NP.: *Tibell 14731* (UPS); NP. side rd. nr. Peases Lookout, off Darymple rd., *Hale 832468* (US); Walking trail from Mt. Darymple rd. to Mt. Darymple summit, *Rambold 4606* (M); Palm Walk Circuit, *Hale 831125* (US); Trail from Broken River station to rainforest, *Lumbsch & Mangold 19108 l* (F); Finch Hatton Gorge, *Lumbsch & Mangold 19116 d* (F). Frasier Coast, River Heads, *Lumbsch & Mangold 19092 o* (F). Carabeen Nature Refuge, 45 km E of Warwick, *Lumbsch & Mangold 19174 a* (F).

Myriotrema myrioporum (Tuck.) Hale

Mycotaxon 11: 134 (1980). Bas.: *Thelotrema myrioporum* Tuck., Proc. Amer. Acad. Arts Sci. . 5: 412 (1862). *Ocellularia myriopora* (Tuck.) Müll. Arg., Rev. Mycol. 10: 114 (1888). Type: Cuba, Monte Verde, *Wright 129* (BM!-lectotype, selected here[10]; FH-Tuck.-, US!-isolectotypes).

ILLUSTRATION – Fig. 76.

Thallus epi- to hypophloedal, moderately thick, up to c. 200 µm high, (pale) olive to pale yellowish-gray. Surface slightly shiny, smooth, continuous to slightly verruculose, unfissured. True cortex usually present, predominantly continuous, slightly yellowish, thickness variable, up to c. 40 µm thick, formed of periclinal to irregular hyphae, sometimes partly not conglutinated forming a protocortex. Algal layer well developed, continuous, presence of calcium oxalate crystals variable, sparse to abundant, predominantly large, clustered, sometimes a distinct medallar layer present. Vegetative propagules not seen. Ascomata inconspicuous but often very abundant, predominantly ±small, up to c. 400 µm in diam., roundish, apothecioid, solitary to marginally fused, predominantly immersed to rarely somewhat emergent, then hemispherical. Disc often becoming partly visible from surface, pale flesh colored, epruinose to slightly pruinose. Pores moderately small, sometimes becoming wide, up to c. 200 µm in diam., predominantly roundish to rarely somewhat irregular, entire, proper exciple not visible from surface. Thalline rim becoming thick to very thick, sometimes funnel-shaped, brighter than thallus, forming a narrow fawnish to off-white ring-like area, thalline rim incurved. Inner ascomata margin two-layered, with a fused, (moderately) thin proper exciple and a thicker layer of conglutinated paraphyses, not clearly separated from the hymenium, pale yellowish, usually ±amyloid, turning reddish, often with a distinct, thick layer of grayish granules towards the epihymenium. Hymenium up to c. 70 µm high, non-inspersed, strongly conglutinated, paraphyses somewhat irregular, unbranched, often distinctly septate, slightly interwoven, with slightly to distinctly thickened, irregular tips, lateral paraphyses land columellar structures absent. Epihymenium indistinct to thin, hyaline, sometimes with fine grayish granules. Asci 8-spored, tholus moderately thin to

[10] The material in BM assigned as Wright 129 consists of several specimen of *M. myrioporum*, the upper, middle piece is here selected as type. In the US sample, the upper, larger specimen resembles the according isolectotype material.

lacking. Ascospores uniform, very small, with a single septum to more rarely not septated, cell walls and septum thick, non-halonate, hyaline, moderately amyloid, ellipsoid to fusiform, with narrowed-roundish to subacute ends, loci subglobose to (roundish-)conical, 10-13 x 4-6 µm with 1- 2 loci. Pycnidia not seen.

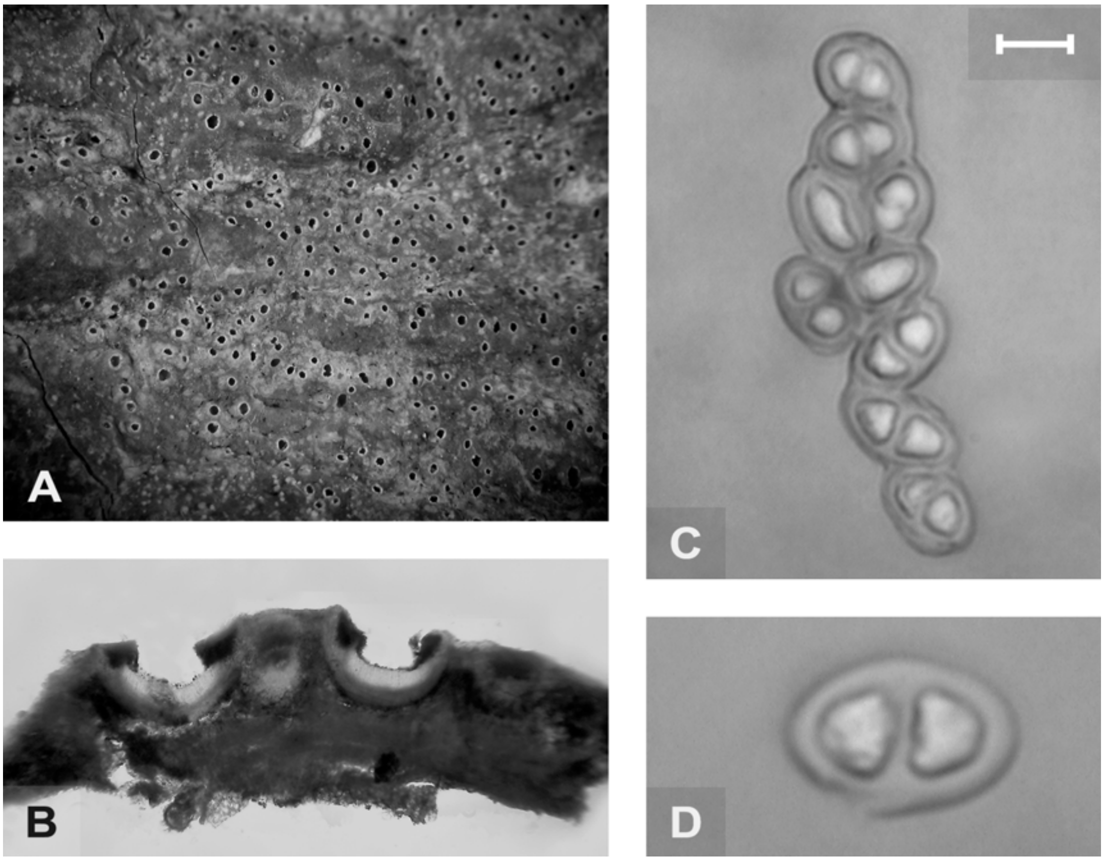

Fig. 76. *Myriotrema myrioporum*: growth habit (**A**), ascomata section (**B**) and ascospores (**C, D**). A.: US-isolectotype; B.: *Hale 830606;* C., D.: *Hale 830011*. Bar= A: 1.75 mm; B: 200 µm; C: 6 µm; D: 3 µm.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Myriotrema myrioporum* was collected in Australia on tree bark in tropical rainforests in 900 m and an unknown altitude. It is a very rare species in Australia, occurring in northern Queensland. This is the first report for Australia and the Paleotropics, it is otherwise known from the Neotropics, indicating a pantropical distribution.

NOTES – The 2-celled ascospores are characteristic of this species as well as the anatomy of the lateral exciple and hymenium, which was also mentioned by Redinger (1936). This ascomatal part shows a reddish amyloid reaction and often

Fig. 77. Australian distribution of *M. myrioporum*.

includes grayish granules. It is morphologically similar to *M. album* and *M. clandestinum* but can be readily distinguished by the unique ascoma characters. *Myriotrema uniseptatum* from Panama is another similar species that differs in a pruinose thallus surface and smaller (up to 7 x 3 µm) up to 3(4)-locular ascospores and in containing psoromic and stictic acid as major secondary metabolites.

SPECIMENS EXAMINED – Australia, Queensland: Iron Range NP., 31 km from western boundary on track to Portland Rds., *Hale 830011* (US). About 8.5 km E of Wallaman Falls, W of Ingham, *Hale 830606* (US).

Myriotrema olivaceum Fée

Méthode lichénographique et genera. Paris: tab. 1, fig. 25 (1824); Essai sur les cryptogames des écorces exotiques officinales. Paris: 103 (1825 ['1824']). *Ocellularia olivacea* (Nyl.) Müll. Arg., Mém. Soc. Phys. Hist. Nat. Genève 29(8): 7 (1887c). *Ocellularia olivacea* (Nyl.) Overeem, in Overeem-de Haas C. & Overeem-de Haas, D., Bull. Jard. Bot., sér. 3, 4: 118 (1922) [superfl. comb.]. Type: South America, "On Bonplandia trifoliata", s.c. (G-Fée 250-lectotype, selected by Hale [1974b: 24]; M-, PC-Mont.-isolectotypes).

Thelotrema subcrassulum Vain., Mycologia 21: 38 (1929). *Ocellularia subcrassula* (Vain.) Zahlbr., Cat. Lich. Univ. 8: 245 (1932). Type: Puerto Rico, near El Yunque, *Fink 725* (MICH-lectotype, selected by Hale [1978: 12]; US!-isolectotype).

ILLUSTRATION – Fig. 78.

Thallus predominantly epi- to somewhat hypophloedal, thick, up to c. 600 µm high, color variable, predominantly (pale) olive in younger thalli, becoming grayish or greenish-gray to yellowish-brown with age, sometimes with a (dark-) gray hue. Surface dull to shiny, smooth, continuous to rugose, becoming distinctly fissured to areolate. Thallus cover variable, often and particularly in younger thalli true cortex present, continuous to incontinuous, hyaline, up to c. 40 µm thick, consisting of periclinal to somewhat irregular hyphae, sometimes lacking a true cortex, then covered by a thin and often incontinuous protocortex. Algal layer well developed, continuous, calcium oxalate crystals lacking or sparse, then ±small and clustered, a distinct medullar layer present. Vegetative propagules not seen. Ascomata becoming abundant, small, up to c. 300 µm in diam., roundish, apothecioid, solitary to marginally fused, predominantly immersed to slightly raised. Disc not visible from surface to very rarely becoming partly visible, pale flesh colored, epruinose. Pores small to more rarely moderately small, up to c. 100 µm in diam., roundish to irregular, predominantly ±split, proper exciple usually becoming apically to rarely entirely visible from surface, off-white, usually shrunken, incurved. Thalline rim margin becoming moderately wide to wide, roundish to somewhat irregular, thin to moderately thick, entire to ±split, often ±distinctly raised, whitish or brighter than thallus, thalline rim incurved. Proper exciple usually becoming free in upper parts, (moderately) thin, with thin hyaline to pale yellowish area internally, orange to pale brown marginally, in older stages often (dark) brown apically, sometimes faintly amyloid in lower parts. Hymenium up to c. 90 µm high, non-inspersed, moderately conglutinated, paraphyses somewhat irregular, ±interwoven, with slightly thickened tips, lateral paraphyses absent, apical exciple sometimes forming lateral paraphyses-like structures due to radiating hyphae, columellar structures absent. Epihymenium indistinct, hyaline, without granules. Asci 8-spored, tholus moderately thick, thinning or not visible at maturity. Ascospores very small, transversely septate, cell walls and endospore (moderately) thick, non-halonate, hyaline, distinctly to strongly amyloid, oblong to ellipsoid to somewhat fusiform in younger stages, with roundish to narrowed-roundish to subacute ends, loci roundish to slightly angular, subglobose to oblong to lentiform, with same shaped to more hemispherical or rarely conical end cells in younger stages, septae moderately thin, regular, 10-15 x 5-7 µm with 3-4(5) loci. Pycnidia not seen.

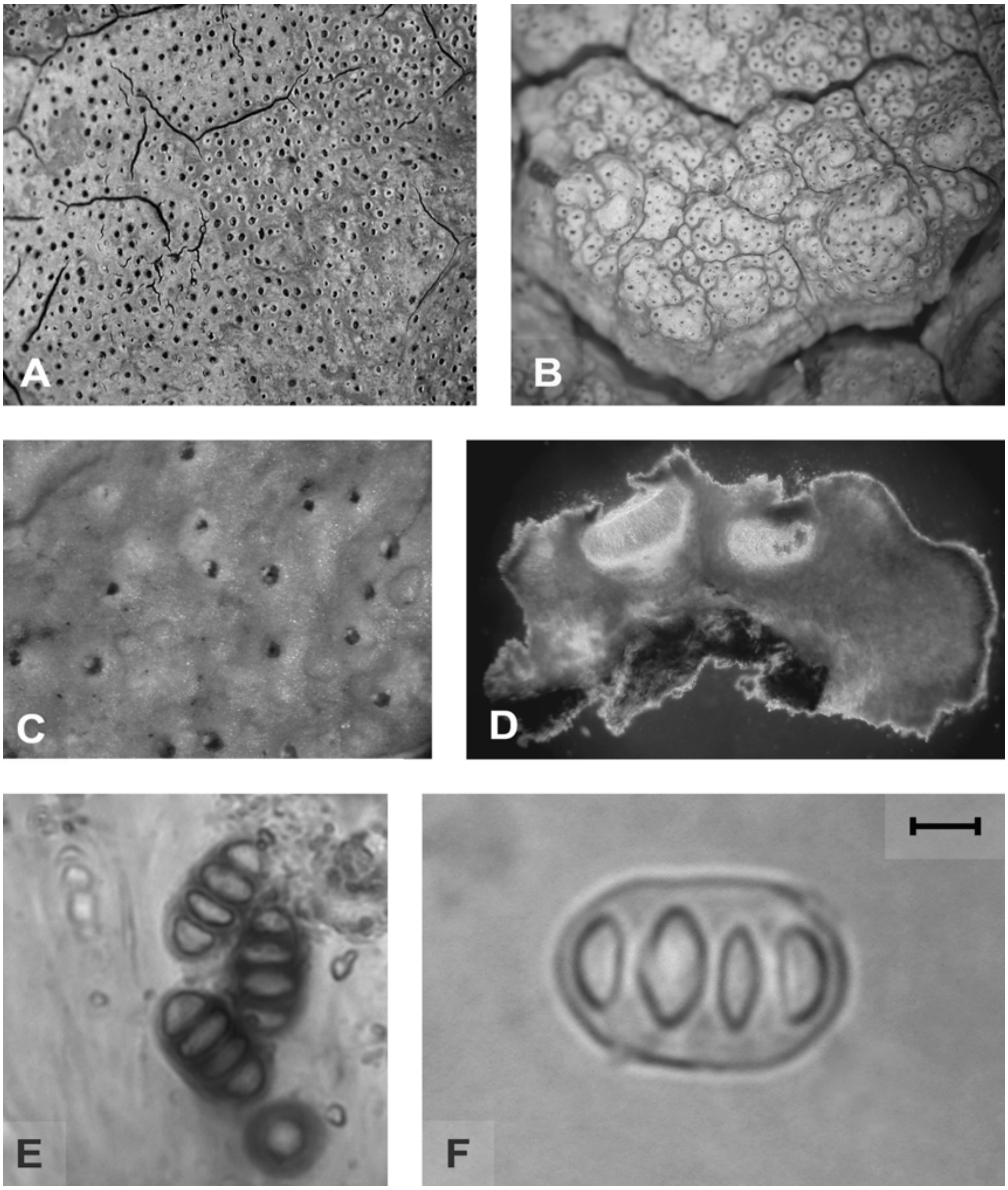

Fig. 78. *Myriotrema olivaceum*: growth habit (**A, B**), ascomata (**C**), ascomata and thallus section (**D**), ascospores showing amyloid reaction (**E**) and ascospore (**F**). A.: *Hale 832174*; B,. D.-F.: *Streimann 30299*; C.: US-isolectotype of *T. subcrassulum*. Bar= A, B: 1 mm; C: 0.75 mm; D: 125 µm; E: 7 µm; F: 2 µm.

CHEMISTRY – Strain I: Thallus K+ red, C-, PD-; containing olivaceic (major) and norsubnotatic (major to minor) acid. Strain II: Thallus K(+) reddish, C-, PD-; containing O-methylolivaceic and norisonotatic (majors) and olivaceic (minor) acid.

ECOLOGY AND DISTRIBUTION – *Myriotrema olivaceum* grows on tree bark in (sub)tropical rainforests and more often in moist habitats as coastal forests, mangroves or monsoon forests in predominantly lower altitudes ranging from sea level to 400 m. Four specimens were collected at 1200 m. It is a common and wide-spread species occurring in north-western Northern Territory and Queensland. This is the first report for Australia. Previously it was recorded from the Neotropics, Africa (Frisch, 2006), Sri Lanka (Hale, 1981), Andaman

Islands (Nagarkar & al., 1986), New Caledonia (Hale, 1981) and Marquesas Islands (ibid.) indicating a pan(sub)tropical distribution.

NOTES – This species is morphologically and anatomically almost indistinguishable from *M. microporum*. However, some minor differences in thallus thickness, ascomata characters and ascospore size (in *M. microporum* the thallus is up to 800 µm thick, the exciple grayish and less pigmented, ascospores up to 18 x 8 µm) were found in the present material. Further, the two species differ chemically (psoromic acid chemosydrome in *M. microporum*). The relationships of the two species require additional studies, including molecular data.

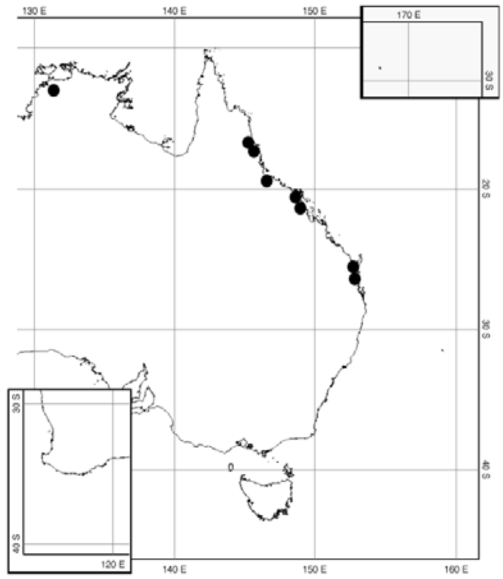

Fig. 79. Australian distribution of *M. olivaceum*.

Unfortunately no type material of *M. olivaceum* was available for study. Three examined specimen, all from the same location (Mt. Lewis area, SW of Mossman - *Elix 16919, 16928, Streimann 30299*) are assigned to the chemical strain II. They chemically agree with Frisch's (2006) description of *M. subterebrans* from Africa. The type collection was also not available for study, hence no further taxonomic statement can be made. Besides olivaceic acid in lower concentrations, strain II contains O-methylolivaceic and norisonotatic acid, with identical Rf-values and spot-characters as described by Frisch (ibid.) for the unknown compounds 'neoterebrans unknown' and 'olivaceum unknown high' reported to occur as major compounds in *M. neoterebrans*. Both latter mentioned compounds are chemically closely related to olivaceic acid. Since strain II is morphologically identical to chemotype I, it is treated as a chemotype until the type material of *M. subterebrans* as well as *M. olivaceum* becomes available.

Thelotrema configuratum[11] from Sarawak (Malaysia) is a similar species, which contains only norsubnotatic acid, has small, immersed ascomata with a free exciple, and similar ascospores. It was combined to *Myriotrema* (Hale, 1980) and thus, could be expected to be closely related to *M. olivaceum* (its chemical relationship was mentioned by Hale, 1974). However, the examination of the type collection revealed conspicuous lateral paraphyses (up to 20 µm long), indicating that the species belongs to *Thelotrema*.

SPECIMENS EXAMINED – Strain I: Australia, Northern Territory, Litchfield NP., 100 km S of Darwin, *A. & K. Kalb 34256* (hb. Kalb). Queensland: Cape Tribulation Area: Cape Tribulation Beach, *Hale 830306* (US); C. 40 km N of Mossman, *A. & K. Kalb 27050* (hb. Kalb). Mossman Gorge NP., near Mossman, *Hale 830637* (US). Main Coast Range, 19 km NNW of Mt. Molloy, *Streimann 30299* (B). Crystal Cascades, 5 km W of Cairns, *Lumbsch & Mangold 19120 f* (F). Boat Ramp c. 2 km E of Edmonton, SE of Cairns, *Lumbsch & Guderley 11139 d* (F). Little Crystal Creek Falls, Mt.Spec NP., the falls on Paluma Rd., *Hale 831218* (US). Murray Falls, W of Kennedy, *Hale 832547* (US). Conway NP., 22 km NE of Proserpine: At the campground 0.5 km E of Shute Harbor, *Tibell 14663, 14671* (UPS); Near Shute Harbour-Airlie Beach, *Hale 832174* (US). Conway Peninsula, E of Proserpine, *Scott 622* (BRI). Eungella NP., Finch Hatton Gorge, *Lumbsch & Mangold 19113 f* (F). Frasier Coast, River Heads, *Lumbsch & Mangold 19092 g* (F). Amama SF., 6 km SW of Amamoor, S of Glympie, *Hale 831365* (US).

Strain II: Australia, Queensland: Main Coast Range, track to Mt. Lewis, 19 km NNW of Mt. Molloy, *Elix 16919, 16928, Streimann 30299* (CANB).

[11] ***Thelotrema configuratum*** (Hale) Mangold comb. nov. ined. Bas.: *Ocellularia configurata* Hale, Phytologia 27: 491 (1974). *Myriotrema configuratum* (Hale) Hale, Mycotaxon 11: 133 (1980). Type: Malaysia, Borneo, Sarawak, N of Sibu, *Hale 31207* (US!-holotype).

Myriotrema phaeosporum (Nyl.) Hale

Mycotaxon 11: 134 (1980). Bas.: *Thelotrema phaeosporum* Nyl., Ann. Sci. Nat. Bot., sér. 4: 242 (1859). *Leptotrema phaeosporum* (Nyl.) Muell.Arg., Flora 65: 499 (1882). Type: Papua New Guinea, New Ireland, Port Carteret, *Lesson* s.n. (G!-, US!-isotypes).

Leptotrema polyporum Riddle, Mycologia 15: 79 (1923). Type: Isle of Pines (New Caledonia), Sierra de los Caballos, *Jennings 229 a* (FH-lectotype, selected by Hale [1972 in herb.], NY!-isolectotype).

ILLUSTRATION – Fig. 80.

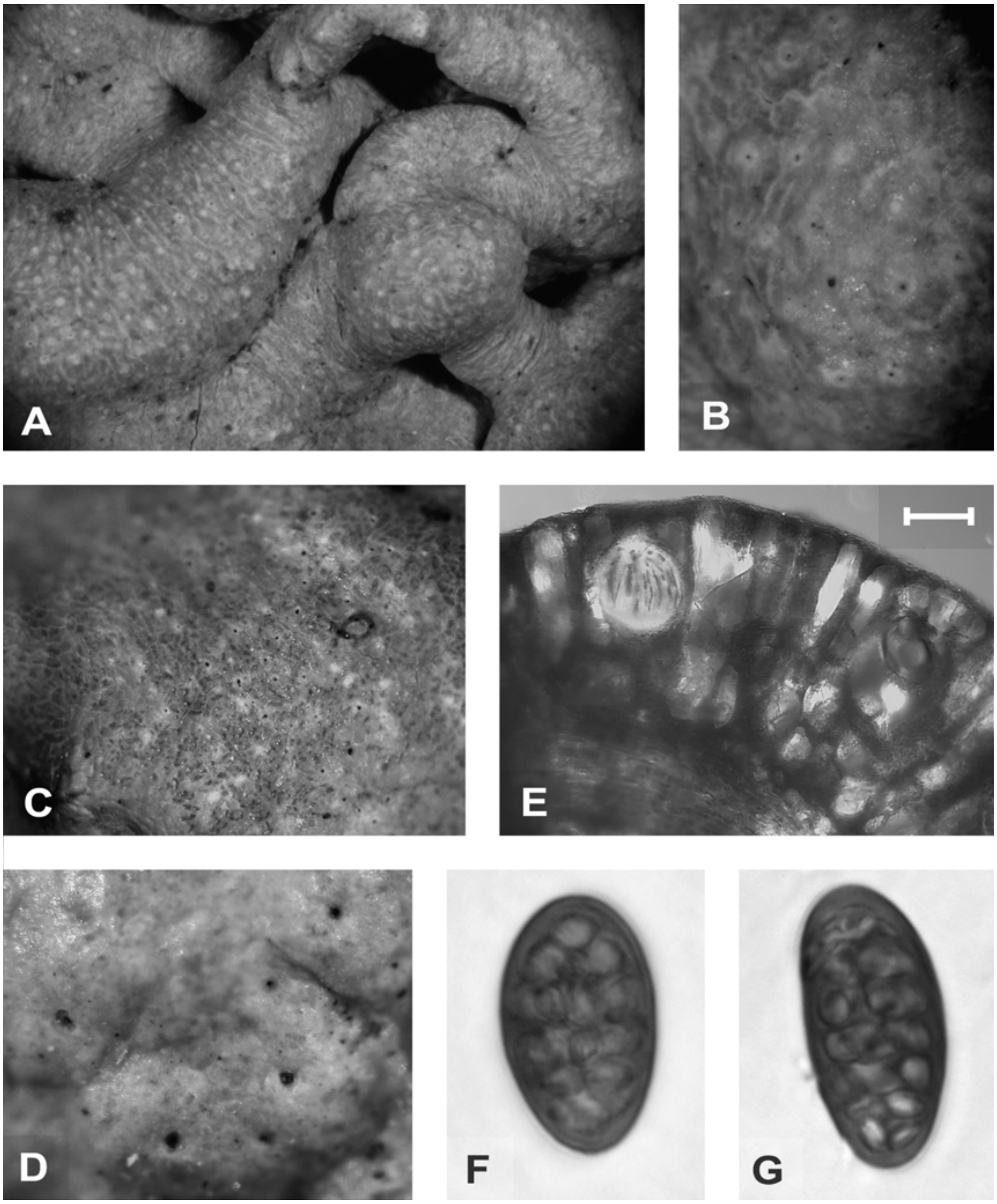

Fig. 80. *Myriotrema phaeosporum*: growth habit (**A**), ascomata (**B-D**), ascoma and thallus section (**E**) and ascospores (**F, G**). A., B.: *Bailey 70*; C., D.: *Elix 20878*; E.-G.: G-isotype. Bar= A: 2 mm; B: 1 mm; C: 1.25 mm; D: 0.3 mm; E: 200 µm; F, G: 6 µm.

Thallus predominantly epiphloedal, (moderately) thick, up to c. 1 mm high, bulging and flaking away from the substrate, pale greenish gray to pale yellowish-green. Surface ±dull, smooth, continuous, with a grainy-speckled pattern, unfissured to sometimes slightly fissured. True cortex absent, thallus covered by a continuous to incontinuous protocortex up to c. 30 µm thick. Algal layer usually well developed, continuous, sometimes becoming incontinuous due to crystal inclusions, calcium oxalate crystals abundant, predominantly large, scattered or more often clustered, sometimes arranged in columns. Vegetative propagules not seen. Ascomata inconspicuous, (moderately) small, up to c. 400 µm in diam., roundish, predominantly perithecioid, solitary, immersed. Disc not visible from surface. Pores tiny to small, up to c. 100 µm in diam., roundish, entire, apical proper exciple becoming visible from the outside, forming a fused to indistinctly free inner pore margin, incurved, bright-translucent to pale brownish, in older ascomata often thinned, then appearing more dark. Thalline rim margin moderately thick, roundish, entire, often brighter then thallus, thalline rim not distinguishable from surface. Proper exciple fused to apically slightly detached, moderately thin to moderately thick, pale yellowish internally, pale orange marginally, non-amyloid. Hymenium up to c. 150 µm high, non-inspersed, weakly conglutinated, paraphyses ±bent to distinctly curly in apical parts, sometimes with ±distinct septation, moderately interwoven, with unthickened to slightly thickened tips, lateral paraphyses and columellar structures absent. Epihymenium indistinct or lacking, hyaline, without granules. Asci 8-spored, tholus distinctly narrowed, thin to not visible at maturity. Ascospores (very) small, (sub-)muriform, cell walls thick, endospore moderately thin, non-halonate, becoming distinctly brown at early maturity, faintly to distinctly amyloid only in younger ascospores, oblong to predominantly ellipsoid to rarely somewhat fusiform, with rounded to narrowed-rounded to rarely subacute ends, loci roundish to slightly angular, oblong to subglobose or somewhat irregular, with same shaped end cells, transverse septae moderately thin to moderately thick, regular to irregular, 10-25 x 7-15 µm with 4-8 x 1-4(-5) loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellow, C-, PD+ orange; containing constictic and stictic acids (majors), cryptostictic, hypoconstictic and hypostictic (minors to traces) acids.

ECOLOGY AND DISTRIBUTION – *Myriotrema phaeosporum* was collected in Australia on tree bark in (sub)tropical rainforests, wet sclerophyll forests and mangroves in altitudes ranging from sea level to 600 m. It is a moderately common and wide-spread species, occurring in northern Queensland, Norfolk Island and Lord Howe Island (New South Wales). This paleotropical species was reported from the Philippines (Vainio, 1921), Papua New Guinea and New Caledonia.

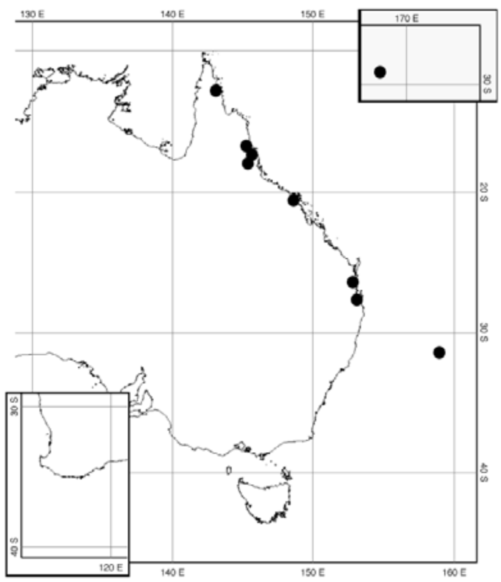

Fig. 81 . Australian distribution of *M. phaeosporum*.

NOTES – This taxon is characterized by a ±dull, smooth, bulging and thick thallus that lacks red crystals, immersed, perithecioid, small-pored ascomata with a predominantly fused exciple, brown, muriform small ascospores and the presence of the stictic acid chemosyndrome. It is similar to *L. wightii*, which can be readily distinguished by the presence of red anthraquinone crystals in the thallus, larger, more open ascomata, more distinctly globose, less oblong ascospores with fewer loci (up to 6 x 4) that are irregularly arranged, and the absence of the stictic acid chemosyndrome. Also similar is *L. subcompunctum*, see under that species for differences. Other similar, brown-spored, stictic acid containing taxa include *L. compunctellum*, *M. desquamans* and *M. trypaneoides*. They can be readily distinguished by larger ascospores (up to 130 µm in *L. compunctellum*, up to 35 µm in *M. desquamans*, up to 40 µm in *M. trypaneoides*), the presence of a true cortex in the latter two taxa, and an inspersed hymenium in *M. trypaneoides*.

SPECIMENS EXAMINED – Australia, Queensland: Iron Range, *Hill 1035497* (MEL). Thornton Range, NW of Mossman, *Hale 832212* (US). Cairns, 5 km N of the city near the airport, *A. & M. Aptroot 22173* (ABL). Clark Range, 46 km SSW of Proserpine, *Elix 20878* (CANB). Wilson Beach, 17 km SE of Proserpine, *Elix 20980* (CANB). Whitsunday Islands, Long Island, N of Happy Bay, *Tibell 14643* (UPS). Conway Range NP., near Shute Harbour-Airlie Beach, *Hale 830972* (US). Noosa NP., E of Noosa Heads, *Hafellner 16729* (GZU). Kondalilla Falls, SW of Nambour, *Hale 832551* (US). Moreton Bay, Mt.Cooluma, *Windolf 694631* (BRI). Blackall Ranges, *Wilson* s.n. (NSW-539380). Upper Coomera, *Wilson* s.n. (NSW-539384). Brisbane, *Bailey 70* (BM). Norfolk Island: Mt. Pitt Reserve, Red Road Track to Mt. Bates, *Elix & Streimann 18614* (B), *Elix 18855* (CANB). New South Wales, Lord Howe Island: Max Nicholls Track, *Elix 32717* (CANB); Jct. of Kims Lookout and Max Nicholls Tracks, *Elix 42061* (CANB); Track from Smoking Tree Ridge to Rocky Fun, *Elix 42461* (CANB); Goat House Cave, *Elix 42096, 42211* (CANB); Trail to Goat House Cave, *Weber & Colson L-72185* (COLO, US). Uncertain locality: 'Bailey Book', p. 21, s.c. (BRI-AQ720151); 'Shirley Book', p. 22, s.c. (BRI-AQ721239).

Myriotrema polytretum Hale

Bull. Br. Mus. nat. Hist. (Bot.) 8(3): 291 (1981). Type: Sri Lanka, Sabaragamuwa, Kegalla, *Hale 50238* (US!-holotype, BM-isotype).

ILLUSTRATION – Fig. 82.

Thallus epi- to hypophloedal, moderately thin to moderately thick, up to c. 300 µm high, (pale) olive to yellowish-gray to grayish, sometimes with pale patches due to a partly absent algal layer. Surfaces shiny to velvety, smooth, continuous to slightly rugose, unfissured. True cortex usually present, predominantly continuous, slightly yellowish, thickness variable, up to c. 30 µm thick, consisting of periclinal to irregular hyphae. Algal layer moderately well developed, continuous but sometimes partly thinning or lacking (see above), calcium oxalate crystals moderately abundant, small to large, clustered to more rarely scattered, sometimes a distinct medullar layer present. Vegetative propagules not seen. Ascomata usually inconspicuous, ±small, up to c. 350 µm in diam., roundish, apothecioid, solitary to marginally to rarely entirely fused, often clustered, forming patches of densely arranged ascomata, immersed. Disc often becoming partly visible from surface, pale flesh colored, epruinose to slightly pruinose. Pores (moderately) small to sometimes becoming wide, up to c. 200 µm in diam., predominantly roundish to somewhat irregular, entire to rarely slightly split, proper exciple not visible from surface. Thalline rim margin (moderately) thin, brighter than thallus, forming a narrow to moderately wide fawnish to more often off-white ring-like area, level with thallus to often somewhat raised, thalline rim incurved. Proper exciple fused, (moderately) thin, hyaline to pale yellowish internally, pale orange to yellowish-brown marginally, sometimes grayish-brown apically, non-amyloid. Hymenium up to c. 70 µm high, non-inspersed, strongly conglutinated, paraphyses straight to slightly bent, ±irregular and distinctly septate, parallel to slightly interwoven, with distinctly thickened, somewhat irregular tips, lateral paraphyses and columellar structures absent. Epihymenium indistinct to thin, hyaline, sometimes with fine grayish granules. Asci 8-spored, tholus (moderately) thick, not visible at maturity. Ascospores (very) small, transversely septate, cell walls (moderately) thick, endospore moderately thick, sometimes with thin halo, hyaline, predominantly distinctly to strongly amyloid, oblong to ellipsoid to somewhat fusiform, with roundish to narrowed-roundish ends, loci predominantly roundish, subglobose to oblong to slightly irregular, with same shaped or hemispherical to conical end cells, septae thin to moderately thick, ±regular, 10-18(22) x 6-8 µm with 3-4 loci. Pycnidia not seen.

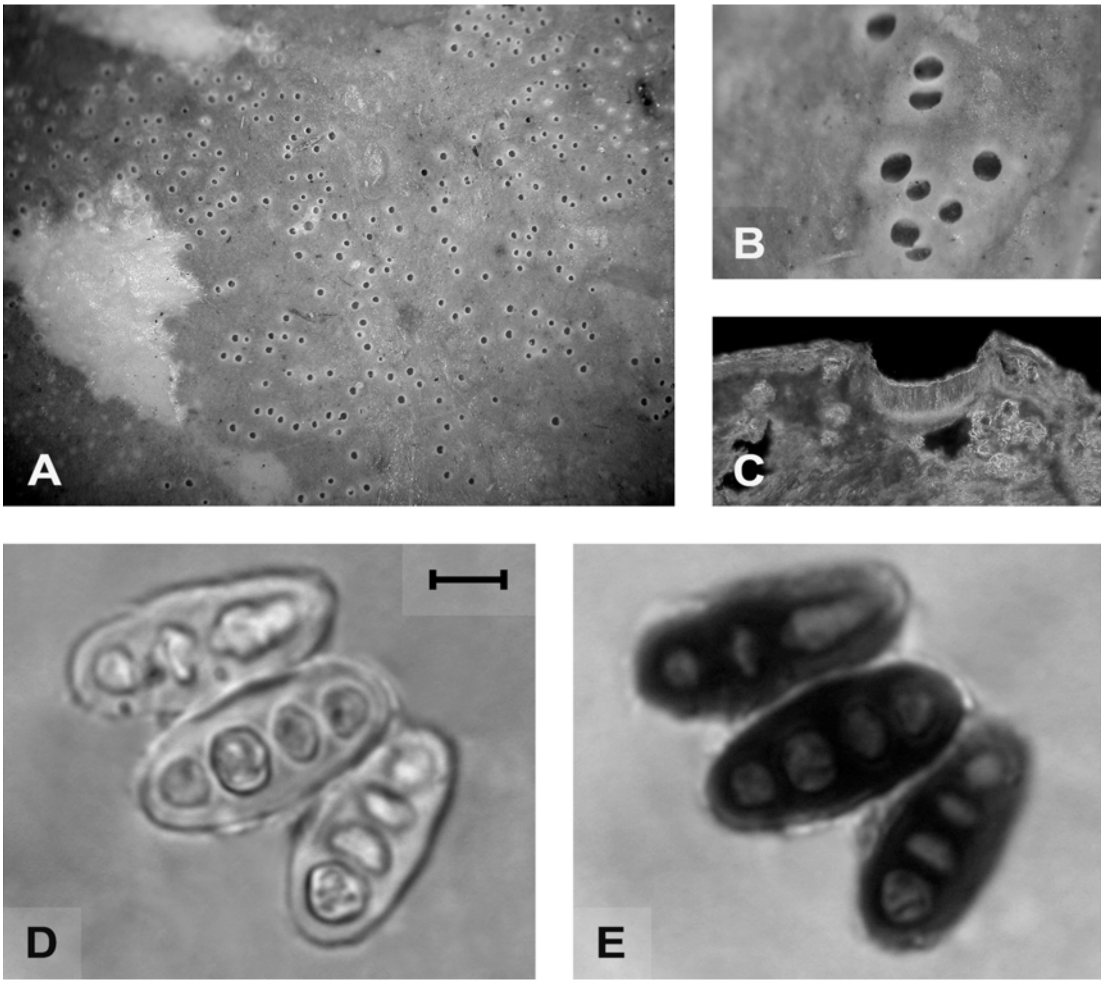

Fig. 82. *Myriotrema polytretum*: growth habit (**A**), ascomata (**B**), ascoma section (**C**), ascospores (**D**) and same ascospores showing amyloid reaction (**E**). A., B.: *Mangold 29 n*; C.-E.: US-holotype. Bar= A: 1 mm; B: 0.5 mm; C: 150 µm; D, E: 5 µm.

CHEMISTRY – Thallus K-, C-, PD+ yellowish to reddish; containing 2-hydroxy-hypoprotocetraric (major), convirensic, 2- hydroxynornotatic and hypoprotocetraric (traces) acids.

ECOLOGY AND DISTRIBUTION – *Myriotrema polytretum* was collected in Australia on tree bark in tropical rainforests. It is extremely rare, being restricted to northern Queensland. This is the first report for Australia. Previously this paleotropical taxon was recorded from Sri Lanka, Malaya and Sarawak (Hale, 1981).

NOTES – This taxon is characterized by its unusual thallus chemistry, otherwise it is very similar to *M. clandestinum* (with the psoromic acid chemosyndrome) and *M. album* (lacking secondary compounds). With these species it has a corticate, unfissured thallus in common with small, immersed ascomata with a fused proper exciple and small, transversely septate, hyaline, amyloid, thick-walled ascospores. 2-hydroxyhypoprotocetraric acid is usually found as an accessory compound of hypoprotocetraric acid, only one other species, the otherwise also quite similar *O. thwaitesii*[12] from Sri Lanka is known to contain 2-hydroxyhypoprotocetraric acid as a major compound, too. It differs, however, by a slightly carbonized exciple and ascospores that have up to 7, distinctly oblong loci (up to 22 x 7 µm in size). *Myriotrema microporellum*, known from Africa and the Neotropics is also similar and contains hypoprotocetraric acid as major compound and 2-hydroxyhypoprotocetraric acid only in traces. However, it also differs in slightly larger ascospores (up to 24 µm, with up to 6 loci). Several other similar taxa with hypoprotocetraric acid as a major compound all differ from *M. polytretum* by a ±distinctly free proper exciple: *M. glauculum*, *M. plurifarium, M. congestum* and *M. neofrondosum*.

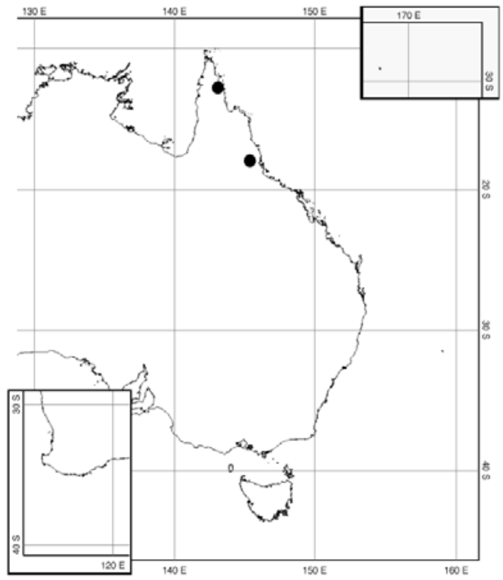

Fig. 83. Australian distribution of *M. polytretum*.

SPECIMENS EXAMINED – Australia, Queensland: Iron Range NP., 31 km from western boundary on track to Portland Rds., *Hale 832650* (US). Atherton Tablelands, Lake Eacham NP., *Mangold 29 n* (F). Malaysia, Sarawak, Sibu, *Hale 30434* (US). Malaya, Selangor, *Hale 30271* (US).

Myriotrema protoalbum Hale

Bull. Br. Mus. nat. Hist. (Bot.) 8(3): 292 (1981). Type: Sri Lanka, Western Province, Kalatura, *Hale 51044* (US!-holotype, BM-isotype).

ILLUSTRATION – Fig. 84.

Thallus epi- to hypophloedal, (moderately) thin, up to c. 100 µm high, (pale) grayish-green. Surface shiny, smooth, continuous, unfissured. True cortex present, continuous to incontinuous, up to c. 30 µm thick, consisting of periclinal hyphae. Algal layer moderately well developed, continuous to incontinuous, presence of calcium oxalate crystals variable, abundant to lacking, small to large, clustered, sometimes forming short layers. Vegetative propagules not seen. Ascomata variable, inconspicuous, small to very small, up to c. 250 µm in diam., roundish to elongate to sometimes distinctly lirelliform (then up to 500 µm long), apothecioid, solitary to marginally fused, often arranged in rows, immersed to slightly raised, then hemispherical. Disc rarely becoming visible from surface, pale flesh colored, epruinose. Pores predominantly small to very small, up to c. 80 µm in diam. (wider in elongate ascomata), roundish to often irregular or elongate, entire to coarsely split, proper exciple not visible from surface. Thalline rim margin (moderately) thin, variable in color, often brighter than thallus to whitish, sometimes brownish, rarely concolorous with thallus, thalline rim incurved. Proper exciple fused, predominantly moderately thin, pale yellowish internally, yellowish-brown to brownish marginally, basally often amyloid, sometimes amyloidity extending throughout the subhymenium. Hymenium up to c. 90 µm high, non-inspersed, moderately conglutinated, paraphyses ±straight to irregular, slightly interwoven, with ±distinctly thickened, somewhat irregular tips, lateral paraphyses and columellar structures

[12] ***Ocellularia thwaitesii*** (Hale) Mangold comb. nov. ined. Bas.: *Myriotrema thwaitesii*, Bull. Br. Mus. nat. Hist. (Bot.) 8(3): 295 (1981). Type: Sri Lanka, Sabaragamuwa, Kegalla, *Hale 50221* (US!-holotype, BM-isotype).

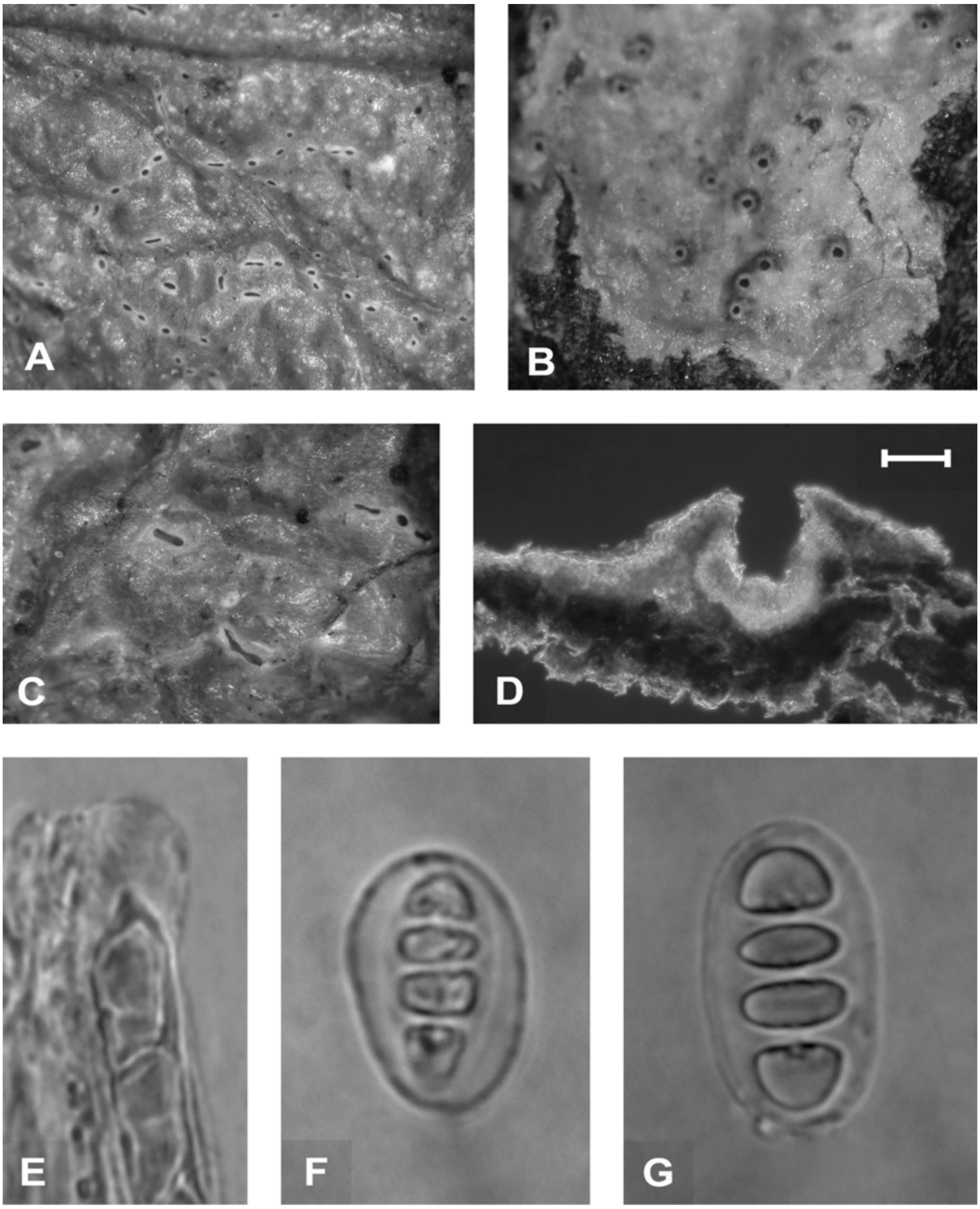

Fig. 84. *Myriotrema protoalbum*: growth habit (**A**), ascomata (**B, C**), ascoma section (**D**), ascus (**E**), younger ascospore (**F**) and mature ascospore (**G**). A., C., E.-G.: *Mangold 39 r*; B., D.: US-holotype. Bar= A: 1 mm; B: 0.5 mm; C: 0.6 µm; D: 100 µm; E: 5 µm; F: 4 µm; G: 3 µm.

absent. Epihymenium indistinct, hyaline, without granules. Asci 8-spored, tholus (moderately) thick, sometimes with distinct, tapered ocular chamber, thin when mature. Ascospores (very) small, transversely septate, rarely with a weakly developed, single longitudinal septum, cell walls (moderately) thick, endospore moderately thin to moderately thick, variably halonate, especially in younger ascospores sometimes with distinct, thick halo, in older ascospores often indistinct or lacking, hyaline, non-amyloid to faintly amyloid, predominantly oblong to ellipsoid, with roundish to narrowed-roundish ends, loci roundish to more rarely somewhat acute, subglobose to oblong to rarely irregular, usually with same shaped end cells, septae moderately thin to often (moderately) thick, regular to irregular, 10-22 x 5-9 µm with 3-4(5) (x2) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Myriotrema protoalbum* was collected in Australia on tree bark in tropical rainforests in altitudes ranging from 60 to 1500 m. It is a rare species in northern Queensland. This is the first report for Australia. Previously it was only known from Sri Lanka.

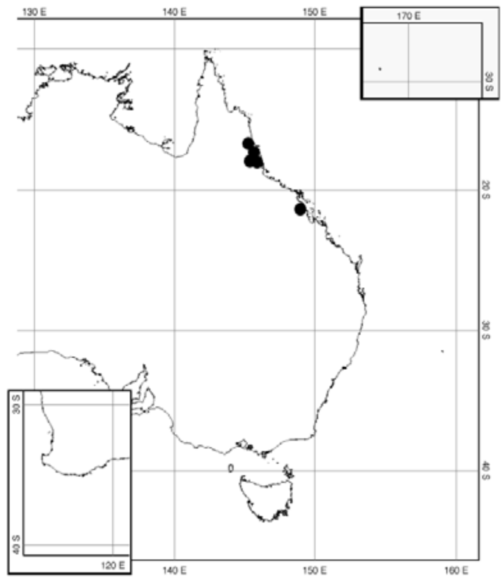

Fig. 85. Australian distribution of *M. protoalbum*.

NOTES – This taxon is characterized by the thin, corticate thallus, small, ±immersed ascomata that are arranged in rows and sometimes are distinctly elongate, the small, hyaline, transversely septate ascospores, and the absence of secondary compounds. *Myriotrema album* is a similar species that can be distinguished by a thicker thallus, somewhat larger, distinctly amyloid ascospores and ascomata that are never elongate. The Australian collections differ from the type in having a thicker thallus, a never brownish thalline rim margin and ascomata that can be often found slightly to distinctly elongate. The typical row-like arrangement of the ascomata, however, was already mentioned in the original species description (Hale, 1981). The tholus of *M. protoalbum* has an often distinct, tapered ocular chamber (Fig. 85, E). A similar tholus structure was reported for two *Chapsa* species, *C. eitenii* and *C. zahlbruckneri* (Frisch, 2006).

SPECIMENS EXAMINED – Australia, Queensland: Daintree NP., Mossman Gorge Section, near western border of National Park along Mossman creek, *Mangold 36 b* (F). Wooroonooran NP., Bellenden Ker Range, centre peak, 7 km W of Bellenden Ker, *A. & M. Aptroot 22503* (ABL). Atherton Tablelands, Lake Eacham NP., *Mangold 29 ar* (F). Babinda Boulders, *Mangold 39 r* (F). Eungella NP., near Pease's Lookout, *Hale 831699* (US). Sri Lanka, Sabaragamuwa: Ratnapura, *Hale 51219* (US); Kegalla, *Hale 50247* (US).

Myriotrema rugiferum (Harm.) Hale

Mycotaxon 11: 135 (1980). Bas.: *Thelotrema rugiferum* Harm., Bull. Séanc. Soc. Sci. Nancy, ser. 3, 13: 44 (1912). Type: New Caledonia, *Pionniero 42* (DUKE!-lectotype, selected by Hale [1981: 292]; S!-isolectotype).

Thelotrema subcaesium Nyl., Flora 52: 120 (1869). *Thelotrema concretum* var. *subcaesium* (Nyl.) Redgr., Arkiv för Bot. 28A, 8: 96 (1936). Type: Brazil, Rio de Janeiro, *Glaziou 2193* (H-Nyl.-lectotype, selected by Hale [1974a: 32]; C!-, US!-isolectotypes).

Myriotrema multicavum Hale, Bull. Br. Mus. nat. Hist. (Bot.) 8(3): 288 (1981). Type: Sri Lanka, Southern Province, Galle Distr., *Hale 46150* (US!-holotype).

ILLUSTRATION – Fig. 86.

Thallus epi- to hypophloedal, predominantly moderately thick, up to c. 400 µm high, (pale) olive to (pale) grayish-green or yellowish-gray to grayish. Surface variable, velvety to shiny, smooth, continuous to more often rugose and/or distinctly verruculose, unfissured to slightly fissured or coarsely cracked. True cortex usually present, predominantly continuous, slightly yellowish, thickness variable, up to c. 30 µm thick, consisting of periclinal hyphae, sometimes partly not conglutinated forming a protocortex. Algal layer well developed, continuous, presence of calcium oxalate crystals variable, sparse to very abundant, predominantly large,

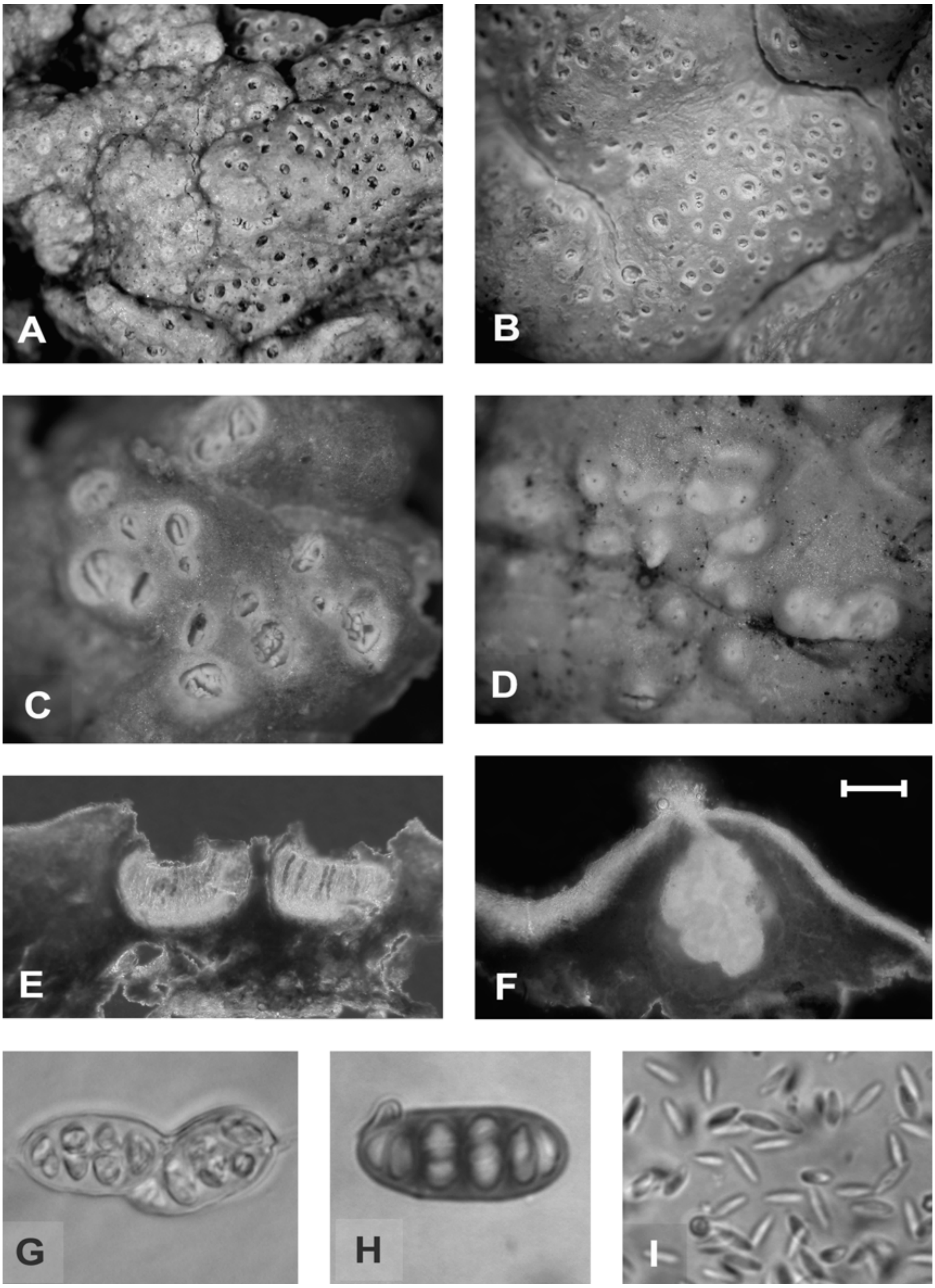

Fig. 86. *Myriotrema rugiferum*: growth habit (**A, B**), ascomata (**C**), pycnidia (**D**), ascomata section (**E**), pycnidium section (**F**), ascospores (**G**), ascospore showing amyloid reaction (**H**) and conidia (**I**). A., G.: DUKE-lectotype; B. C., E., H.: *Lumbsch & Mangold 19116 a*; D., F., I.: *Lumbsch & Mangold 19116 h*. Bar= A, B: 1 mm; C, D: 0.3 mm; E: 100 µm; F: 50 µm; G: 8 µm; H: 7 µm; I: 6 µm.

clustered, distinct medullar layer present. Vegetative propagules not seen. Ascomata inconspicuous but often very abundant, small, up to c. 400 µm in diam., roundish to irregular in fused ascomata, apothecioid, solitary to fused, predominantly immersed to rarely somewhat emergent, then hemispherical to cone-shaped. Disc usually not visible from surface, sometimes becoming partly visible, pale flesh colored, distinctly to strongly pruinose. Pores (moderately) small, sometimes becoming wide or gaping, up to c. 100(200) µm in diam., predominantly irregular and ±split, proper exciple becoming apically to more rarely entirely visible from surface, whitish, shrunken, incurved. Thalline rim margin becoming moderately wide to wide or gaping, roundish to somewhat irregular, (moderately) thin, predominantly entire to slightly split, whitish, thalline rim incurved to very rarely somewhat erect. Proper exciple free in upper parts, thin, hyaline internally to brownish or grayish-brown marginally, often with an apical ±thick layer of grayish granules, non-amyloid. Hymenium up to c. 90(110) µm high, non-inspersed, strongly conglutinated, paraphyses bent, unbranched to slightly branched towards the exciple, moderately to slightly interwoven, with slightly to distinctly thickened, irregular tips, lateral paraphyses and true columella absent, in fused ascomata columella-like structures sometimes present. Epihymenium predominantly (moderately) thick, hyaline, with fine to more often coarse grayish granules. Asci (4-)8-spored, tholus thick, thin when mature. Ascospores small, submuriform, cell walls thick, endospore (moderately) thick, non-halonate, hyaline, distinctly to strongly amyloid, subglobose to oblong or ellipsoid to more rarely fusiform, with roundish to narrowed-roundish to rarely subacute ends, loci roundish to slightly angular, subglobose to oblong or somewhat irregular, with hemispherical to same shaped end-cells, transverse septae distinct, moderately thin, regular to irregular, 15-25 x 7-10 µm with 4-6(7) x 1-3(4) loci. Pycnidia present, in thallus warts, often crowded, with colorless to dark, often wide pore surrounded by a bright area, conidia fusiform to somewhat irregular, up to c. 5 x 1.5 µm.

CHEMISTRY – Thallus K+ yellowish, C-, PD+ yellow; containing psoromic (major), 2'-0-demethylpsoromic (major to minor) and subpsoromic (trace) acid.

ECOLOGY AND DISTRIBUTION – *Myriotrema rugiferum* occurs on tree bark in (sub)tropical rainforests, coastal forests and mangroves, rarely also in wet sclerophyll forests in altitudes ranging from sea level to 1200 m. This common and wide-spread species occurs in Queensland and northern New South Wales. This is the first report for Australia. It is pantropical and has been recorded from the Neotropics, India (Hale, 1981), Sri Lanka, Philippines (Ibid.), New Caledonia and Solomon Islands (Ibid.).

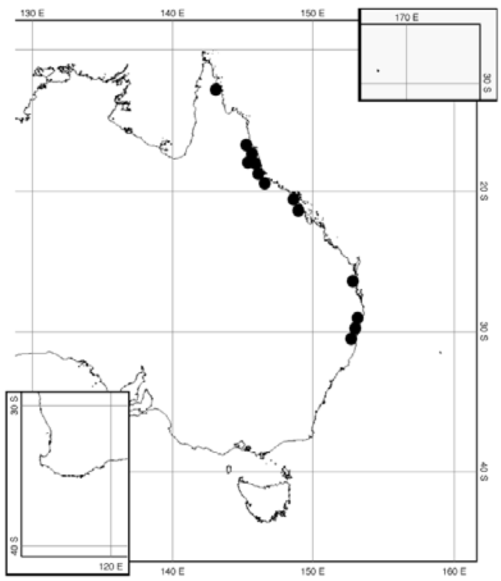

Fig. 87. Australian distribution of *M. rugiferum*.

NOTES – *Myriotrema rugiferum* is morphologically variable, but all samples agree in having a thick, corticate thallus, small, predominantly immersed ascomata with a visible free exciple, small, hyaline, submuriform, thick-walled, amyloid ascospores and containing the psoromic acid chemosydrome. Similar is *M. viridialbum*; for differences see under this species. The morphological extremes of *M. rugiferum* were previously regarded as different species, but are connected by intermediate forms. One of the morphological extremes resembles the type of

T. subcaesium, with a velvety, continuous and unfissured thallus, few calcium oxalate crystals and grouped, predominantly solitary ascomata with only indistinctly visible free proper exciple. The more common morph, in which agrees with the New Caledonian type, has a shiny, incontinuous, thallus with abundant, usually large and clustered crystals.

A similar Australian species with small, submuriform, hyaline, amyloid ascospores that lacks thallus chemistry is *M. subconforme*, for further differences see under this species. A similar psoromic acid containing taxon known from South America and Borneo (Hale, 1978) is *M. concretum*. The type material of *M. concretum* was not available, but is distinguished from *M. rugiferum* by a strongly fissured, dull thallus and urceolate ascomata with fused exciple.

SPECIMENS EXAMINED – Australia, Queensland: Iron Range NP., 31 km from western boundary on track to Portland Rds., *Hale 832747* (US). Browns Creek, Lockhart River Settlement rd., 30 km SW of Cape Weymouth (18 km NW of Lockhart River Settlement), *Streimann 56457* (B, CANB). Cape Tribulation Area: Cape Tribulation Beach, *Hale 831746* (US); Track to Cape Tribulation Beach, *Mangold 32 ze* (F); Myall Beach, *Lumbsch & Mangold 19160 n, s, x, 19161 f, j, u, Mangold 31 f* (F); Noah Head (Mairdja Botanical Walk), *Streimann 45784* (CANB); Cow Bay, *Streimann 45991* (B, CANB); 2 km W of main rd. between Oil Palms and Coopers Creek, *Hale 832104* (US). Thornton Range, at tower turnoff on CREB rd (to Cooktown), c.15 km N of the Daintree River crossing, NW of Mossman, *Hale 832144* (US). Near Daintree, along Daintree River, *A. & K. Kalb 27051* (hb. Kalb). Mt. Windsor Tableland, 38-45 km NW of Mossman, *Elix 16432, 16526, 16548* (CANB). Mt. Windsor, 5 km W of new Forestry Camp, NW of Mossman, *Hale 831868, 832598, 832611, 832644* (US). Mt. Windsor logging area, near jct. rd. to old Forestry Camp and main rd., NW of Mossman, *Hale 831859* (US). Newell Beach, 5 km NE of Mossman, *Elix 17430* (CANB). Daintree NP., Mossman Gorge Section, near western border of National Park along Mossman creek, *Mangold 36 s* (F). Mossman Gorge NP., near Mossman, *Hale 831842, 832769* (US). Mt. Lewis Rd. 4 km N from Kennedy Hwy., W of Mossman, *Hale 832572, 832590* (US). S of Mossman, *Weber 227890* (CANB, COLO, US). Kuranda, 1893, *Wilson '2'* (H-Raes.). End of Clohesy River Rd. 16 km SE Kennedy Hwy., W of Cairns, *Hale 830610, 830840, 832334* (US). Thompson Rd., Edmonton, 9 km S of Cairns, *Elix 17621* (CANB). Atherton Tablelands: Davies Creek Rd. 17 km S of Kennedy Hwy., S of Davies Creek Falls NP., E of Mareeba, *Hale 831267, 832604, 832614* (US); Danbulla Forest Drive, 4 km E of Tinaroo, *Hale 831185* (US); Lake Euramoo, *Lumbsch & Mangold 19127 za* (F); Lake Barrie NP., *Hale 830751* (US); Lake Eacham NP., *Mangold 29 ad* (F); Area below crater, Mt. Hypipamee NP., S of Atherton, *Hale 831518, 832524, 832758* (US); 18 km S of Atherton, Mt. Hypipamee, at Crater lake, *Tibell 15421, 15432* (UPS); Plath Rd. logging head, 9 km W of Plath Rd., off Kennedy Hwy, Herberton Range, S of Atherton, *Hale 830981, 830995, 832574* (US); SW of K-1 tree rd. off Palmerston Hwy., 11 km from main hwy. and 2 km N of S.Johnstone Forestry Camp, SE of Millaa Millaa, *Hale 831883, 832594, 832680, 832692, 832697* (US); Zillie Falls, *Lumbsch & Mangold 19141 b* (F); Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Mangold 30 n, zh* (F); Tully Falls NP., S of Ravenshoe, *Hale 832444* (US). Francis Range, Woopen Creek Rd., 25 km in from Bruce Hwy, NW of Innisfail, *Hale 830714, 831901, 831951* (US). Dawson logging area, State Forest Reserve 605, 24 km S of Koombooloomba turnoff, WSW of Tully, *Hale 830693, 832196, 832602* (US). State Forest area on Tully Rd., 1 km from jct. with S. Mission Beach Rd., S of Mission Beach, *Hale 831123, 831198* (US). Cardwell Range, Echo & Davidson Creek Drive, 46 km SE of Ravenshoe, *Elix 16130* (CANB). Blencoe Creek, Cardwell Range, 48 km NW of Cardwell, *Elix 20116, 20132* (CANB). Kirrima SF., Cardwell Range, 24 km WNW of Cardwell, *Elix 15679, 15715* (CANB), *Streimann 28535* (B, CANB), *223545* (H, US). Edmund Kennedy NP., on Clift Rd., NW of Cardwell, *Hale 830832, 832593, 832817* (US). 1 km N of Murray Falls, W of Kennedy, *Hale 831394* (US). About 7.5 km E of Wallaman Falls, W of Ingham, *Hale 831882, 832350, 832591* (US). Little Crystal Creek Falls, Mt. Spec NP., the falls on Paluma Rd., *Hale 831119* (US). Conway SF., 18 km E of Prosperpine, *Elix 20778*, *20787, 20791* (CANB). Clarke Range, 46 km SSW of Proserpine, *Elix 20860* (CANB). Eungella NP., Finch Hatton Gorge: *Lumbsch & Mangold 19115 h, 19116 a, g*, (F); Verdon 5245 (CANB). Wooroi Forest, 2 km W of Tewantin: *Elix 10423* (CANB); *Hale 831877* (US). Noosa Heads, Noosa NP.: *A. & K. Kalb 25793* (hb. Kalb); Palm Grove Track, *Hale 831296, 831760* (US). Mapleton Falls, 13 km W of Nambour, *Hale 830287* (US). New South Wales: Nightcap NP., Mnt. Nardi/Mnt. Matheson Track, *Mangold 22 p, zi* (F). Iluka Nature Reserve, 50 km NE of Grafton: *Hale 58728* (US); *Mangold 23 k, m, n* (F). Dorrigo NP., Sassafras Creek Track, *Mangold 25 g* (F).

Myriotrema subconforme (Nyl.) Hale

Mycotaxon 11: 135 (1980). Bas.: *Thelotrema subconforme* Nyl., J. Linn. Soc. London, Bot. 20: 53 (1883). Type: Malaya, Malacca, May 1864, *Maingay 64* (BM!-lectotype, selected by Hale [1981: 294]; H-Nyl. 22587!-, FH-Tuck.!-isolectotypes).

ILLUSTRATION – Fig. 88.

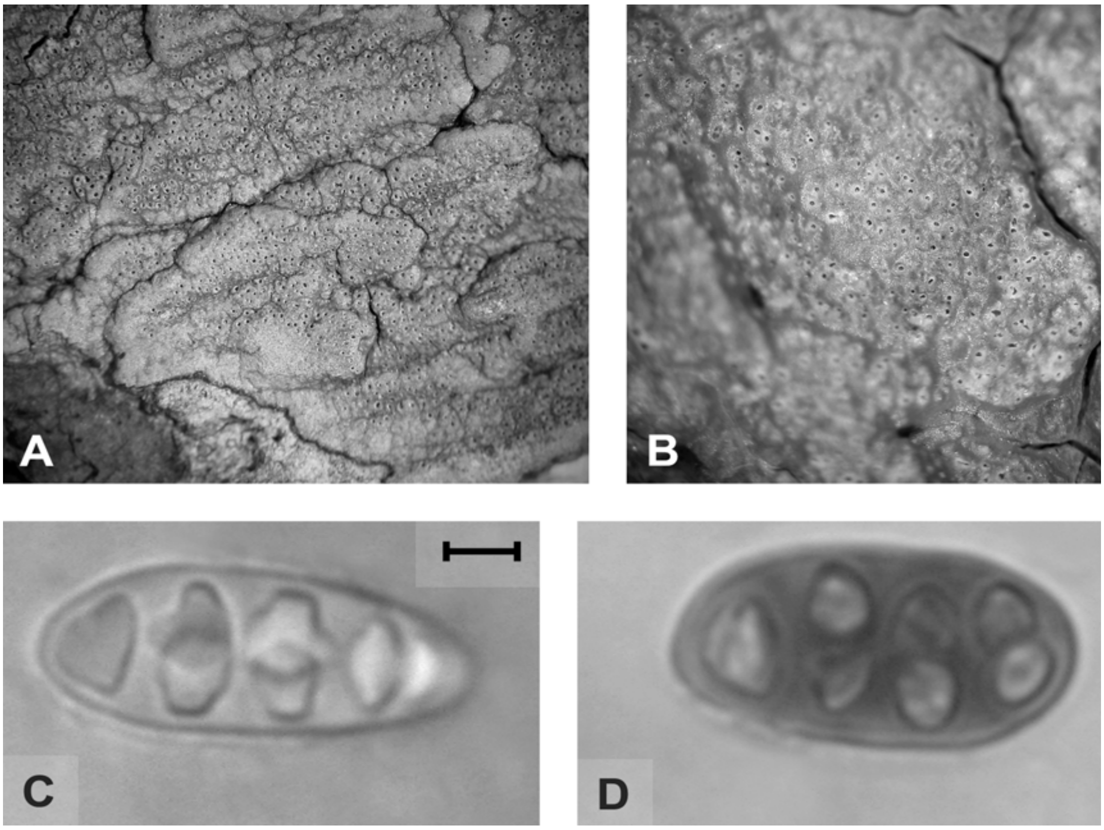

Fig. 88. *Myriotrema subconforme*: growth habit (**A**), ascomata (**B**), ascospore (**C**) and ascospore showing amyloid reaction (**D**). A.: BM-lectotype; B.-D.: *Mangold 31 l*. Bar= A: 1.25 mm; B: 0.5 mm; C, D: 3 µm.

Thallus epi- to hypophloedal, moderately thin, up to c. 200 µm high, (pale) olive to (pale) grayish-green. Surface shiny, smooth, rugose and/or distinctly verrucose to verruculose, unfissured to fissured. True cortex present, continuous, thick to very thick, up to c. 60 µm thick, consisting of periclinal hyphae. Algal layer well developed, continuous, becoming incontinuous due to crystal inclusions, calcium oxalate crystals abundant, small to large, scattered to clustered. Vegetative propagules not seen. Ascomata inconspicuous but often very abundant, (very) small, up to c. 200 µm in diam., roundish, apothecioid, solitary to slightly fused, immersed. Disc usually not visible from surface, rarely becoming partly visible, pale flesh colored, distinctly pruinose. Pores tiny to small, up to c. 50(80) µm in diam., predominantly irregular and ±split, proper exciple becoming apically to more rarely entirely visible from surface, whitish, shrunken, incurved. Thalline rim margin (moderately) small, roundish to somewhat irregular, (moderately) thin, entire to split, whitish or brighter than thallus, flush with thallus to somewhat raised, thalline rim incurved. Proper exciple free in upper parts, thin, hyaline internally, pale yellowish to yellowish-brown marginally, often grayish to more darkened apically, non-amyloid. Hymenium up to c. 80 µm high, non-inspersed, strongly conglutinated, paraphyses bent, unbranched to slightly branched towards the exciple, moderately interwoven, with slightly to distinctly thickened, irregular tips, lateral paraphyses and columellar structures absent. Epihymenium predominantly (moderately) thick, hyaline, with grayish granules. Asci 8-spored, tholus thick, thin at maturity. Ascospores (very) small, submuriform, cell walls thick, endospore (moderately) thick, non-halonate or with thin halo in younger stages, hyaline, moderately to strongly amyloid, oblong to ellipsoid to more rarely fusi- or claviform, with roundish to subacute ends, loci roundish to angular, subglobose to oblong to more often irregular, with hemispherical to conical end cells, transverse septae distinct, moderately thin to thick, becoming irregular in older ascospores, 10-18(20) x 6-9 µm with 4-6 x 1-3(4) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Myriotrema subconforme* was collected in Australia on tree bark in coastal forests, mangroves and monsoon forests in low altitudes ranging from sea level to 150 m. It is common in the north-western Northern Territory and northern Queensland. This is the first report for Australia. The paleotropical species was previously known from India (Hale, 1981), Sri Lanka (ibid.), Malaya, Philippines (ibid.), Java (ibid.), Sarawak (ibid.) and Solomon Islands.

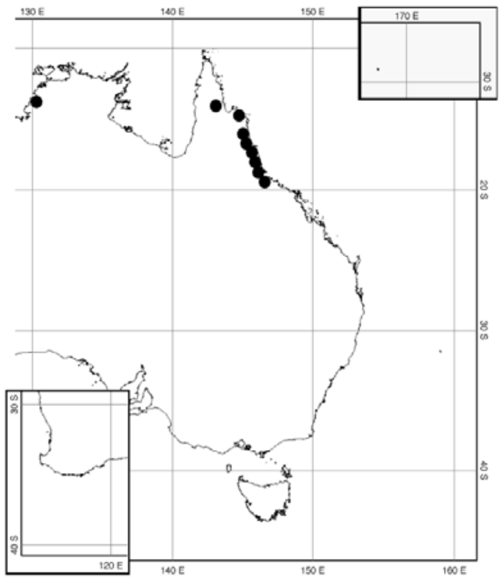

Fig. 89. Australian distribution of *M. subconforme*.

NOTES – Among *Myriotrema* species with ±small, immersed ascomata with free proper exciple and small, hyaline and amyloid ascospores, *M. subconforme* is distinguished by the thin, distinctly corticate thallus with numerous crystal inclusions, ascospores with ±irregular, distinctly submuriform loci arrangement and the absence of secondary compounds. *Myriotrema viridialbum* and *M. rugiferum* are similar, but can be readily distinguished by larger ascomata, distinctly exceeding 200 µm in diam., and their chemistry, containing hypoprotocetraric acid (*M. viridialbum*) and psoromic acid (*M. rugiferum*), respectively.

SPECIMENS EXAMINED – Australia, Northern Territory: Channell Point, 23 km NNW of Daly River, *Elix 27702* (B, CANB). Queensland: Easternfall of Mc Ilwraith Range, about 15 km upstream from the upper crossing at Massy Creek on Silver Plains Stn., *Clarkson 2638* (BRI). Cape Flattery sand dunes, *McCracken 694741* (BRI). Hope Vale Cutoff, NE of Cooktown, *Hale 830761* (US). Helensvale-Rossville Rd., 29 km S of Cooktown, *Elix 17386* (B, CANB).Cape Tribulation Area: Track to Cape Tribulation Beach, *Mangold 32 n* (F); Myall Beach, *Lumbsch & Mangold 19160 p, 19161 k, t, Mangold 31 l, r* (F); 2 km W of main rd. between Oil Palms and Coopers Creek, N of Daintree, *Hale 831857* (US). Fitzroy Island on Great Barrier Reef, 25 km E of Cairns, *A. & M. Aptroot 22316* (ABL). Fresh Water Gorge, outside of city of Cairns, *Hale 831657* (US). Thompson Rd., Edmonton, 9 km S of Cairns, *Elix 17607* (B, CANB). Stallion Pocket logging area, 14 km from Gillies Hwy. and 1 km E from Mulgrave River Forestry rd., S of Gordonvale, *Hale 832398* (US). State Forest area on Tully Rd., 1 km from jct. with S. Mission Beach Rd., S of Mission Beach, *Hale 831541* (US). Few km N of Cardwell, Edmund Kennedy NP., *A. & K. Kalb 34234* (hb. Kalb). Edmund Kennedy NP., on Clift Rd., NW of Cardwell, *Hale 832365, 832393* (US). Hinchinbrook Islands, Rainforest Creek (Bishop Creek), *Stevens 689498, 689499* (BRI). Solomon Isld., *Hill 10043* (US).

Myriotrema temperatum Mangold spec. nov. ined.

Type: Australia, New South Wales, Chaelundi Rd., near Fellabindi Rd., Chaelundi SF., 51 km NW of Dorrigo, *Streimann 47489* (CANB-holotype).

ETYMOLOGY – The epithet refers to the temperate distribution of the species.

ILLUSTRATION – Fig. 90.

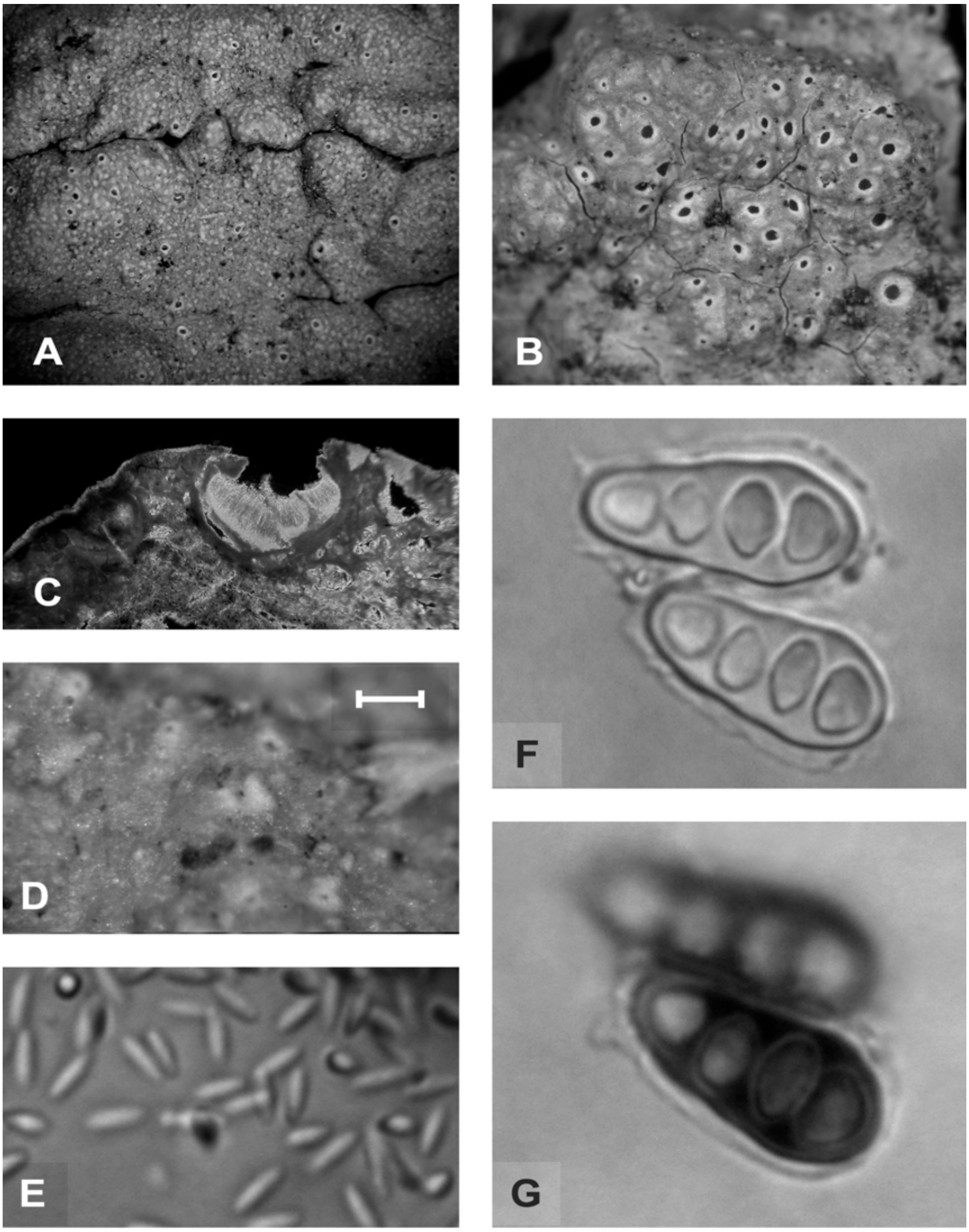

Fig. 90. *Myriotrema temperatum*: growth habit (**A**), ascomata (**B**), ascoma and thallus section (**C**), pycnidia (**D**), condidia (**E**), ascospores (**F**) and same ascospores showing amyloid reaction (**G**). A.: *Verdon 3882*; B.-G.: CANB-holotype. Bar= A: 1.5 mm; B: 1 mm; C: 150 µm; D: 0.1 mm; E: 5 µm; F, G: 4 µm.

Thallus variable, epi- to hypophloedal, (moderately) thick, up to c. 600 µm high, (pale) olive to yellowish-olive, sometimes with bright speckles. Surface dull to slightly shiny, smooth, ±rugose, usually distinctly to strongly verrucose to verruculose, unfissured to more often distinctly fissured. Cortex structures variable, often true cortex present, ±continuous, thin, hyaline to slightly yellowish, up to c. 25 µm thick, consisting of periclinal to irregular hyphae, sometimes lacking a true cortex, then covered by a thin ±incontinuous protocortex. Algal layer well developed, continuous, calcium oxalate crystals abundant, often large, clustered, sometimes forming column-like structures. Vegetative propagules not seen. Ascomata variable, sparse to abundant, becoming moderately large, up to c. 600 µm in diam., roundish, apothecioid, solitary to marginally or more rarely entirely fused, immersed to emergent, then usually ±conical. Disc often becoming partly visible, pale flesh colored, epruinose. Pores (moderately) small, sometimes becoming wide, up to c. 400 µm in diam., predominantly roundish, entire, proper exciple not visible from surface. Thalline rim margin moderately thick, distinctly bright, off-white or brighter than thallus, in specimen with predominantly immersed ascomata sometimes sunken, thalline rim incurved. Proper exciple fused to apically slightly detached, moderately thin to moderately thick, hyaline internally, grayish to pale grayish-brown marginally, non-amyloid. Hymenium up to c. 100 µm high, non-inspersed, moderately to weakly conglutinated, paraphyses straight, slightly interwoven, with slightly to distinctly thickened tips, lateral paraphyses lacking and columellar structures absent. Epihymenium indistinct to thin, hyaline, rarely with fine grayish granules. Asci 8-spored, tholus moderately thick, thin when mature. Ascospores (very) small, transversely septate, cell walls and endospore (moderately) thick, usually with a thick halo, hyaline, distinctly to strongly amyloid, oblong to ellipsoid or somewhat fusi- to rarely claviform, with roundish to subacute ends, loci roundish, oblong to lentiform, with hemispherical to conical end cells, septae (moderately) thin, regular, 10-17 x 5-8 µm with 3-4(5) loci. Pycnidia present, immersed or in thallus warts, with bright rimmed, dark pore, conidia fusiform, up to c. 5 x 2 µm.

CHEMISTRY – Thallus K+ yellowish, C-, PD+ yellow; containing psoromic (major), 2'-0-demethylpsoromic and subpsoromic (traces) acids.

ECOLOGY AND DISTRIBUTION – *Myriotrema temperatum* grows on tree bark in subtropical rainforests in altitudes ranging from 400 to 1380 m. It is moderately common in the Queensland/New South Wales border region and northern New South Wales and currently only known from there.

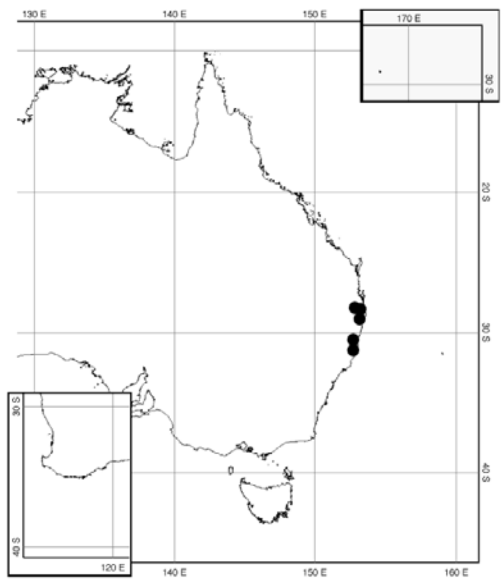

Fig. 91. Australian distribution of *M. temperatum*.

NOTES – This taxon is characterized by the thick, predominantly corticate thallus with a rugose, verrucose to verruculose surface, abundant calcium oxalate crystals, ascomata with a fused proper exciple and a distinct, entire bright margin, small, transversely septate, hyaline, amyloid ascospores with a distinct halo, and the presence of the psoromic acid chemosydrome. It may be difficult to distinguish from *M. microporum* and *M. clandestinum*, but it differs from both in the thallus surface structure and the thicker thalline rim margin. Further differences to *M. microporum* are listed under this species. *Myriotrema clandestinum* differs further by having longer ascospores (up to 25 µm) that either lack a halo or have only a thin halo. Another similar species is *M. glaucophaenum*, which can be readily distinguished by larger ascomata with a free proper exciple and an often split to lacerate thalline rim margin.

SPECIMENS EXAMINED – Australia, Queensland: Cunninghams Gap NP., 50 km NE of Warwick, *Hale 831346* (US). Lamington NP.: Python Rock Track, *Hale 831011* (US); Beechmont Range, Binna Burra, *A. & K. Kalb 19864, 21581* (hb. Kalb). New South Wales: Mt. Warning NP., W of Murwillumbah, *Hale 832565* (US). Trail from Black Butt Picnic Area, Wiangaree Forest Drive, NE of Kyogle, *Hale 831732* (US). Gibbergunyah Roadside Reserve, Nightcap Forest Drive, Whian Whian SF., W of Mullumbimby, *Hale 831476* (US). 37 km N of Ebor, Chaelundi Mt., *Verdon 3882* (CANB, H, TNS). Dorrigo NP., summit of Dorrigo Mt., *Elix 3480* (CANB). Beech Plateau, Werrikimbe NP., 80 km NW of Port Macquarie, *Streimann 63985* (B).

Myriotrema trypaneoides (Nyl.) Hale

Mycotaxon 11: 135 (1980). Bas.: *Thelotrema trypaneoides* Nyl., Ann. Sci. Nat. Bot. ser. 4, 19: 335 (1863). *Leptotrema trypaneoides* (Nyl.) Riddle, Bull. Torrey Bot. Cl. 43: 151 (1916). Type: Cuba, *Wright 156* (FH-Tuck.–lectotype selected by Hale [1978: 54]; US!–isolectotype).

Thelotrema subterebrans Nyl., Flora 59: 561 (1876). *Leptotrema subterebrans* (Nyl.) Zahlbr., Cat. Lich. Univ. II: 640 (1923). [fide Hale 1978].

Thelotrema laevius Vain., Journ. of Botan. 34: 207 (1896). *Leptotrema laevius* (Vain.) Zahlbr., Cat. Lich. Univ. II: 635 (1923). Type: St. Vincent, *Elliott* s.n. (TUR-Vain. 26774!-lectotype, here selected).

ILLUSTRATION – Fig. 92.

Thallus epi- to hypophloedal, (moderately) thick, up to c. 1 mm high, sometimes bulging and splitting away from the substrate, (pale) greenish gray, often with a grainy-speckled pattern. Surface ±shiny, smooth, continuous to verruculose, unfissured to rarely somewhat rimose. True cortex present, continuous, up to c. 40µm thick, hyaline, predominantly consisting of periclinal hyphae. Algal layer continuous and well developed, calcium oxalate crystals usually abundant, small to large, predominantly clustered, often forming columnar structures. Vegetative propagules not seen. Ascomata inconspicuous, (moderately) small, up to c. 500 µm in diam., roundish, predominantly perithecioid, solitary, immersed to slightly emergent, then hemispherical. Disc not visible from surface. Pores tiny, up to c. 50 µm in diam., roundish, entire, apical proper exciple becoming visible from surface, forming a fused inner pore margin, pore margin level thallus to often sunken, incurved, bright-translucent to (dark-)gray. Thalline rim margin moderately thick, roundish, entire, concolorous with thallus, thalline rim not developed or not distinguishable from surface, in emergent ascomata incurved. Proper exciple fused, (moderately) thin, pale yellowish internally, yellowish- to orange-brown marginally, sometimes dark-brown apically, non-amyloid. Hymenium up to c. 250 µm high, densely inspersed, moderately conglutinated, paraphyses thin, straight to slightly bent, parallel, unbranched, tips unthickened to slightly thickened, lateral paraphyses and columellar structures absent. Epihymenium indistinct to moderately thin in older stages, hyaline to yellowish or orange towards proper exciple, without granules or crystals. Asci 8-spored, tholus moderately thick, thin when mature. Ascospores (moderately) small, eumuriform, cell walls and endospore (moderately) thick in younger stages, moderately thick to moderately thin at maturity, becoming brown in early stages, non-amyloid, oblong to ellipsoid with roundish to narrowed-roundish ends, loci large in early stages, becoming small with late maturity, roundish to slightly angular, subglobose to oblong or irregular with same shaped end cells, transverse septae (moderately) thin, ±regular, 25-40 x 8-15 µm with 6-12 x 1-6 loci. Pycnidia not seen.

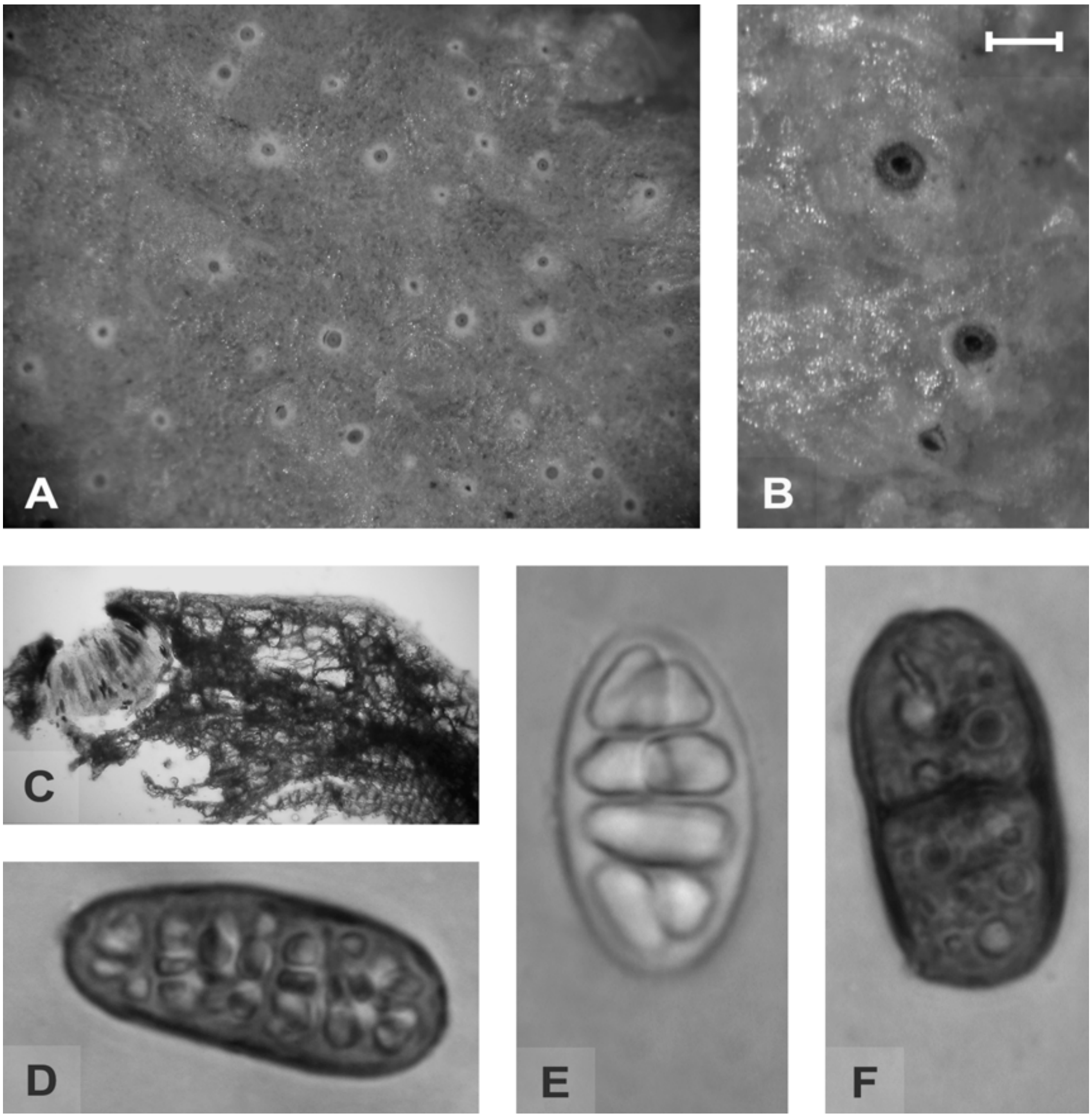

Fig. 92. *Myriotrema trypaneoides*: growth habit (**A**), ascomata (**B**), ascoma and thallus section (**C**), ascospore (**D**), young ascospore (**E**) and old ascospore (**F**). A.: *Hale 831360*; B., C.: TUR-holotype of *T. laevius*; D.-F.: *Lumbsch & Mangold 19167 v*. Bar= A: 1 mm; B: 0.15 mm; C: 225 µm; D: 7 µm; E: 4 µm; F: 6 µm.

CHEMISTRY – Thallus K+yellow, C-, PD+orange; containing constictic and stictic acids (majors), cryptostictic, hypoconstictic and hypostictic (minors) acids.

ECOLOGY AND DISTRIBUTION – *Myriotrema trypaneoides* was collected in Australia on tree bark in tropical rainforests in altitudes ranging from sea level to 700 m. It is moderately common in northern and central Queensland. This is the first report for Australia. This pantropical species has been recorded from Central America, India (Patwardhan & Kulkarni, 1977) and the Philippines (ibid.).

NOTES – This taxon is characterized by the shiny, corticate, thick thallus, the immersed to slightly emergent perithecia with tiny pores, the dark exciple, an inspersed hymenium, the moderately small, brown, muriform ascospores with a thick-walled young stage and the presence of the stictic acid chemosydrome. It is similar to *M. desquamans*, but can be readily distinguished by the darker proper exciple and the inspersed hymenium. The only similar species with inspersed hymenium is *L. bisporum* from Guadeloupe, which differs in having larger ascospores up to 180 µm long.

SPECIMENS EXAMINED – Australia, Queensland: Cape York Peninsula, Iron Range NP., *Hale 830051*, *830061* (US). Near Cedar Bay NP., Rd. to Cooktown, *Mangold 34 x* (F). Cape Tribulation Area: Cape Kimberley, *Lumbsch & Mangold 19167 v* (F); Cape Tribulation NP., *Hale 69193, 831360* (US). Fresh Water Gorge, outside of city of Cairns, *Hale 831731* (US). Fitzroy Island on Great Barrier Reef, *A. & M. Aptroot 22315* (ABL). Crystal Cascades, *Lumbsch & Mangold 19129 k* (F). Atherton Tablelands: Lake Tinaroo, *Lumbsch & Mangold 19127 b, zb* (F); Curtain Fig Tree, *Lumbsch & Mangold 19128 o* (F); Souita Falls, *Lumbsch & Mangold 19155 j, 19156 e* (F); S of Tolga on Kennedy Hwy, *Hale 831617* (US); Wongabel SF., *Hale 830604* (US); 27 km on Mulgrave River Rd., SW of Gordonvale, *Hale 830313, 830681* (US). Francis Range, Woopen Creek Rd., *Hale 832067* (US). Murray Falls, W of Kennedy, *Hale 831399* (US); 2 km N of Murray Falls, W of Kennedy, *Hale 831244, 832323* (US). Conway Peninsula, E of Proserpine, *Scott 620* (BRI). Conway SF., 18 km E of Proserpine, *Elix 20185, 20202* (CANB). N of Emu Park, near Rockhampton, *Selling 16442* (S).

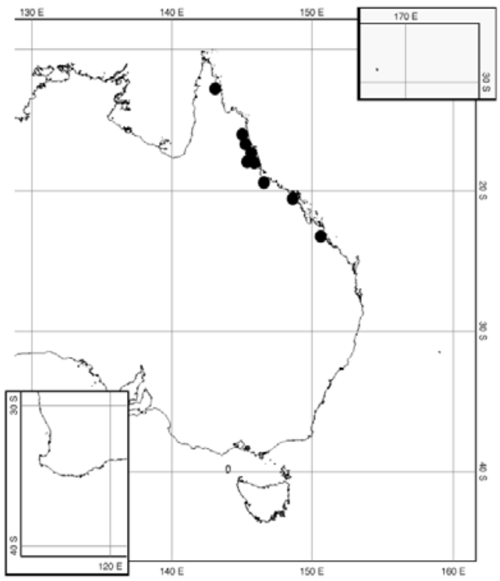

Fig. 93. Australian distribution of *M. trypaneoides*.

Myriotrema viridialbum (Kremp.) Hale

Mycotaxon 11: 135 (1980). Bas.: *Thelotrema viridialbum* Kremp., Flora 49: 221 (1876). *Ocellularia viridialba* (Kremp.) Müll. Arg., Flora 70: 398 (1887). *Rhabdodiscus viridialbus* (Kremp.) Vain., Ann. Acad. Scient. Fenn. A15(6): 184 (1921). Type: Brazil, Rio de Janeiro, *Glaziou 3193* (M-lectotype, selected by Hale [1972 in herb.]; C!-isolectotype).

Thelotrema myrioporoides Müll. Arg., Bull. Soc. Bot. Belgique 32: 147 (1893). *Myriotrema myrioporoides* (Müll. Arg.) Hale, Mycotaxon 11: 134 (1980). Type: Costa Rica, Boruca, 1893, *Tonduz s.n.* (com. Pittier 6104) (G!-lectotype, selected by Hale [1978: 45]).

Thelotrema leucohymenium Zahlbr., Denkschr. math.-naturw. Classe K. Akad. Wiss. Wien 83: 120 (1909). Type: Brazil, Sao Paulo, 16.07.1901, *Schiffner* s.n. (W-holotype, BM!-isotype).

Thelotrema steyermarkii Hale, Phytologia 27: 496 (1974). *Myriotrema steyermarkii* (Hale) Hale, Mycotaxon 11: 135 (1980). Type: Venezuela, Bolivar, *Steyermark 98008* (US!-holotype).

ILLUSTRATION – Fig. 94.

Thallus corticolous, sometimes overgrowing adjacent bryophytes, predominantly epi- to sometimes slightly hypophloedal, thick, up to c. 700 µm high, pale yellowish- to greenish gray or (pale) olive. Surface dull to shiny, smooth, continuous to rugose to more rarely verrucose, unfissured to more often distinctly fissured. True cortex present, ±continuous, sometimes yellowish, up to c. 50 µm thick, predominantly consisting of periclinal hyphae. Algal layer well developed, continuous, calcium oxalate crystals lacking or sparse, then large and clustered, distinct medullar layer present. Vegetative propagules not seen. Ascomata variable, small to large, up to c. (500)800 µm in diam., predominantly roundish, apothecioid, solitary to often fused, immersed to ±distinctly emergent in older ascomata, then hemispherical to urceolate. Disc sometimes becoming partly visible from surface, pale flesh colored, pruinose. Pores small to gaping, up to c. (300)600 µm in diam., roundish, entire to slightly split, proper exciple often becoming apically or entirely visible from surface, off-white, sometimes slightly shrunken, incurved. Thalline rim margin becoming moderately wide to gaping, roundish, moderately thick, predominantly ±entire, whitish or brighter than thallus, thalline rim incurved. Proper exciple fused to partly or entirely free, moderately thick

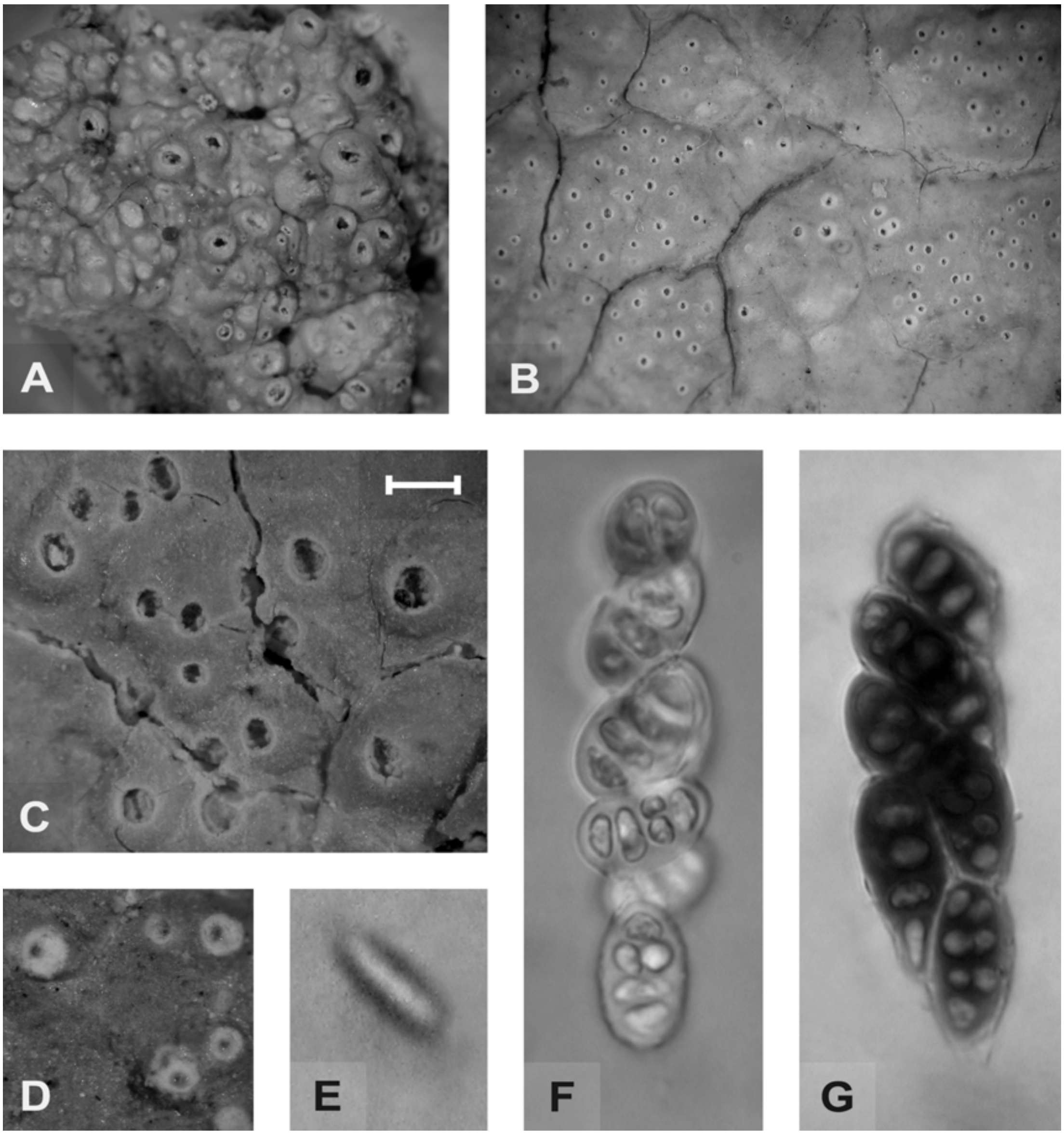

Fig. 94. *Myriotrema viridialbum*: growth habit (**A, B**), ascomata (**C**), pycnidia (**D**), conidium (**E**), ascospores (**F**) and ascospores showing amyloid reaction (**G**). A.: US-holotype of *T. steyermarkii*; B.: *Hale 830899*; C.-G.: C-isolectotype. Bar= A: 1 mm; B: 1.5 mm; C: 0.5 mm; D: 0.2 mm; E: 2 µm; F, G: 7.5 µm.

to moderately thin, with thin or absent hyaline area internally, entirely or marginally grayish, sometimes faintly amyloid (reddish). Hymenium up to c. 160 µm high, non-inspersed, sometimes interspersed with large, ±columnar aggregates of bacilliform crystals (dissolving in KOH) strongly conglutinated, paraphyses thick, irregular and often distinctly septated, ±interwoven, with thickened, irregular tips, lateral paraphyses and true columella absent, columella-like structures sometimes present in fused ascomata. Epihymenium moderately thick, hyaline, with grayish granules. Asci 8-spored, tholus moderately thick to moderately thin. Ascospores (very) small, predominantly submuriform, cell walls and endospore (moderately) thick, often covered by a thin halo, hyaline, distinctly to strongly amyloid, subglobose to ellipsoid or somewhat claviform, with roundish to subacute, rarely acute ends, loci roundish, subglobose to lentiform, with same shaped to more hemispherical or rarely conical end cells, septae (moderately) thick, often irregular, 10-20 x 5-12 µm with 3-6 x 1-2(3) loci. Pycnidia often present, variable, immersed or in distinct thallus warts, with brownish pore area surrounded by a ±eroded, bright region, conidia fusiform, up to c. 6 x 1 µm.

CHEMISTRY – Thallus K-, C-, PD-, UV±; containing hypoprotocetraric (major), 4-0-demethylnotatic, convirensic, conhypoprotocetraric (minors to traces) and conprotocetraric (trace) acids, and sometimes lichexanthone.

ECOLOGY AND DISTRIBUTION – *Myriotrema viridalbum* occurs on tree bark in tropical rainforests at elevations ranging from 600 to 1100 m altitude. It is rare in Australia, occurring only in northern Queensland. This is the first report for Australia. Previously only known from the Neotropics.

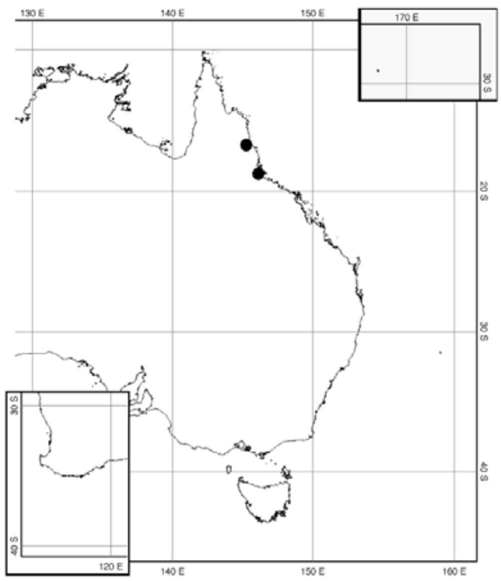

Fig. 95. Australian distribution of *M. viridialbum*.

NOTES – The species is characterized by a thick, epiphloedal, corticate thallus, small, submuriform, amyloid ascospores with distinctly thickened parts and the presence of the hypoprotocetraric acid chemosydrome. *Myriotrema glaucophaenum* is similar, but can be readily distinguished by transversely septate ascospores and psoromic acid (for a discussion of the columella-like structures in the '*M. viridialbum*-group' see under *M. glaucophaenum*). Also similar is *M. microporum*, which differs in having transversely septate ascospores and psoromic acid. *Myriotrema rugiferum* is another taxon that can be confused with *M. viridialbum*, but differs by smaller ascomata (not exceeding 400 µm in diameter) with less widened pores. The Australian collections agree well with the Neotropical specimen, except for the absence of lichexanthone and smaller ascomata. An unusual feature in *M. viridialbum* is the presence of large crystal aggregates in the hymenium, found in the type and in the type collection of *T. leucohymenium* (the epithet even refers to the phenomenon) and *T. myrioporoides*. It only occurs in older samples.

SPECIMENS EXAMINED – Australia, Queensland: Mt.Windsor, 5 km W of new Forestry Camp, NW of Mossman, *Hale 830663, 830899* (US). Cardwell Range: Blencoe Creek, 48 km NW of Cardwell, *Elix 20134, 20138* (CANB); 24km WNW of Cardwell, *Streimann 28545* (B, CANB). Lannercost SF., Blue Water Creek, Old Mill Rd., 39 km WSW of Ingham, *Elix & Streimann 15572* (CANB). Venezuela, Paramo La Negra, Estado Merida, (as T. steyermarkii, Lichenes Americani Exsiccati no. 199), *Hale 42871* (MEL). Costa Rica, Cartago, Cordillera de Talmanaca, *Filson 16272* (MEL).

2. 9. 8. ***Nadvornikia*** Tibell, Beih. Nova Hedw. 79: 672 (1984). Type species*: Acolium hawaiense* Tuck. [=*N. hawaiensis* (Tuck.) Tibell].

Stephanophoron Nádv., Ann. Mycol. 40: 136 (1942), nom. illeg. [non *Stepahnophoron* Flotow].

Nadvornikia hawaiensis is the only known species in Australia, for a description see there.

NOTES – This genus was introduced by Tibell (1984) in the family *Caliciaceae* with *N. hawaiensis* as the only member. Tuckerman (1867) already pointed out the similarities to Thelotremataceae in his original description of the species (as *Acolium hawaiense*). Harris

(1990) proposed to classify the genus in this family, which was later accepted by Tibell (1996) and has been recently confirmed using molecular analysis (Lumbsch & al., 2005). Two additional species were since described for the genus, *N. diplotylia* (Pant & Awasthi, 1989), which is included as a synonym in *N. hawaiensis* [following Tibell (1996)], and *N. sorediata* (Harris, 1990). The latter species (only known from the Neotropics) differs from *N. hawaiensis* by the presence of soralia.

The genus is readily distinguished by the mazaedious ascomata with small, brown bilocular ascospores and no other similar genus is known.

Species description:

Nadvornikia hawaiensis (Tuck.) Tibell

Beih. Nova Hedwigia 79: 672 (1984). Bas.: *Acolium hawaiense* Tuck., Proc. Amer. Acad. Arts Sci. 7: 232 (1866). Type: Hawaii, Oahu, Wailaua Mts., *Mann* s.n. (UPS!-lectotype, here selected [annotated as 'syntype', Tibell 1987 - see also notes]).

Tylophoron diplotylium Nyl., Bull. Soc. Linn. Normandie 2: 46 (1868). *Nadvornikia diplotylia* (Nyl.) Pant & Awasthi, Biovigyanam 15(1): 12 (1989). Type: New Caledonia, Wagap, 1863, ("D23"), s.c. (H-Nyl. 40422!-holotype).

ILLUSTRATION – Fig. 96.

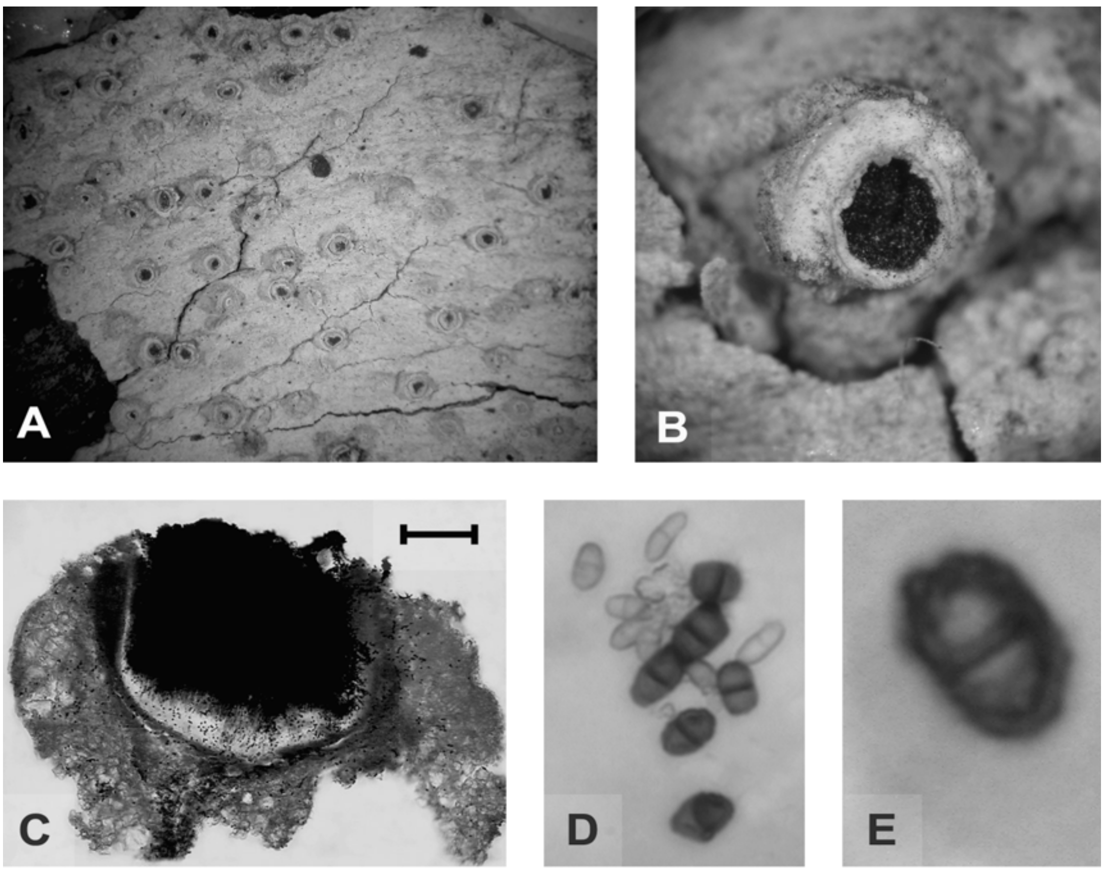

Fig. 96. *Nadvornikia hawaiensis*: growth habit (**A**), ascoma (**B**), ascoma section (**C**), ascospores (**D, E**). A.: H-lectotype of *T. diplotylium*; B., D., E.: *Tibell 12673*; C.: *Mangold 36 x*. Bar= A: 3 mm; B: 0.5 mm; C: 300 µm; D: 10 µm; E: 3 µm.

Thallus epi- to hypophloedal, moderately thick, up to c. 300 µm high, often bulging and flaking away from the substrate, pale greenish- to pale yellowish-gray. Surface dull to glittering or slightly shiny, smooth to somewhat roughened, ±rugose, continuous to usually distinctly to strongly verruculose, unfissured. Cortex structures absent or with a thin, incontinuous protocortex up to c. 20 µm thick. Algal layer moderately well developed, continuous to incontinuous, calcium oxalate moderately abundant, predominantly small, scattered to clustered. Vegetative propagules not seen. Ascomata conspicuous, large, up to c. 1.5 mm in diam., roundish to slightly irregular, mazaedious, solitary, strongly emergent, subglobose to urceolate in older ascomata. Pores becoming wide to gaping, up to c. 800 µm in diam., roundish to somewhat elongated, entire to slightly split, apical proper exciple often becoming visible from surface due to eroded thalline rim, forming a brownish to reddish-brown ring, and/or the proper exciple becomes visible as a distinctly raised, slightly incurved to erect, corona-like velum, slightly pruinose. Thalline rim margin thick, roundish to slightly elongate, becoming distinctly eroded with age, brighter then thallus, thalline rim becoming erect, with same surface as thallus. Proper exciple fused, in older ascomata becoming apically free, thick, hyaline basally, pale orange to orange-brown apically, in upper, internal parts often covered by brownish-gray granules, non-amyloid. Hymenium only visible in younger ascomata, clear, distinctly conglutinated, paraphyses thin, slightly interwoven, unbranched, straight to somewhat bent, in mature stages distinctly mazaedious, lateral paraphyses and columellar structures absent. Asci 8-spored, tholus not visible. Ascospores very small, bi-locular, with thickened cell walls and septae, non-halonate, surface becoming distinctly, ±irregularly ornamented with age, brown, non-amyloid, predominantly oblong to fusiform or more rarely subglobose, with roundish to somewhat subacute ends, loci predominantly hemispherical, 6-10 x 4-6 µm. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing stictic, constictic (majors), hypostictic (minor to trace), α-acetylconstictic and hypoconstictic (traces) acids. (See notes regarding the presence of lichexanthone.)

ECOLOGY AND DISTRIBUTION – *Nadvornikia hawaiensis* was collected in Australia on tree bark in (sub)tropical rainforests, rarely in wet sclerophyll forests, in altitudes ranging from 50 to 900 m. It is moderately common and widespread in Queensland and in the Queensland/New South Wales border region. It is pantropical, being recorded from Hawaii, Brazil (Tibell, 1984), the Andman Islands (Pant & Awasthi, 1989) and New Caledonia.

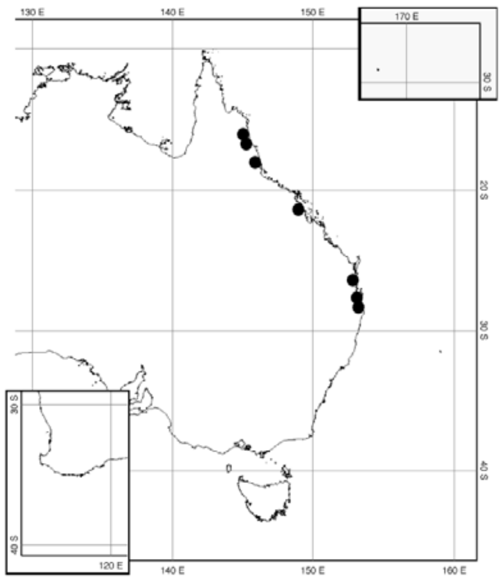

Fig. 97. Australian distribution of *N. hawaiensis.*

NOTES – This taxon is unusual in thelotremataceaen Graphidaceae for having mazaedious ascomata. *Nadvornikia* includes two species, the second being *N. sorediata* from the Neotropics. The phylogenetic placement of the genus in Thelotremataceae was confirmed using molecular analysis (Lumbsch & al., 2004), see also Tibell (1984) and Harris (1990) for a more detailed discussion on the taxonomy of the genus. The syntypes in FH were not available for study, Tibell (1989) neither saw this material but a specimen in UPS. Harris (1990) states that he saw two isotypes but does not give any further information. Since the UPS collection is the only widely available type material it is here selected as lectotype. The chemistry of this species caused some confusion. Tibell (1984, 1989) stated the UV-reaction ('brilliant UV+ yellow' and 'faintly greenish green' in the Australian material; 'intense UV+ fluorescent') and concluded the presence of lichexanthone, additionally, he notes about the Australian material that "no secondary products have been identified". Consequently Pant & Awasthi (1989) classified *Nadvornikia diplotylia* (ex *Tylophoron diplotylium*) as a distinct species (formerly treated as a synonym by Tibell), based on the lack of lichexanthone and the presence of the stictic acid chemosydrome. The chemical analysis of the examined specimen conducted here confirmed Harris' (1990) statement (type collection and several other specimen tested) that they contain the stictic acid chemosydrome but lack lichexanthone.

SPECIMENS EXAMINED – Australia, Queensland: Big Tableland, 26 km S of Cooktown, *Elix 17265* (CANB). Daintree NP., Mossman Gorge Section, near western border of National Park along Mossman creek, *Mangold 36 w, x* (F). Babinda Boulders, *A. & M. Aptroot 22391* (ABL), *Lumbsch & Guderley 11151 e* (F). Near Yabba Rd., 6 km N of Jimna, *Rogers 2247* (BRI). Mt. Glorious, 2 km W of Maiala picnic area, *Rogers 2577* (BRI). B.Rose Park, Samford-Mt.Glorious Rd., *Rogers 2702, 2703* (BRI). Duck Creek rd. near Lamington NP., close to O'Reilly's, (Lichenoth. Graecensis 12), *Mayrhofer, Hierzer & Rogers* s.n. (M). Lamington NP.: 13 km SW of Beechmont, along Blue Pool Track, (Calic. exs. 121), *Tibell 12673* (F, COLO); Binna Burra, *Aptroot 46103* (ABL). Springbrook-Numinbah-Nerang intersection, *Rogers 2975* (BRI). New South Wales: Unumgar SF., 4 km S from Qld. border, *Lumbsch & Mangold 19176 q* (F).

2. 9. 9. ***Pseudoramonia*** Kantvilas & Vezda, Lichenologist 32: 344 (2000). Type species: *Pseudoramonia. stipitata* (Vezda & Hertel) Kantvilas & Vezda. Type: Venezuela, Estado Merida, Sierra de Santo Domingo, *Hertel & Oberwinkler 10412* (hb. Hertel-holotype, hb. Vezda-isotype).

Pseudoramonia richeae is the only known species in Australia, for a description see there.

NOTES – This recently introduced genus (Kantvilas & Vezda, 2000) consists of two species, *P. richeae* which is so far only known from Tasmania and the neotropical *P. stipitata* (for distinguishing characters of the two taxa see under *P. richeae*), that differ from other thelotrematoid taxa by distinctly stipitate ascomata. Otherwise *Pseudoramonia* is similar to *Topeliopsis, Melanotopelia* and the '*Leptotrema schizoloma*-group'.

Species description:

Pseudoramonia richeae Kantvilas & Vezda

Lichenologist 32: 344 (2000). Type: Tasmania, Mt.King William, *Kantvilas 105/84* (HO!-holotype, hb. Vezda-isotype).

ILLUSTRATION – Fig. 98.

Thallus corticolous to foliicolous epi- to endosubstratic, moderately thin, up to c. 200 µm high, pale gray to yellowish-gray or rarely greenish-gray. Surface dull to slightly shiny, smooth, continuous, unfissured to slightly fissured. Cortex structures variable, predominantly covered by an incontinuous protocortex up to c. 25 µm thick, in ascoma region often becoming distinctly conglutinated, forming a true cortex of irregular to periclinal hyphae.

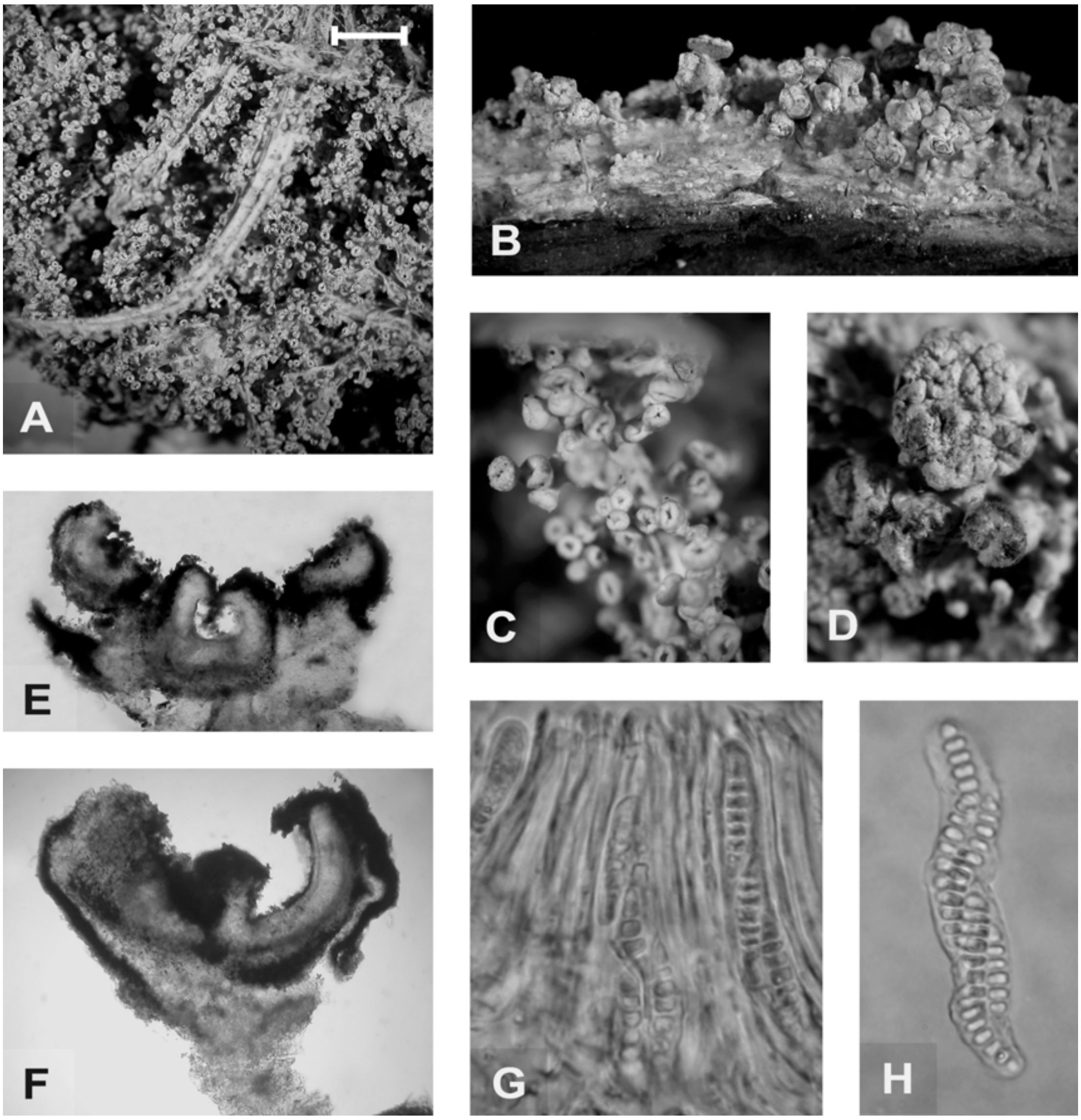

Fig. 98. *Pseudoramonia richeae*: growth habit (**A, B**), ascomata (**C, D**), ascomata sections (**E. F**), hymenium and asci (**G**) and ascospores (**H**). A.-H.: HO-holotype. Bar= A: 4 mm; B: 1 mm; C: 0.7 mm; D: 0.5 mm; E: 150 µm; F: 120 µm; G: 10 µm; H: 12 µm.

Algal layer poorly developed, incontinuous, calcium oxalate crystals absent. Isidia-like structures often present, probably representing immature ascomata (see notes). Ascomata very characteristic, conspicuous, moderately small to moderately large, up to c. 600 µm in diam., roundish to irregular in fused ascomata, peri- to apothecioid, solitary to fused, stipitate, growing successively, either depressed, forming a broad, verrucose base or emerging, forming somewhat coralloid structures. Disc usually not visible from surface, rarely becoming somewhat visible, grayish, epruinose. Pores small to moderately wide, up to c. 400 µm in diam., predominantly irregular or slightly elongate, margin ±split, incurved and often distinctly sunken, concolorous with thallus or darkened due to protuberant proper exciple, otherwise proper exciple not visible from surface. Thalline rim moderately thick, concolorous to somewhat darkened, predominantly depressed-subglobose to irregular with ±strongly restricted base, base stiped, stipes up to c. 2 mm long, concolorous with thallus to reddish-brown. Proper exciple fused, moderately thick, pale yellowish to pale yellowish-brown internally, brown to carbonized marginally, not separated from subhymenium, non-amyloid. Hymenium up to c. 90 µm high, non-inspersed, strongly conglutinated, paraphyses straight, parallel, with unthickened tips, lateral paraphyses indistinct, up to c. 15 µm long, not clearly separated from the exciple, true columella absent, columella-like structures sometimes present in fused ascomata. Subhymenium conspicuous, usually dark-brown to carbonized in upper part, sometimes followed by a lower layer of ±hyaline, loosely organized to paraplectenchymatous hyphae, resembling a newly developing hymenial layer. Epihymenium indistinct, hyaline and without granules. Asci 8-spored, tholus moderately thin, not visible at maturity. Ascospores small, transversely septate, cell walls and endospore thin, distinctly halonate, hyaline, non-amyloid, oblong to somewhat fusi- to claviform, with roundish to narrowed-roundish ends, loci roundish to slightly angular, subglobose to oblong to slightly irregular, with same shaped or hemispherical to conical end cells, septae moderately thin to moderately thick, slightly irregular, 12-26 x 3-6 µm with 8-12 loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish-brown, C-, PD+ orange-red; containing succinprotocetraric (major), protocetraric and fumarprotocetraric (major to minor) acids.

ECOLOGY AND DISTRIBUTION – *Pseudoramonia richeae* occurs on bark and dead leafs of *Richea scoparia*, in (sub-)alpine heathland shrubs in altitudes ranging from 700 to 1300 m. It is a moderately common species occurring in several regions of Tasmania.

NOTES – This taxon is characteristic by having stipitate ascomata. One other species is known in the genus, *P. stipitata* from Venezuela, which differs in having the stictic acid chemosyndrome and smaller ascospores. Regarding the presence of isidia, the original description (Kantvilas & Vezda, 2000) is followed here, in which the isidia-like structures are defined as immature ascomata. In contrast to Kantvilas and Vezda (2000) I found the ascomata of *P. richeae* being carbonized.

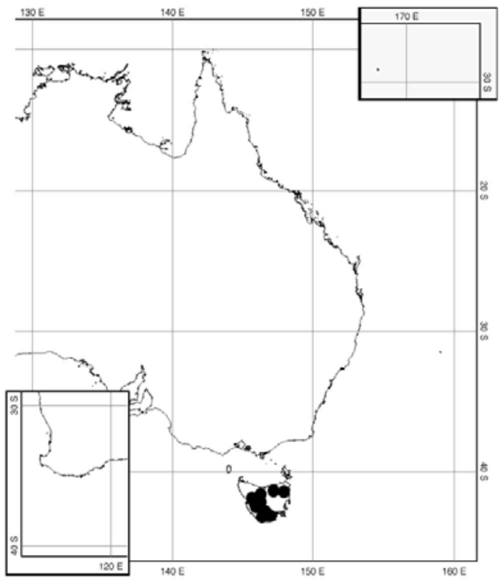

Fig. 99. Australian distribution of *P. richeae*.

SPECIMENS EXAMINED – Australia, Tasmania: Mount Field NP., near Lake Dobson, 65 km WNW of Hobart, *Aptroot 23397* (ABL).

2. 9. 10. ***Reimnitzia*** Kalb, Mycotaxon 79: 325 (2001). Type species: *Reimnitzia santensis* (Tuck.) Kalb.

Reimnitzia santensis is the only known species in the genus, for a description see there.

NOTES – This monotypic genus was erected (Kalb, 2001) based mainly on the unusual structure of the apical hymenium with paraphyses having branched and interwoven tips. Since similar structures could be also found in *Chapsa*, Frisch (2006) points out several distinguishing characters to justify its status as a separate genus. Hence *Reimnitzia* is characterized by chroodiscoid ascomata and a '*Thelotrema*-type' exciple and distinguished, particularly from *Chapsa*, by thick-walled ascospores at early stages, ascus tips with a "distinct key-hole appearance" (ibid.: 271) (not found in all specimen), "rather lax and less distinct" (ibid.: 272) paraphyses, a thallus with large, columnar calcium oxalate crystals and typical pycnidia that occur in ±strongly emergent thallus warts and on the tips of isidia-like structures, and bacilliform conidia. In my studies, I could not confirm the presence of a '*Thelotrema*-type' exciple in *Reimnitzia.* The examined material, which did not include the type, however, lacked lateral paraphyses. This agrees well with the protologue of *Reimnitzia* in which the genus is separated from *Thelotrema* "by the lack of distinct periphyses" (Kalb, 2001: 326). The genus is accepted here tentatively and needs evaluation by molecular data.

Species description:

Reimnitzia santensis (Tuck.) Kalb

Mycotaxon 79: 325 (2001). Bas.: *Thelotrema santense* Tuck., Proc. Amer. Acad. Arts Sci. 5: 406 (1862). *Leptotrema santense* (Tuck.) Zahlbr., Cat. Lich. Univ. 2(4): 635 (1923). Type: U.S.A., South Carolina, Santee, 1860, *Ravenel* s.n. (BM-lectotype, selected by Salisbury [1972b: 288]).

(?) *Thelotrema heterosporum* C. Knight in Bailey, Synops. Queensland Flora, Suppl. 1: 72 (1886) - fide Müller 1887 [as synonym of *L. mastoideum*]. *Leptotrema heterosporum* (C.Knight) Zahlbr., Cat. Lich. Univ. 2(4): 635 (1923). Type: Australia, S. Queensland, on moss, *C. Knight* s.n. (?WELT, not seen - see also notes).

Leptotrema mastoideum Müll.Arg., Flora 70: 400 (1887) - ?nom. superfl. pro *T. heterosporum* (if conspecific). Type: Paraguay, *Balansa 38* (G-holotype).

ILLUSTRATION – Fig. 100.

Thallus corticolous to rarely muscicolous, epi- to hyposubstratic, moderately thick, up to c. 300 µm high, rarely bulging, grayish to pale grayish-green or grayish-olive, often with distinctly speckled pattern. Surface dull, smooth to mealy to slightly pruinose or rough, continuous to verruculose, unfissured to fissured or coarsely cracked. Cortex structures absent. Algal layer generally continuous and well developed, appearing incontinuous due to crystal inclusions, calcium oxalate crystals abundant, small to large, scattered or clustered, forming column-like structures, distinct medulla layer mostly absent, basal thallus often formed of conglutinated ±periclinal hyphae, forming a lower cortex-like structure. Isidia often present, abundant, concolorous with thallus, unbranched, first globular, becoming vermiform with a ±constricted base, up to c. 1.5 mm long. Ascomata conspicuous, up to c. 2 mm in diam., roundish to irregular, in particular in fused ascomata, chroodiscoid, solitary to fused, erumpent, immersed to slightly raised. Disc usually becoming entirely visible from surface, (dark) grayish, pruinose. Proper exciple not visible from surface, thalline rim margin becoming wide to gaping, up to c. 1.8 mm in diam., entire to more often ±coarsely split and lobed, ±eroded, whitish or brighter than thallus, thalline rim first incurved and moderately thin, becoming thick, predominantly erect to slightly recurved in older stages. Exciple fused, hyaline to pale yellowish-brown internally, brownish marginally, apically dark-brown to rarely slightly carbonized and with grayish granules, non-amyloid. Hymenium up to c. 120 µm high, non-inspersed, distinctly conglutinated, paraphyses straight, ±interwoven, sometimes slightly branched, particularly towards the margins and the apical hymenium, tips slightly thickened and irregular, lateral paraphyses not seen, [according to Frisch (2006) present, scattered and free, up to 15 µm long], true columella absent, in fused ascomata sometimes columella-like structures present. Epihymenium moderately thick, hyaline to sometimes brownish marginally, with pale grayish-brown granules. Asci 8-spored, tholus moderately thin, thin at maturity. Ascospores small, submuriform, cell walls and endospore moderately thick, non-halonate, brown, non-amyloid to rarely very faintly amyloid, subglobose to ellipsoid to fusiform, with roundish to subacute ends, loci roundish to angular, predominantly irregular, septae (moderately) thin, predominantly irregular, often with a

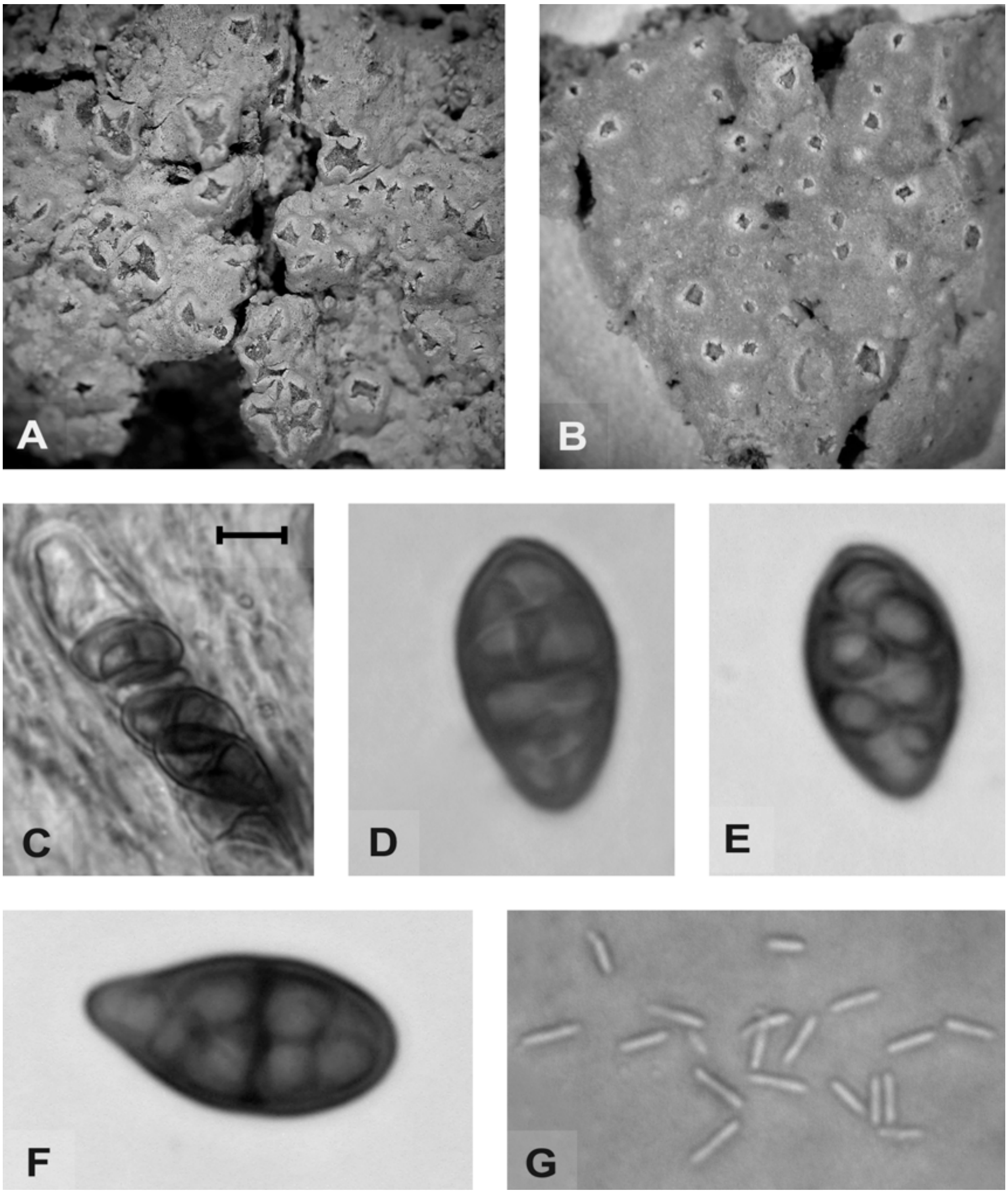

Fig. 100. *Reimnitzia santensis*: growth habit (**A, B**), ascus (**C**), ascospores (**D-F**), conidia (**G**). A., D.-F.: *Tucker 7614*; B.: *A. & K. Kalb 30585*; C.: *Calkin 146*; G.: *Tucker 32240*. Bar= A, B: 2 mm; C: 10 µm; D-G: 5 µm.

single, more distinct central septum, 12-25 x 8-12 µm with 4-6 x 1-3 loci. Pycnidia present, immersed or in ±globular warts, with brownish to blackish pore area, conidia bacilliform to oblong-fusiform, up to c. 6(10) x 1 µm.

CHEMISTRY – Thallus K-, C-, PD-; no secondary substances detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Reimnitzia santensis* occurs on tree bark and in Australia is restricted to monsoon forests at low altitudes. It is rare in the area, only known from north-western Northern Territory, and probably southern Queensland (19th century collections). (The location in southern Queensland is not marked in the distribution map Fig. 101 due the uncertain locality). This is a pantropical species that has been recorded from the Neotropics and Africa (Frisch, 2006).

Fig. 101. Australian distribution of *R. santensis*.

NOTES – This taxon is characterized by an isidiate, dull, ecorticate thallus, large, chroodiscoid ascomata with pruinose, grayish discs, a fused proper exciple, small, brown, submuriform ascospores with irregular loci arrangement and the absence of secondary compounds. The only similar species in Australia is *Leucodecton glaucescens*, for differences see under this species. *Thelotrema leiospodium* Nyl. from Portugal is similar but distinguished by a free proper exciple and apothecioid rather than chroodiscoid ascomata with distinct lateral paraphyses. In contrast to the descriptions given by Kalb (2001) and Frisch (2006), lateral paraphyses could not be found in the examined material. Although the hyaline, inner parts of the proper exciple sometimes are formed by a short-celled plectenchyma that remotely appears to be laterally organized, however, distinctly filamentous, paraphyses-like structures were absent. Several characters indicate a close relationship to *Leptotrema wightii*, in particular the habitus, and certain features of ascomata, asci and ascospore morphology . The Knight collection from Southern Queensland was not available from WELT. Hence the conspecificity to *R. santensis* is uncertain and it is suggested to treat the name as a tentative synonym based on Müller's observations.

SPECIMENS EXAMINED – Australia, Northern Territory: Kakadu NP., "Gungarre Monsoon Forest", near South Alligator, *K. & A. Kalb 30585* (CANB, hb. Kalb). U.S.A.: Louisiana: East Baton Rouge Parish, *S. Tucker 32240* (WIS); Livingston Parish, *S. Tucker 7614* (WIS). Florida: St, George Isl., *W. Calkin 146* (WIS); Sanford, Jul. 1907/Oct. 1911 (two collections), *S. Rapp* s.n. (WIS). Brazil: Parana, *Kalb 33324* (hb. Kalb); Mato Grosso, *Kalb 33348* (hb. Kalb).

2. 9. 11. ***Thelotrema*** Ach., Meth. Lich.: 130 (1803). Type species: *Thelotrema lepadinum* (Ach.) Ach.

Antrocarpum G. Mey., Nebenstunden: 326 (1825), nom. illegit. [based on *Lichen lepadinus* Ach.]

Brassia Massal., Atti Reale Ist. Veneto Sci. Lett. Arti, ser. 3, 5: 259 (1860). Type species: *Thelotrema porinoides* Mont. & Bosch.

Thelotrematomyces Thomas, in Ciferri & Tomaselli, Istit. Bot. Univ. Lab. Crittog. Pavia Atti, ser. 5, 10(1): 52, 77 (1953), nom. illegit.

THALLUS – Crustose, corticolous or sometimes saxicolous. Predominantly very thin to moderately thick, rarely distinctly thick, hyposubstratic to episubstratic, up to c. 50-800 µm high, grayish to greenish or olive with yellow, brown or white tones. Surface dull to slightly shiny, rarely shiny or ceraceous, smooth to rough or rarely pruinose, in predominantly hypophloedal thalli often with protuberant substrate structures, continuous to ±distinctly verrucose or verruculose, unfissured to fissured to rarely areolate. Prothallus thin to indistinct, brown. Thallus either without cortical structures or covered by a continuous to discontinuous protocortex up to c. 10-30 µm thick, or true cortex present, continuous to discontinuous, hyaline to yellowish, up to c. 10-50 µm, rarely up to c. 80-100 µm thick and consisting of irregular to periclinal hyphae. Algal layer continuous to discontinuous, poorly to well developed, calcium oxalate crystals sparse to abundant, small to large, scattered to clustered, rarely in columnar arrangement. Distinct medulla layer absent to rarely present. Vegetative propagules absent in Australian species, but isidia known from the south-east Asian *T. isidiophorum*.

ASCOMATA – Conspicuous to inconspicuous, small to very large, up to c. 0.3-2 mm in diam., predominantly roundish to rarely slightly irregular, only in fused ascomata appearing distinctly irregular, rarely slightly elongated. Peri- to apothecioid, rarely becoming ±indistinctly chroodiscoid with age, mostly sessile to rarely erumpent, solitary to fused, non-regenerating to rarely regenerating, distinctly immersed to distinctly emergent, then hemispherical, conical, cylindrical, urceolate or subglobose, rarely annular, with same surface as thallus or sometimes more distinctly verruculose or verrucose. Disc not visible from surface to partly or rarely entirely visible, grayish to flesh-colored, rarely with white or brown tones, epruinose to strongly pruinose. Pores predominantly tiny to wide, up to c. 50-800 µm in diam., more rarely gaping, up to c. 1-1.5 mm in diam., roundish to ±irregular, entire to ±split, proper exciple rarely not visible from surface, pore margin then formed by thalline rim, to predominantly becoming visible from surface, free to rarely fused, off-white to whitish in upper parts to sometimes yellowish or brownish towards the base, often jagged and/or shrunken, mostly incurved to slightly erect, rarely distinctly erect to ±recurved. Thalline rim margin small to gaping, thin to thick, entire to distinctly split and/or lacerate, sometimes eroded and/or pruinose, unlayered to ±distinctly layered, concolorous with thallus to ±brighter or whitish, off-white or pale brownish, incurved to ±recurved. Proper exciple predominantly ±free, rarely fused, thin to thick, hyaline to pale yellowish internally, yellowish, orange, grayish or brownish marginally, sometimes with substrate or crystal inclusions, apically often dark-brown to rarely slightly carbonized and often covered by grayish granules, non-amyloid to ±distinctly amyloid at the base, rarely faintly amyloid also towards the upper parts. Subhymenium indistinct, evanescent to moderately thin, hyaline to yellowish or brownish. Hymenium non-amyloid, discoid, sometimes with a ±broader base or ±cupular, in perithecioid ascomata also subglobose, up to c. 80-400 µm high, predominantly non-inspersed and clear, sometimes inspersed, usually moderately to strongly, rarely weakly conglutinated. Paraphyses not thickened, rarely distinctly thin, rarely straight to usually ±bent, rarely distinctly curly in apical parts, parallel to ±distinctly interwoven, unbranched to rarely slightly branched, tips slightly to distinctly thickened, rarely not thickened, sometimes ±irregular. Lateral paraphyses present, conspicuous to inconspicuous, sometimes distinctly unconglutinated, up to c. 10-40 µm long. True columella absent, in fused ascomata rarely columella-like structures present. Epihymenium indistinct to ±thick, hyaline to sometimes grayish or brownish, rarely yellowish, egranulose to granulose.

Asci 1-8-spored, non-amyloid, clavate, ascus walls predominantly not thickened and with a distinct tholus (at least in younger stages), sometimes ascus walls distinctly thickened and with indistinct or absent tholus. Ascospores uni- to triseriate, small to large, 10-350(400) x 5-50 µm, transversely septate to eumuriform. Cell walls thin to thick, smooth to sometimes crenate, endospore in muriform ascospores thin to thick, non-halonate to ±distinctly halonate, halo predominantly present in younger stages, thin to thick, sometimes ±distinctly irregular, hyaline to yellowish or brown, sometimes distinctly pigmented only in late stages of development, non- to distinctly amyloid; oblong to ellipsoid or clavi- to fusiform or cylindrical, rarely subglobose; with roundish to subacute, rarely distinctly acute and strongly tapered ends; with 4-46 x 0-10 or multiple loci, loci roundish to ±angular, subglobose, oblong, lentiform or ±irregular, with same shaped, hemispherical or conical end cells, transverse septae thin to thick, distinct to sometimes indistinct with age in densely muriform ascospores, regular to irregular.

PYCNIDIA – Present in several species, immersed or in thallus warts with dark pore area, conidia ellipsoid to oblong to rarely irregular, up to c. 2-4 x 1 µm.

CHEMISTRY – β-Orcinol depsidones present or absent.

ECOLOGY AND DISTRIBUTION – The *Thelotrema* species in Australia predominantly occur on tree bark and rarely on siliceous rock in altitudes ranging between sea level and 1500 m. The majority of species is found in rainforests, coastal forests and mangroves, rarely wet sclerophyll forests and shrubs, in tropical to sub-tropical climates of north-western Northern Territory, along the eastern coast of Queensland and northern New South Wales and on Lord Howe Island. Some species ±extend into warm- to cool-temperate zones from Pacific north-central New South Wales to southern Victoria and Tasmania. *T. lepadinum* also occurs in dry sclerophyll forests, heath shrubs and swamplands and in Karri-Forests in Western Australia. At present state of knowledge, amongst the 38 species known in Australia, eleven are endemic (*T. crespoae, T. capetribulense, T. crassisporum, T. cyphelloides, T. eungellaense, T. gallowayanum, T. oleosum, T. pseudosubtile, T. subadjectum, T. thesaurum, T. triseptatum*), two are Australasian (*T. circumscriptum, T. monosporum*), eight are paleotropical to paleotemperate (*T. bicavatum, T. conveniens, T. cupulare, T. foveolore, T. nostalgicum, T. nureliyum, T. polythecium, T. rugatulum*), 15 are pansubtropical to pantropical (*T. adjectum, T. alboolivaceum, T. defossum, T. diplotrema, T. lacteum, T. lepadodes, T. leucophthalmum, T. myriocarpum, T. pachysporum, T. porinaceum, T. porinoides, T. saxatile, T. saxicola, T. subtile, T. suecicum*) and one subcosmopolitan (*T. lepadinum*).

NOTES – *Thelotrema* is the oldest genus in the family (Acharius, 1803), with *T. lepadinum* as the first described and best known species (Acharius, 1798, as *Lichen lepadinus*). After some earlier modifications, it was more recently widely accepted to accommodate species with uncarbonized ascomata with lateral paraphyses (e.g., Salisbury, 1972a, 1972b [as *Thelotrema* sect. *Thelotrema*]; Hale, 1980, 1981). Since then, several species were excluded and placed in other genera: *Topeliopsis* (Kantvilas & Vezda, 2000), *Reimnitzia* (Kalb, 2001) and *Chapsa* (Frisch, 2006). Hence, in his revision, Frisch (2006) only accepted species of the *T. lepadinum*-group (=*Thelotrema* s. str.) in the genus, which is also accepted here in large parts and which is well supported by molecular data (Frisch & al., 2006; see part 3.). However, extended molecular analyses (see part 3.) also showed that *Thelotrema* is polyphyletic. Morphologically differing are the species '*Thelotrema' glaucopallens* (with myriotremoid ascomata, placed in a separate group of uncertain taxonomic position [Frisch, 2006]) and '*Thelotrema' zebrinum* (with distinctly carbonized exciple, see under '*Leptotrema' schizoloma*-group). Not surprisingly, these taxa cluster in clades distinct from *Thelotrema* s. str. However, two species that morphologically agree well with *Thelotrema* s. str., *T. bicinctulum* and *T. rugatulum* do not cluster within *Thelotrema* s. str., and their phylogenetic placement requires further studies. *Thelotrema polythecium* is tentatively included in the genus, since it shows similarities with *Chapsa*, *Topeliopsis* as well as the *O. clandestina*-group (see also under this species).

Thelotrema species are characterized by peri- to apothecioid ascomata with a ±free proper exciple and lateral paraphyses. Similar genera are *Chapsa* and *Topeliopsis*, for differences see there.

Species descriptions:

Thelotrema adjectum Nyl.

Flora 49: 290 (1866). Type: Cuba, *Wright ser. 2, 82* (H-Nyl. 22572-lectotype, selected by Hale [1978: 39]; UPS-, US!-isolectotypes).

ILLUSTRATION – Fig. 102.

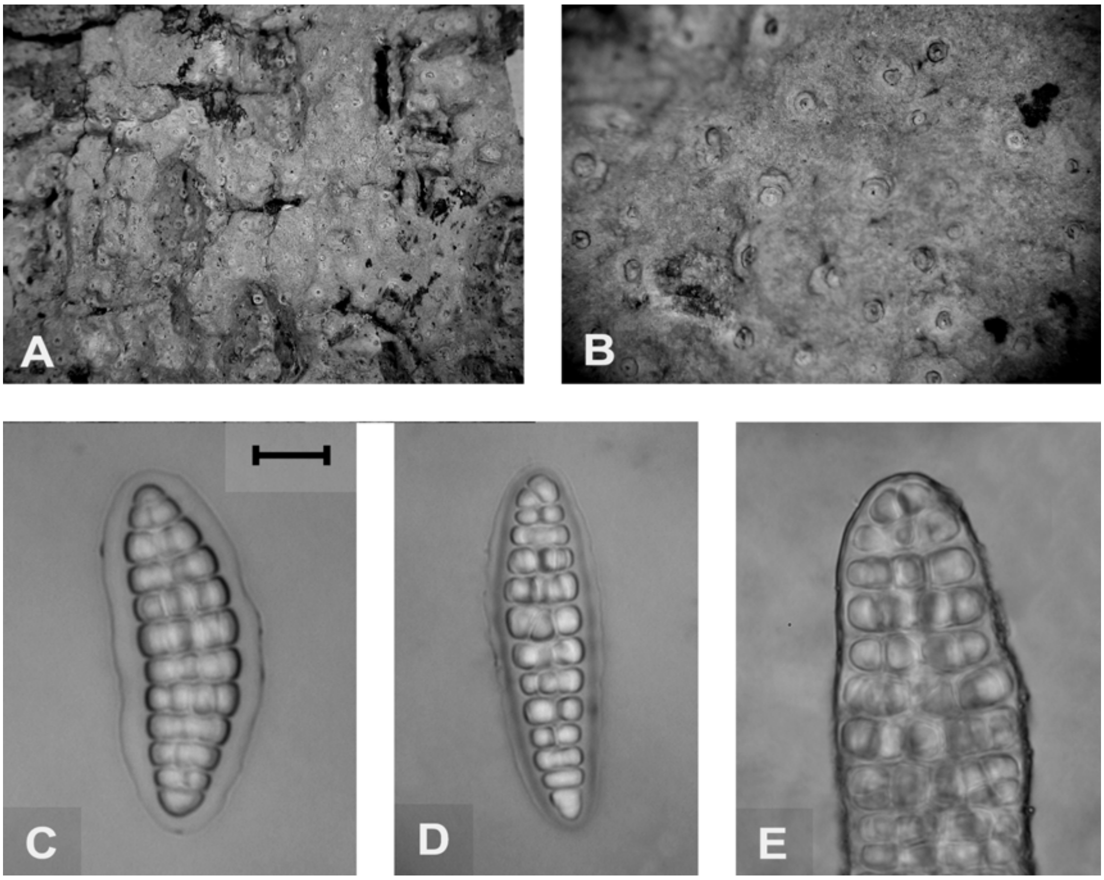

Fig. 102. *Thelotrema adjectum*: growth habit (**A**), ascomata (**B**), younger ascospores (**C, D**) and ascospore detail (**E**). A., B.: US-isolectotype; C.: *Mangold 38 f*; D.: *Lumbsch & Mangold 19127 I*; E.: *Lumbsch & Mangold 19165 d*. Bar= A: 2 mm; B: 0.8 mm; C, E: 10 µm; D: 12 µm.

Thallus epi- to predominantly hypophloedal, very thin to thin, up to c. 70 µm high, grayish-green to pale olive. Surface dull to slightly shiny, smooth to somewhat roughened, continuous to very rarely slightly verrucose, fissured to unfissured. Cortex structures absent or covered by a predominantly thin, incontinuous protocortex up to c. 10(25) µm thick. Algal layer well developed, continuous, calcium oxalate very abundant, small to large, often clustered, incorporated in hypophloedal thallus parts. Vegetative propagules not seen. Ascomata inconspicuous, (moderately) small, up to c. 400 µm in diam., roundish, apothecioid, solitary to rarely marginally fused, immersed to slightly emergent, then (flattened-)hemispherical. Disc sometimes partly visible from surface, pale grayish to pale flesh-colored, epruinose. Proper exciple not visible from surface to apically visible, off-white, incurved (inner thalline rim layers might be confused with proper exciple!), pores (moderately) small, up to c. 200 µm in diam., roundish to irregular, entire to more often split.

Thalline rim margin moderately thick, roundish to irregular, entire to more often split to somewhat eroded, slightly layered, inner parts/layers off-white to pale bright-brown, outer parts/layers concolorous with thallus to pale (reddish-)brown due to protuberant substrate, incurved to erect. Proper exciple fused to apically free, moderately thin to moderately thick, hyaline internally, pale yellowish to pale orange marginally, sometimes with substrate particles incorporated, often amyloid at the base or in the lower parts. Hymenium up to c. 200 µm high, non-inspersed, moderately conglutinated, paraphyses parallel to slightly interwoven, unbranched, tips unthickened to slightly thickened, lateral paraphyses present, conspicuous to inconspicuous, up to c. 20 µm long, columellar structures absent. Epihymenium indistinct to thin, hyaline, without granules or crystals, or with fine grayish granules. Asci 4-8-spored, tholus (moderately) thick, thin when mature. Ascospores variable, moderately small to moderately large, eumuriform, cell walls very thick to moderately thick with age, endospore (moderately) thin, often covered by a thin to rarely moderately thick, sometimes irregular halo, hyaline, non-amyloid to faintly amyloid, predominantly fusiform to rarely somewhat claviform, with predominantly narrowed-roundish ends, loci roundish to slightly angular, especially in younger ascospores, subglobular to oblong to somewhat irregular, transverse septae (moderately) thin, regular to slightly irregular, 40-80 x 8-25 µm with 12-18 x 1-6 loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary substances detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Thelotrema adjectum* was collected in Australia on tree bark in tropical rainforests in altitudes ranging from sea level to 900 m. It is a rare species restricted to northern Queensland. This is the first report for Australia and the Paleotropics, it was previously known from the Neotropics, hence being a pantropical species.

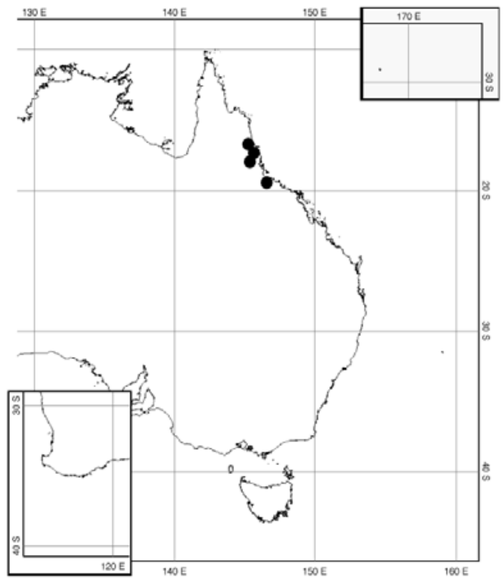

Fig. 103. Australian distribution of *T. adjectum*.

NOTES – This taxon is characterized by the thin, ecorticate thallus, the immersed to slightly emergent, small ascomata, the moderately large, muriform, hyaline, non- to weakly amyloid ascospores with thick to very thick cell walls and the absence of secondary compounds. The ascospore morphology is similar to *T. lepadinum*, which, however, differs in ascoma morphology, being emergent with entirely free proper exciple. For differences to *T. subadjectum* see under this species. Two other similar species lacking secondary metabolites and having muriform, hyaline, large ascospores are known, viz. *T. laceratula* and *T. defectum* from southern U.S.A. *Topeliopsis laceratula* can be readily distinguished by the thick, yellowish true cortex and monosporic asci with larger (up to 170 µm long), strongly amyloid ascospores. *Thelotrema defectum* differs by having non-layered ascomata and smaller (up to 40 µm long) ascospores in 2-4 per asci.

SPECIMENS EXAMINED – Australia, Queensland: 4.5 km on Buchanan Rd., Cape Tribulation, N of Mossman, *Hale 831361, 831386* (US). Cape Tribulation Area: Cape Tribulation NP., about half way along the Cape Kimberly Rd., *Hale 831090, 831319* (US); Cape Kimberley, *Lumbsch & Mangold 19164 h, 19165 d* (F). Daintree NP., Mossman Gorge section, near eastern border of the park, *Mangold 36 i, r* (F). Atherton Tablelands: 14.5 km on Mulgrave River Forestry Rd., SW of Gordonvale, *Hale 831652* (US); Lake Euramoo, *Lumbsch & Mangold 19127 i*, *Mangold 38 d, f* (F); Along west boundary of Lake Eacham NP., on rd. from Atherton, *Hale 832222* (US); Danbulla Forest Drive, E of Tinaroo Dam, 1 km W of Cathedral Fig Tree nr. Yungaburra, *Hale 831345, 831383* (US). 2 km N of Murray Falls, W of Kennedy, *Hale 831430, 831651* (US).

Thelotrema alboolivaceum Vain.

Mycologia 21: 38 (1929). *Ocellularia alboolivacea* (Vain.) Zahlbr., Catal. Lich. Univers. 8: 244 (1932). Type: Porto Rico, Vega Baja, *Fink 2153* (TUR-Vain.34714!-holotype; FH- [invalidly lectotypified by Nagarkar & al. 1988], NY!-isotypes).

ILLUSTRATION – Fig. 104.

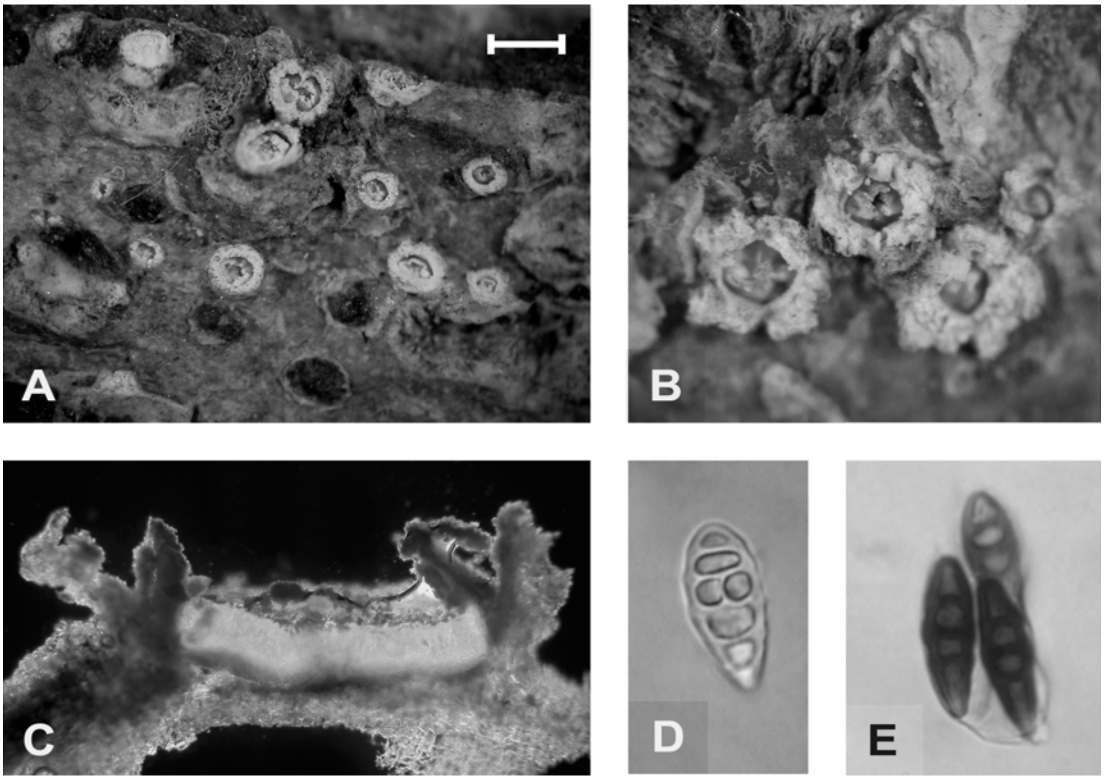

Fig. 104. *Thelotrema alboolivaceum*: growth habit (**A**), ascomata (**B**), ascoma section (**C**), ascospore (**D**) and ascospores showing amyloid reaction (**E**). A., E.: TUR-holotype; B.-D.: *Lumbsch & Mangold 19129 s*. Bar= A: 1 mm; B: 0.3 mm; C: 200 µm; D: 13 µm; E: 10 µm.

Thallus epi- to predominantly hypophloedal, very thin to thin, epiphloedal parts in ascomata area up to c. 100 µm high, olive to brownish-olive or pale yellowish-brown. Thallus ±shiny, smooth, continuous to slightly verruculose, unfissured. Covered by ±continuous true cortex, consisting of periclinal to irregular hyphae, sometimes with crystal inclusions, up to c. 35 µm thick. Algal layer poorly developed and incontinuous, calcium oxalate crystals abundant, small to large, often clustered. Vegetative propagules not seen. Ascomata conspicuous, moderately large, up to c. 700 µm in diam., roundish, apothecioid, solitary to marginally fused, erumpent, usually distinctly emergent, cylindrical to cone-shaped with flattened apex. Disc sometimes becoming partly visible from surface, pale grayish, distinctly pruinose. Pores small to wide, up to c. 400 µm in diam., roundish to roundish-irregular, entire to slightly split, proper exciple usually entirely visible from surface, free, apically whitish to off-white, pale brownish towards the base, incurved, often shrunken. Thalline rim margin entire to more often and split to lacerate or eroded, sometimes ±coarsely lobed, unlayered, roundish, whitish to off-white, often slightly pruinose, thalline rim concolorous with thallus, surface often slightly verruculose, becoming erect in early stages to slightly recurved with age. Proper exciple free, thin, hyaline internally to yellowish-brown marginally, apically covered with grayish granules, non-amyloid. Hymenium up to c. 100 µm high, non-inspersed, moderately conglutinated, paraphyses slightly interwoven, unbranched, tips thickened, lateral paraphyses present, usually conspicuous, up to c. 25 µm long, columellar structures absent. Epihymenium thick, hyaline, with grayish granules. Asci 8-spored, tholus (moderately) thick, thin when mature. Ascospores small, transversely septate, very rarely with a single longitudinal septum, cell walls thick, sometimes slightly crenate, with moderately thick to moderately thin halo in younger stages, non-halonate at maturity, hyaline, distinctly amyloid, fusi- to claviform, ends narrowed-roundish to subacute, loci roundish to rarely slightly angular, subglobose to lentiform or roundish-rectangular to ±irregular, end cells hemispherical to more often and ±distinctly conical, septae (moderately) thick, ±regular, 15-23 x 5-7 µm with 4-6 (x 2) loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing constictic and stictic (majors), α-acetylconstictic and cryptostictic (traces) acids.

ECOLOGY AND DISTRIBUTION – *Thelotrema alboolivaceum* was collected in Australia on tree bark in a tropical rainforest at 700 m altitude. It is rare in northern Queensland. This is the first report for Australia. This pantropical species has been recorded from Central America, India (Patwardhan & Kulkarni, 1977) and Sri Lanka (Nagarkar, 1988).

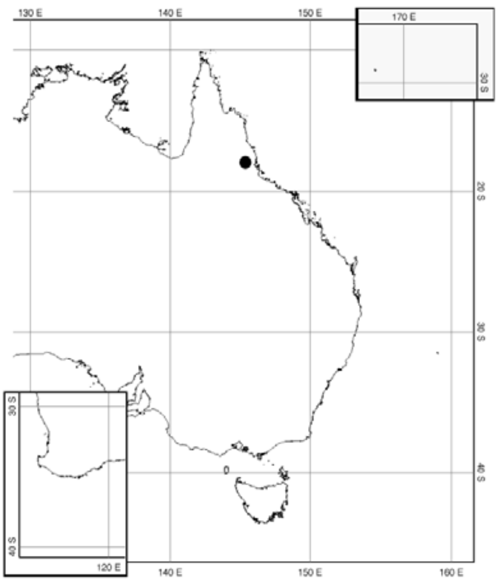

Fig. 105. Australian distribution of *T. alboolivaceum*.

NOTES – This taxon is characterized by the thin, mostly hypophloedal, corticate thallus, the conspicuous, emergent ascomata with free proper exciple, small, transversely septate, amyloid ascospores with conical end cells, thickened cell walls and septae, and the presence of the stictic acid chemosyndrome. Similar taxa with transversely septate ascospores and stictic acid include *T. capetribulense*, *T. bicinctulum*, *T. porinoides* and *T. triseptatum*. All but *T. triseptatum* can be readily distinguished by larger ascospores (up to 50 µm with up to 14 loci in *T. capetribulense*, up to 35 µm with up to 11 loci in *T. bicinctulum*, up to 140 µm with up to 30 loci in *T. porinoides*), for differences to *T. triseptatum* see under this species. Two morphologically similar, stictic acid containing species are *T. cupulare* and *T. leucophthalmum*, which are readily distinguished by muriform, non-amyloid ascospores.

SPECIMENS EXAMINED – Australia, Queensland: Atherton Tablelands, Malanda Falls, *Lumbsch & Mangold 19129 s* (F). India, Karnataka, *Hale 48002 (*US).

Thelotrema bicavatum Nyl.

Flora 47: 269 (1864). *Ocellularia bicavata* (Nyl.) Müll. Arg., Bullet Herbier Boissier 2(1): 74 (1894). Type: Australia ('Nova Hollandia'), with *'Lecanora subfusca* var. *chlarona*', com. *Hochstetter* s.n. (H-Nyl. 22790-holotype, M!-isotype).

ILLUSTRATION – Fig. 106.

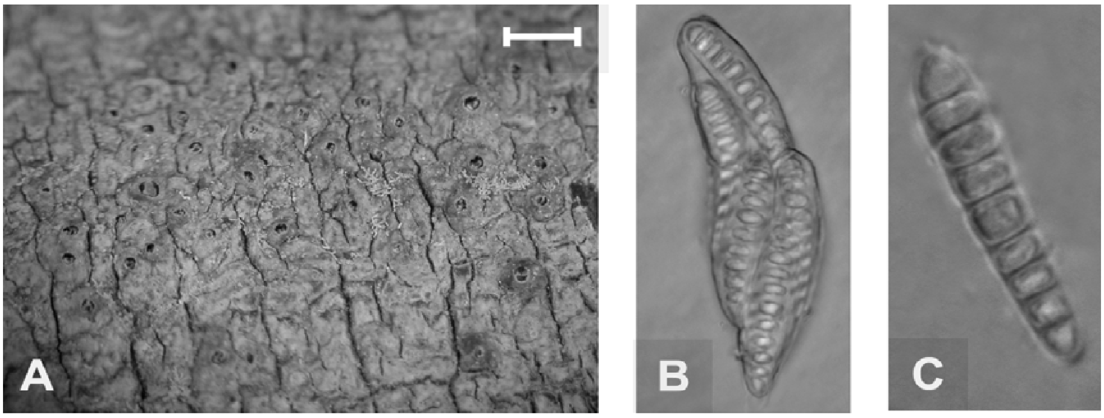

Fig. 106. *Thelotrema bicavatum*: growth habit (**A**) and ascospores (**B, C**). A., C.: M-isotype; B.: *Hale 830650*. Bar= A: 1 mm; B: 17 µm; C: 7 µm.

Thallus hypo- to epiphloedal, (moderately) thin, up to c. 250 µm high, pale grayish-green to pale yellowish-gray. Thallus surface dull, smooth, continuous to more rarely verrucose, slightly to distinctly fissured. Thallus covered by an incontinuous protocortex up to 20 µm thick. Algal layer poorly developed, incontinuous, calcium oxalate crystals sparse and small, scattered or in large clusters. Vegetative propagules not seen. Ascomata inconspicuous, moderately small, up to c. 600 µm in diam., roundish to somewhat irregular, apothecioid, solitary to rarely marginally fused, immersed to emergent, then hemispherical to conical to more rarely verrucose-urceolate. Disc partly visible from surface in mature ascomata, grayish, distinctly pruinose. Pores moderately small to more rarely wide, up to c. 300(500) µm in diam., roundish to roundish-irregular to irregular, entire to slightly split, apical to upper proper exciple visible from surface, free, off-white to pale yellowish, pale brownish towards the base, predominantly incurved to rarely somewhat erect, often ±distinctly shrunken. Thalline rim margin moderately thick to thin, roundish to slightly irregular, entire to slightly split, concolorous with thallus, thalline rim incurved to slightly erect, concolorous with thallus to rarely slightly brownish and with same surface. Proper exciple free, moderately thick, hyaline to pale yellowish internally, grayish-brown to yellowish-gray marginally, apically sometimes dark brownish, often with substrate particles incorporated, ±distinctly amyloid at the base. Hymenium up to c. 150 µm high, non-inspersed, moderately conglutinated, paraphyses ±straight, parallel to slightly interwoven, unbranched, tips slightly thickened, lateral paraphyses present, inconspicuous, up to c. 15 µm long, columellar structures absent. Epihymenium moderately thick, hyaline, with grayish to brownish granules. Asci 8-spored, tholus thick, thin when mature. Ascospores (moderately) small, transversely septate, cell walls and endospore (moderately) thick, hyaline, with thin halo in younger stages, faintly to moderately amyloid, oblong to predominantly fusi- or claviform, with rounded to subacute ends, loci roundish to slightly angular, oblong to lentiform, with hemispherical to conical end cells, septae moderately thick, ±regular, 20-40(45) x 6-9 µm with 8-14(16) loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ orange-red, C-, PD-; containing norstictic (major) and connorstictic (minor to trace) acids.

ECOLOGY AND DISTRIBUTION – *Thelotrema bicavatum* occurs on tree bark in (sub)tropical, warm- and cool-temperate rainforests in altitudes ranging from sea level to 800 m. Although it is rare its is a wide-spread species occurring in northern and southern Queensland, north-central and central New South Wales and in Tasmania. This paleo-subtropical species was previously reported from New Zealand (Nylander, 1888) and Japan (Asahina, 1931; Yasuda, 1935).

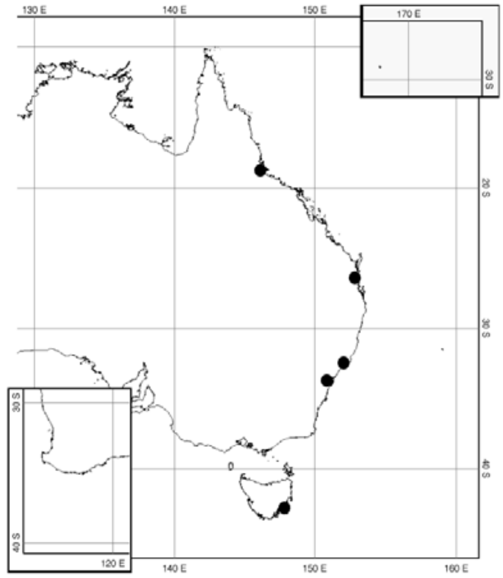

Fig. 107. Australian distribution of *T. bicavatum*.

NOTES – This taxon is characterized by the thin, ecorticate thallus, moderately small, immersed to emergent ascomata with free proper exciple, moderately small, transversely septate, hyaline, amyloid, thick-walled ascospores and the presence of the norstictic acid chemosyndrome. There are several similar taxa in Australia, all distinguished by the absence of lichen substances, including *T. pseudosubtile*, *T. subtile* and *T. suecicum* with similar ascospore size. *Thelotrema suecicum* further differs in the distinctly thick-walled immature ascospores. *Thelotrema pseudosubtile* has somewhat larger ascospores, up to 60 µm long. *Thelotrema subtile* has slightly larger ascospores, up to 50 µm long. The latter taxon was considered conspecific with *T. bicavatum* (Salisbury, 1972a; Matsumoto, 2000) but recently regarded as a distinct species (Mangold & al., 2007) predominantly due the chemical differences. Frisch (2006) lists *T. bicavatum* tentatively under *T. diplotrema*, see under this species for further differences. The identity of the *T. bicavatum* specimens from New Zealand and Japan remains uncertain, since no information on secondary metabolites of these collections was given. *Thelotrema patwardhanii* from India is the only other currently known *Thelotrema* with norstictic acid and transversely septate ascospores. It is readily distinguished by perithecioid ascomata and larger ascospores (up to 200 µm long).

SPECIMENS EXAMINED – Australia, Queensland: Cardwell, *Scarlett & Bell 1000* (BRI). Culpa logging area, SE of Tully Falls, *Hale 830650* (US). Wooroi State Forest Park, W of Teewantin, *Hale 830885* (US). New South Wales: Bulahdelah District, Myall River SF., *K. & A. Kalb 18052* (hb. Kalb). Royal NP., S of Sydney, *K. & A. Kalb 21691* (hb. Kalb). Tasmania: Maria Island NP., 1.5 km NW of summit of Mt.Maria, uppermost Counsel Creek, *Tibell 11348* (UPS).

Thelotrema bicinctulum Nyl.

Ann. Sci. Nat. Bot., ser. 4, 15: 46 (1861b). Type: New Caledonia, *Pancher* s.n. (H-Nyl. 22804a!-lectotype, selected by Frisch [2006: 282]).

Thelotrema terebrans Nyl., Bull. Soc. Linn. Normandie 2(7): 166 (1873). *Ocellularia terebrans* (Nyl.) Zahlbr., Cat. Lich. Univers. 2: 602 (1923). *Myriotrema terebrans* (Nyl.) Hale, Mycotaxon 11: 138 (1980). Type; India, Andaman Islands, *Kurz 80* (H-Nyl. 22771!-lectotype, selected by Hale [1981: 294]; BM-, UPS!-, ZT-isolectotypes).

Ocellularia demersa Müll.Arg., Mém. Soc. Phys. Hist. Nat. Geneve 29(8): 9 (1887), nom. nov. pro *Pyrenula clandestina* Fée, Ess. Crypt. Suppl. 83 (1837), nom. illeg. [non *P. clandestina* Ach., 1814: 8; nec. *T. clandestinum* Fée, 1837: 6]. *Thelotrema albidulum* Nyl., Mém. Soc. Sci. Nat. Cherbourg 5: 118 (1857), nom.

nov. inval. [non *T. albidulum* Nyl., 1861: 46]. *Thelotrema demersum* (Müll.Arg.) Salisb., Nova Hedwigia 29: 408 (1978). Type: 'Regio tropica - habitat non raro supra cortices Crotonis Cascarillae, L.' (G-Fée 207!-lectotype, selected by Salisbury [1978: 408]; H-Nyl. 22768-, 22769-isolectotypes).

Ascidium octolocularis C. Knight in Bailey, Proc. Roy. Soc. Queensland 1: 152 (1884). *Ocellularia octolocularis* (C. Knight) Shirley, Proc. Roy. Soc. Queensland 6: 188 (1889). *Porina octolocularis* (C. Knight) C. Knight in Shirley, Proc. Roy. Soc. Queensland 6: 183 (1889). Type: Australia, Queensland, Brisbane, on shrub trees, *Bailey 204* (WELT!-lectotype, here selected; BRI-'Shirley Book', p. 22, n. 10 [BRI-AQ721230]!-, BRI-'Bailey Book', p. 22 [BRI-AQ720161]!-isolectotypes).

ILLUSTRATION – Fig. 108.

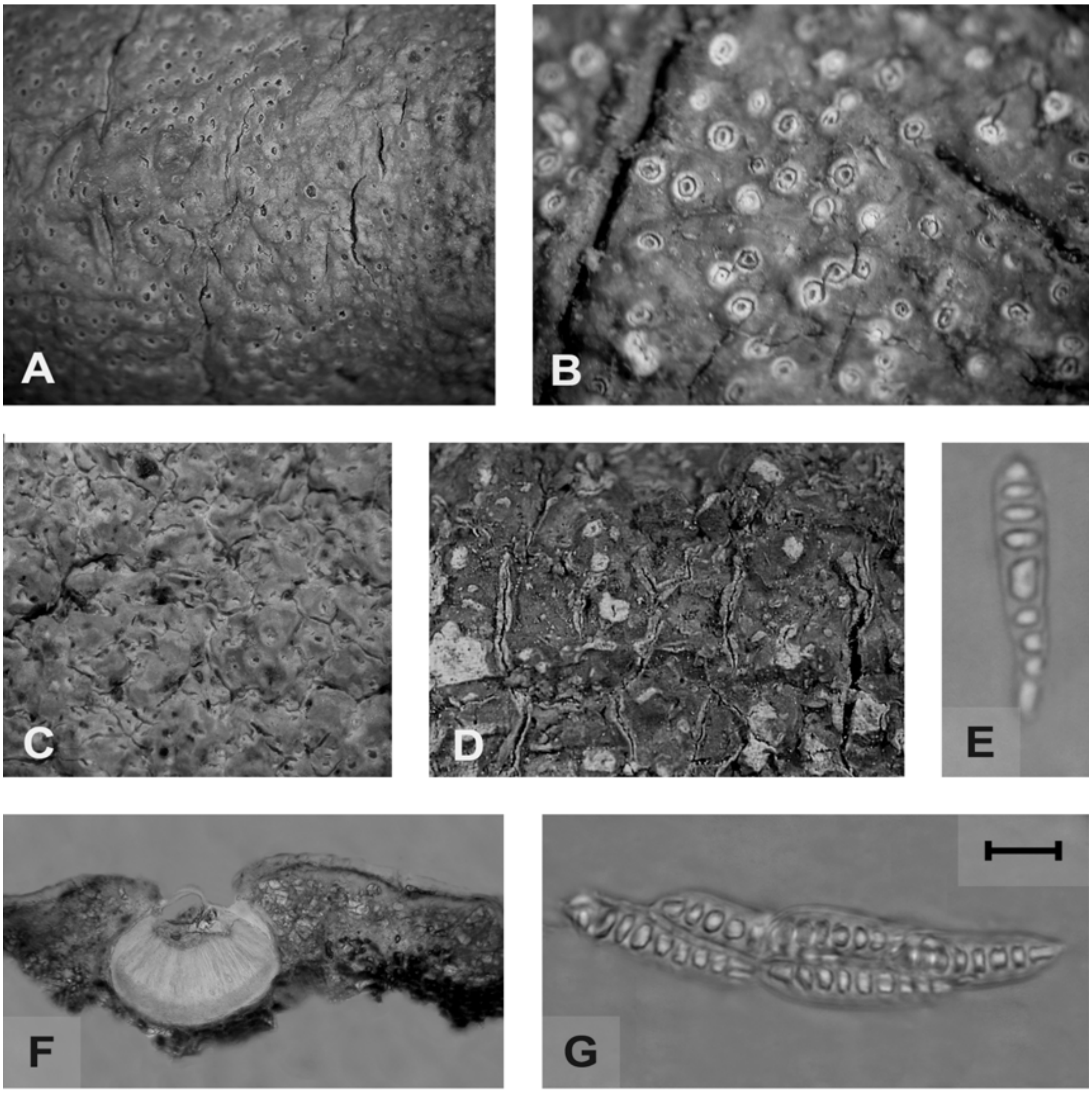

Fig. 108. *Thelotrema bicinctulum*: growth habit (**A, C, D**), ascomata (**B**), ascospores (**E**, **G**) and ascoma and thallus section (**F**). A.: UPS-isolectotype of *T. terebrans*; B.: *Lumbsch & Mangold 19162 e*; C.: *A. & K. Kalb 26569*: D.: BRI-isolectotype of *A. octolocularis*; E., F.: H-lectotype: G.: G-lectotype of *O. demersa*. Bar= A: 1.5 mm; B: 1 mm; C: 1.5 mm; D: 1 mm; E: 7 µm; F: 150 µm; G: 10 µm.

Thallus variable, epi- to hypophloedal, thin to more rarely thick, c. up to 500(800) µm high, pale grayish-green to pale yellowish-gray or (pale) olive. Surface dull to shiny, smooth to sometimes partly porous-rough, continuous to verrucose, unfissured to strongly fissured or rimose, then upper thallus usually partly flaking away, exposing the whitish medulla. True cortex present, very variably developed, continuous to sometimes incontinuous or lacking in large parts, consisting of irregular to periclinal hyphae, up to c. 35 µm thick. Algal layer mostly ±well developed, continuous, sometimes becoming incontinuous due to large crystal inclusions, calcium oxalate crystals very abundant, often almost filling the entire lower thallus, variable in size, in clusters or scattered, distinct whitish medulla layer present. Vegetative propagules not seen. Ascomata ±inconspicuous, moderately small, up to c. 400 µm in diam., roundish, apothecioid, predominantly solitary, rarely slightly fused, predominantly ±immersed. Disc often becoming partly visible, grayish, coarsely pruinose. Pores small, up to c. 120 µm in diam., roundish to somewhat irregular, apical to upper proper exciple visible from surface, free, entire to slightly split, sometimes ±jagged, off-white to whitish, predominantly incurved to rarely somewhat erect, sometimes ±distinctly shrunken. Thalline rim margin (moderately) thin, roundish to slightly irregular, entire to slightly split, concolorous with thallus to brighter than thallus, often somewhat raised, thalline rim incurved, concolorous with thallus. Proper exciple free in the upper parts, (moderately) thin, hyaline internally to pale yellowish to dark yellowish-brown marginally, apically often covered by grayish granules, non-amyloid to sometimes amyloid at the base. Hymenium up to c. 100 µm high, non-inspersed, moderately conglutinated, paraphyses straight to slightly bent, slightly interwoven, unbranched, tips slightly thickened, lateral paraphyses present, often inconspicuous, up to c. 25 µm long, columellar structures absent. Epihymenium usually thick, hyaline, with grayish granules. Asci 8-spored, tholus moderately thick, thinning or not visible at maturity. Ascospores variable, small, transversely septate, cell walls thin to moderately thick, usually with thin halo, hyaline, non-amyloid to faintly amyloid, narrow, ellipsoid to fusi- or claviform with roundish to subacute ends, loci roundish to angular, predominantly oblong to lentiform or rectangular, with hemispherical to conical end cells, septae moderately thin, regular, 20-35 x 5-7 µm with 8-11 loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing stictic (major), constictic, hypostictic (minor to trace), α-acetylconstictic, hypoconstictic, cryptostictic and α-acetylhypoconstictic (traces) acids.

ECOLOGY AND DISTRIBUTION – *Thelotrema bicinctulum* was collected in Australia on tree bark in (sub)tropical rainforests, mangroves, coastal forests and wet sclerophyll forests in altitudes ranging from sea level to 800 m. It is a moderately common and wide-spread species occurring in north-western Northern Territory and Queensland. Besides Australia it was reported from Africa (Frisch, 2006), India (Hale, 1981), Sri Lanka (ibid.), India (ibid.), Andman Islands (Nagarkar & al., 1988) and New Caledonia indicating a paleo(sub)tropical distribution.

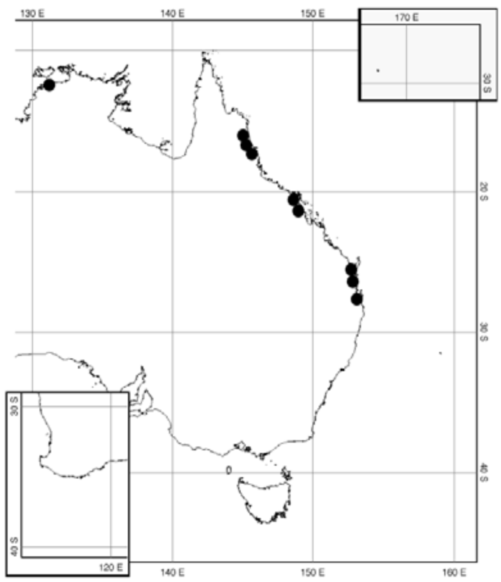

Fig. 109. Australian distribution of *T. bicinctulum*.

NOTES – It is a variable species that is characterized by the ±corticate thallus with abundant crystals, the small ascomata with free proper exciple and ±inconspicuous lateral paraphyses, moderately small, transversely septate, hyaline, narrow, non-amyloid to faintly amyloid ascospores and the stictic acid chemosyndrome.

Similar are *T. alboolivaceum*, *T. capetribulense* and *T. triseptatum*, for differences see under these species. *Thelotrema euphorbia* from Africa is also similar but no type material was available for study (Frisch, 2006). Two collections are only tentatively identified as *T. bicinctulum* here: *Kalb 21620* has distinctly larger ascospores, up to 45 µm long with up to 14 loci, and *Hale 832714* has distinctly submuriform ascospores. Four Australian collections are sterile and hence only tentatively identified as well: *Hale 832151*, *832434*, *Mangold 38 a*, *Wilson 1450*.

SPECIMENS EXAMINED – Australia, Northern Territory: Doctors Gully, 2 km NW of Darwin, Streimann *8762* (CANB). Queensland: Near Cedar Bay NP., on rd. to Cooktown, *Mangold 34 f* (F). NW of Mossman, Km 45 on Mt. Windsor Rd., *Hale 832458* (US). Cape Tribulation Area: Myall Beach, *Lumbsch & Mangold 19161 q, 19162 c, e* (F); Track to Cape Tribulation Beach, *Mangold 32 a, c* (F). Kuranda Range, SE of Kuranda, *K. & A. Kalb 21620* (hb. Kalb). W of Palm Cove, 25 km N of Cairns, *K. & A. Kalb 19972* (hb. Kalb). Manchans Beech, N of Cairns, *K. & A. Kalb 21182* (hb. Kalb). Atherton Tablelands, Lake Euramoo, *Mangold 38 a* (F). 13 km from Koombooloomba rd. turnoff, SE of Tully Falls, *Hale 832434* (US). Dawson logging area, SF. Reserve 605, 24 km S of Koombooloomba turnoff, WSW of Tully, *Hale 832714* (US). Conway Range NP., near Shute Harbour-Airlie Beach, *Hale 832421* (US). Cape Hillsborough NP., NW of Mackay: *Hale 832513* (US); Along the walking track from the Casuarina Beach to Beachcombers cove, *Thor 5138* (S). Frasier Coast, River Heads, *Lumbsch & Mangold 19092 c, j, l, n* (F). Noosa NP., Palm Grove Track, *Hale 831707* (US). Mt. Mee SF., NW of Mt. Mee, *Hale 832151* (US). Mt. Glorious, Brisbane SF., 40 km WNW of Brisbane, *K. & A. Kalb 26569* (hb. Kalb). Goodna (near Brisbane), *Wilson 1450*, pr. p. (NSW).

Thelotrema capetribulense Mangold spec. nov. ined.

Type: Australia, Queensland: Cape Tribulation Area, Myall Beach, *Lumbsch & Mangold 19161 x* (CANB-holotype; BRI-, F-isotypes).

ETYMOLOGY – The epithet refers to Cape Tribulation in northern Queensland where the species is most common.

ILLUSTRATION – Fig. 110.

Thallus epi- to hypophloedal, thin to moderately thick, up to c. 400 µm high, grayish to pale grayish-green. Surface slightly shiny, smooth, distinctly verrucose, unfissured to slightly fissured. Cortex structures variable, predominantly an ±incontinuous protocortex present, up to c. 30µm thick, in some parts becoming distinctly conglutinated forming a true cortex of irregular to periclinal hyphae. Algal layer poorly developed, usually incontinuous due to calcium oxalate crystal inclusions, calcium oxalate crystals abundant, small to more often large, scattered or clustered. Vegetative propagules not seen. Ascomata conspicuous, moderately large, up to c. 700 µm in diam., roundish, apothecioid, solitary to sometimes slightly fused marginally, usually distinctly emergent, predominantly subglobose to urceolate to more rarely broad-cylindrical with ±verrucose surface. Disc not visible from surface to rarely becoming somewhat visible, pale brownish-gray, indistinctly pruinose. Pores small to more rarely moderately wide, up to c. 300 µm in diam., roundish, entire to split, proper exciple entirely to apically visible from surface, becoming free, apically bright, darker towards the base, predominantly incurved. Thalline rim margin thick, entire to somewhat split to slightly lacerate or eroded, often slightly layered, ±roundish, mostly whitish or brighter than thallus, sometimes slightly pruinose, incurved to more rarely erect. Proper exciple becoming free, ±thin, hyaline internally to pale yellowish-brown marginally, amyloid at the base. Hymenium up to c. 150 µm high, non-inspersed, moderately conglutinated, paraphyses interwoven, unbranched, tips slightly thickened, lateral paraphyses present, usually conspicuous, up to c. 30 µm long, columellar structures absent. Epihymenium inconspicuous, thin, hyaline, with grayish granules. Asci 8-spored, tholus thick to moderately thin at

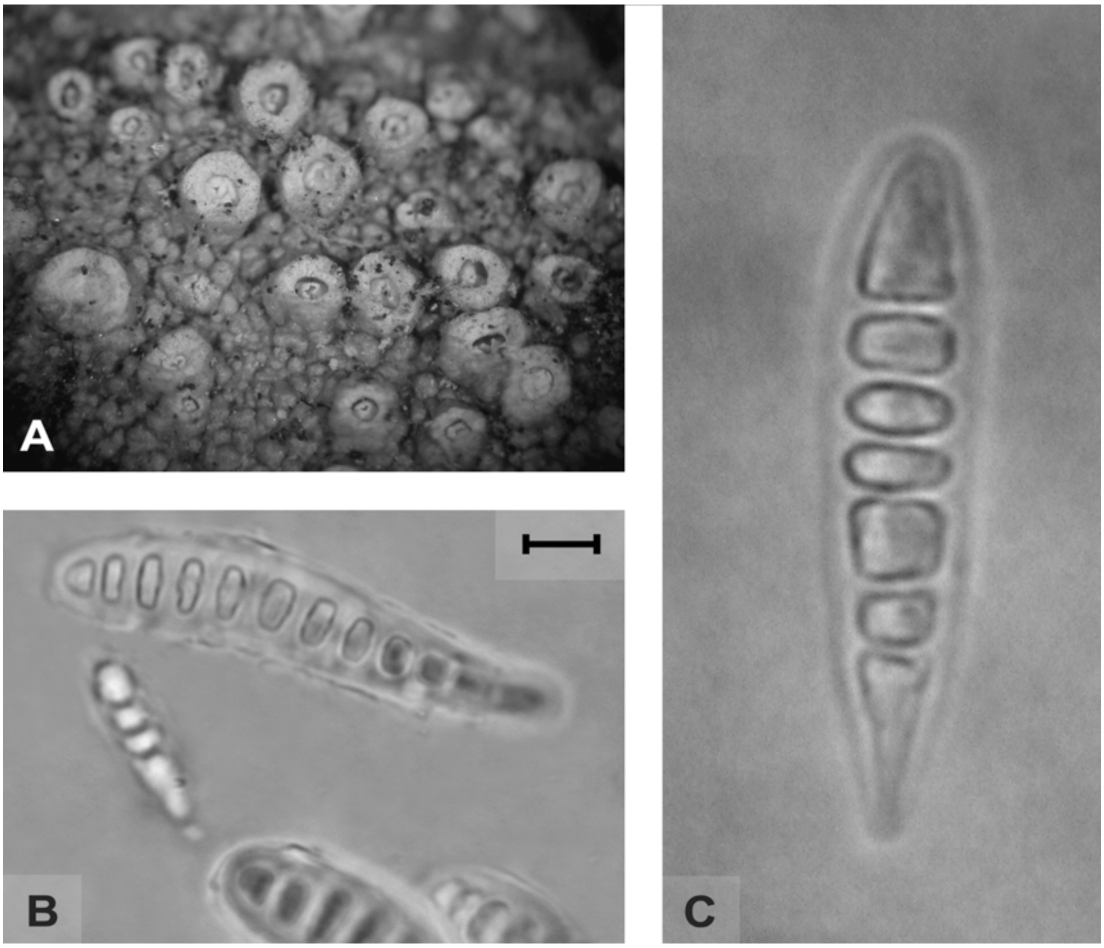

Fig. 110. *Thelotrema capetribulense*: growth habit (**A**) and young and mature ascospores (**B, C**). A.-C.: CANB-holotype. Bar= A: 0.5 mm; B: 7 µm; C: 4 µm.

maturity. Ascospores typical, (moderately) small, transversely septate, cell walls (moderately) thick, with thin, sometimes irregular halo, hyaline, moderately amyloid, fusi- to more often claviform, ends narrowed-roundish to subacute, loci irregular and variable, roundish to moderately angular, subglobose to lentiform, end cells hemispherical to conical, septae (moderately) thick, regular to ±irregular, 25-50 x 5-10 µm with 6-14 loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing constictic, stictic, hypostictic (majors), hypoconstictic and crypto-stictic (traces) acids.

ECOLOGY AND DISTRIBUTION – *Thelotrema capetribulense* occurs on tree bark in tropical rainforests and mangroves in altitudes ranging from 10 to 700 m. It is rare and currently only known from northern Queensland.

Fig. 111. Australian distribution of *T. capetribulense*.

NOTES – This new species is characterized by the verrucose, moderately thick thallus, the conspicuous, emergent ascomata with free proper exciple, medium-sized, amyloid ascospores with thick cell walls and septae and the presence of the stictic acid chemosyndrome. It is similar to *T. porinoides*, for differences see under this species. Morphologically similar ascospores are found in *T. triseptatum* and *T. suecicum.* These two species differ in having usually smaller ascospores. *Thelotrema triseptatum* also contains the stictic acid chemosyndrome, while *T. suecicum* lacks secondary metabolites. *Thelotrema bicinctulum* can be readily distinguished by smaller (up to 400 µm in diam.), immersed ascomata and smaller ascospores (up to 35 µm long with up to 11 loci) with thinner walls and septae.

SPECIMENS EXAMINED – Australia, Queensland: Cape Tribulation Area, Myall Beach, *Lumbsch & Mangold 19158 u, 19160 q, y, 19162 i* (F). Atherton Tablelands, Lamb Range, N of Gillies Rd., 22 km ENE of Atherton, *Thor 5738* pr.p. (S).

Thelotrema circumscriptum C. Knight

Trans. New Zealand Inst. 15: 349 (1883). *Ocellularia circumscripta* (Knight) Dodge, Nova Hedwigia 19: 489 (1970). Type: New Zealand, s.l. (?Wellington), 1883, *C. Knight* s.n. (WELT-Knight 35A: 2-lectotype, selected by Galloway [1985: 573]; G!-isolectotype).

ILLUSTRATION – Fig. 112.

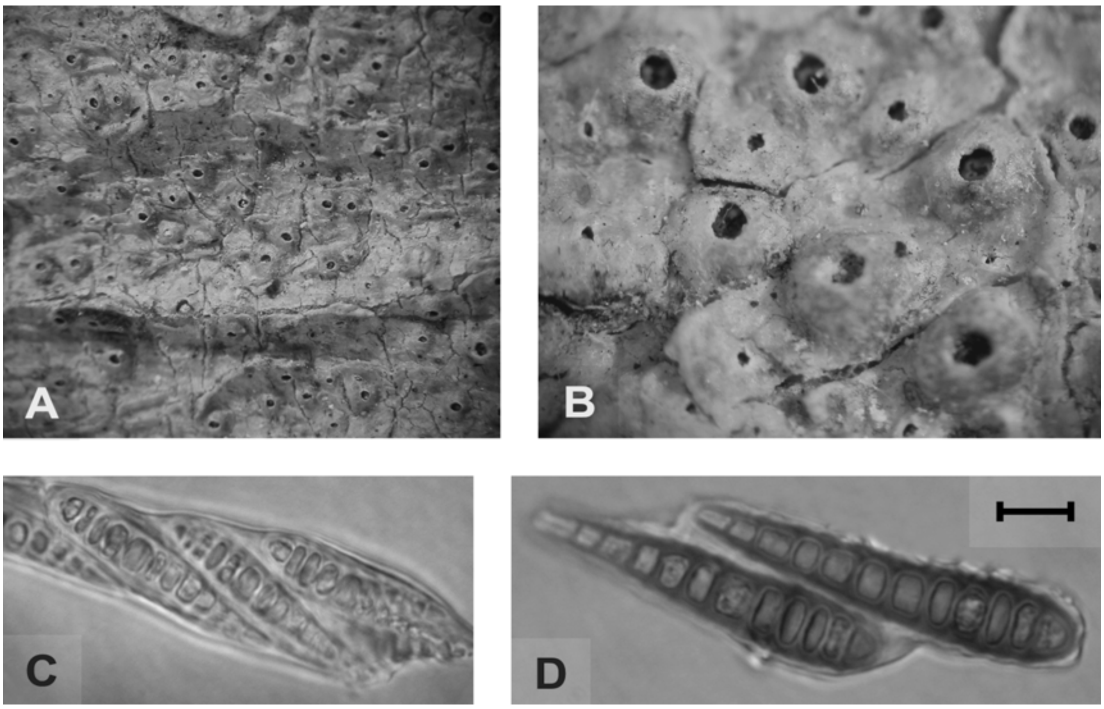

Fig. 112. *Thelotrema circumscriptum*: growth habit (**A**), ascomata (**B**), ascospores (**C**) and ascospores showing amyloid reaction (**D**). A.-D.: G-isolectotype. Bar= A: 1.5 mm; B: 0.6 mm; C: 10 µm; D: 8 µm.

Thallus epi- to hypophloedal, thin to moderately thick, up to c. 300 µm high, pale grayish-green to pale olive. Surface dull to slightly shiny, smooth, continuous to slightly verrucose, slightly to distinctly fissured. Cortex structures variable, predominantly an ±continuous protocortex present, up to c. 25 µm thick, in some parts becoming distinctly conglutinated forming a true cortex consisting of irregular hyphae. Algal layer well developed and continuous, becoming somewhat incontinuous due to large calcium oxalate crystal inclusions, calcium oxalate crystals moderately abundant, usually large, scattered to more rarely clustered. Vegetative propagules not seen. Ascomata conspicuous, moderately large, up to c. 800 µm in diam., roundish, apothecioid, solitary to sometimes fused, becoming distinctly emergent, predominantly hemispherical with same surface as thallus. Disc not visible from surface to sometimes becoming partly visible, pale grayish, indistinctly pruinose. Pores (moderately) small, up to c. 200 µm in diam., roundish, entire to split, proper exciple apically more rarely entirely visible from surface, free, often shrunken, apically bright, darker towards the base, predominantly incurved. Thalline rim margin moderately thin to moderately thick, predominantly entire, ±roundish to more rarely slightly elongate, incurved, usually slightly brighter than thallus. Proper exciple becoming free, thin, hyaline internally to pale brownish marginally, apically often with grayish granules, often moderately amyloid at the base. Hymenium up to c. 130 µm high, non-inspersed, moderately conglutinated, paraphyses interwoven, unbranched, tips distinctly, irregularly thickened, lateral paraphyses present, sometimes inconspicuous, up to c. 20 µm long, columellar structures absent. Epihymenium inconspicuous, thin, hyaline, with small grayish to colorless granules. Asci 8-spored, tholus thick, thin when mature. Ascospores typical, (moderately) small, transversely septate, cell walls (moderately) thick, with thin halo, hyaline, moderately to distinctly amyloid, fusi- to more often claviform, ends narrowed-roundish to subacute, loci variable, roundish to moderately angular, subglobose to lentiform, end cells hemispherical to conical, septae (moderately) thick, slightly irregular, 25-45 x 7-9 µm with 8-14(15) loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellow becoming red, C-, PD+ orange; containing salazinic acid.

ECOLOGY AND DISTRIBUTION – *Thelotrema circumscriptum* was collected in Australia on bark of a dead palm in a subtropical lowland rainforest at 170 m. In Australia it is only known from Lord Howe Island. This is the first report for Australia. It has previously been known from New Zealand, being an Australasian element.

Fig. 113. Australian distribution of *T. circumscriptum*.

NOTES – This taxon is characterized by the moderately thick, predominantly corticate thallus, emergent ascomata with free proper exciple, moderately small, transversely septate, hyaline, amyloid ascospores with thick cell walls and septae and salazinic acid as secondary metabolite. It is similar to the salazinic acid containing *T. hians,* which can be distinguished by the thinner thallus, the reddish-brown, more gaping thalline rim margin, a somewhat thicker, apically more distinctly darkened exciple, and larger and broader ascospores (up to 80 x 12 µm in size with up to 16 loci). Another similar Australian species with almost identical ascospores is the tropical *T. capetribulense*, which differs in containing the stictic acid chemosyndrome and a thicker, split to lacerate, sometimes layered, distinctly bright thalline rim margin. *Thelotrema subtile* can be distinguished by a usually thinner thallus, ascospores that turn brownish in over-mature or decayed stages, and the absence of secondary compounds. Zahlbruckner (1924) considered *T.*

circumscriptum as conspecific with *O. cavata*, a distinct taxon with carbonized exciple and a columella.

SPECIMENS EXAMINED – Australia, New South Wales: Lord Howe Island, Smoking Tree Ridge, *Elix 42148* (CANB). New Zealand, nr. Wellington, *Buchanan 141 pr. p.* [with lectotype of *T. hians*] (GLAM).

Thelotrema conveniens Nyl.

Bull. Soc. Linn. Normand. 2(7): 168 (1873). Type: Colombia ("Nova Granata"), Tequendama, 1863, *Lindig* s.n. (H-Nyl. 22496!-lectotype, selected by Hale [1978: 42]).

ILLUSTRATION – Fig. 114.

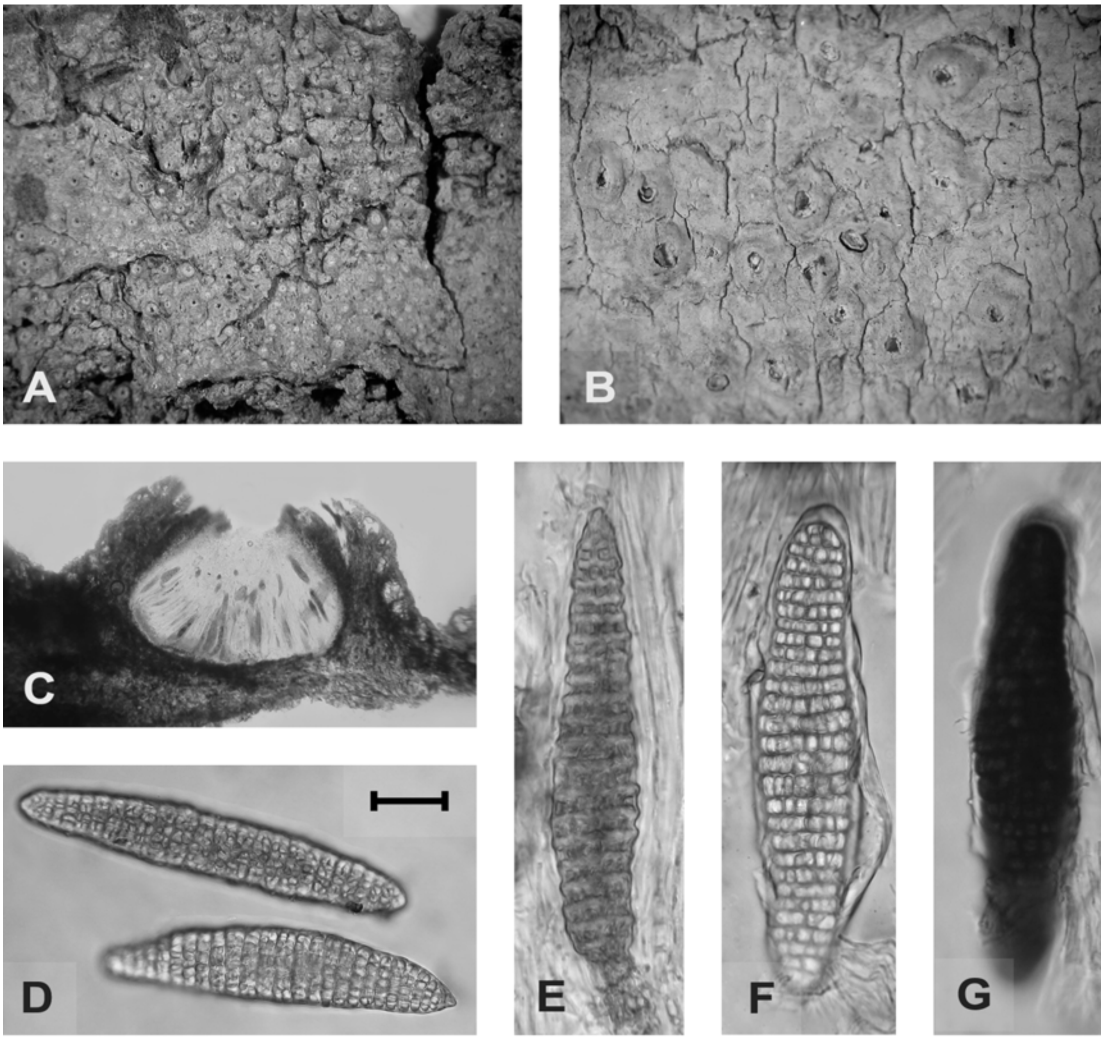

Fig. 114. *Thelotrema conveniens*: growth habit (**A**), ascomata (**B**), ascoma section (**C**), ascospores (**D, F**), over-mature ascospore (**E**) and ascospore showing amyloid reaction (**G**). A., C., E.-G.: H-lectotype; B., D.: *Tibell 12638*. Bar= A: 2 mm; B: 0.75 mm; C: 150 µm; D: 35 µm; E-G: 25 µm.

Thallus variable, corticolous to rarely saxicolous, epi- to predominantly hypophloedal, predominantly epilithic in saxicolous specimen, very thin to thin to more rarely moderately thick, up to c. 300 µm high, in shades of gray to pale yellowish-brown or pale grayish-green. Surface variable, dull to slightly shiny, smooth to roughened, often due to protuberant substrate, continuous to slightly verrucose, ±fissured to sometimes areolate. True cortex usually absent, thallus predominantly covered by an continuous to incontinuous protocortex up to 25 µm thick, rarely becoming weakly conglutinated forming a true cortex of periclinal to irregular hyphae. Algal layer variable, well to poorly developed, predominantly incontinuous, calcium oxalate usually abundant, rarely sparse, small to large, scattered or clustered. Vegetative propagules not seen. Ascomata variable, conspicuous to more often inconspicuous, moderately small to moderately large, up to 600 µm in diam., ±roundish, peri- to predominantly apothecioid, solitary to marginally slightly fused, immersed to ±distinctly emergent, (verrucose-)hemispherical to more rarely (verrucose-)urceolate. Disc sometimes becoming partly visible from surface, pale grayish to gray, distinctly pruinose. Pores variable, small to wide, up to c. 300 µm in diam., roundish to more often roundish-irregular to irregular, proper exciple rarely entirely to more often only apically visible from surface, rarely entirely free to more often free only in upper parts, off-white to whitish, ±shrunken, predominantly incurved to rarely somewhat erect. Thalline rim margin roundish to irregular, small to gaping, entire to ±distinctly split, rarely somewhat eroded, moderately thin to moderately thick, incurved to rarely slightly erect, concolorous with thallus to sometimes brighter than thallus or brownish. Proper exciple free usually only in the upper parts, moderately thin to moderately thick, hyaline to pale yellowish internally, yellowish-brown to sometimes brownish marginally, apically sometimes dark-brown to dark-gray, very rarely slightly amyloid at the base and in parts of subhymenium. Hymenium up to c. 250 µm high, non-inspersed, moderately conglutinated, paraphyses parallel or slightly interwoven, unbranched, tips moderately thickened, lateral paraphyses present, sometimes inconspicuous, up to c. 30 µm long, columellar structures absent. Epihymenium variable, indistinct to moderately thin to thick, hyaline, without granules or usually with fine to coarse grayish to dark-gray granules. Asci 1-spored, tholus (moderately) thick, moderately thin when mature. Ascospores moderately to very large, densely eumuriform, cell walls and endospore predominantly (moderately) thin, only in younger stages and early maturity sometimes distinctly thickened parts present, non-halonate, hyaline becoming yellowish to brownish with age, distinctly brown usually only at late stages of maturity or in decayed ascospores, distinctly amyloid at maturity, showing a very strong amyloid reaction at maturity (before becoming distinctly pigmented), cylindrical to oblong-ellipsoid or broad-fusiform to more rarely bifusiform, with roundish to narrowed-roundish ends, loci predominantly roundish to slightly angular, subglobular to ±irregular, transverse septae thin, distinct and regular throughout development, 80-200 x 20-40 µm with multiple loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Thelotrema conveniens* was collected in Australia on tree bark and on rock, in (sub)tropical and warm-temperate rainforests in altitudes ranging from 100 to 800 m. It is moderately common and wide-spread occurring in northern and southern Queensland and in south-central New South Wales. This is the first report for Australia and the paleotropics (see notes below). Previously this pan(sub)tropical species was known from the Neotropics.

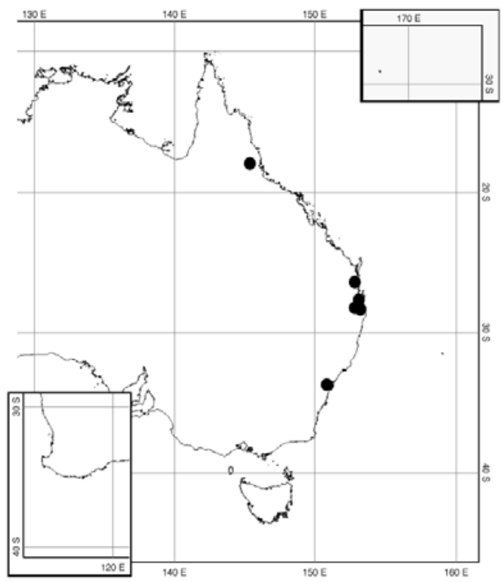

Fig. 114. Australian distribution of *T. conveniens*.

NOTES – *Thelotrema conveniens* is a variable taxon that is characterized by a predominantly thin and ecorticate thallus, immersed to emergent ascomata with apically free exciple, monosporic asci, large, desnely muriform ascospores and the absence of secondary compounds. It is similar to *T. monosporum* and *T. saxatile*. *Thelotrema conveniens* can be readily distinguished by less distinctly pigmented ascospores. *Thelotrema monosporum* differs in smaller (up to 100 µm long) ascospores in 2-4-spored asci. Another similar species is *T. rugatulum*, which differs in unpigmented ascospores and 2-spored asci. For differences to *T. lepadodes* see under that species. Parts of the Australian collections are somewhat different from the Columbian type, which has a thicker thallus that is covered by more distinct cortex structures and has more distinctly emergent ascomata with smaller pores, usually not exposing the disc. However, several Australian specimens show intermediate morphs.

SPECIMENS EXAMINED – Australia, Queensland: Atherton Tablelands: Danbulla Forest Drive: 4 km E of Tinaroo, *Hale 8325339* (US); Near Lake Euramoo parking lot, *Mangold 37 c* (F); Lake Eacham NP., *Mangold 29 af* (F). 5 km N of Yarraman and Yarraman Forest Drive, *Hale 831397* (US). 6 km N of Jimna, *Tibell 12795, 12638* (UPS). 25 km WNW of Nambour, 3 km N of Kenilworth, *Tibell 12638* (UPS). Mt. Mee SF., 6 km NW of Forestry Office, NW of Mt. Mee, *Hale 830617, 830838, 830839* (US). Darling Downs [Brisbane area], 1893, *Bailey* s.n. (G-10194/13, -10194/14, BRI-AQ721254 ['Shirley Book', p. 23, n. 14]). Head of Teviot Brook, NE of the Head, Boonah rd., *Hale 59485* (US). Cunninghams Gap NP., lower slopes of Mt. Cordeaux exposed to the south, *Hafellner 16234, 16277* (GZU). Lamington NP., Python Rock Track, *Hale 832430* (US). New South Wales: Bairne Track, 30 km N of Sydney, 30.09.1989, *Archer 'P 62'* (HO). Uncertain location [?Queensland], (as *Porina praestantior* var. *nana*), *Bailey 802* (BRI). New Caledonia, Yaté, *Hill 11661* (US).

Thelotrema crassisporum Mangold spec. nov. ined.

Type: Australia, Queensland, Eungella National Park, *Tibell 14717* (UPS-holotype).

ETYMOLOGY – The epithet refers to the form of the ascospores (from lat. *crassus* =thick).

ILLUSTRATION – Fig. 116.

Thallus predominantly hypophloedal, epiphloedal usually only in ascomata area, thin, up to c. 100 µm high, pale yellowish gray to pale greenish gray. Surface dull to slightly shiny, smooth, continuous to slightly verrucose, unfissered, appearing somewhat fissured due to substrate structure. True cortex present, continuous to somewhat incontinuous, up to 30 µm thick, consisting of periclinal hyphae, usually with incorporated substrate particles. Algal layer well developed, continuous to incontinuous, calcium oxalate crystals lacking to sparse, large. Vegetative propagules not seen. Ascomata conspicuous, moderately large, up to c. 600 µm in diam., roundish, apothecioid, solitary to slightly marginally fused, emergent, predominantly hemispherical. Disc not visible from surface to rarely partly visible, pale grayish, slightly pruinose. Pores small, up to c. 100 µm in diam., irregular, proper exciple visible from surface, free, off-white to pale grayish, incurved and distinctly shrunken. Thalline rim margin moderately thin to moderately thick, entire, roundish to slightly irregular, thalline rim incurved, pale reddish brown, with same surface as thallus. Proper exciple usually entirely free, thin, hyaline internally to predominantly yellowish-brown marginally, apically usually dark-brown, non-amyloid. Epihymenium indistinct to thin, hyaline, with sparse grayish granules, without crystals. Asci 8-spored, tholus (moderately) thick, moderately thin when mature. Ascospores small, (sub-)muriform, cell walls moderately thin to moderately thick, endospore thin, non-halonate, hyaline, non-amyloid, subglobose to ellipsoid to more rarely oblong, with predominantly roundish ends, loci roundish to angular, (roundish-)cubical

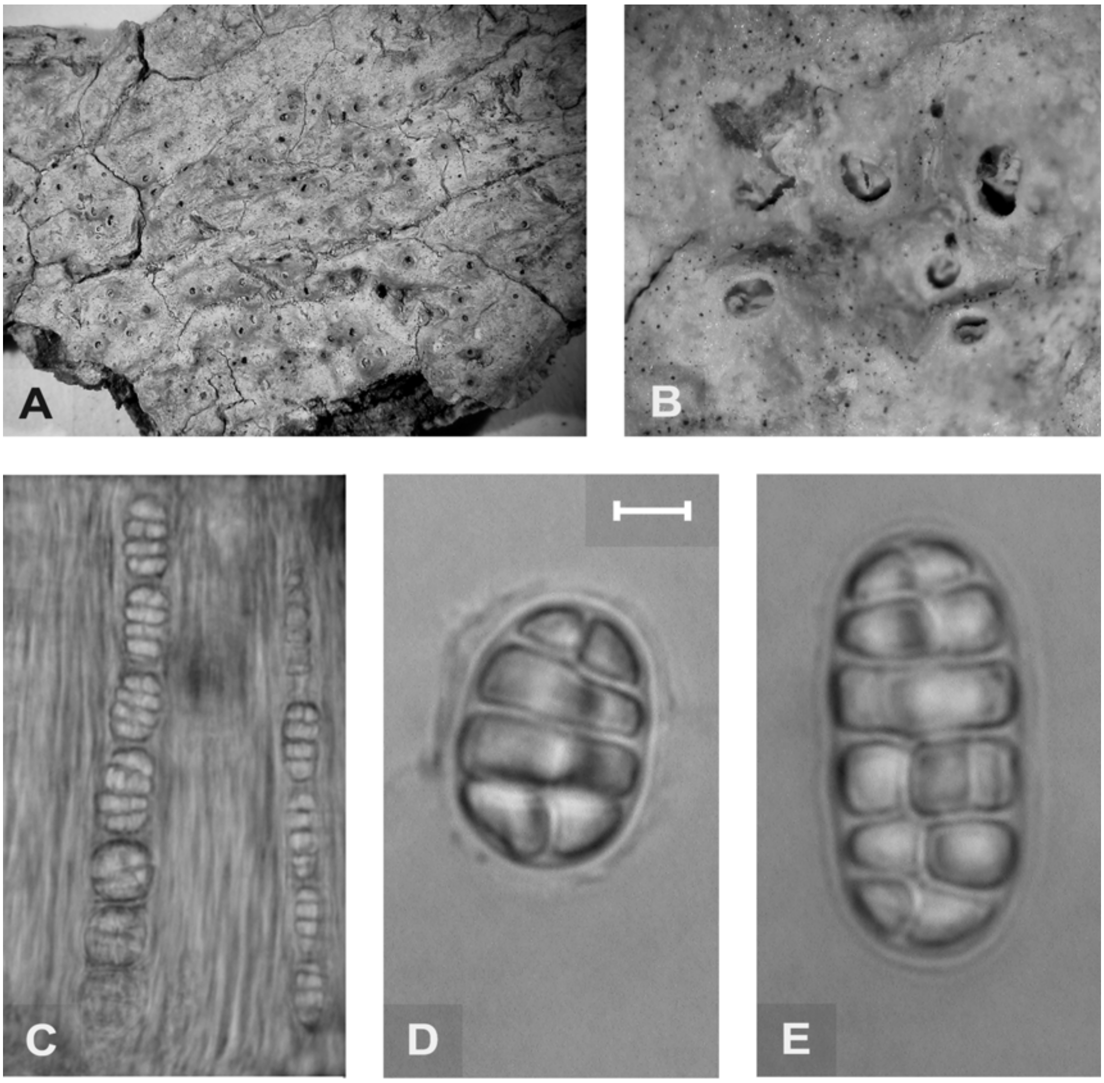

Fig. 116. *Thelotrema crassisporum*: growth habit (**A**), ascomata (**B**), and ascospores (**D-E**). A.-E.: UPS-holotype. Bar= A: 2 mm; B: 0.4 mm; C: 15 µm; D, E: 3.5 µm.

to irregular, transverse septae (moderately) thin, in immature ascospores irregular, becoming ±regular with maturity, 12-20 x 8-12 µm with 4-7 x 1-4 loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing constictic and stictic (majors) acids.

ECOLOGY AND DISTRIBUTION – *Thelotrema crassisporum* was collected in Australia on a soft bark of an unknown tree in a tropical rainforest. It is only known from the type locality in north-central Queensland.

NOTES – This taxon is characterized by a thin, hypophloedal thallus, large, emergent, ascomata

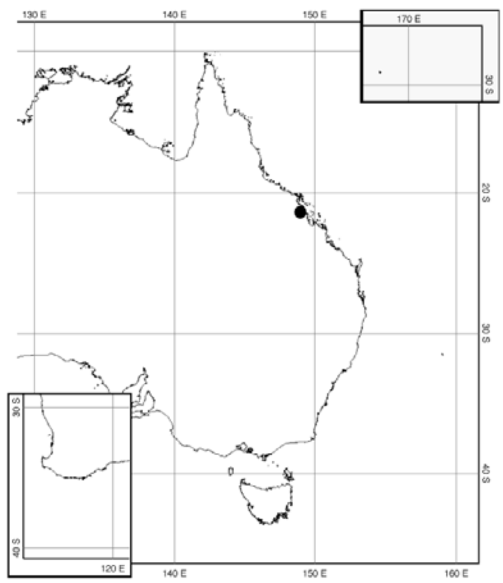

Fig. 117. Australian distribution of *T. crassisporum*.

with free exciple, small, hyaline, (sub-)muriform, non-amyloid ascospores and the stictic acid chemosyndrome. It is similar to the temperate *T. lepadinum* that can be distinguished by the lack of secondary compounds and distinctly larger ascospores (up to 140 µm long). *Thelotrema myriocarpum* is another similar species, which can be readily distinguished by the thicker thallus and the predominantly immersed, smaller ascomata with only partly free exciple and larger ascospores (up to 40 µm long). *Thelotrema cyphelloides* agrees in having stictic acid and similar ascospores but differs by a dull, roughened, ecorticate thallus and smaller, immersed ascomata.

SPECIMENS EXAMINED – See type collection of this species.

Thelotrema crespoae Mangold spec. nov. ined.

Type: Australia, Queensland, Wooroi State Forest Park, W of Teewantin, *Hale 832786* (US-holotype).

ETYMOLOGY – This new species is dedicated to the Spanish lichenologist Ana Crespo.

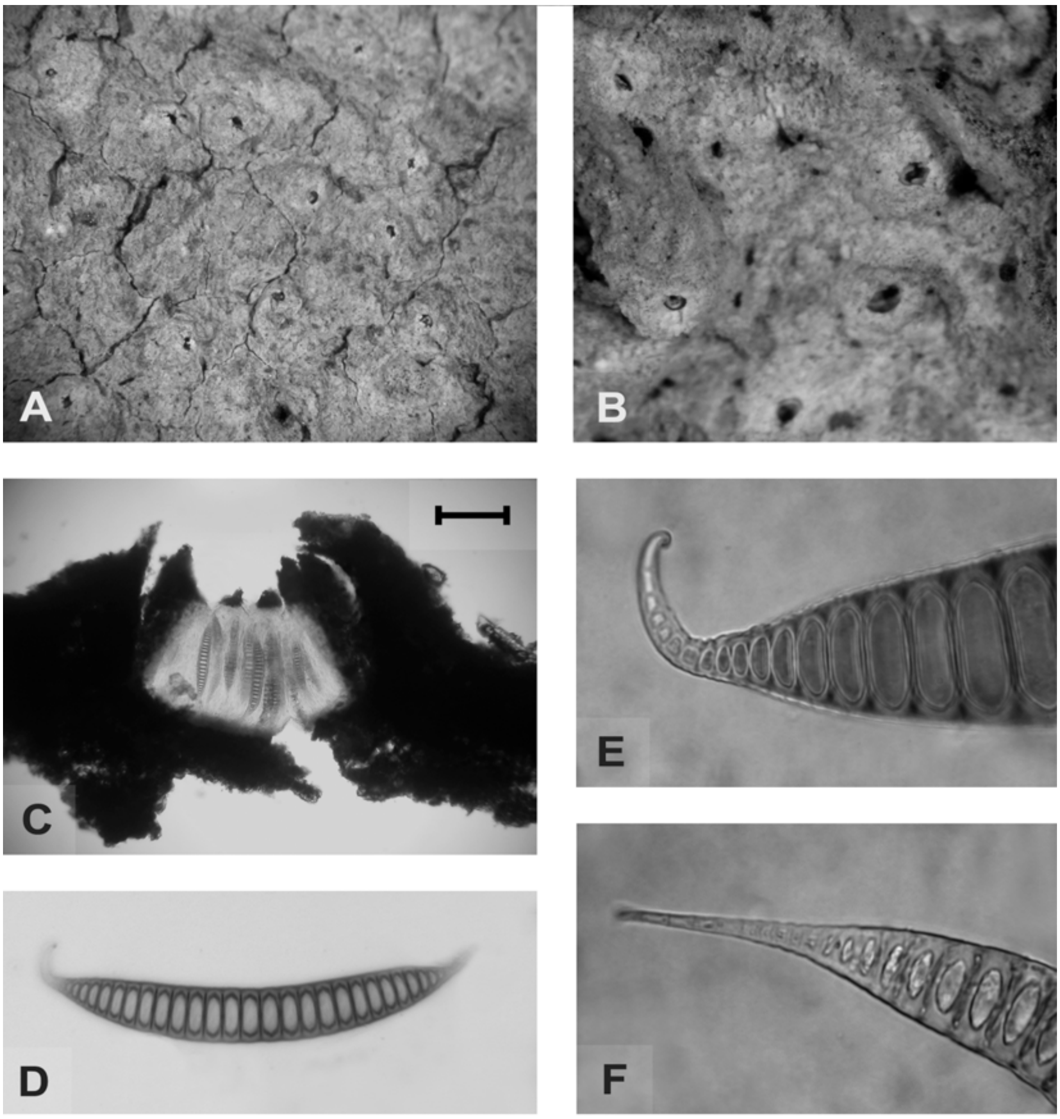

Fig. 118. *Thelotrema crespoae*: growth habit (**A**), ascomata (**B**), ascoma section (**C**), ascospore (**D**), and ascospore details (**E, F**). A., C.-F.: US-holotype; B.: *Mangold 27 v*. Bar= A: 0.8 mm; B: 0.6 mm; C: 200 µm; D: 40 µm; E: 12 µm; F: 20 µm.

ILLUSTRATION – Fig. 118.

Thallus epi- to hypophloedal, thin, up to c. 150 µm high, pale grayish-green to grayish. Surface dull, roughened, continuous, often with protuberant substrate structure, unfissured (appearing fissured due to substrate structure). Cortex structures absent. Algal layer moderately to poorly developed, incontinuous, calcium oxalate crystals predominantly abundant, usually small, scattered to more rarely clustered. Vegetative propagules not seen. Ascomata inconspicuous, (moderately) large, up to c. 800 µm in diam., roundish, perithecioid in younger stages, becoming apothecioid with age, solitary, moderately to distinctly emergent at maturity, hemispherical to urceolate. Disc usually not visible from surface, rarely becoming somewhat visible, grayish, pruinose. Pores small to moderately wide, up to c. 400 µm in diam., roundish to slightly irregular, entire to slightly split, apical proper exciple becoming visible from surface, often somewhat shrunken, off-white, pale brownish towards the base, incurved to slightly erect. Thalline rim margin moderately small, becoming moderately wide to gaping with age, moderately thin to thick, predominantly split, sometimes rugged to somewhat lacerate, thalline rim incurved to slightly erect, concolorous with thallus to more rarely brownish. Proper exciple becoming entirely free, predominantly moderately thin, hyaline internally to (pale)brownish or yellowish-brown marginally, apically sometimes with coarse grayish granules, non-amyloid. Hymenium up to c. 300 µm high, non-inspersed, moderately conglutinated, paraphyses parallel to somewhat interwoven, unbranched, tips slightly to distinctly thickened, lateral paraphyses present, inconspicuous, up to c. 20 µm long, columellar structures absent. Epihymenium (moderately) thick, hyaline, with (dark) grayish granules. Asci single-spored, tholus moderately thick, not visible at maturity. Ascospores typical, very large, transversely septate, cell walls thick, non-halonate, ±distinctly brown at late stage, non-amyloid to distinctly amyloid at early maturity (just before initial pigmentation), oblong-fusiform, ends characteristic, distinctly acute, appendix-like in younger stages to strongly tapered in older ascospores, loci roundish to somewhat acute, oblong to (acute-)lentiform, loci in tapered areas ±rectangular to irregular, end cells distinctly conical, septae thin to thickened in late maturity, distinctly regular, 150-280 x 25-35 µm with multiple loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Thelotrema crespoae* was collected in Australia on tree bark in a subtropical and in a warm-temperate coastal rainforest in altitudes ranging from 10 to 50 m. It is a rare species, currently only known from southern Queensland and central New South Wales.

NOTES – This new species is easily recognized by the large (up to 280 µm), transversely septate, brownish ascospores with strongly acute, usually appendix-like tips. The most similar species is *T. lacteum*, which is readily distinguished by smaller (up to 130 µm) ascospores in 4-8-spored asci.

SPECIMENS EXAMINED – Australia, New South Wales: Myall Lakes NP., Mungo Brush Camping Area, *Mangold 27 v* (F).

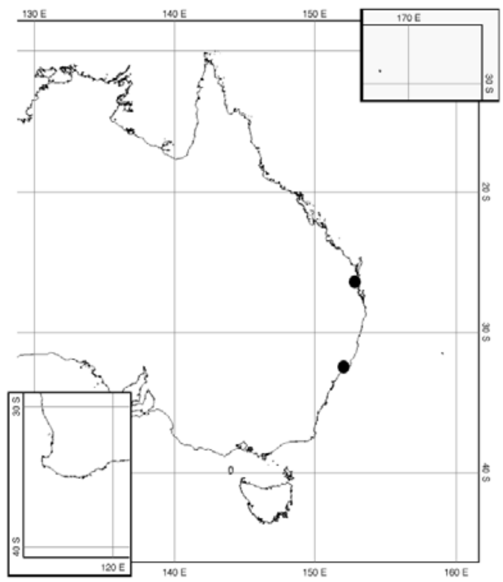

Fig. 119. Australian distribution of *T. crespoae*.

Thelotrema cupulare Müll.Arg.

Hedwigia 32: 131 (1893). Type: Australia, Queensland, Brisbane, *Bailey 375* (G!-holotype; BRI-'Shirley Book', p. 22, n. 20 [BRI-AQ721240]!-isotype).

Thelotrema dissultum Hale, Bull. Br. Mus. nat. Hist. (Bot.) 8(3): 254 (1981). Type: Sri Lanka, Sabaragamuwa, *Hale 51139* (US!-holotype, BM-isotype).

ILLUSTRATION – Fig. 120.

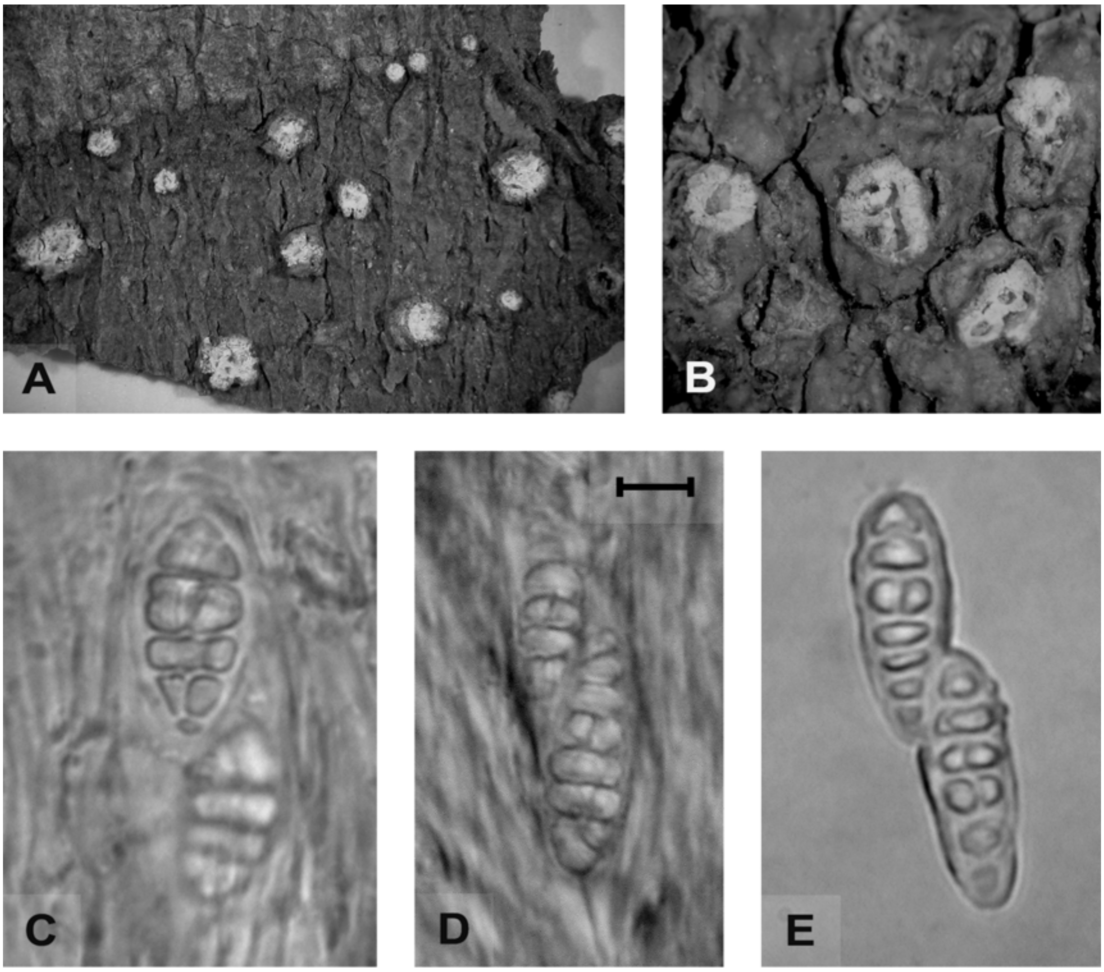

Fig. 120. *Thelotrema cupulare*: growth habit (**A**), ascomata (**B**) and ascospores (**C-E**). A.: *Hale 831595*; B.: G-holotype; C.: *A. & K. Kalb 19834*; D.: US-holotype of *T. dissultum*; E.: *Hale 831591*. Bar= A: 2 mm; B: 1.2 mm; C: 4 µm; D, E: 6 µm.

Thallus epi- to hypophloedal, thin to moderately thick, up to c. 200 µm high, yellowish-brown to olive. Surface waxy, smooth, continuous, unfissured, sometimes appearing fissured due to substrate structure. True cortex present, yellowish, up to c. 100 µm thick, consisting of irregular to periclinal hyphae. Algal layer continuous to incontinuous, well developed, calcium oxalate crystals abundant, large to more often small, scattered to clustered. Vegetative propagules not seen. Ascomata very conspicuous, large, up to c. 1.8 mm in diam., roundish, ±irregular in fused ascomata, erumpent, apothecioid to sometimes chroodiscoid, solitary to distinctly fused, sometimes regenerating, immersed to moderately emergent, then depressed-cylindrical to irregular. Disc partly to sometimes entirely visible from surface, pale grayish to pale flesh-colored, coarsely pruinose. Pores becoming wide to gaping, up to

c. 1 mm in diam., roundish to moderately irregular, inner and apical proper exciple becoming visible from surface, fused to free, ± jagged, whitish, incurved to recurved, somewhat shrunken in entirely free proper exciples. Thalline rim margin predominantly thick, roundish to moderately irregular, split to lacerate, ±coarsely lobed, sometimes indistinctly layered, becoming ±distinctly eroded with age, whitish, pruinose, thalline rim concolorous and with same surface as thallus, predominantly erect to recurved. Proper exciple partly to distinctly free in older stages, moderately thick, hyaline internally to (pale)yellowish-gray or brownish marginally, often with calcium oxalate crystal inclusions, apically usually covered by grayish granules, non-amyloid to rarely faintly amyloid at the base. Hymenium up to c. 100 µm high, non-inspersed, moderately conglutinated, paraphyses ±bent, ±interwoven, unbranched, tips slightly thickened and somewhat irregular, lateral paraphyses present, usually very inconspicuous, up to c. 20 µm long, true columella absent, in fused ascomata sometimes with columella-like structures. Epihymenium ±thick, hyaline to pale grayish-brown, with grayish granules and sometimes small crystals. Asci 8-spored, tholus (moderately) thick, thin when mature. Ascospores small, transversely septate when young, becoming (sub-)muriform in late stage, cell walls moderately thin to moderately thick, endospore moderately thick, non-halonate, hyaline, non-amyloid, ellipsoid to fusi- or claviform, with roundish to subacute ends, loci roundish to slightly angular, subglobose to lentiform, transverse septae moderately thick, regular, 15-25(30) x 5-8(12) µm with 4-9(10) x 1-3(4) loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing stictic (major), constictic (major to minor) and α-acetylconstictic (trace) acids.

ECOLOGY AND DISTRIBUTION – *Thelotrema cupulare* occurs on tree bark in (sub)tropical rainforests in altitudes ranging from sea level to 500 m. This rare species occurs in northern and southern Queensland. Previously it was recorded from Sri Lanka.

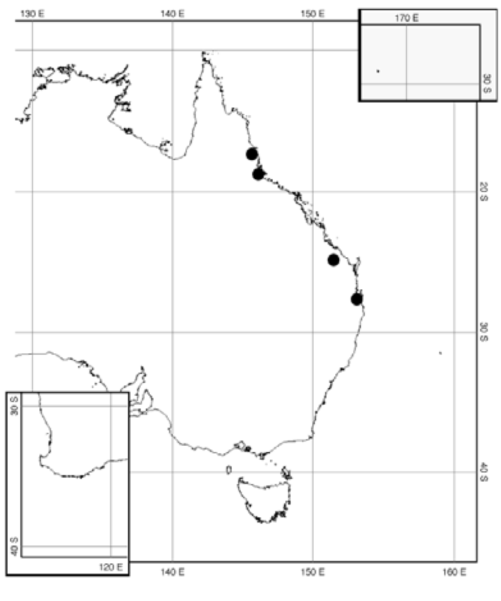

Fig. 121. Australian distribution of *T. cupulare*.

NOTES – This taxon is characterized by a dark, waxy thallus with a true cortex, large ascomata with a whitish, lacerate to eroded, ±pruinose thalline rim margin, moderately small, (sub-) muriform, hyaline, non-amyloid ascospores and the presence of the stictic acid chemosydrome. It is similar to *T. leucophthalmum* and *T. thesaurum*, which both differ in larger ascospores (up to 60 µm long with up to 16 x 6 loci in *T. leucophthalmum*, up to 130 µm long in *T. thesaurum*). *Thelotrema paralbidum* from the Bahamas is also similar, but the thallus is ecorticate and the ascospores are more distinctly muriform and have smaller loci.

SPECIMENS EXAMINED – Australia, Queensland: Kuranda Range, NW of Cairns, *A. & K. Kalb 19834* (hb. Kalb). Kalpowar Forest Drive, 40 km NE of Monto, SW of Gladstone, *Hale 831591* (US). Brisbane: *Bailey 278* (BM, BRI); s.c. [?*Bailey*] (F).

Thelotrema cyphelloides Müll.Arg.

Bull. Herb. Boissier 3: 314 (1895). Type: Australia, Queensland, Brisbane, *Bailey 700* (G!-holotype, BRI-'Shirley Book', p. 22, n. 17 [BRI-AQ721237]!-isotype).

ILLUSTRATION – Fig. 122.

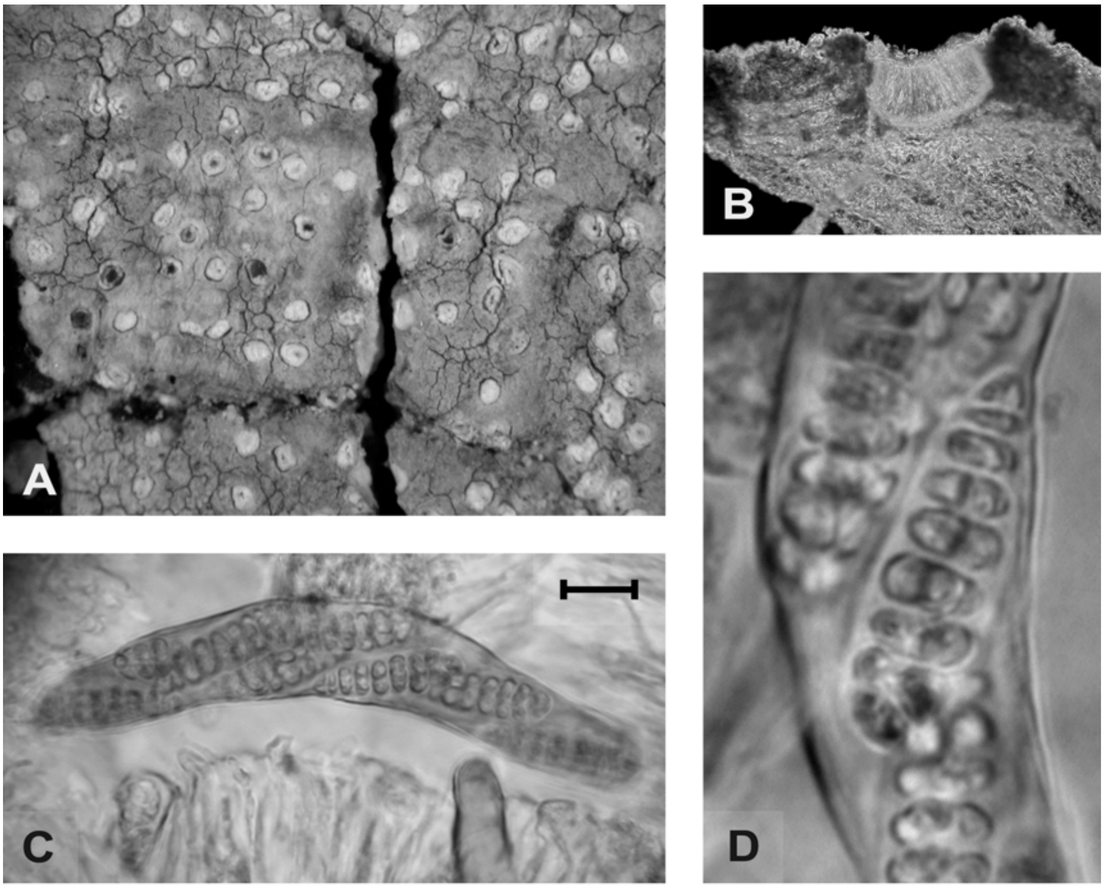

Fig. 122. *Thelotrema cyphelloides*: growth habit (**A**), ascoma and thallus section (**B**) and ascospores (**C, D**). A.: G-holotype: C.-D.: BRI-isotype. Bar= A: 1 mm; B: 150 µm; C: 12.5 µm; D: 5 µm.

Thallus predominantly hypophloedal, thin, up to c. 100 µm high, pale grayish-green. Surface dull, rough, continuous to verruculose, strongly fissured. Cortex structures absent. Algal layer well developed and continuous, calcium oxalate crystals absent to very sparse, if present, large. Vegetative propagules not seen. Ascomata conspicuous, moderately small, up to 300 µm in diam., roundish to slightly irregular, apothecioid, solitary, immersed. Disc often partly visible from surface, pale flesh-colored to orange, epruinose. Pores (moderately) small, up to c. 250 µm in diam., roundish to sometimes slightly irregular, upper proper exciple visible from surface, free, entire to more rarely slightly split, ±whitish, incurved to erect. Thalline rim margin moderately thick, roundish to slightly irregular, entire to somewhat eroded, concolorous with thallus, margin area sometimes circularly fissured, somewhat resembling a layered margin, thalline rim indistinctly incurved to erect, not distinguishable from main thallus. Proper exciple apically free, moderately thin, hyaline to pale yellowish internally, pale orange marginally, non-amyloid. Hymenium up to c. 100 µm high, non-inspersed, distinctly conglutinated, paraphyses straight to slightly bent, slightly interwoven, unbranched, tips slightly thickened, lateral paraphyses present, inconspicuous, up to c. 15 µm long, columellar structures absent. Epihymenium indistinct, hyaline, without granules or crystals. Asci 8-spored, tholus thick, becoming moderately thin when mature. Ascospores small, (sub-)muriform, cell walls moderately thick, endospore (moderately) thick, non-halonate, hyaline, non-amyloid to faintly amyloid in older stages, oblong to ellipsoid to somewhat claviform, with roundish to narrowed-roundish ends, loci predominantly roundish, subglobose to oblong, transverse septae moderately thick, regular, 20-27 x 8-10 µm with 7-9 x 1-4 loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing constictic, stictic, (majors), and hypostictic (minor) acids.

ECOLOGY AND DISTRIBUTION – *Thelotrema cyphelloides* was collected in Australia on resinous bark. It is only known from the type from southern Queensland, which has no further information concerning the habitat.

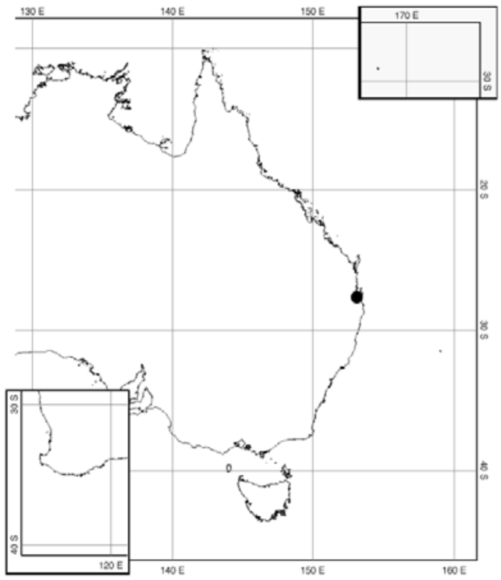

Fig. 123. Australian distribution of *T. cyphelloides*.

NOTES – This taxon is characterized by a thin, ecorticate, dull, rough and strongly fissured thallus, immersed ascomata with relatively wide pores and a free proper exciple, small, hyaline, (sub-) muriform, thick-walled ascospores and the stictic acid chemosyndrome. It is similar to *T. myriocarpum*, but differs morphologically. *Thelotrema myriocarpum* has a shiny, smooth, corticate, non-fissured thallus. Another similar Australian species with stictic acid and small, hyaline, muriform, non-amyloid ascospores is *T. crassisporum*, which has large, emergent ascomata and smaller (up to 15 µm long) ascospores. For differences to *T. subadjectum* see under that species. *Thelotrema polythecium* is distinguished by the absence of the stictic acid chemosydrome, distinctly split ascomata margins and a fused proper exciple. *Thelotrema subexpallescens* from the Andaman Islands (and probably Africa, see Frisch, 2006) is similar and might be synonymous with *T. cyphelloides*, type material was unfortunately not available for study.

SPECIMENS EXAMINED – See type collection of this species.

Thelotrema defossum (Müll.Arg.) Mangold comb. nov. ined.

Bas.: *Ocellularia defossa* Müll. Arg. in Engler, Botan. Jahrbücher 5: 138 (1884). Type: Timor, Mt. Taimanani, 1883, *Naumann 386* pr. p. (G!-holotype).

ILLUSTRATION – Fig. 124.

Thallus epi- to hypophloedal, predominantly thin, up to c. 200 µm high, pale yellowish gray to pale olive. Surface dull to slightly shiny, smooth, continuous to distinctly verrucose, distinctly fissured. Thallus covered by an incontinuous protocortex up to 10 µm thick. Algal layer well developed, continuous to incontinuous due to crystal inclusions, calcium oxalate abundant to sometimes sparse, small to large, clustered or scattered. Vegetative propagules not seen. Ascomata inconspicuous, predominantly small, up to c. 300 µm in diam., roundish

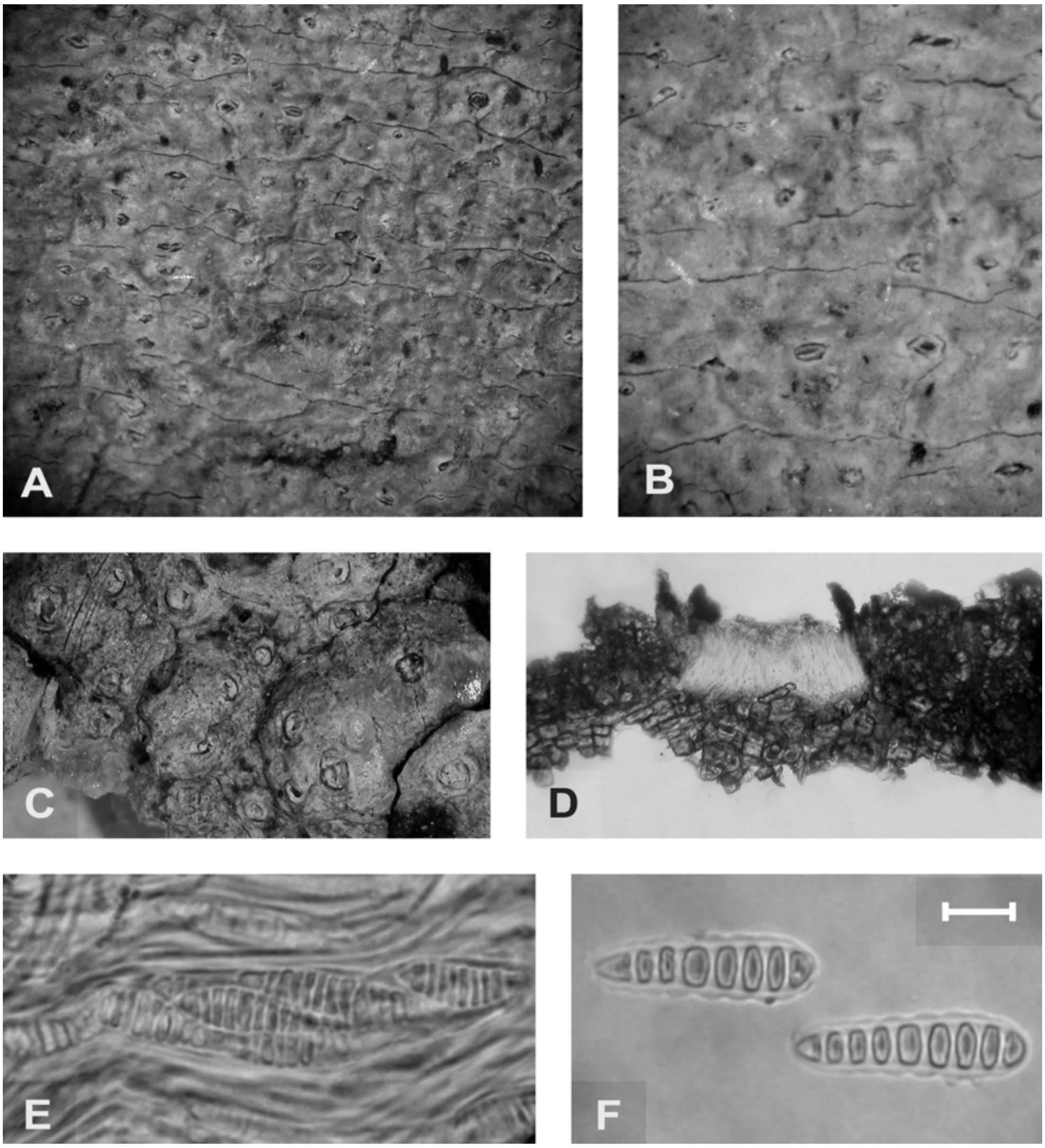

Fig. 124. *Thelotrema defossum*: growth habit (**A-C**), ascoma section (**D**) and ascospores (**E, F**). A., B.: *A. & K. Kalb 21713*; C., E.: G-holotype; D., F.: *Lumbsch & Mangold 19161 v*. Bar= A: 1 mm; B: 0.5 mm; C: 0.75 µm; D: 100 µm; E: 10 µm; F: 8 µm.

to sometimes slightly elongated, apothecioid, solitary to fused, predominantly immersed, in strongly verrucose thalli sometimes becoming somewhat raised. Disc not visible from surface to sometimes becoming partly visible, grayish, predominantly epruinose. Pores (moderately) small, up to c. 200 µm in diam., roundish to sometimes slightly elongate or somewhat irregular, predominantly entire to slightly split, apical proper exciple visible from surface, sometimes somewhat shrunken, whitish to off-white, pale brownish towards the base, predominantly incurved. Thalline rim margin thin to moderately thick, moderately wide to wide, predominantly entire to rarely slightly split, roundish to irregular-roundish to somewhat elongate, rarely slightly layered, predominantly incurved to more rarely somewhat erect, concolorous with thallus or slightly brighter. Proper exciple becoming partly free in upper parts, moderately thin, hyaline internally, pale to dark brown marginally, apically often dark brown to slightly carbonized, often amyloid at the base. Hymenium up to c. 80 µm high, non-inspersed, moderately conglutinated, paraphyses moderately interwoven, unbranched, tips slightly to moderately thickened, lateral paraphyses present, inconspicuous, up to c. 15 µm long, columellar structures absent. Epihymenium indistinct to thin, hyaline, rarely with sparse grayish granules. Asci 4-8-spored, tholus moderately thin to moderately thick, thin when mature. Ascospores very to moderately small, transversely septate, cell walls predominantly (moderately) thin, with distinct, often moderately thick, smooth to irregular halo, hyaline, non-amyloid in younger ascospores to weakly amyloid in mature stages, sometimes oblong to fusiform to predominantly clavate, ends roundish to subacute, loci roundish to and more often ±angular, in particular in younger stages, lentiform to flattened cubical, end cells hemispherical to conical, septae (moderately) thick with age, regular, 10-30(40) x 5-8 µm with 4-11(12) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Thelotrema defossum* occurs on tree bark in (sub)tropical to warm-temperate rainforests in altitudes ranging from sea level to 950 m. This moderately common and wide-spread species, occurs in northern Queensland, the Queensland/New South Wales border region, New South Wales and on Lord Howe Island. This is the first report for Australia. The species was described from Timor and one collection from Florida belongs to this species as well (see below).

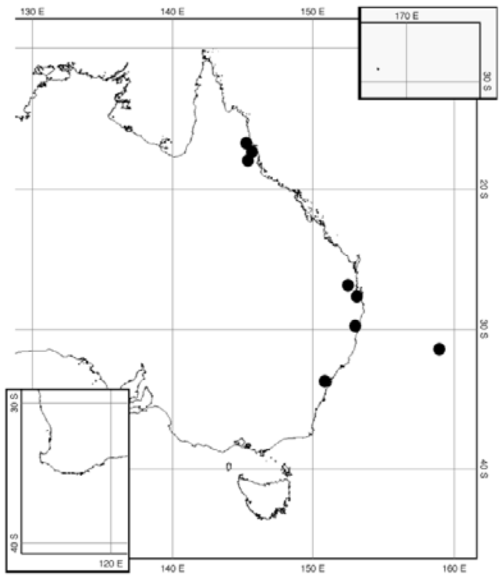

Fig. 125. Australian distribution of *T. defossum*.

NOTES – This species belongs to the *T.subtile*-group. Within this group of similar species, *T. defossum* is characterized by small, faintly amyloid ascospores with thin cell walls, distinct halo and flattened-angular loci. The ascospores of *T. suecicum* partly fall within the range of those found in *T. defossum* with 20-40(60) µm in length and 6-12(14) loci, but are distinctly broader (8-15 µm), have thick to usually very thick cell walls and different shaped loci (see also under this species). *Thelotrema parvizebrinum* is a similar Australian species, see there for differences. One collection from Florida in US determined by Harris as *T. lathraeum* agrees well with the type of *T. defossum* and the Australian collections. It is therefore possible that *T. defossum* is synonymous to *T. lathraeum* since it is the older name (Tuckerman, 1882). The type of *T. lathraeum* was unfortunately not available for study.

SPECIMENS EXAMINED – Australia, Queensland: Cape Tribulation Area, Myall Beach, *Lumbsch & Mangold 19161 s, v, 19162 m, Mangold 31 o* (F). Near end of Black Mountain Rd., 33 km WNW of Kuranda, *Hale 832187, 832704* (US). Atherton Tablelands, Lake Euranoo, *Lumbsch & Mangold 19127 k* (F). Bunya Mountains, Mt. Mowbullan, *Kalb & Rogers 20283* (hb. Kalb). Wolston nr. Brisbane, *Wilson '1464'* (as O. cf. jugalis) (NSW-539407, US). New South Wales: Nightcap Forest Drive, 1 km W of Minyon Falls, N of Lismore, *Hale 832087, 832180, 832543* (US). Iluka Nature Reserve, 50 km NE of Grafton, *Mangold 23 i* (F). Blue Mnts., Below Bridal Veil Falls, near Blackheath, *Hale 58543* (US). Royal NP., S of Sydney, Bola Creek, E of Waterfall, *K. & A. Kalb 21711, 21713* (hb. Kalb). Lord Howe Island, near Golf Club, *Elix 42072* (CANB). U.S.A., Florida, *Hale 53103* (US).

Thelotrema diplotrema Nyl.

Ann. Sci. Nat., Bot., sér. 4, 11: 258 (1859). *Ocellularia diplotrema* (Nyl.) Zahlbr., Cat. Lich. Univ. II: 588 (1923). Type: Réunion ['Borbonia'], s.c. (H-Nyl. 22737!-lectotype, selected by Hale [1972 in herb.]).

Ocellularia turgidula Müll. Arg., Journ. de Botan. 7: 94 (1893). *Thelotrema turgidulum* (Müll. Arg.) Hale, Mycotaxon 11: 132 (1980), nom. illeg. [non *Thelotrema turgidulum* Vain.]. Type: New Caledonia, Mt. Mou, 1870, *Balansa* s.n. (PC-lectotype, selected by Hale [1978: 33]; G!-isolectotype).

ILLUSTRATION – Fig. 126.

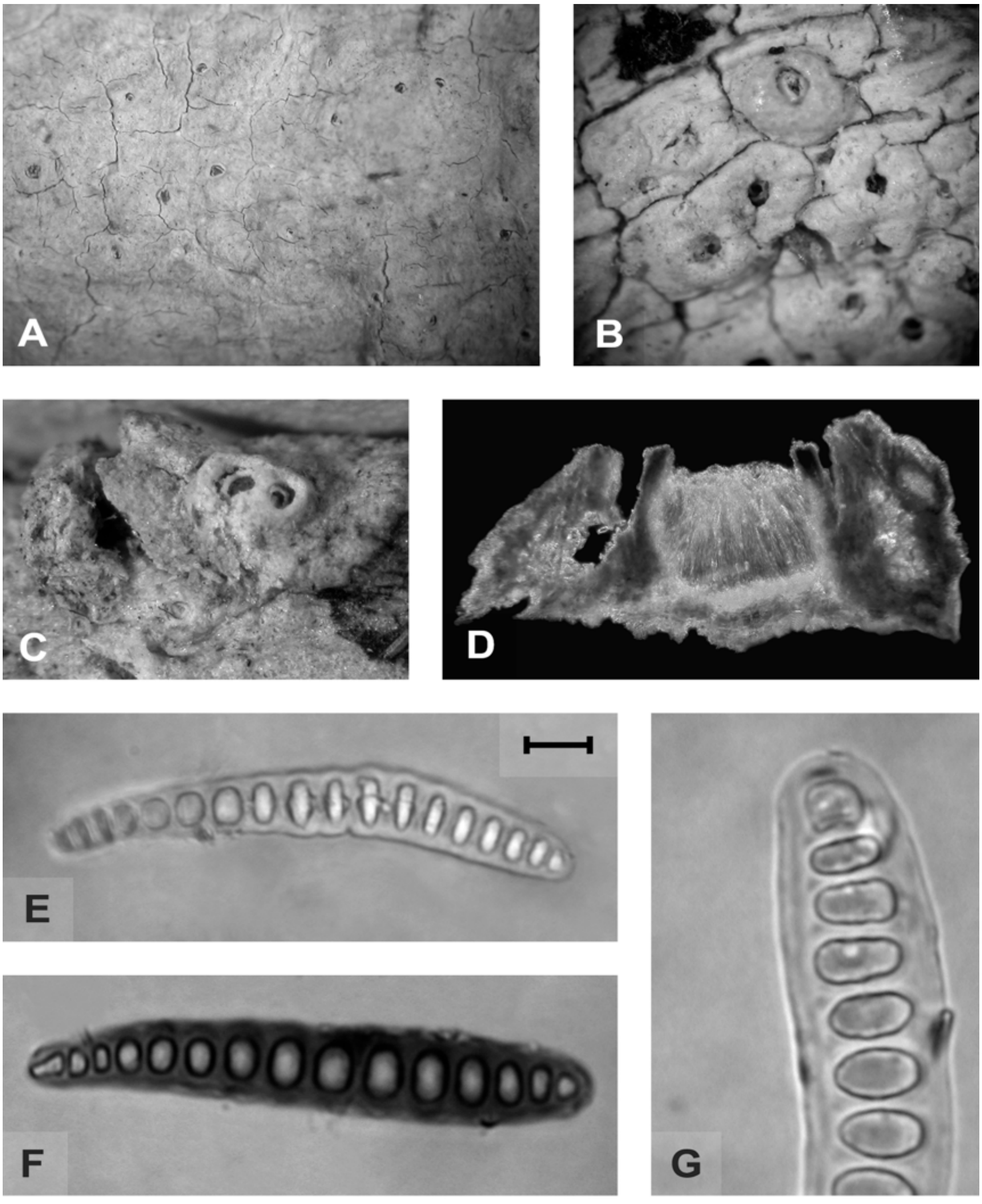

Fig. 126. *Thelotrema diplotrema*: growth habit (**A**), ascomata (**B, C**), ascoma section (**D**), ascospore (**E**), ascospores showing amyloid reaction (**F**) and ascospore detail (**G**). A., E.-G.: *Lumbsch & Mangold 19127 v*; B.: G-isolectotype of *O. turgidula*; C.: H-lectotype; D.: *Lumbsch & Mangold 19139 r*. Bar= A: 1 mm; B: 0.35 mm; C: 0.75 mm; D: 100 µm; E: 11 µm; F: 9 µm, G: 7 µm.

Thallus epi- to hypophloedal, moderately thin, up to c. 200 µm high, pale greenish gray to pale olive. Surface predominantly dull to rarely slightly shiny, smooth to more often roughened, sometimes porous, continuous to ±distinctly verrucose to verruculose, slightly to distinctly fissured. Cortex structures absent or covered by a usually thin, incontinuous protocortex up to c. 20 µm thick. Algal layer well developed, continuous to incontinuous, often due to calcium oxalate crystal inclusions, calcium oxalate crystals abundant, predominantly small, often clustered. Vegetative propagules not seen. Ascomata usually inconspicuous, predominantly small to rarely moderately large, up to c. 400(700) µm in diam., roundish to slightly irregular, apothecioid, solitary to marginally or entirely fused, immersed to ±distinctly emergent, then flattened-hemispherical to flattened-urceolate, with same surface as thallus. Disc often becoming partly visible from surface, (pale) grayish to pale flesh-colored, epruinose to slightly pruinose. Pores (moderately) small, up to c. 150 µm in diam., roundish to slightly irregular, entire to split, apical to rarely entire proper exciple visible from surface, often only slightly separated from thalline rim margin, rarely somewhat shrunken, whitish to off-white, pale brownish towards the base, incurved to somewhat erect. Thalline rim margin moderately thin to more often moderately thick, predominantly entire, roundish to irregular-roundish, becoming moderately wide, incurved to more rarely somewhat erect, concolorous with thallus to sometimes brownish. Proper exciple becoming apically to partly, rarely entirely free, moderately thin to moderately thick, hyaline to pale yellowish internally, brownish or yellowish-brown marginally, apically often dark-brown, often amyloid at the base. Hymenium up to c. 180 µm high, non-inspersed, moderately conglutinated, paraphyses ±interwoven, unbranched, tips moderately to distinctly thickened, lateral paraphyses present, predominantly inconspicuous, up to c. 30 µm long, columellar structures absent. Epihymenium variable, indistinct to moderately thick, hyaline, with grayish to sometimes brownish granules and small crystals. Asci 4-8-spored, tholus (moderately) thick, thin when mature. Ascospores moderately large, transversely septate, very rarely with a single longitudinal septum, cell walls thick, often slightly crenate, thinly halonate, hyaline, distinctly to strongly amyloid, sometimes clavate to more often ±fusiform, ends roundish to narrowed-roundish to more rarely subacute, loci ±roundish, subglobose to lentiform or somewhat irregular, end cells hemispherical to conical, septae (moderately) thick, regular to slightly irregular, 50-90(110) x 8-12 µm with 14-20(22) (x 2) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Thelotrema diplotrema* was collected in Australia on tree bark predominantly in (sub)tropical to warm-temperate rainforests, more rarely in wet sclerophyll forests in altitudes ranging from sea level to 1100 m. It is a common and widespread species occurring in Queensland and northern New South Wales. It is also known from Central America (Hale, 1978), Africa (Frisch, 2006) Reunion, Andaman Islands (Sethy & al., 1987) and Japan (Hale, 1978), indicating a pan(sub)tropical distribution.

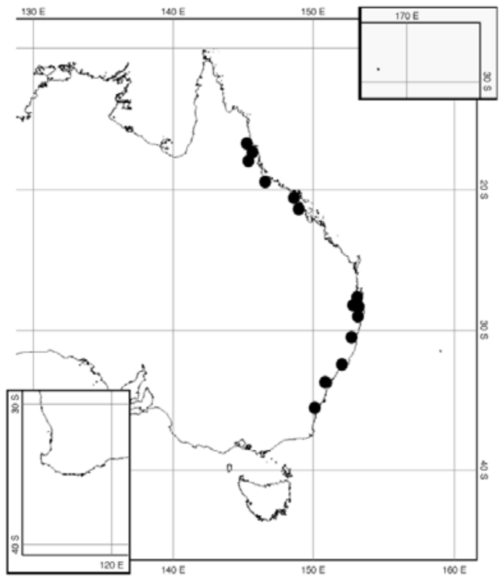

Fig. 127. Australian distribution of *T. diplotrema*.

NOTES – This taxon is characterized by an ecorticate, often roughened thallus, immersed to emergent, small apothecia with often only indistinctly free proper exciple, moderately large, transversely septate, thick-walled, distinctly amyloid ascospores, and the absence of secondary compounds. It is similar to *T. pseudosubtile*, especially when younger or poorly developed ascomata are observed that lack fully developed ascospores; see under this species for differences. *Thelotrema diplotrema* is another member of the *T. subtile*-group. Within this group *T. nureliyum* is also similar but readily distinguished by larger ascomata with a more distinctly free proper exciple and larger ascospores (up to 220 µm long with up to 35 loci). As mentioned above, *T. bicavatum* was included as a (tentative) synonym to *T. diplotrema* (Frisch, 2006). This species, however, differs in smaller ascospores (up to 45 µm long with up to 16 loci) and contains norstictic acid and is therefore here regarded as a distinct taxon.

SPECIMENS EXAMINED – Australia, Queensland: Cape Tribulation Area, Myall Beach, *Lumbsch & Mangold 19161 r* (F). Mt. Windsor, 5 km W of new Forestry Camp, NW of Mossman, *Hale 830868* (US). Near Lake Placid, S of Kuranda, *K. & A. Kalb 21301* (hb. Kalb). End of Clohesy River Rd., 16 km SE Kennedy Hwy., W of Cairns, *Hale 832241* (US). Atherton Tablelands: Davies Creek Rd. 17 km S of Kennedy Hwy., S of Davies Creek Falls NP., E of Mareeba, *Hale 831247, 832691* (US); Danbulla Forest Drive: 4 km E of Tinaroo, *Hale 831210* (US), Lake Euramoo, *Hale 831521* (US), *Lumbsch & Mangold 19127 v* (F); Area below crater, Mt. Hypipamee NP., S of Atherton, *Hale 832550* (US); Millaa Millaa falls, *Lumbsch & Mangold 19139 j, r* (F); Souita Falls, *Lumbsch & Mangold 19155 y* (F); Along road going S from Ravenshoe to Tully Falls, *Hale 832566* (US); 13 km S of Ravenshoe on Tully Falls Rd., *Hale 831286, 831696* (US); Culpa logging area, 13 km from Koombooloomba rd. turnoff, SE of Tully Falls, *Hale 832119* (US). Murray Falls, W of Kennedy, *Hale 831612, 832465* (US). Mt. Spec NP., Ridge on the Loop, on the Paluma Rd., WNW of Townsville, *Hale 832321, 832760* (US). Conway Range NP., near Shute Harbour-Airlie Beach, *Hale 830882* (US). Eungella NP.: 'Credition Track', *K. & A. Kalb 26678* (hb. Kalb); Rosser Rd. entry point off Darymple rd. (near Pease's Lookout), *Hale 831126, 831351, 381354, 831623, 831406, 831745* (US). Mt.Mee SF., 6 km NW of Forestry Office, NW of Mt.Mee, *Hale 832553, 832782* (US). D'Anguilar Range NW of Brisbane, about 2 km N of Mt.Glorious W of the rd. to Mt.Tenison Woods, *Hafellner 16988* (GZU). Brisbane, [as T. rimulosum], *Bailey* s.n. (NSW-539340). Cunninghams Gap NP., 50 km NE of Warwick, *Hale 831733* (US). Carabeen Nature Refuge, 45 km E of Warwick, *Lumbsch & Mangold 19174 m, 19175 b* (F). Best of All Lookout, 4 km S of Springbrook, Wunburra Range, *Elix 2517* (CANB). Lamington NP.: Python Rock Track, *Hale 832736, 832755* (US); Main Border Track out of O'Reillys, *Hale 830962, 831930* (US). New South Wales: Lions Tourist Rd. near Queensland border, N of Waingaree, *Hale 830942* (US). Tweed Range, Mebbin NP., 25 km SW of Murwillumbah, *Mangold 21 c, d, h, j, k* (F). Gibbergunyah Roadside Reserve, Nightcap Forest Drive, Whian Whian SF., W of Mullumbimby, *Hale 832538* (US). Nightcap NP., Mnt. Nardi/Mnt. Matheson Track, *Mangold 22 h, i* (F). Waingaree Forest, N of Kyogle: Black Butt Picnic Area, Loop Drive, *Hale 830285* (US); NW part of Wiangaree Forest Drive, *Hale 831192, 831390, 831391, 831524, 831616, 832471, 832502* (US). Mt.Warning NP., track from summit to parking lot, *Mangold 19 d, l, p, q, r, y, za, zf, zi* (F). Cambridge Plateau Forest Drive, 3 km N of picnic area, Richmond Range SF., 30 km W of Casino, *Hale 832486* (US). Richmond River, Jun. 1884, *Wilson* s.n. (NSW-539420). Dorrigo NP.: Never Never Picnic Area and Rosewood Creek Track, *Mangold 24 a, g, h* (F); Sassafras Creek Track, *Mangold 25 e, t* (F). Doyles River SF. on Oxley Hwy., 95 km SE Walcha, *Hale 58590* (US). Barrington Tops NP., NE of Scone, *K. & A. Kalb 21787* (hb. Kalb). Bulahdelah District, Myall River SF., E of Stroud, Jarrah Rd., *Kalb & Filson 17888, 17940, 17949, 17955, 17960* (hb. Kalb). Royal NP., S of Sydney, Bola Creek, E of Waterfall, *K. & A. Kalb 21712, 21722* (hb. Kalb). Monga NP., 27 km SE of Braidwood, *Mangold 11 w* (F). New Caledonia: Riviere Blanche, *Hill 11716* (US); Yate, *Hill 11768* (US).

Thelotrema eungellaense Mangold, Elix & Lumbsch

Bibl. Lichenol. 95: 463 (2007). Type: Australia, Queensland, Eungella NP., trail from Broken River Station to rainforest, *Lumbsch & Mangold 19108 k* (CANB!-holotype, BRI!-isotype).

ILLUSTRATION – Fig. 128.

Thallus hypo- to epiphloedal, thin to moderately thick, up to c. 400 µm high, pale grayish- or yellowish-green to olive. Surface dull, smooth, ±verrucose, fissured. True cortex present, continuous to sometimes incontinuous, up to c. 50 µm thick, consisting of irregular to more often periclinal hyphae. Algal layer variable, continuous to incontinuous, moderately well to poorly developed, calcium oxalate crystals abundant, small to large, scattered to clustered. Vegetative propagules not seen. Ascomata usually conspicuous, moderately large, up to c.

800 µm in diam., roundish, perithecioid, solitary, immersed to emergent, then predominantly (verrucose-)hemispherical to more rarely (verrucose-)subglobose. Discs not visible from surface. Pores small, up to c. 150 µm in diam., roundish, entire, apical proper exciple usually becoming visible from surface, forming a predominantly entirely free inner pore margin, often slightly sunken, incurved, whitish to off-white. Thalline rim margin moderately thick to more often conspicuously thick, roundish, entire to more rarely slightly split, usually whitish to off-white or brighter then thallus, sometimes concolorous with thallus or more rarely brownish, level with thalline rim to ±distinctly annulate or funnel-shaped to more rarely sunken, thalline rim not developed or not distinguishable from thallus in immersed ascomata, in emergent ascomata incurved, with same surface as thallus. Proper exciple partly fused to entirely free, moderately thick, hyaline to pale yellowish internally, yellowish-gray marginally, apically sometimes brownish, non-amyloid to more rarely faintly amyloid at the base. Hymenium up to c. 400 µm high, non-inspersed, moderately conglutinated, paraphyses thin, distinctly bent to curly towards tips, parallel to slightly interwoven, unbranched, tips slightly thickened, lateral paraphyses present, mostly inconspicuous, not conglutinated, up to c. 40 µm long, columellar structures absent. Epihymenium indistinct, hyaline, without granules or crystals. Asci 2-4-spored, tholus thick, thin when mature. Ascospores large, densely eumuriform, cell walls and endospore thin, non-halonate, hyaline, rarely pale yellowish at late maturity, non-amyloid to faintly amyloid in mature spores, predominantly ellipsoid to fusiform, with narrowed-roundish to rarely slightly subacute ends, rarely slightly bent, loci small, roundish to slightly angular, subglobose to roundish-cuboid or irregular, transverse septae thin, distinct throughout development, regular to slightly irregular, 80-180 x 20-40 µm, with multiple loci. Pycnidia not seen.

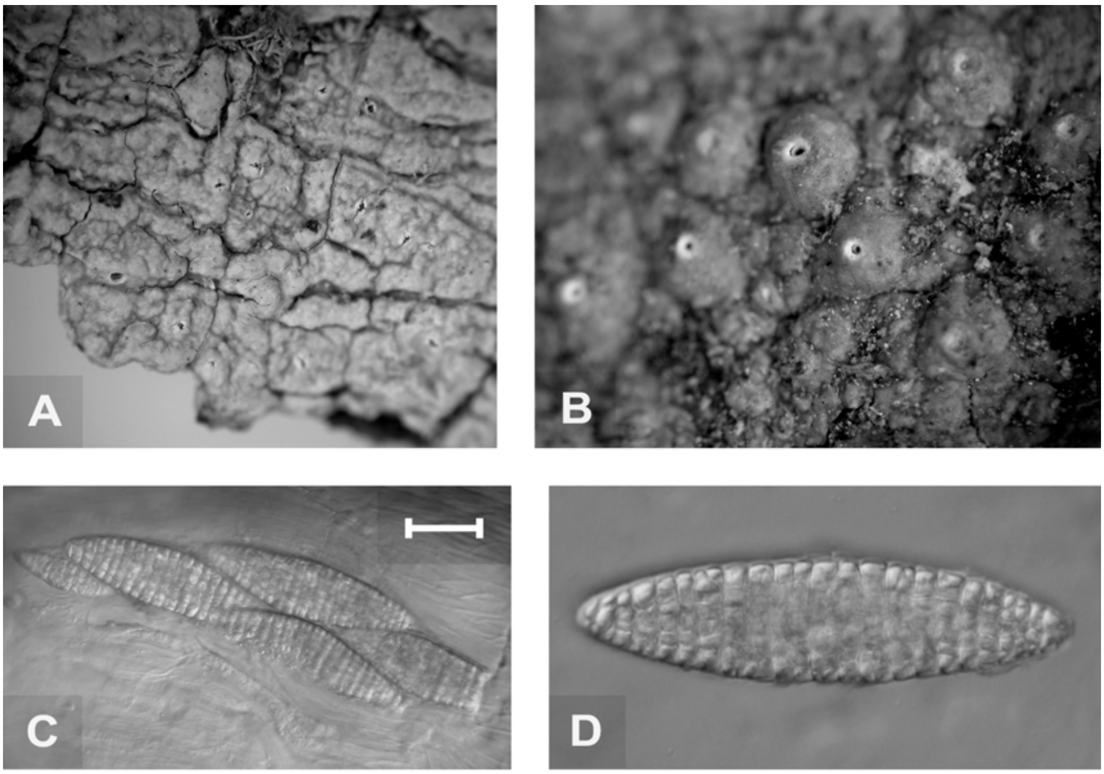

Fig. 128. *Thelotrema eungellaense*: growth habit (**A**), ascomata (**B**) and asccospores (**C, D**). A.: *Hale 832175*; B., D.: CANB-holotype; C.: *Hale 831311*. Bar= A: 1 mm; B: 0.65 mm; C: 25 µm; D: 25 µm.

CHEMISTRY – Thallus K+ orange-red, C-, PD-; containing norstictic (major) and connorstictic (minor to trace) acids.

ECOLOGY AND DISTRIBUTION – *Thelotrema eungellaense* grows on tree bark in tropical highland rainforests in altitudes ranging from 600-1500 m. It is moderately common in northern Queensland and is currently only known from there.

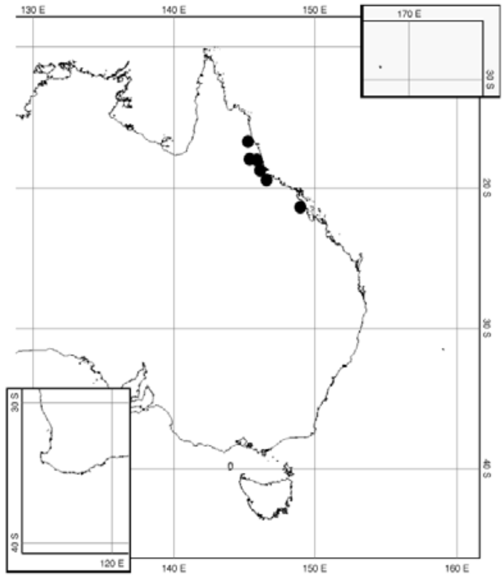

Fig. 129. Australian distribution of *T. eungellaense*.

NOTES – This taxon is characterized by a verrucose, corticate thallus, perithecioid ascomata with a ±free proper exciple, large, densely eumuriform, hyaline, thin-walled, non-amyloid or indistinctly amyloid ascospores, and the norstictic acid chemosyndrome. It is similar to *T. porinaceum*, which differs by larger ascospores (up to 230 µm long). Another similar species is the paleotropical *T. weberi*, this taxon differs by a thin, evanescent thallus and large, smooth, urceolate, wide-pored ascomata and distinctly amyloid, thick-walled ascospores.

SPECIMENS EXAMINED – Australia, Queensland: Mt. Windsor Rd., NW of Mossman, *Hale 831310, 831311* (US). Mt. Windsor logging area, NW of Mossman, *Hale 830842, 832175* (US). Mt. Lewis Rd., W of Mossman, *Hale 830625, 830643, 832172, 832399, 832620, 832659, 832661* (US). Davies Creek Rd., S of Davies Creek Falls NP., *Hale 830662, 830631, 830864* (US). Atherton Tablelands: Plath Rd. logging head, S of Atherton, *Hale 830649, 831845, 831944, 832641* (US); Mt. Hypipamee NP., *Hale 830646, 832814* (US); Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Mangold 30 y* (F); 10 km S of Ravenshoe on Tully Falls Rd., *Hale 831016* (US). Bellenden Ker NP., centre peak, *A. & M. Aptroot 22484, 22512* (ABL). Dawson logging area, WSW of Tully, *Hale 830698, 830905, 830906, 832136, 832520, 832660, 832663, 832693* (US). Culpa Logging area, SE of Tully Falls, *Hale 830628, 830703, 832190, 832137, 832584, 832652* (US). Mt. Spec NP., WNW of Townsville, *Hale 830632, 830647, 830648, 830659, 830722, 80915, 831608, 832134, 832545, 832774* (US). Eungella NP.: Rd. to rainforest at NP. margin, *Lumbsch & Mangold 19110 d* (F); Rosser Rd. entry point off Darymple rd., *Hale 831525, 831740* (US).

Thelotrema foveolore Müll. Arg.

Nuov. Giorn. Bot. Ital. 23: 129 (1891). Type: Japan, Tosa, (com. Miyoshi 110), *Yoshinaza 26* (G!-holotype).

ILLUSTRATION – Fig. 130.

Thallus epi- to hypophloedal, (moderately) thin, up to c. 150 µm high, grayish to yellowish- or greenish-gray. Surface dull, smooth, continuous to verrucose, fissured to sometimes appearing areolate due to substrate structure. Cortex structures absent or with a usually thin, incontinuous protocortex up to c. 20 µm thick. Algal layer poorly developed, incontinuous, calcium oxalate usually abundant in ascomata area, otherwise sparse, small to large, clustered. Vegetative propagules not seen. Ascomata conspicuous, large, up to 1.2 mm in diam., roundish to slightly irregular, perithecioid when young, becoming apothecioid at maturity, solitary to marginally fused, ±distinctly emergent, predominantly (irregular-)subglobose to (irregular-)urceolate, sometimes flattened-cylindrical. Disc not visible from surface. Pores opening in late stages, relatively small, up to c. 400 µm, roundish to more often roundish-irregular to irregular, apical proper exciple visible from surface, becoming entirely

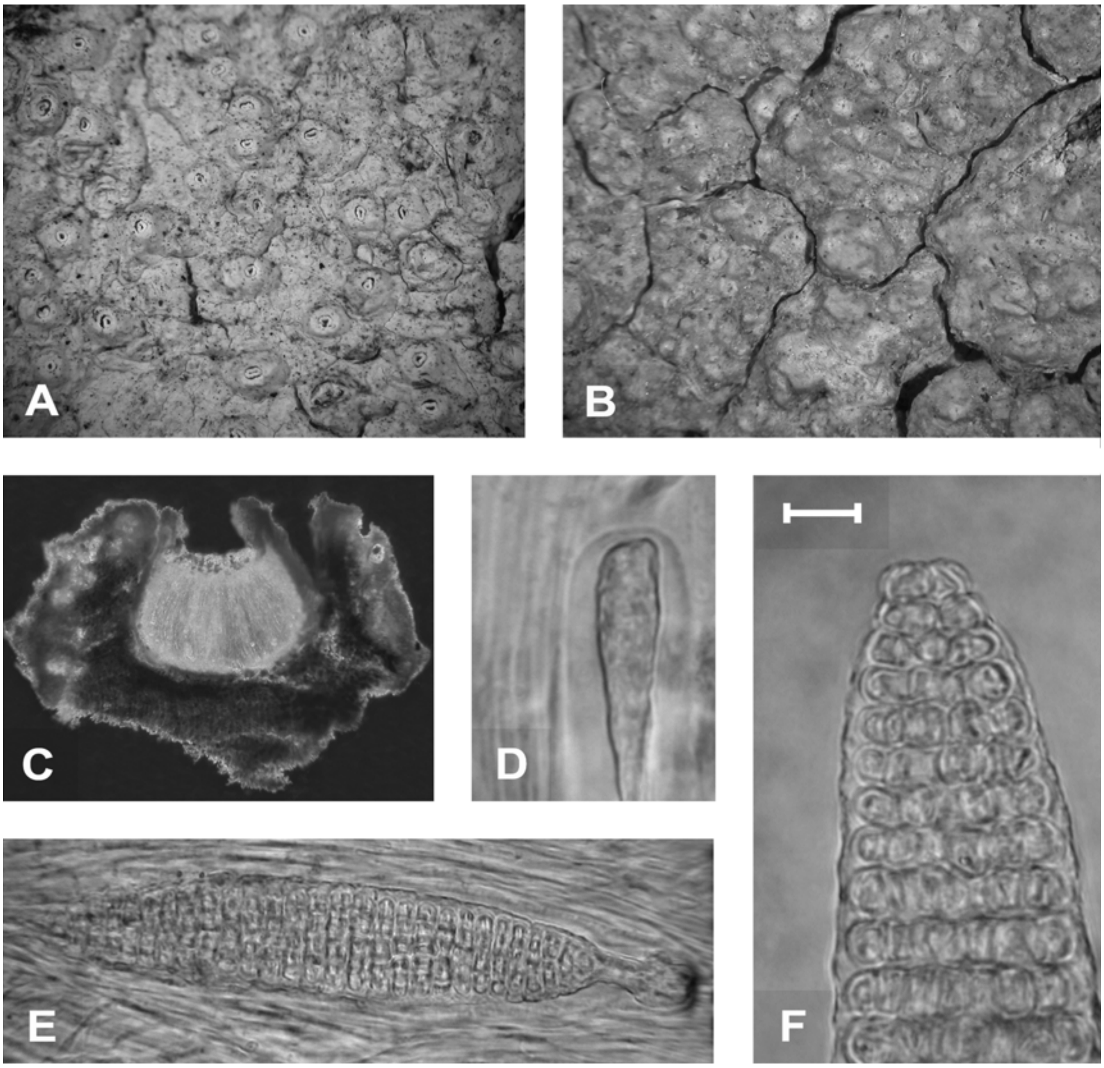

Fig. 130. *Thelotrema foveolare*: growth habit (**A, B**), ascoma section (**C**), asci (**D, E**) and ascospore detail (**F**). A., C., D.: *Hale 831230*; B.: G-holotype; E., F.: *Hale 83146*. Bar= A: 1.5 mm; B: 2 mm; C: 200 µm; D: 10 µm; E: 25 µm; F: 10 µm.

free, off-white, often shrunken, incurved to somewhat erect. Thalline rim margin roundish to irregular, (moderately) thick, wide to gaping, predominantly entire, incurved, concolorous with thallus to brownish due to protuberant substrate. Proper exciple becoming entirely free, moderately thick, hyaline internally, (pale) brownish to brownish-gray or grayish marginally, apically often covered by grayish granules, non-amyloid. Hymenium up to c. 300 µm high, non-inspersed, moderately conglutinated, paraphyses parallel or slightly interwoven, unbranched, tips moderately to distinctly thickened, lateral paraphyses present, inconspicuous, up to c. 20 µm long, columellar structures absent. Epihymenium variably thick, indistinct in younger stages to moderately thick in older ascomata, hyaline, with fine to coarse grayish or grayish-brown granules. Asci 1-spored, tholus absent, lateral ascus walls distinctly thickened, becoming thin when mature in lower parts. Ascospores (very) large, densely eumuriform, in early stages cell walls and endospore distinctly thickened, becoming moderately thin to moderately thick at maturity, non-halonate, hyaline to rarely somewhat yellowish in depauperate ascospores, loci strongly to opaque amyloid, cell walls and endospore non-amyloid, predominantly fusiform, with narrowed-roundish to subacute ends, loci large, roundish to slightly angular, subglobular to roundish-cuboid, transverse septae (moderately) thin, distinct, regular, 110-230(250) x 20-40(50) µm with multiple loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish, C-, PD+ yellow; containing psoromic and 2'-0-demethylpsoromic acids (majors).

ECOLOGY AND DISTRIBUTION – *Thelotrema foveolare* was collected in Australia on tree bark in tropical highland rainforests in altitudes ranging from 530 to 1200 m. It is a moderately common species occurring in northern and north-central Queensland. This is the first report for Australia, it is otherwise only known from Japan.

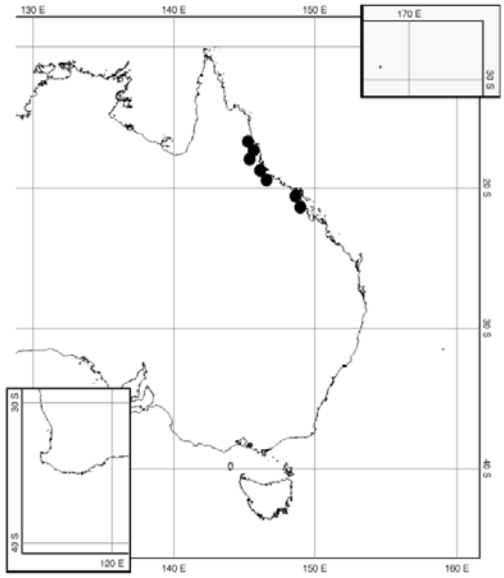

Fig. 131. Australian distribution of *T. foveolare*.

NOTES – *Thelotrema foveolare* is a uniform species, which is characterized by large, emergent ascomata with relatively small pores and free proper exciple, monosporic asci that lack a tholus but have distinctly thickened lateral walls, large, densely eumuriform, hyaline, ±thick-walled, amyloid ascospores, and the presence of the psoromic acid chemosyndrome. Ascospores with a similar reaction in iodine - the inner parts turning distinctly purple, cell walls and endospore remaining hyaline - can be found in *Topeliopsis azorica* and *Thelotrema laceratulum*, two taxa that otherwise differ in several characters (ascomata with ±lacerate thalline rim margins, ascospores not exceeding 160 µm in length, containing either stictic acid or lacking secondary compounds). Similar is *T. saxicola*, which can be readily distinguished by fused proper exciple and an inspersed hymenium. Similar species in Australia with different secondary chemistry are *T. porinaceum* and *T. rugatulum*. *Thelotrema porinaceum* shares the same ascus-type with *T. foveolare* but contains norstictic acid and is further distinguished by perithecioid ascomata at maturity. *Thelotrema rugatulum* lacks lichen substances, has asci with distinct tholus, at least in younger stages, and further differs in a slightly lower hymenium (up to 250 µm high) and ascospores without distinctly thickened walls. The type collection differs from Australian material slighly in having indistinctly emergent ascomata with tiny ostioles and resembles an immature sample. One Hale collection from Townsville area (*Hale 831887*) differs in less distinctly emergent ascomata, 8-spored asci with non- or faintly amyloid ascospores. This specimen is tentatively included here.

SPECIMENS EXAMINED – Australia, Queensland: Mt.Windsor logging area, near jct. rd. to old Forestry Camp and main rd., NW of Mossman, *Hale 831902, 832621, 832696* (US). Mt.Windsor, 5 km W of new Forestry Camp, NW of Mossman, *Hale 832688* (US). End of Clohesy River Rd. 16 km SE Kennedy Hwy., W of Cairns, *Hale 830835, 830879, 831900* (US). Atherton Tablelands: Lamb Range, near Mt. Haig, 23 km SE of Mareeba, *Streimann 57728 c* (B); Area below crater, Mt. Hypipamee NP., Dinner Creek Falls, S of Atherton, *Hale 831392, 831469, 832339* (US); SW of K-1 tree rd. off Palmerston Hwy., 11 km from main hwy. and 2 km N of S. Johnstone Forestry Camp, SE of Millaa Millaa, *Hale 830859* (US); Just S of hwy., 13-23 km E of jct. Kennedy Hwy. and Palmerston Hwy., E of Ravenshoe, *Hale 831277, 831284, 831908, 832176, 832511* (US). About 7.5 km E of Wallaman Falls, W of Ingham, *Hale 832245* (US). Mt.Spec NP., Ridge on the Loop, on the Paluma Rd., WNW of Townsville, *Hale 831887, 831921* (US). Cedar Creek Falls, SE of Mt.Julian, 33 km S of Airlie Beach, *Hale 831124* (US). Eungella NP., NP. side rd. nr. Peases Lookout, off Darymple rd., *Hale 830749, 831230, 831233, 831551, 831647, 831711* (US).

Thelotrema gallowayanum Mangold, Elix & Lumbsch

Bibl. Lichenol. 95: 465 (2007). Type: Australia, Queensland, Atherton Tablelands, Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Lumbsch & Mangold 19151 t* (CANB!-holotype; BRI!-isotype).

ILLUSTRATION – Fig. 132.

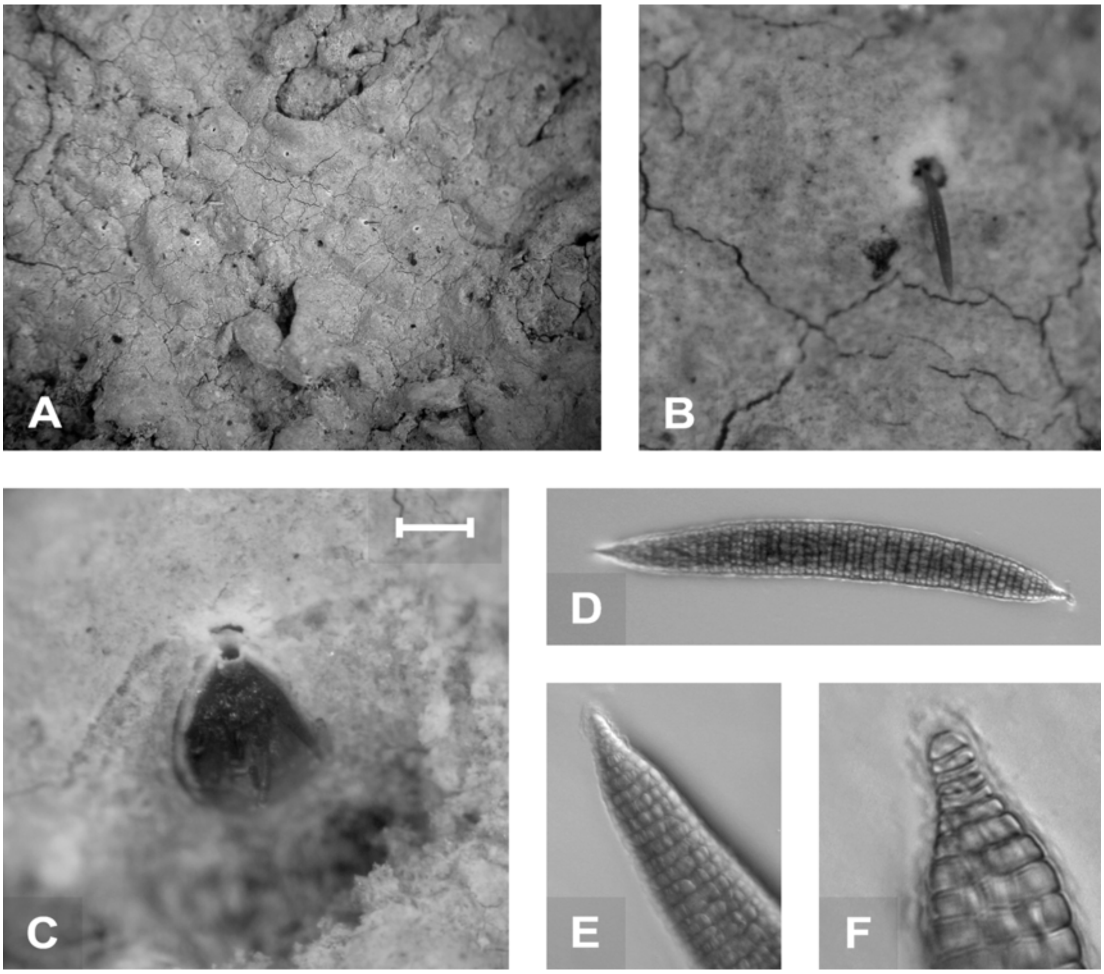

Fig. 132. *Thelotrema gallowayanum*: growth habit (**A**), ascoma with emerging ascospore (**B**), ascoma section (**C**), ascospore (**D**) and details of ascospores (**E, F**). A.-F.: CANB-holotype. Bar= A: 1.5 mm; B: 0.2 mm; C: 0.25 mm; D: 50 µm; E: 25 µm; F: 15 µm.

Thallus epi- to hypophloedal, thin to moderately thick, up to c. 400 µm high, pale grayish-green to pale yellowish-gray. Surface dull, smooth to roughened, continuous to more often verruculose to verrucose, fissured. Thallus covered by an incontinuous protocortex, up to c. 20 µm thick. Algal layer variable, continuous to incontinuous, moderately well to poorly developed, calcium oxalate crystals abundant, small to large, scattered to clustered. Vegetative propagules not seen. Ascomata inconspicuous, moderately large, up to c. 800 µm in diam., roundish, perithecioid, solitary, immersed to emergent, then predominantly hemispherical. Disc not visible from surface. Pores tiny to small, up to c. 120 µm in diam., roundish, entire, apical proper exciple sometimes becoming visible from surface, then forming a fused to more often entirely free inner pore margin, often ±sunken, incurved, predominantly off-white, otherwise pore margin formed by thalline rim. Thalline rim margin moderately thick, roundish, entire, concolorous with thallus to whitish or brownish, level with thalline rim, thalline rim not distinguishable from thallus in immersed ascomata, in emergent ascomata incurved, with same surface as thallus. Proper exciple partly fused to entirely free, thin, hyaline to pale yellowish internally, yellowish-gray marginally, non-amyloid. Hymenium up to c. 500 µm high, non-inspersed, moderately conglutinated, paraphyses thin, distinctly bent, parallel to slightly interwoven, unbranched, tips slightly thickened, lateral paraphyses present, inconspicuous, not conglutinated, up to c. 30 µm long, columellar structures absent. Epihymenium indistinct, hyaline, without granules or crystals. Asci 1- to very rarely 2-spored, tholus thick, moderately thin when mature. Ascospores typical, very large, densely eumuriform, cell walls and endospore (moderately) thin, non-halonate, brown to yellowish-brown at late stage of maturity, non-amyloid to faintly amyloid, predominantly oblong-fusiform, sometimes slightly irregular in outline, straight to slightly bent, ends typical, strongly tapered, forming distinct short conical appendixes with 3 - 6 transversely septate loci, loci roundish to angular, particularly in later stages, subglobose to oblong or irregular, transverse septae thin, remaining distinct and regular throughout development, 180-350(400) x 20-45(50) µm, with multiple loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ orange-red, C-, PD-; containing norstictic (major) and con-norstictic (minor to trace) acids.

ECOLOGY AND DISTRIBUTION – *Thelotrema gallowayanum* was grows on tree bark in (sub)tropical rainforests in altitudes ranging from sea level to 1100 m. It is moderately common and wide-spread in Queensland and the Queensland/New South Wales border region. So far it is only known from there.

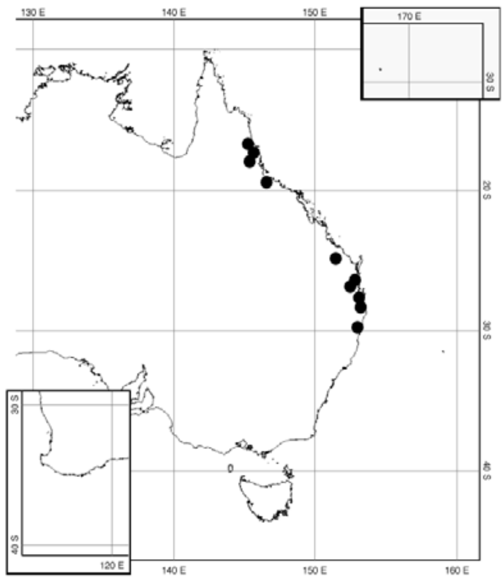

Fig. 133. Australian distribution of *T. gallowayanum*.

NOTES – This taxon can be easily identified by the inconspicuous, perithecioid ascomata, large, densely eumuriform, thin-walled, brown ascospores with tapered ends and the presence of norstictic acid. *Thelotrema eungellaense* and *T. porinoides*, both also with norstictic acid, are similar species in Australia, both readily distinguished by smaller, hyaline ascospores.

SPECIMENS EXAMINED – Australia, Queensland: Daintree NP., Mossman sct., lower Mossman River, *Mangold 36 m* (F). Mt.Windsor, 5 km W of new Forestry Camp, *Hale 830618* (US). Mt.Lewis Rd., 13 km N from Kennedy Hwy., *Hale 831237* (US). Davies Creek Rd., S of Davies Creek Falls NP., *Hale 830856* (US). Atherton Tablelands: SW of K-1 tree rd. off Palmerston Hwy., *Hale 832331* (US); Lake Barrine NP., *Hale 830756* (US); Mt.Hypipamee NP., *Hale 830627* (US); Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Lumbsch & Mangold 19151 b, f, g, r, s, zb, zc* (F); *Mangold 30 r, y* (F). Kalpowar Forest Drive, 40 km NE of Monto, *Hale 831712* (US). Bunya Mnts. NP., *Hale 831486* (US). Wooroi SF., W of Tewantin, *Hale 830655* (US). Mt.Spec NP., Paluma Rd., *Hale 830907* (US). Mt.Mee SF., 6 km NW of Forestry Office, *Hale 830844, 832727* (US). Lamington NP.: *A. & M. Aptroot 21834* (ABL); *Tibell 12713* (UPS). New South Wales: Iluka Nature Preserve: *Mangold 23 g* (F); *Hale 58718, 58734* (US).

Thelotrema lacteum Kremp.

in Nyl., Flora 47: 269 (1864). *Phaeotrema lacteum* (Kremp.) Müll.Arg., Flora 70: 398 (1887). Type: Australia, *com. Hochstetter* (M!-lectotype, selected by Hale [1981: 256]; H-Nyl. 22814!- isolectotype).

Phaeotrema consimile Müll.Arg., Flora 70: 398 (1887). Type: Australia, Queensland, Russell River, *Sayer* s.n. (G!-lectotype, here selected).

Thelotrema sitianum Vain., Étud. Lich. Brésil 2: 81 (1890). *Phaeotrema sitianum* (Vain.) Zahlbr., in Engler-Prantl, Nat. Pflanzenfam. 1: 119 (1905). *Thelotrema lepadodes* Tuck. ssp. *sitianum* (Vain.) Salisb., Lichenologist 5: 270 (1972). Type: Brazil, Minas Gerais, *Vainio - Lich. bras. exs. 565* (TUR-Vain. 26808!-lectotype, selected by Salisbury [1972: 270]).

Ocellularia cricota F.Wilson in Bailey, Bot. Bull. Dept. Agric., Queensland 7: 32 (1891). *Phaeotrema cricotum* (F.Wilson) Müll.Arg., Hedwigia 32: 130 (1893). Type: Australia, Queensland, Southport, *Wilson* s.n. (G-lectotype, selected by Hale 1981: 256] not seen; BRI-'Shirley Book', p. 22, n. 11 [BRI-AQ721231]!-isolectotype]).

Ocellularia zeorina Müll.Arg., Nuovo Giorn. Bot. Ital. 23: 394 (1891). Type: Australia, Brisbane, *Bailey 460 pr. p.* [with *O. profunda*] (G!-holotype). [The material in BRI-'Shirley Book', p. 22 notated as *O. zeorina* is the in Müller's description mentioned intermixed specimen determined as *Campylothelium nitidum* Müll.Arg.].

Ocellularia annulosa Müll.Arg., Bull. Herb. Boissier 3: 314 (1895). Type: Australia, Queensland, [app. Mt. Gravatt (Brisbane)], 1894, *Shirley* s.n. (G!-holotype; BRI-'Shirley Book', p. 21 [BRI-AQ721217]!-isotype).

ILLUSTRATION – Fig. 134.

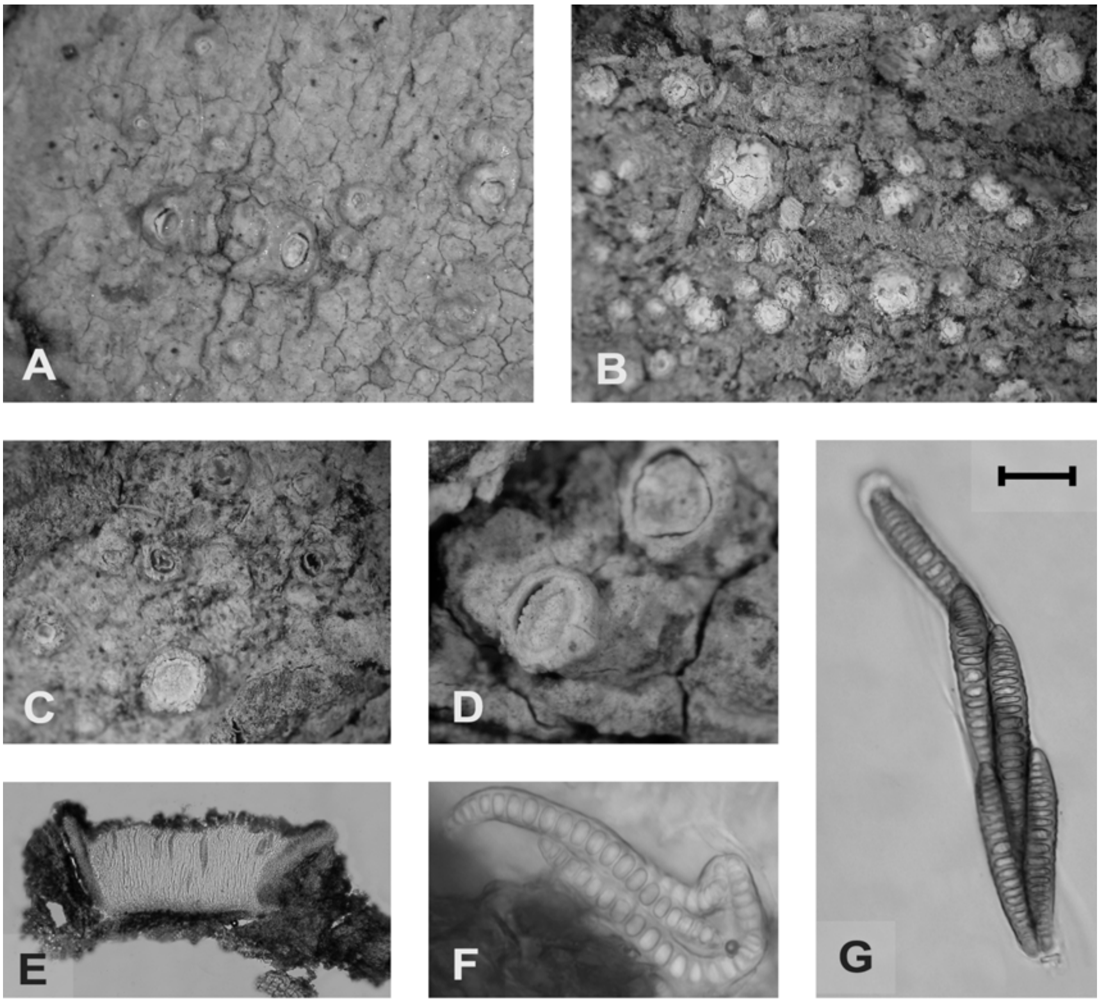

Fig. 134. *Thelotrema lacteum*: growth habit (**A, B**), ascomata (**C, D**), ascoma section (**C**), younger ascospores (**F**) and mature ascospores (**G**). A.: M-lectotype; B., C.: *Mangold 27 p*; D.: *Hale 34276*; E.: H-isolectotype; F.: *Hafellner 19629*; G.: TUR-lectotype of *T. sitianum*. Bar= A: 1 mm; B: 1.25 mm; C: 1.25 mm; D: 0.75 mm; E: 200 µm; F; 20 µm; G: 25 µm.

Thallus variable, thin to moderately thick, epi- to hypophloedal, up to c. 300 µm thick, pale gray to pale yellowish-gray or pale grayish-green. Surface dull to sometimes slightly shiny, smooth to rough, continuous to verrucose or verruculose, often ± fissured. Thallus predominantly covered by an ±continuous protocortex up to c. 30 µm thick, rarely becoming distinctly conglutinated forming a true cortex of periclinal hyphae. Algal layer variable, continuous to more often discontinuous, well to poorly developed, calcium oxalate crystals usually abundant, small to large, scattered or in clusters, sometimes sparse. Vegetative propagules not seen. Ascomata usually conspicuous, (moderately) large, up to c. 1 mm in diam., roundish to slightly irregular, apothecioid to more rarely somewhat chroodiscoid, somewhat erumpent to sessile, solitary to fused, ±distinctly emergent, predominantly (depressed-)urceolate to depressed cylindrical. Disc usually partly to entirely visible from surface, pale grayish to usually whitish, distinctly to strongly pruinose. Pores moderately wide to gaping, up to c. 800 µm in diam., roundish to (slightly) irregular, apical to upper proper exciple visible from surface, free, predominantly entire and ±jagged, sometimes eroded, whitish to off-white, often pruinose, incurved to more often erect or recurved, sometimes slightly shrunken. Thalline rim margin predominantly thick, roundish to slightly irregular, entire to more often distinctly split to lacerate, often eroded, concolorous with thallus, thalline rim concolorous and with same surface as thallus, predominantly erect to slightly recurved. Proper exciple free, (moderately) thick, pale yellowish internally, yellowish-brown to grayish-brown marginally, apically sometimes dark brownish and usually covered by grayish granules, ±distinctly amyloid at the base. Hymenium up to c. 200 µm high, non-inspersed, moderately conglutinated, paraphyses straight to slightly bent, parallel to slightly interwoven, unbranched, tips slightly thickened, somewhat irregular, lateral paraphyses present, sometimes inconspicuous, up to c. 30 µm long, columellar structures absent. Epihymenium predominantly thick, hyaline, with dark gray granules. Asci 4-8-spored, tholus thick, moderately thin when mature. Ascospores (moderately) large, transversely septate, cell walls moderately thick to very thick, becoming distinctly crenate in older stages, in younger stages with thick, irregular halo, hyaline, becoming distinctly brown usually in later stages of maturity or when decayed, moderately to strongly amyloid, oblong to oblong-fusi- to claviform with rounded to subacute ends, often ±bent, loci roundish to slightly angular, subglobose to lentiform, end cells hemispherical to conical, septae moderately thin to moderately thick, regular, (50)70-110(130) x 8-12 µm with (12)16-24(26) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Thelotrema lacteum* grows on tree bark in mangroves, beech forests, wet sclerophyll forest and rain forests in (sub)tropical to warm-temperate climates in altitudes ranging from sea level to 920 m. It is moderately common and wide-spread, occurring in northern and southern Queensland and northern and south-central New South Wales. It is also known from Brazil and Japan (Hale, 1981).

NOTES – The ascomata of this taxon are almost *Chapsa*-like with exposed and conspicuously bright discs and a erect to recurved proper exciple. It is further characterized by a pale, ecorticate to

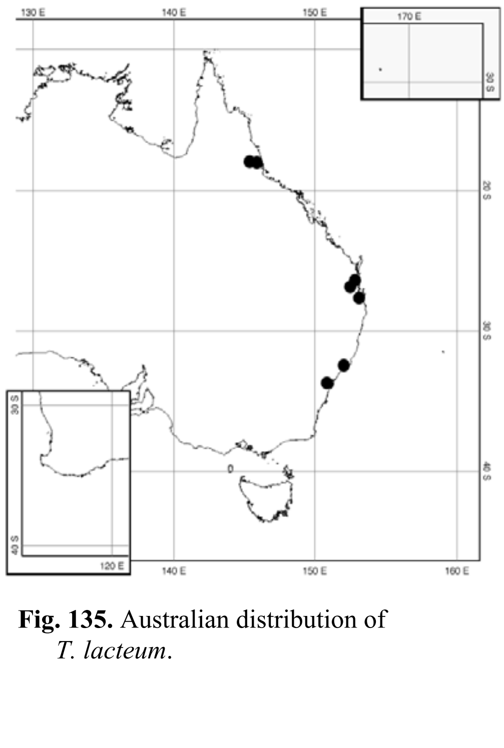

Fig. 135. Australian distribution of *T. lacteum*.

indistinctly corticate thallus, moderately large, transversely septate, narrow, thick-walled, indistinctly brown, amyloid ascospores and the absence of secondary com-pounds. A similar species is *T. pachysporum*, which has smaller (up to 75 µm long), broader ascospores. Specimens with young, unpigmented ascospores may be confused with *T. diplotrema*, which differs in having constantly hyaline ascospores and ascomata with darker, less distinctly pruinose discs and incurved to slightly erect, but never recurved proper exciple. The type specimen of *Phaeotrema consimile* is in poor condition and has ascomata with small, entire, almost round and slightly brown rimmed margins with hardly visible proper exciples. Since anatomically identical to the other examined collections, it is considered conspecific. Salisbury (1972) mistakenly identified *T. lepadodes* (= *T. monosporum*) with transverse septate ascospores (see also under remarks for *T. pachysporum*) and combined *T. sitianum* as a subspecies of *T. lepadodes*, differing in larger ascospores. The examination of the type revealed that it is conspecific with *T. lacteum*, slightly differing in somewhat larger ascospores. One collection from southern Queensland (*Rogers 2604*) has small-pored ascomata with an incurved exciple and ascospores that are consistently slightly above average (up to 130 µm) although the number of loci is in accordance with those usually found in *T. lacteum* (up to 26).

SPECIMENS EXAMINED – Australia, Queensland: Atherton Tablelands, Dunbulla Forest Drive, near Lake Euranoo parking lot, *Mangold 37 g* (F). Noosa River NE of Tewantin, about 70 km SE of Gympie, *Hafellner & Stevens 19629* (GZU). E of the Tingarana Lookout SE of Noosa Heads, *Hafellner & Stevens 16832* (GZU). Bunya Mountains, rd. from the ridge to Maidenwell, *Hafellner & Rogers 19688* (GZU). Mt. Tennison Woods, near Mt. Glorious, *Rogers 2604* (BRI). Moggill SF., Mt. Crosby, Brisbane, *Stevens 694628* (BRI). New South Wales: Watercatchment of the Karuah River, W of Stroud, *Filson 15317 b* (MEL). Myall Lakes NP., Mungo Brush Camping Area, *Mangold 27 a, h, n, p, y, z, ze* (F). Trail on eastern bank of Berowra Creek, 25 km NNW of Sydney, *K. & A. Kalb 34274, 34276* (hb. Kalb).

Thelotrema lepadinum (Ach.) Ach.

Meth. Lich.: 132 (1803). Bas.: *Lichen lepadinus* Ach., Lich. Suec. Prodr.: 30 (1798). Type: Sweden, Ostrogathia, *Acharius* s.n. (UPS-Ach.-lectotype, selected by Purvis & al. [1995: 344]).

Thelotrema aemulans Kremp., Verhandl. zool.-bot. Gesellsch. Wien 26: 453 (1876). *Leptotrema aemulans* (Kremp.) Müll. Arg., Bull. Herb. Boissier 2(1): 75 (1894). Type: New Zealand, hb. Krempelhuber n. 12, *Knight s.n.* (M!-holotype).

Thelotrema flavescens Darb. in Nordenskjöld, Wiss. Ergebnisse Schwed. Südpolarexpedit. 1901-1903, 4(4): 6 (1912). Type: Chile, Tierra del Fuego, Navarin Island, 04. Mar. 1902, *Skottsberg* s.n. (S!-holotype).

Thelotrema obconicum Raes., Arch. Soc. zool.-bot. fenn. Vanamo 3: 184 (1949). Type: Australia, New South Wales, Katoomba, Sept. 1889, *Wilson* s.n. (H!-holotype).

[For additional synonyms see Frisch 2006, Salisbury 1972 and Zahlbruckner 1923.]

ILLUSTRATION – Fig. 136.

Thallus epi- to hypophloedal, predominantly thin, up to c. 300 µm high, pale yellowish brown to pale grayish-green or pale olive. Surface dull to slightly shiny, smooth, continuous to distinctly verrucose, slightly to distinctly fissured. Cortex structures variable, predominantly an incontinuous protocortex present, up to c. 30 µm thick, in some parts, usually at thalline rim, becoming distinctly conglutinated forming a true cortex of irregular to periclinal hyphae. Algal layer usually ±well developed and continuous, often becoming somewhat incontinuous due to calcium oxalate crystal inclusions, calcium oxalate crystals ±abundant, small to large, scattered to clustered. Vegetative propagules not seen. Ascomata usually conspicuous, moderately large to very large, up to c. 2 mm in diam., roundish to sometimes slightly irregular, apothecioid, sessile, solitary to sometimes marginally fused, distinctly emergent, hemispherical to more often urceolate or subglobose, with same surface as thallus to often more distinctly shiny. Disc sometimes becoming partly visible from

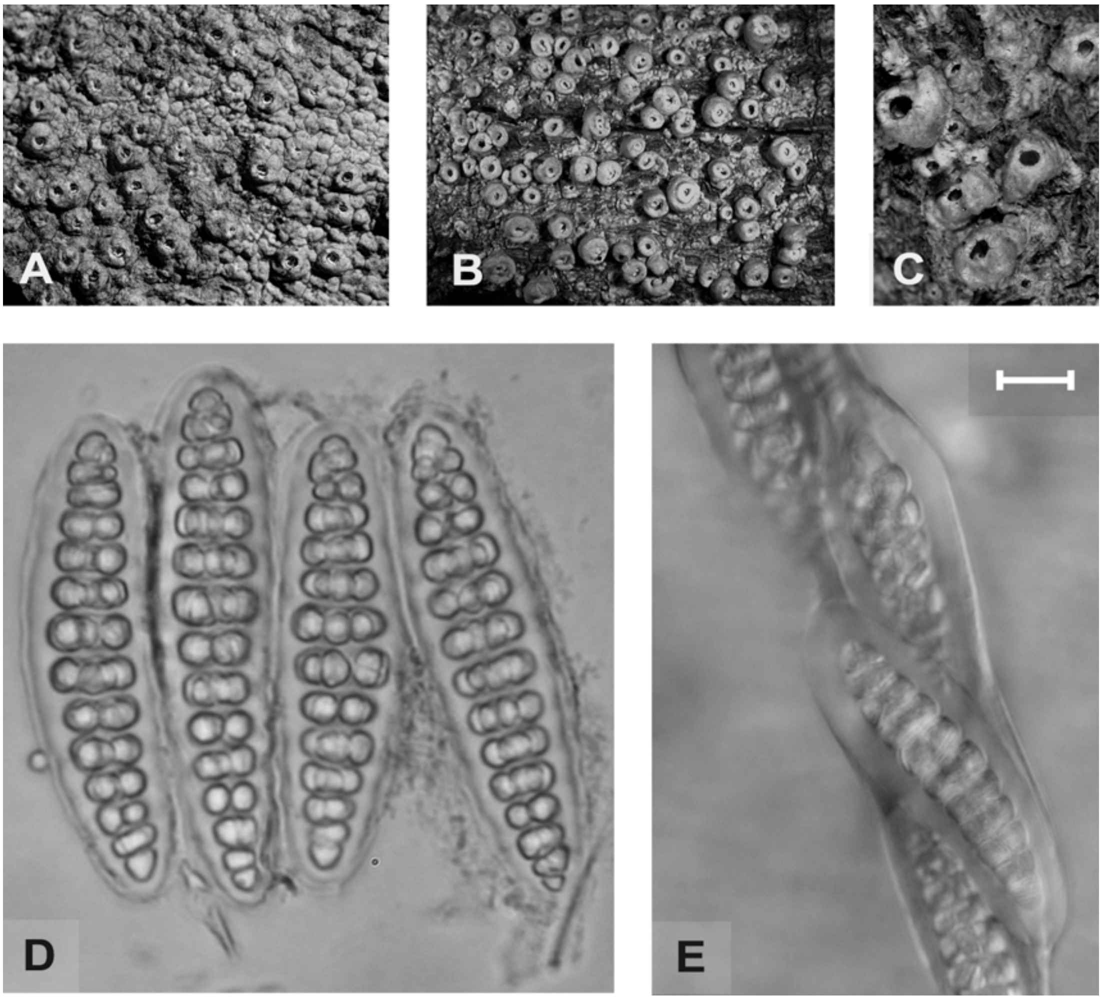

Fig. 136. *Thelotrema lepadinum*: growth habit (**A**), ascomata (**B**), ascoma and thallus section (**C**), pycnidia (**D**), condidia (**E**), ascospores (**F**) and same ascospores shwowing amyloid reaction (**G**). A.: *Verdon 3882*; B.-G.: CANB-holotype. Bar= A: 1.5 mm; B: 1 mm; C: 150 µm; D: 0.1 mm; E: 5 µm; F, G: 4 µm.

surface, grayish to brownish, indistinctly pruinose. Pores small to moderately wide, up to c. 500 µm in diam., roundish to more often irregular, entire to split, apical to more often entire proper exciple visible from surface, free, usually shrunken, apically bright, bright yellowish towards the base, incurved. Thalline rim margin thin to thick, entire to somewhat eroded, ±roundish to more rarely slightly elongate, usually becoming wide to gaping, incurved to somewhat erect, predominantly concolorous with thallus. Proper exciple free, (moderately) thin, hyaline to pale yellowish internally, yellowish to brownish or grayish marginally, non-amyloid. Hymenium up to c. 200 µm high, non-inspersed, moderately conglutinated, paraphyses parallel to slightly interwoven, unbranched, tips slightly thickened, lateral paraphyses present, usually conspicuous, up to c. 40 µm long, columellar structures absent. Epihymenium moderately thin, hyaline, with grayish to brownish granules and small crystals. Asci 4-8-spored, tholus (moderately) thick, usually not visible at maturity. Ascospores typical, (moderately) large, submuriform in younger stages to eumuriform at maturity, cell walls thick to very thick, endospore usually only slightly thickened, with thin to moderately thick, often distinctly irregular halo, hyaline, non-amyloid to faintly amyloid, predominantly fusiform to ellipsoid to more rarely clavate, ends narrowed-roundish to subacute, loci predominantly roundish, subglobose to flattened-subglobose to more rarely lentiform, end cells usually subglobose to slightly conical, septae thin to moderately thick, distinct throughout development, ±regular, 60-140 x 15-30 µm with 12-22 x 1-6 loci. Pycnidia not seen (reported by Frisch 2006, for descriptions see there).

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Thelotrema lepadinum* grows on tree bark in rainforests, wet and dry sclerophyll forests, heath shrubs, Karri-forests and swamplands in temperate to sub-tropical regions in altitudes ranging from sea level to 1500 m. It is the most frequently collected species in southern Australia and widespread in temperate, oceanic Australia. It is the only species of the family with trentepohlioid photobiont occurring in south-western Australia. It further occurs in southern Queensland, New South Wales (incl. Lord Howe Island), Victoria and Tasmania. It is a subcosmopolitan species that is known from all continents except Antarctica (Frisch, 2006).

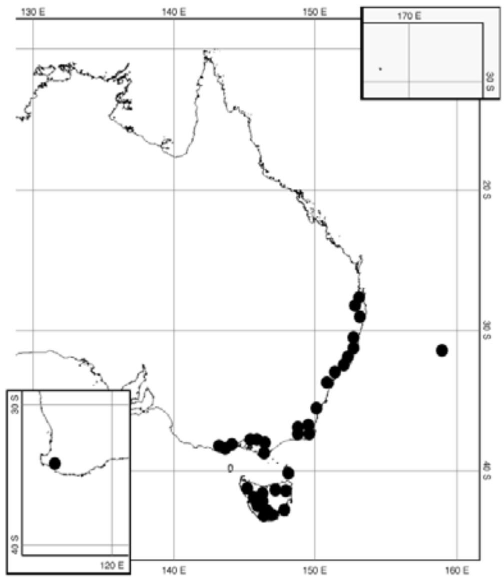

Fig. 137. Australian distribution of *T. lepadinum*.

NOTES – This species is characterized by a thin thallus, distinctly emergent, large ascomata with free, basally yellowish proper exciple and an entire, roundish thalline rim margin, (moderately) large, indistinctly muriform, hyaline, non- to faintly amyloid, thick-walled ascospores and the absence of secondary compounds. Several species of the *Thelotrema* s. str. group are morphologically close, particularly *T. crassisporum* (see there for differences). The temperate taxa *T. subtile* and *T. suecicum* are also similar (the latter often found growing in immediate proximity), both, however, are distinguished by smaller ascomata and transversely septate ascospores. *Thelotrema adjectum* has similar ascospores but differs in its morphology, *T. lepadodes* differs in ascospores that turn brownish at maturity (see also under that species). *Thelotrema subgranulosum* from Tasmania might represent an additional synonym, unfortunately the type collection was not available and is probably lost, see also under this species (appendices, part 5. 2.).

SPECIMENS EXAMINED – Australia, Western Australia: The Cascades: 8 km S of Pemberton, *Elix 10703* (CANB); 4 km S of Pemberton, *Elix 41100, 41101, 41112* (CANB), *Lumbsch, Elix & Streimann 10789 a, 10791 c* (F). Warren NP.: 10-11 km SW of Pemberton, *Elix 41233, 41238* (CANB); At Warren River, *Tibell 14027* (UPS). Near jct. of Heartbreak Trail and Old Vasse Rd., 10 km WSW of Pemberton, *Kantvilas & Jarman 349/92* (HO, PERTH). Darling: Karri forest, Pemberton, *Baird 19741* (MEL); Beedelup Falls, WNW of Pemberton, *Beauglehole 1035131* (MEL). Queensland: Mt. Mee SF., about 1 km NW of the forest station, *Hafellner 16869* (GZU). Gambubal SF., Cons Plain (Bald Mtn.) E of Emu Vale, *Hafellner 16399, 16402* (GZU). New South Wales: Mt.Warning, track to and on summit, *Mangold 18 a, l* (F). Border Ranges NP., NE of Wiangaree: McPherson Range, uppermost part of Gradys Creek, *Hafellner 16653* (GZU); Tweed Range, The Pinnacle, *Hafellner 19180* (GZU). Nightcap NP., Mt. Nardi/Mt. Matheson Track, *Mangold 22 j* (F). Dorrigo SF., near Dorrigo, *Hale* s.n. (US). Dorrigo NP., Never Never Picnic Area and Rosewood Creek Track, *Mangold 24 k, q* (F). Gully W of radar tower adjacent to New England NP., *Rogers 10312* (BRI). New England NP.: Above visitors' center, *Hale 58774, 58778, 58782, 58834* (US); Track to Wrights Lookout, *Elix 33931* (CANB); Radar Station Site, 1,5 km NW of Point Look Out, *Kalb & Wiliams 20397, 20398, 20428, 20435, 20446, 20449, 20451, 21213, 21232, 21397, 21927* (hb. Kalb). Styx River SF., 85 km E of Armidale: *Kalb & Wiliams 21674, 21676* (hb. Kalb); Softwood Rd., *Rogers 10059* (BRI). C. 1 km W of Mt. Banda Banda, *Kantvilas* s.n. (NSW-219642). Barrington Tops SF., 40 km WNW of Gloucester: Dilgry River, Dilgry Circle Rd., *Elix 24939, 24968* (CANB); *Streimann 44614* (B, CANB); Barrington Tops Forest Rd., *Elix 24870, 24875* (CANB). Barrington Tops NP.: Gloucester Tops: *Kantvilas* s.n. (NSW-226538), W of Darby Munro Hut, *Filson 1035799* (MEL); Thunderbolt Lookout,. (NSW-231139); Mt. William, *Kantvilas 287/88* (NSW-221286), (HO). Allyn River

Forest Park: Start of track to Burraga swamp, *Kantvilas* s.n. (NSW-216962); Burraga Swamp, *Kantvilas 165/88* (HO, NSW-219642), *229/88* (HO). Old mill site c. 6 km N of Simsville and c. 30 km NW of Stroud, *Filson 1048795* (MEL). Duck Creek Rd., 22 km WNW of Buladelah, *Elix 24412, 22414* (CANB). Trail along bank of Mill Creek, 50 km NW of Sydney, *K. & A. Kalb 34271* (hb. Kalb). Blue Mountains NP.: Mt. Wilson: *Weber 220972, 229409* (COLO), *Ewers 3095* (CANB), *Kantvilas* s.n. (HO), Chimney Cottage, *K. & A. Kalb 20485, 20578* (hb. Kalb); Near Blackheath, below Bridal Veil Falls, *Hale 58671, 58675* (US); Cathedral Reserve circuit walk, *Stajsic 2147425* (MEL). Mt. Tomah c. 20 km N of Katoomba, *Thor 6171* (S). Katoomba, track between Leura Falls and Giant Stairways, *K. & A. Kalb 20580, 20582, 20587, 20588, 20598* (hb. Kalb). 'National Park' [Royal NP.], *Cheel 539350* (NSW). Stanwell Park [S of Royal NP.], *Cheel 539351* (NSW). Monga SF./NP.: Clyde Mt., below the rd., *Elix 972* (CANB); Milo Road, *Streimann 43597* (CANB); 27 km SE of Braidwood, *Mangold 11 a, l, y, z* (F); 4-6 km S of Monga along Mungarlow River, *Miller 426, Verdon 1349, Elix 11714, 22692, 22696, 30223* (CANB), *Kalb & Elix 21811, 21817, 21852* (hb. Kalb), *Mangold 13 e* (F). Glenbog SF., 13 km ESE of Nimmitabel: Headwaters, Bemboka River, Bemboka River Rd., *Streimann 43881* (B, CANB); Fastigata Rd., *Streimann 43849* (CANB). Rutherford Creek, 11-17 km SE of Nimmitabel, *Streimann 16755, Elix 24290, 40813, 40840* (CANB). Brown Mt., 30 km SE of Nimmitabel, *Kalb & Elix 30427*, *30430, 30437, 30443* (hb. Kalb). Lord Howe Island, Track to Goat House Cave, *Elix 42187* (CANB). Victoria: Uncertain localities: 'Waterloo Gypsland' [=Waterloo Bay, Wilsons Promontory], *Paton* (BM-761914, -761915); 'Cunningham', *Wilson* s.n. (NSW-603860). Croajingolong NP., Double Creek Nature Walk, *Mangold 9 b* (F). Result Creek, Bendoc-Orbost Rd., 13 km SW of Bendoc, *Elix 19837, 19839, 19871, 19873, 24146, Streimann 36530* (CANB). Hensleigh Rd., Queensborough River, 13 km SE of Bendoc, *Elix 24081* (CANB). From Headwaters of West Errinundra River, Errinundra Plateau, *Chesterfield 1060710, 1060741, 1060720, 1060178* (MEL). Errinundra NP.: Goonmirk Rocks, 14 km S of Bendoc, *Elix 21877, 24190, 24204* (CANB); Coast Range Rd., 18 km SSE of Bendoc, *Elix 21929, 24027* (CANB); Hammonds Rd., 19 km SSW of Bendoc, *Elix 24169* (CANB). Jct. of Coast Range Rd. and Cobon Rd., 18.5 km SSE of Bendoc, *Streimann 36708* (CANB). Ellery Camp, 30 km SSW of Bendoc, *Elix 21442* (CANB). Club Terrace-Combienbar rd., 6 km N of Club Terrace, *Elix 19516* (CANB). Bemm River, Princes Hwy., 8 km SSW of Club Terrace, *Elix 19465* (CANB). Fernshaw at Watts River, NE of Healesville, *Hafellner 18397* (GZU). Bonang rd., NE of Orbost, *Mangold 8 a, f, h* (F). Arte River, 30 km NE of Orbost, *Elix 24212, 24215, 24223* (CANB). Lake Wat Wat, Dec. 1888, *Wilson* s.n. (NSW-518306, -539317). Lake Tyers, Mar. 1888, *Wilson* s.n. (NSW-539319). Lakes Entrance, *Wilson* s.n. (NSW-539328). Baw Baw NP., Mt. Erica carpark at start of walking track to Mt. Erica summit, *Ford 2075897* (MEL). Moe Swamps [Moe], s.c. (MEL-26230). Strzelecki SF.: N of Grand Ridge Rd., 24.5 km SSE of Taralgon, *Elix 29772* (CANB); Grand Ridge Rd., c. 3 km E of Gunyah Junction, 17 km NE of Foster *Elix 29824* (CANB). Head of Franklin River, Thora-Gunyah Rd., 16 km NE of Foster, *Streimann 65294* (B, CANB). [Tarra-]Bulga NP., Lyrebird-Ash Track, 26 km ESE of Traralgon, *Elix 29742, 29765 Streimann 51644* (CANB). Korumburra, 26. Jan. 1894, *Wilson* s.n. (NSW-539330). Wilsons Promontory NP.: Chinamans Creek, *McVean 6557* (COLO); On Sealers Cove hiking track, *Mangold 6 a, c, e, i, m* (F). 90 km ENE of Melbourne, Cumberland Falls scenic reserve, Cora Lynn Falls, *Thor 6030* (S). Wallaby Ck. Reserve, nr. Kinglake West, *Willis 1023625* (MEL). Cumberland Valley at falls, c. 16 km E of Marysville, *Filson & Mayrhofer 508* (BM, CANB, H, US). Headwaters of Whitehouse Creek between Keppels Hut and Mt. Margaret, *Filson 1023602* (MEL). Mt. Margaret Saddle, Blue Range, *Filson 1052096* (MEL). Along rd. to Lake Mountain [nr. Yarra Ranges NP.], *Kantvilas* s.n. (HO). Cement Creek Scenic Reserve, 5.5 km N of Warburton, *Lumbsch, Dickhaeuser & Streimann 10974 a* (F). River Watts [Yarra Ranges], 1891, *Wilson* s.n. (NSW-539318). Black Spur [Yarra Ranges], *Wilson* s.n. (NSW-170675), 20. Mar. 1885 (NSW-539321), 23. Mar. 1885 (NSW-539315), Feb. 1888 (NSW-603849, -603850), 1888 (NSW-603841, -603857, -603865), Jan. 1890 (S), 12. Nov. 1900, *Bastow* s.n. (MEL-26232). Warburton, *Wilson* s.n. (NSW-603853), 28. Feb. 1902, *Bastow* s.n. (MEL-26168, -16233). Gembrook [W of Bunyip State Park], 27. Oct. 1901, *Bastow* s.n. (MEL-26234). Ferntree Gully [W of Melbourne]: 1875, *Paton* s.n. (BM-761910, -761913, -761923), 28. Jan. 1892, *Wilson* s.n. (NSW-603859), *Bastow 26166, 26231, 724547* (MEL). Ottway Range: *Ewers 7260* (CANB); Todds Corner, Mt. Sabine Rd., *Elix 25862* (CANB); Arkins Creek, watercatchment area in the Otway District, *Filson 1023605* (MEL); gray River Rd., Angahook-Lorne SF., 17-28 km NE of Apollo Bay, *Streimann 58867, 58945* (CANB), *58962* (B, CANB); 14 km N of Apollo Bay, *Mangold 5 h* (F); Beauchamp Reserve, Otway SF., 13 km NNW Apollo Bay, *Streimann 58839* (CANB); Skene Creek-Colac rd., 13 km ENE of Apollo Bay, *Streimann 42860* (CANB); 10 km N of Apollo Bay, *Mangold 3 b, f, I* (F); Barham R. Rd.-Apollo Bay, *Ewers 639920* (CANB); Binns Rd., 8 km WNW of Apollo Bay, *Streimann 42672* (CANB); Maits Rest, Ocean Rd., 10 km W of Apollo Bay, *Streimann 58645* (CANB). Ottway NP.: 10 km W of Apollo Bay, *Mangold 1 a* (F); Sandy Ridge Track Spur, 12 km W of Apollo Bay, *Elix 25920, 25929, 25935* (CANB); Lighthouse Rd., 11 km WSW of Apollo Bay, *Curnow 1344* (CANB). Johanna River, Melba State Park, Lavers Hill, 26 km WNW of Apollo Bay, *Streimann 58485, 58509* (CANB). Melba Gully, *Ewers 3436, 3437* (CANB). Cobden, Devils Gully, 20. Jan. 1885, *Wilson* s.n. (NSW-539316). Lake Elingamite [SW of Cobden], 15. Jan. 1885, *Wilson* s.n. (NSW-539320). Tasmania: Furneaux Group, Strezelecki Peaks, Flinders Island, Bass Strait, *Filson 1023573* (MEL). Mt. Victoria Track, *Kantvilas 54/81* (BM, HO). South Sister, near summit, *Kantvilas 392/04*, *409/04* (HO). Betw. Pyengana and Weldborough, *Ewers 931* (CANB). Mt. Arthur, 23. Feb. 1891, *Wilson* s.n. (BM-726585, NSW-539394, UPS). Cheshunt [State Forest], 1867, *Archer* s.n. (BM-761894, -761896, -761897, -761898, -

761899, -761900, -761985). Near Projection Bluff, Lake Highway, *Kantvilas 157/80* (BM, HO). Quamby Bluff, c. 15 km SSE Deloraine, along track from Lake Highway, *Wedin 3135* (UPS). Warners Sugarloaf, 18.5 km S of Deloraine, *Curnow 2023* (CANB). Gog Range, Mole Creek- Paradise Rd., 13 km SSE of Sheffield, *Elix 26752, 26757, 26762* (CANB). Rd. from Daisy Dell to Murchison Hwy., 17 km W of Daisy Dell, *Elix 26804, 26833* (CANB). Robbins Island Track, just N of Denium Hill, 25 km NW of Smithton, *Elix 40257, 40262, 40270, 40277* (CANB). Golden Valley, nr. Chestnut, *Bratt 2428* (BRI). Sumac Spur 2, S of Arthur river, *Kantvilas* s.n. (BM-761920). Hellyer Gorge, *McVean 6835* (CANB). Murchison Hwy., 57 km S of Bass Hwy., S of Hellyer Gorge, *Hale 68793* (US). 6 km S of Warratah Hwy. jct. with the Murchinson Hwy., *Hale 68727* (US). Doherty's Cradle Mountain Hotel grounds, *Kantvilas 417/03* (HO). Cradle Mountain Lodge, 37 km NE of Rosebery, *Elix 23747* (CANB). Along the 'king billy track', Cradle Mountain Lodge, *Elix 23598* (CANB). SE foothills of Mt. Black, *Kantvilas 17/89* (HO). Near Williamsford, 6 km SSW of Rosebery, *Elix 26874, 26880* (CANB). Anthony Rd., *Kantvilas 194/91* (M), *577/92* (HO). Cradle Mtn. Lake St Clair NP., Pelion Plains, 1 km SW of Pelion Hut, *Kantvilas 211/92* (HO). Corinna, *Kantvilas 55/82* (HO). Zeehan, *Fitzgerald 539325* (NSW). 10 km W of Strahan, along the Queenstown rd., *Elix 5647* (CANB). 3 km S of Teepookana, *Kantvilas 665/90, 670/90* (HO). Timbs Track, 27 km WSW of Maydena, *Elix 27142, 27145* (CANB). Scotts Peak Rd., *Kantvilas 433/80* (HO). W of Tahune Bridge, "Strips" Coupe CFI Plot in the Warra SST, *Kantvilas* s.n. (HO). Along Cracroft River near Cracroft Hut (Cracroft Crossing), *Filson 1023608* (MEL). Mount Field NP.: Near Russell Falls, 55 km WNW of Hobart, *A. & M. Aptroot 23297* (ABL); Lyrebird Trail, *Hale 68758* (US). Myrtle Forest, *Bratt* s.n. (BM 761917). Lonnavale, *Bratt* s.n. (BM 761916). Track to Kermandie Falls, *Gray* s.n. (HO). SW Deadmans Bay, South Coast, *Moscal 14095* (HO). De Witt Island, *Elix 3332, 3340* (CANB). Five Road, Florentine Valley, *Kantvilas 289/80* (B, HO). Mt. Wellington: *Wilson* s.n. (NSW-539322); East slope, *A. & M. Aptroot 22806* (ABL). Wielangta Rd., site E12 [WNW of Hobart], *Kantvilas* s.n. (HO). Uncertain locality: *Turner* s.n. (BM-761902). 'Shirley Book', p. 121 (BRI-AQ721649, -AQ721650, -AQ721651). [Herb. Kremp., 1883], *Hochstetter* s.n. (M-34706).

Thelotrema lepadodes Tuck.

Proc. Amer. Acad. Arts Sci. . 5: 405 (1862). *Leptotrema lepadodes* (Tuck.) Zahlbr., Cat. Lich. Univ. II: 636 (1923). Type: Cuba, Filanthropia, *Wright* s.n. (FH-Tuck.-lectotype, selected by Hale [1978b: 52]; FH-Tuck.-isolectotype).

Thelotrema monosporum var. *patulum* Nyl., Acta Soc. Sci. Fenn. 7: 452 (1863a). *Leptotrema patulum* (Nyl.) Müll. Arg., Bull. Herb. Boissier 3: 315 (1895b). Type: Colombia (Nova Granata), 1860, *Lindig* s.n. (H-Nyl.22715-lectotype, selected by Hale [1978b: 52]; H-Nyl.22717-isolectotype).

Thelotrema disciforme Leight., Trans. Linn. Soc. London 27: 170 (1869). *Phaeotrema disciforme* (Leight.) Hale, Smithsonian Contrib. Bot. 16: 29 (1974b). Type: Sri Lanka (Ceylon), Central Prov., *Thwaites C.L. 128 pr.p.* (BM!-lectotype, selected by Frisch [2006: 300]; H-Nyl. 3851-isolectotype).

Leptotrema aemulum Müll. Arg., Bull. Herb. Boissier 3: 316 (1895). Type: Australia, Queensland, 1887, *Knight 27 + 295* [same specimen] (G!-[*Knight 295*]-lectotype, selected by Hale [1972 in herb.]; G!-[*Knight 27*]-isolectotype).

Leptotrema bisporum Szatala, Ann. Mus. Nat. Hungar. n.s.7: 30 (1956). Type: Solomon Islands, ('Nova Guinea'), Berlinhafen, Seleo Isl., *Biro 254* (BP!-holotype).

[For additional synonymy see Frisch 2006 (as *T. monosporum*), but see also note on *T. saxatile* below.]

ILLUSTRATION – Fig. 138.

Thallus epi- to predominantly hypophloedal, very thin to thin, up to c. 150 µm high, pale gray to yellowish-gray. Surface dull to somewhat glittering, smooth to more often roughened, often due to protuberant substrate, predominantly continuous, predominantly unfissured, sometimes appearing fissured due to substrate structure. Cortex structures absent or covered by a thin, incontinuous protocortex up to c. 15 µm thick. Algal layer poorly developed, continuous to incontinuous, calcium oxalate abundant to more rarely sparse, usually small to more rarely large, scattered to more rarely clustered. Vegetative propagules not seen. Ascomata conspicuous to inconspicuous, (moderately) large, up to c. 900 µm in diam., roundish, apothecioid, ±sessile, solitary to marginally fused, becoming ±distinctly emergent, hemispherical to urceolate with same surface than thallus. Disc becoming partly visible from surface, pale grayish to dark gray, distinctly pruinose. Pores moderately small to usually wide or gaping, up to c. 700 µm, roundish to more rarely roundish-irregular, entire to slightly split,

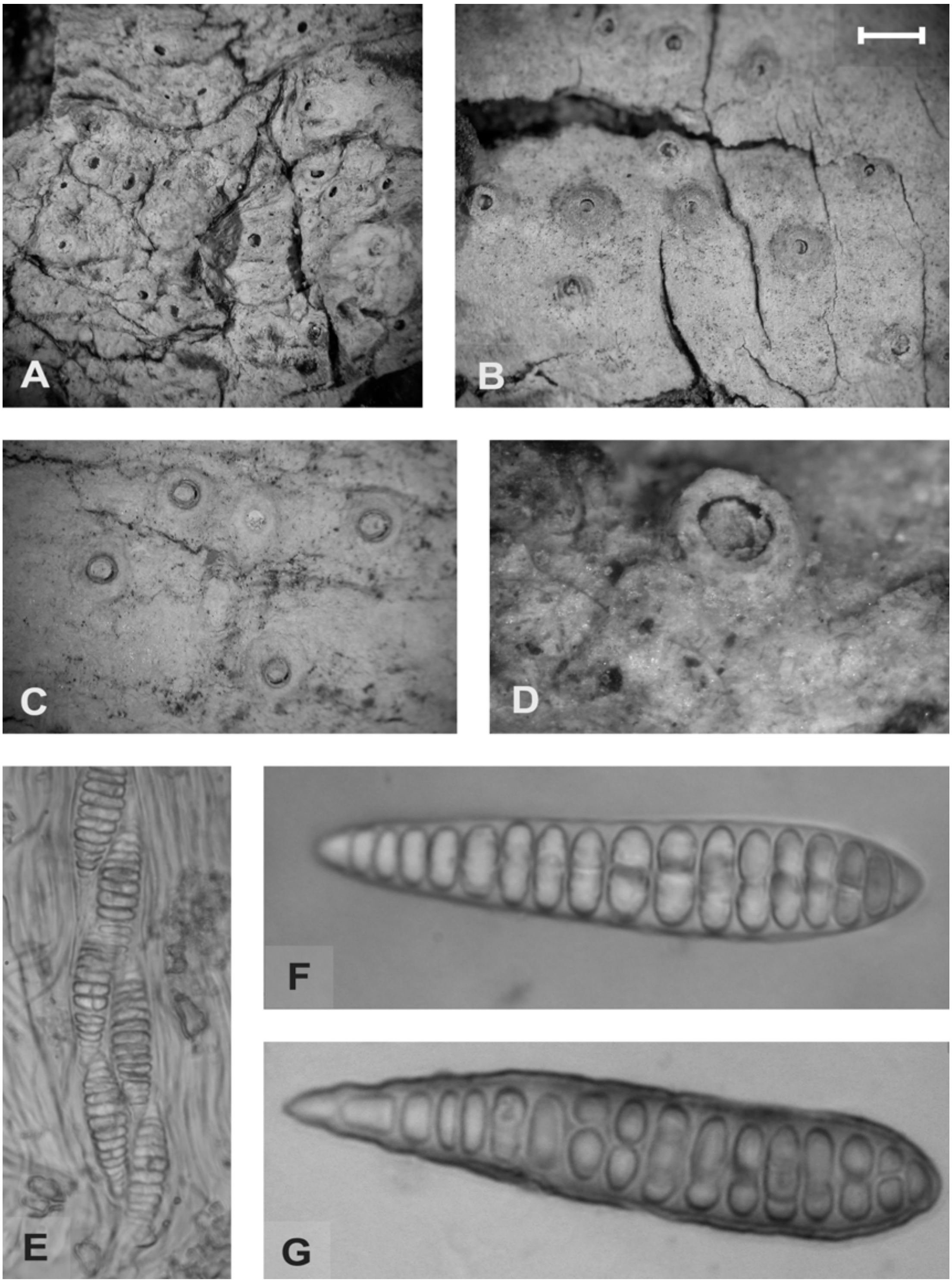

Fig. 138. *Thelotrema lepadodes*: growth habit (**A, B**), ascomata (**C, D**), ascospores (**E**), younger ascospore (**F**) and mature ascospore (**G**). A.: G-lectotype of *L.* aemulum; B., E.-G.: *Lumbsch & Guderley 11138 d*; C.: BM-lectotype of *T. disciforme*; D.: BP-holotype of *L. bisporum*. Bar= A: 1 mm; B, C: 0.8 mm; D: 0.4 mm; E: 20 µm; F, G: 9 µm.

proper exciple apically to entirely visible from surface, off-white, sometimes shrunken, incurved to more rarely erect. Thalline rim margin roundish, wide to gaping, entire to somewhat split or eroded, thin to moderately thick, incurved to rarely slightly erect, thalline rim concolorous with thallus to sometimes darker than thallus. Proper exciple becoming free, (moderately) thin, predominantly hyaline internally, pale to dark brown marginally, sometimes amyloid at the base. Hymenium up to c. 200 µm high, non-inspersed, distinctly conglutinated, paraphyses parallel or slightly interwoven, unbranched, tips unthickened to slightly thickened, lateral paraphyses present, inconspicuous, up to c. 20 µm long, columellar structures absent. Epihymenium (moderately) thick, hyaline, with fine to coarse grayish granules and small crystals. Asci 2-8-spored, tholus (moderately) thick, thin when mature. Ascospores moderately large, (sub-)muriform, cell walls moderately thin in younger stages to thick at maturity, endospore (moderately) thick, covered by a thin, smooth to somewhat irregular halo, hyaline to slightly brown at early maturity, becoming distinctly brown, non-amyloid to faintly to more rarely moderately amyloid, rarely cylindrical to usually fusi- or claviform, with roundish to subacute ends, loci roundish, subglobose to lentiform or oblong, end cells hemispherical to conical, transverse septae moderately thin to thick, distinct, regular, 40-100 x 10-25(30) µm with c. 12-20(22) x 1-5(6) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Thelotrema lepadodes* grows on tree bark in coastal rainforests and mangroves in altitudes ranging from sea level to 20 m. It is moderately common occurring in northern to north-central Queensland. The pantropical species is also known from Polynesia, Hawaii, the Neotropics, Africa, Sri Lanka, Philippines and Solomon Islands (Frisch, 2006, as *T. monosporum*).

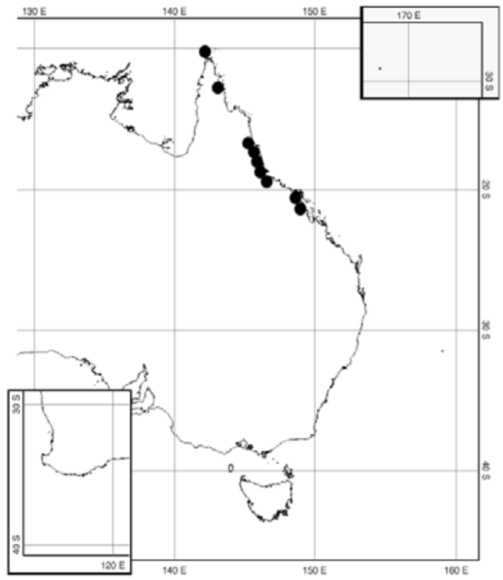

Fig. 139. Australian distribution of *T. lepadodes*.

NOTES – This taxon is characterized by a thin, predominantly hypophloedal thallus, open-pored, ±emergent ascomata, moderately large, (sub-) muriform, thick-walled, indistinctly brownish, non- to faintly amyloid, fusi- to claviform ascospores in 8-spored asci, and the absence of secondary compounds. Similar species include *T. lepadinum* and *T. conveniens*, which can be distinguished by constantly hyaline ascospores (*T. lepadinum*), and monosporic asci with larger (up to 200 µm long), thin-walled, distinctly amyloid ascospores (*T. conveniens*), respectively. Unfortunately the type of *T. lepadodes* was not available for study, however, it is referred to Frisch's (2006) detailed description of the species under the name *'T. monosporum'* which agrees well with the Australian specimens. Frisch (2006) noted that since the H-Nyl. type of *T. monosporum* is in bad condition, the correct name for this species remains uncertain. Further he wrote (2006: 303): "If it (…) represents a species separate from the collections (…) presently identified with the name *T. monosporum*, *T. lepadodes* is the oldest name available for these collections at species level." This approach is also supported by the fact that Frisch lists four tentatively included specimens that differ from his concept of *T. monosporum* (=*T. lepadodes*) by single spored asci and elliptical ascospores. It is assumed that the specimens described belong to *T. saxatile* since the anomalous characters described agree well with the differences of *T. lepadodes* and *T. saxatile*. Frisch (ibid.) lists *T. saxatile* as a synonym to *T. monosporum* without having seen the type, referring to Salisbury (1972). However, it is here regarded as a distinct species. For a detailed list of differences between *T. lepadodes* and *T. monosporum/T. saxatile* see under these taxa. In Müller's original description of *L. aemulum* (Müller 1895) he noted a collection from Victoria, the sample in G (*Knight 303*), however, lacks any locality data. Since the species is tropical, the Victorian locality is most probably erroneous.

SPECIMENS EXAMINED – Australia, Queensland: Thursday Island (N of York Peninsula), 1887, *Knight* s.n. (G-10194/5). Iron Range NP., c. 3.5 - 31 km from western boundary on track to Portland Rds., *Hale 830010, 830020* (US). Cape Tribulation Area: Myall Beach, *Lumbsch & Mangold 1958 k, 19162 o* (F); Track to Cape Tribulation Beach, *Mangold 32 q* (F). Cooga Beach, 5 km E of Mossman, *Lumbsch & Mangold 19169 d* (F). Cairns Airport, *Ewers 8724* (CANB). Russell River NP., 8 km NE of Babinda, mangrove at Russell River, *Lumbsch & Guderley 11138 d* (F). 3 km S of Forrest Beach, 16 km SE of Ingham, *Elix & Streimann 15924, 15933* (CANB). Three Mile Creek, 5 km N of Townsville, *Elix & Streimann 20049* (CANB). Mangrove swamp on rd., just before Shute Harbour, *Hale 831576* (US). Conway Range NP., near Shute Harbour-Airlie Beach, *Hale 832127* (US). Cape Hillsborough NP., NW of Mackay, *Hale 831494* (US). Mimeo Swamp, Sunset Beach (N of Mackay), *Stevens 2545* (BRI). Notch Point rd., S of Cape Palmerston NP., *Hale 832107, 832124* (US). Uncertain locality, *Knight 303* (G).

Thelotrema leucophthalmum Nyl.

Bull. Soc. Linn. Normand. 2(2): 39 (1868). Type: New Caledonia, Lifu, Loyalty Isl., 1864, *Thiebaut* s.n. (H-Nyl. 22518!-lectotype, selected by Hale [1972 in herb.]).

Leptotrema albocoronata C. Knight in Shirley, Proc. Roy. Soc. Queensland 6: 192 (1889). Type: Australia, Queensland, Sankey's Shrub (Brisbane), *Shirley 509* (WELT!-lectotype, selected here; BRI-‘Shirley Book’, p. 23, n. 8 [BRI-AQ721248]!-isolectotype).

ILLUSTRATION – Fig. 140.

Thallus epi- to hypophloedal, thin to moderately thick, up to c. 300 µm high, pale yellowish-green to yellowish-brown to pale olive. Surface waxy, smooth, continuous, unfissured. True cortex present, yellowish, up to c. 80 µm thick, consisting of irregular to periclinal hyphae. Algal layer continuous to incontinuous, well developed, calcium oxalate crystals abundant, variable in size, often clustered. Vegetative propagules not seen. Ascomata very conspicuous, (very) large, up to c. 2 mm in diam., roundish, slightly irregular in fused ascomata, apothecioid, erumpent, solitary to fused, moderately emergent, conical to broad annular. Disc partly to rarely entirely visible from surface, pale grayish to pale flesh-colored, coarsely pruinose. Pores becoming wide to gaping, up to c. 1.5 mm in diam., roundish to moderately irregular, inner and apical proper exciple becoming visible from surface, fused to free, ± jagged, whitish, incurved to recurved, somewhat shrunken only in entirely free proper exciples. Thalline rim margin predominantly thick, roundish to moderately irregular, split to lacerate, ±coarsely lobed, sometimes indistinctly layered, becoming ±distinctly eroded, whitish, pruinose, thalline rim concolorous and with same surface as thallus, predominantly erect to recurved. Proper exciple moderately thick, hyaline internally, (pale) yellowish-gray to brownish marginally, often with calcium oxalate crystal inclusions, apically usually covered by grayish granules, non-amyloid to rarely faintly amyloid at the base. Hymenium up to c. 130 µm high, non-inspersed, moderately conglutinated, paraphyses ±bent, ±interwoven, unbranched, tips slightly thickened and somewhat irregular, lateral paraphyses present, usually very inconspicuous, up to c. 25 µm long, true columella absent, in fused ascomata sometimes columella-like structures present. Epihymenium ±thick, hyaline to pale grayish-brown, with grayish granules and sometimes small crystals. Asci 6- to 8-spored, tholus moderately thick, thin when mature. Ascospores moderately small, distinctly muriform in late stages, cell walls (moderately) thick, endospore moderately thick, sometimes with a moderately thin, irregular halo, hyaline, non-amyloid to rarely faintly amyloid, oblong to ellipsoid to more rarely fusi- or claviform, with roundish to narrowed-roundish ends, loci roundish to slightly angular, subglobose to oblong or irregular, transverse septae moderately thin, distinct, regular, 30-50(60) x 10-15 µm with 8-16 x 1-5(6) loci. Pycnidia not seen.

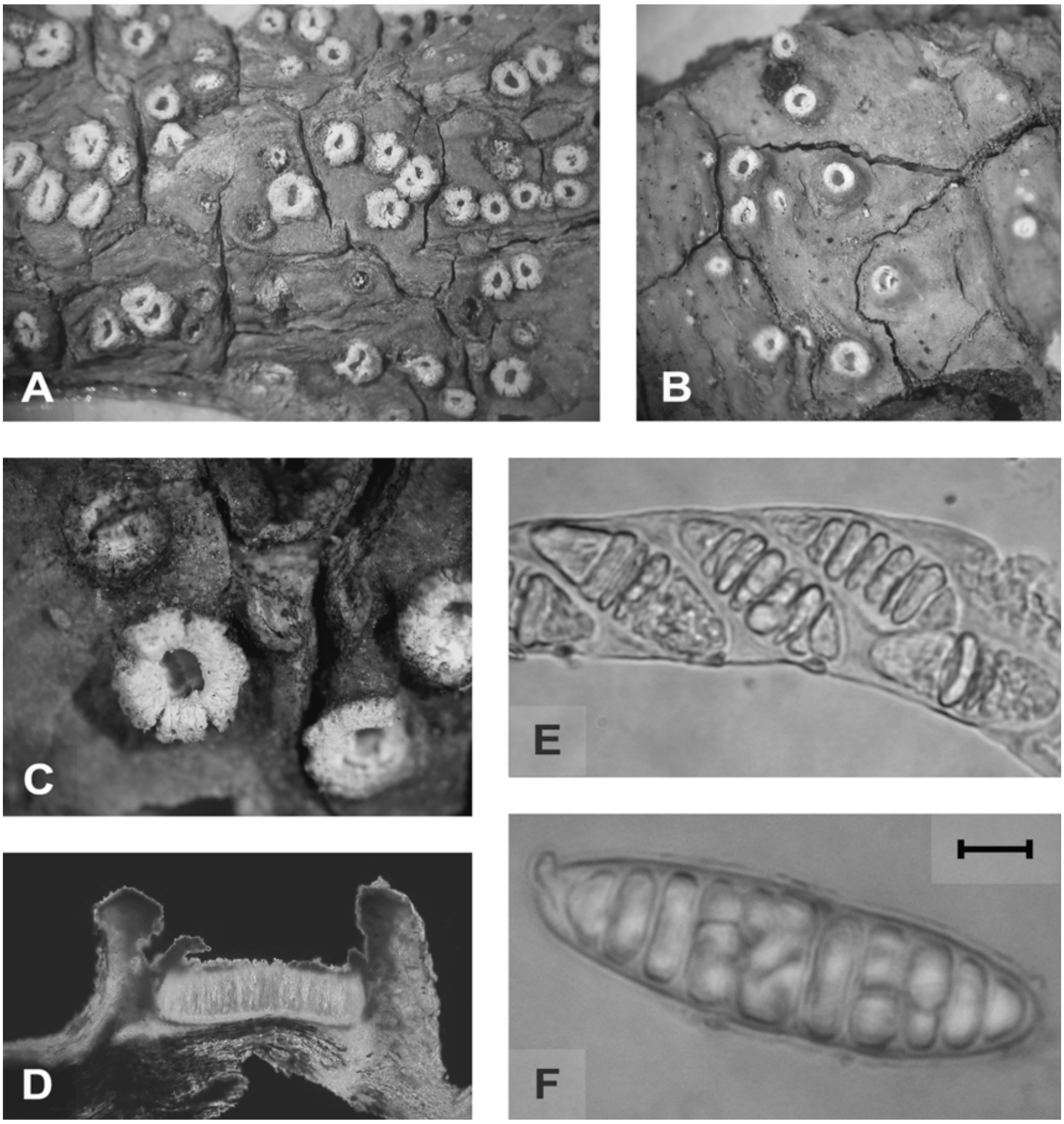

Fig. 140. *Thelotrema leucophthalmum*: growth habit (**A, B**), ascomata (**C**), ascoma section (**D**), immature ascospores (**E**) and mature ascospore (**F**). A., C., E.: WELT-lectotype of *L.* albocoronata; B., D., F.: *Tibell 14660.* Bar= A: 1.7 mm; B: 1.3 mm; C: 1 mm; D: 120 µm; E: 10 µm; F: 6 µm.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing stictic, constictic (majors), hypostictic (major to trace), α-acetylconstictic and cryptostictic (traces) acids.

ECOLOGY AND DISTRIBUTION – *Thelotrema leucophthalmum* was collected in Australia growing on tree bark in (sub)tropical rainforests and wet sclerophyll forests in altitudes ranging from sea level to 900 m. It is moderately common and wide-spread in northern to southern Queensland. It is also known from New Caledonia and the Andman Islands (Sethy & al., 1987) and newly reported here for the Neotropics (Puerto Rico), being pantropical.

NOTES – The species is characterized by a dark, waxy, corticate thallus, conspicuous, large ascomata with a whitish, split to lacerate and ±eroded, pruinose thalline rim margin, moderately large, indistinctly muriform, hyaline, non-amyloid to faintly amyloid ascospores and the stictic acid chemosydrome. It is similar to *T. cupulare* and *T. thesaurum,* both readily distinguished by smaller and larger ascospores respectively (up to up to 30 µm in *T. cupulare*, up to 130 µm in *T. thesaurum*).

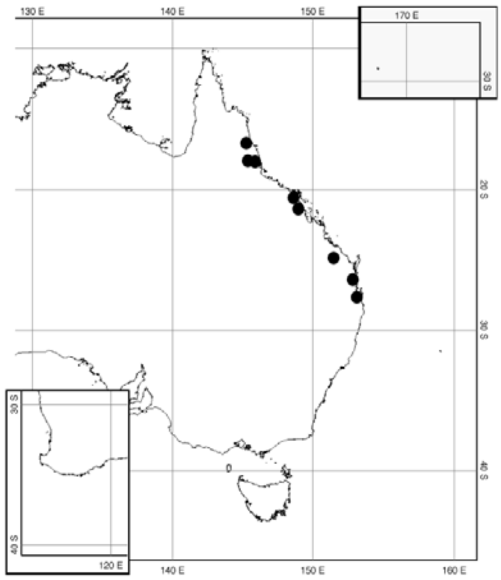

Fig. 141. Australian distribution of *T. leucophthalmum*.

SPECIMENS EXAMINED – Australia, Queensland: Cape Tribulation Area: Teahouse at intersection of Buchanan Creek Rd. and Cape Tribulation Rd., *Hale 831180* (US); Cape Kimberley, *Lumbsch & Mangold 19164 q* (F). Julatten, *Ewers 8446* (CANB). Stallion Pocket logging area, 14 km from Gillies Hwy and 1 km E from Mulgrave River Forestry rd., S of Gordonvale, *Hale 832326* (US). Mt. Hypipamee NP., Dinner Creek Falls, S of Atherton, *Hale 831369* (US). Conway Range NP.: Near Shute Harbour-Airlie Beach, *Hale 71182* (US); At the campground 0.5 km E of Shute Harbour, *Tibell 14660* (UPS). Conway SF., 18 km E of Proserpine, *Elix & Streimann 20210* (CANB). Cape Hillsborough NP., NW of Mackay, *Hale 831290* (US). Kalpower Forest Drive, 40 km NE of Monto, SW of Gladstone, *Hale 831500, 831649* (US). Wooroi SFP., W of Teewantin, *Hale 832168* (US). Blackall Ranges, *Wilson* s.n. (NSW-539400). Brisbane, *Bailey 143* (BM, BRI), *Bailey* s.n. (BM -726590). Porto Rico, Indiera Fria, near Maricao, Britton, *Cowell & Brown 4501* (US).

Thelotrema monosporum Nyl.

Ann. Sci. Nat., Bot., 4(15): 46 (1861b). Type: New Caledonia, *Pancher* s.n. (H-Nyl.22709!-lectotype, selected by [Hale 1981: 260]).

ILLUSTRATION – Fig. 142.

Thallus predominantly hypophloedal, very thin to thin, up to c. 100 µm high, pale yellowish-gray to pale grayish-green. Surface dull, usually roughened, continuous, unfissured. Cortex structures absent or covered by an incontinuous protocortex up to 15 µm thick. Algal layer moderately well developed, continuous to incontinuous, calcium oxalate usually abundant, sometimes sparse, small to large, scattered or clustered. Vegetative propagules not seen. Ascomata inconspicuous, moderately small to moderately large, up to 600 µm in diam., roundish, somewhat peri- to predominantly apothecioid, ±sessile, solitary to marginally fused, becoming ±distinctly emergent, predominantly hemispherical. Disc not visible from surface to very rarely becoming somewhat visible, usually only in defective ascomata, grayish, moderately pruinose. Pores (moderately) small, up to c. 300 µm, roundish to more often roundish-irregular, proper exciple apically visible from surface, entirely free, off-white to whitish, often shrunken, predominantly incurved to more rarely somewhat erect. Thalline rim margin roundish to irregular, predominantly moderately small, entire to slightly split, moderately thin to thick, incurved, concolorous with thallus to more rarely brighter than thallus. Proper exciple ±free, moderately thin to moderately thick, hyaline to pale yellowish internally, yellowish-brown marginally, apically often brownish to dark-brown or dark-gray, sometimes amyloid at the base. Hymenium up to c. 200 µm high, non-inspersed, moderately conglutinated, paraphyses parallel or slightly interwoven, unbranched, tips moderately to distinctly thickened, lateral paraphyses present, often inconspicuous, up to c. 20 µm long, columellar structures absent. Epihymenium variably thick, hyaline, usually with small crystals and fine to coarse grayish granules. Asci 1 to 4-spored, tholus (moderately) thin, not visible at maturity. Ascospores moderately large, eumuriform, cell walls and endospore predominantly (moderately) thin, in younger stages often distinctly thickened parts present, non-halonate, brown at early maturity, non-amyloid to very faintly amyloid in young ascospores, ellipsoid to predominantly (broad-)fusiform, very rarely somewhat claviform, with narrowed-roundish ends, loci predominantly roundish to slightly angular, subglobular to somewhat oblong, transverse septae thin, distinct, regular, 40-90(100) x 15-30 µm with c. 14-26 x 2-8 loci. Pycnidia not seen.

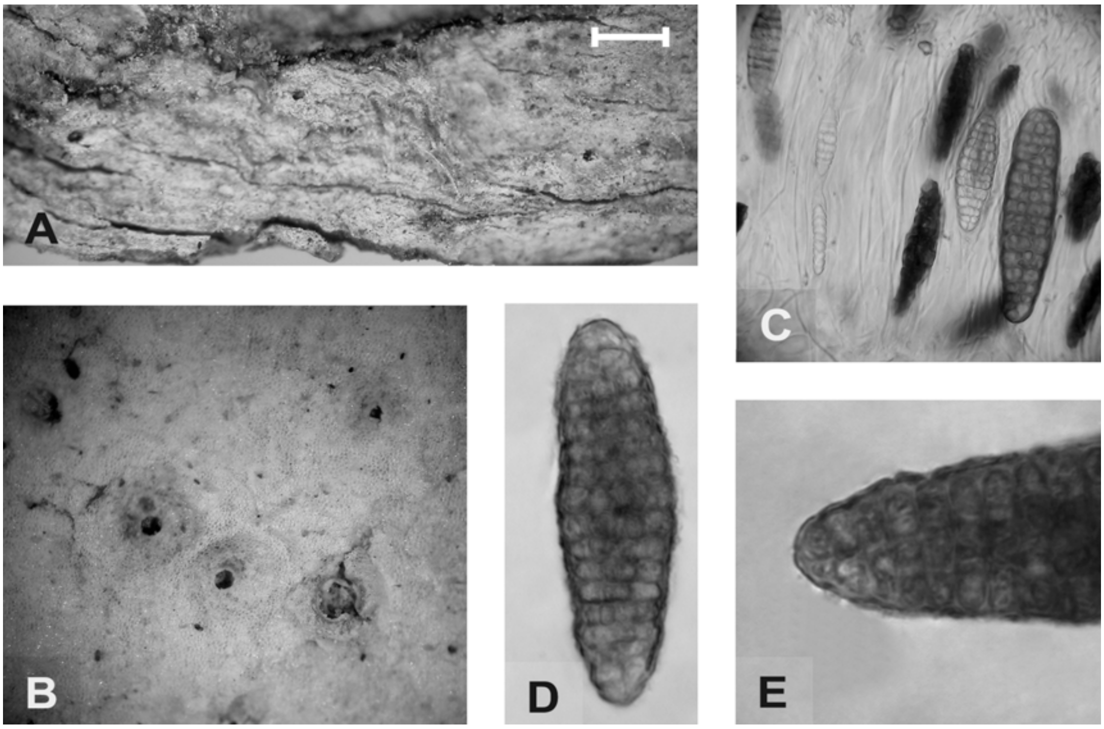

Fig. 142. *Thelotrema monosporum*: growth habit (**A**), ascomata (**B**), immature, mature and over-mature ascospores (**C, D**) and ascospore detail (**E**). A., D., E.: H-lectotype; B., C.: *Mangold 32 u*. Bar= A: 0.75 mm; B: 0.6 mm; C: 30 µm; D: 15 µm; E: 10 µm.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Thelotrema monosporum* occurs in tropical rainforests in low altitudes ranging from sea level to 20 m on tree bark. It is rare in Australia being restricted to northern Queensland. The distribution is unclear, given the taxonomic difficulties (discussed below). The type was collected in New Caledonia.

Fig. 143. Australian distribution of *T. monosporum*.

NOTES – This taxon is characterized by a thin, mainly hypophloedal and ecorticate thallus, moderately large, muriform, brown, thin-walled, non- or faintly amyloid ascospores in 1-4-spored asci and the absence of secondary metabolites.

The circumscription of this species has differed widely between authors [see Frisch, 2006;

Matsumoto, 2000; Purvis & al., 1995 (*T. macrosporum*); Harris, 1990 (*T. monospermum*)]. The main reason for the problems lie in the poor conidition of the type of *T. monosporum* and consequently, different concepts of its differences to *T. lepadodes* and *T. saxatile*. While some authors consider these as synonymous with *T. monosporum,* they are regarded as distinct species here (see also under that species). The Nylander-type specimen has a moderately thin, ecorticate, roughened thallus with numerous calcium oxalate crystal inclusions, small, slightly raised ascomata with small openings, a free proper exciple that is partly visible, several decayed, but also a few intact ascospores that were distinctly brown, densely eumuriform, non-amyloid, broadly fusiform with rounded ends, with (moderately) thin cell walls, thin endospore and septae, 70-90 x 20-30 µm in size (Fig. 143, D, E). The number of spores per ascus, structure of lateral paraphyses or exciple structure could not be studied due to the poor material. However, ascomata are present that agree with the protologue. *Thelotrema lepadodes* differs in having 4-8 spored asci, and more distinctly tapered ascospores with ±subacute ends. Additionally, the ascospores of *T. lepadodes* become brown late in development and are often distinctly amyloid. Another problematic species is *T. saxatile* see under this species for differences. Galloway (1985) considers *Ascidium attenuatum* from New Zealand as a synonym of *T. monosporum*, which could not be checked since the type material is lost and only a drawing of a single ascospore (selected as the type by Galloway) is available. *Ascidium attenuatum* is considered a nomen dubium (see appendix). It is questionable that it really is conspecific with *T. monosporum*, since the drawing as well as the protologue state transversely septate ascospores.

SPECIMENS EXAMINED – Australia, Queensland: Iron Range NP., 21 km from western boundary on track to Portland Rds., *Hale 832441* (US). Cape Tribulation Area: Myall Beach, *Lumbsch & Mangold 19158 g, i, j, v, w, 19160 d, 19161 n, x, 19162 i, p, Mangold 31q* (F); Track to Cape Tribulation Beach, *Mangold 32 u* (F).

Thelotrema myriocarpum Fée

Essai Cryptog. Écorc. Officin.: 94 (1824). *Myriotrema myriocarpum* (Fée) Hale, Mycotaxon 11: 134 (1980). Type: 'America meridionali, ad corticem Cinchonae rubrae' (PC-lectotype, selected by Hale [1978:45]; G-Fée 242-, L-Buse!-isolectotypes).

ILLUSTRATION – Fig. 144.

Thallus epi- to slightly hypophloedal, moderately thick, up to c. 400 µm high, pale yellowish green to usually (pale) olive. Surface shiny, smooth, continuous to rugose and/or verruculose, unfissured. True cortex present, continuous, consisting of periclinal hyphae, up to 30 µm thick. Algal layer well developed, continuous, often becoming incontinuous due to crystals inclusions, calcium oxalate crystals very abundant, small to large, scattered or clustered, sometimes forming column-like structures. Vegetative propagules not seen. Ascomata variable, inconspicuous, (moderately) small, up to 350 µm in diam., roundish, peri- to apothecioid, solitary, immersed to slightly raised. Disc usually becoming partly visible from surface, pale grayish to pale flesh-colored, epruinose. Pores (moderately) small, up to c. 250 µm in diam., roundish to sometimes slightly irregular, apical proper exciple becoming ±visible from surface, predominantly fused to rarely partly to entirely free, entire to more rarely slightly split, ±whitish to pale brownish, incurved. Thalline rim margin (moderately) thin, entire, roundish, usually brighter than thallus to whitish, thalline rim incurved, concolorous with thallus to rarely grayish-brown, with same surface as (or not distinguishable from) main thallus. Proper exciple fused to partly free, predominantly thin, hyaline to pale yellowish internally to orange marginally, apically sometimes dark-brown, non-amyloid to weakly amyloid at the base. Hymenium up to c. 130 µm high, non-inspersed, distinctly conglutinated, paraphyses ±straight, ±interwoven, unbranched, tips thickened, lateral paraphyses present, inconspicuous, up to c. 20 µm long, columellar structures absent. Epihymenium indistinct and thin, hyaline, rarely with grayish granules. Asci 8-spored, tholus (moderately) thick, moderately thin when mature. Ascospores small, (sub-)muriform, cell walls (moderately) thin, endospore moderately thick, non-halonate, hyaline, non-amyloid to rarely faintly amyloid (reddish), oblong to ellipsoid to somewhat claviform, with roundish to narrowed-roundish to rarely subacute ends, loci roundish to ±angular, in particular in younger stages, subglobose to oblong to predominantly ±irregular, transverse septae (moderately) thin, distinct, regular, 20-30(40) x 7-10 µm with 6-11(12) x 1-4 loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing constictic, stictic, (majors), α-acetylconstictic, cryptostictic, α-acetyl-hypoconstictic (minors to traces) and hypostictic (trace) acids.

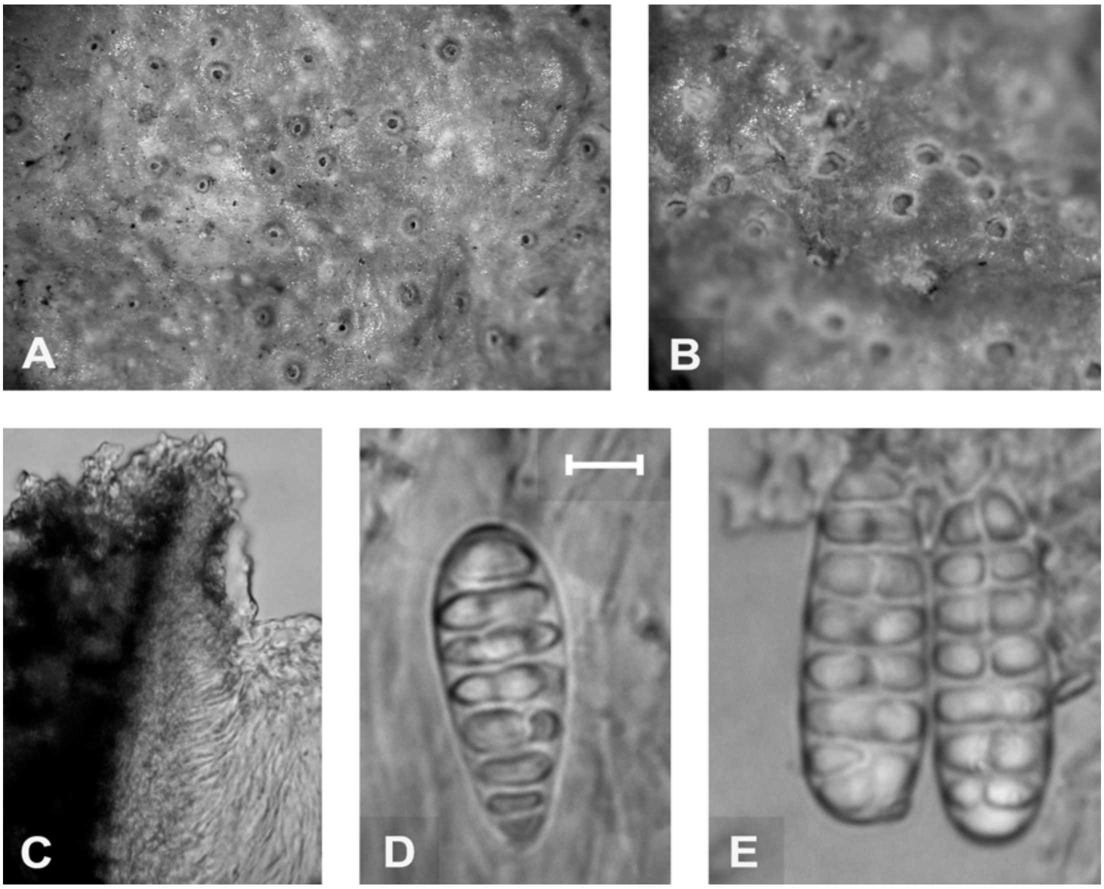

Fig. 144. *Thelotrema myriocarpum*: growth habit (**A**), ascomata (**B**), lateral paraphyses (**C**), and ascospores (**D, E**). A.-D.: *Lumbsch & Mangold 19120 l*; E.: *Lumbsch & Mangold 19167 c*. Bar= A: 1 mm; B: 0.7 mm; C: 20 µm; D, E: 5 µm.

ECOLOGY AND DISTRIBUTION – *Thelotrema myriocarpum* grows on tree bark in tropical rainforests in altitudes ranging from sea level to 900 m. It is moderately common in northern Queensland. This is the first report for Australia and the paleotropics. The pantropical species was previously regarded as neotropical (Hale, 1978).

NOTES – The species is characterized by a shiny, corticate, thick thallus, small ±immersed ascomata, indistinct lateral paraphyses, moderately small, hyaline, (sub-)muriform, predominantly non-amyloid ascospores with thin walls but thickened endospore and the presence of the stictic acid chemosyndrome. The pantropical (but not known from Australia) *'Thelotrema' glaucopallens* is similar but differs in the absence of lateral paraphyses. A similar Australian species is *T. cyphelloides*, for differences see under this species. The Australian collections confirm well with the type except for smaller ascospores. In contrast to sizes of up to 40 µm found in the type, the ascospores in the Australian material never exceed 30 µm in length. The measures found in literature range from up to 50 µm (Salisbury, 1978) to 25 µm in Hale (1978), however, the latter author stated that he found length of up to 36 µm in the PC type.

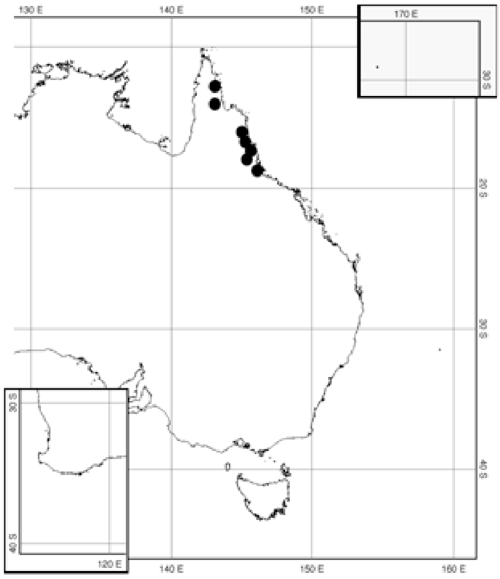

Fig. 145. Australian distribution of *T. myriocarpum*.

SPECIMENS EXAMINED – Australia, Queensland: Cape York Peninsula: Iron Range NP., 4-9 km from western boundary on track to Portland Roads, *Hale 830022, 830044, 830046, 830050, 830080, 832672, 832810* (US); McIlwraith Range, Rocky River, 60 km SE of Coen, *Jones* s.n. (MEL). Near Cedar Bay NP., on rd. to Cooktown, *Mangold 34 k, p, s* (F). Cape Tribulation Area: Cow Bay, *Hale 831190, 832464* (US); Cape Kimberley, *Lumbsch & Mangold 19167 c, r* (F). Mossman Gorge NP., *Hale 831055, 832606* (US). Crystal Cascades, 5 km W of Cairns, *Lumbsch & Mangold 19120 d, l* (F). SW of Gordonvale, 25-30 km on Mulgrave River Forestry Rd., *Hale 831015, 832266* (US). Atherton Tablelands: Lake Euranoo, *Lumbsch & Mangold 19127 g, j, l, w* (F); Curtain Fig Tree SFP., *Hale 831220* (US); Along west boundary of Eacham NP., on rd from Atherton, *Hale 831018* (US); Palmerston NP. (=south part of Wooroonooran NP.), *Hale 831130* (US). Picnic area 2 km E of Cardstone on Tully River Rd. to Kareeya Power Station, *Hale 830958* (US). Uncertain location: 'Shirley book', p. 23, n. 7 [as *'Leptotrema phaeosporum'*], s.c. (BRI-AQ721247).

Thelotrema nostalgicum Salisb.

Lichenologist 5: 266 (1972). Type: Sri Lanka, Pidurutalga, 15.-22. Dec. 1879, *Almquist* s.n. (H-Nyl. 22741!-lectotype, selected by Hale [1981: 260]; S!-isolectotype).

ILLUSTRATION – Fig. 146.

Thallus predominantly epi- to slightly hypophloedal, moderately, up to c. 200 µm high, (pale) greenish gray to (pale) olive or yellowish gray. Surface dull to slightly shiny, smooth to slightly rough, continuous to more often distinctly or strongly verruculose, unfissured to slightly cracked. Algal layer well developed, continuous, calcium oxalate crystals abundant, predominantly small, scattered or clustered. Vegetative propagules not seen. Ascomata ±conspicuous, predominantly large, up to c. 1.3 mm in diam., roundish to irregular-roundish, sessile, peri- to apothecioid, solitary to marginally fused, becoming distinctly emergent, hemispherical to urceolate, with same surface as thallus. Disc not visible from surface to rarely partly visible, grayish, epruinose to slightly pruinose. Pores moderately small, up to c. 300 µm in diam., roundish to slightly irregular, entire to somewhat split, apical proper exciple sometimes becoming visible from surface, fused to indistinctly free, rarely somewhat shrunken, whitish to off-white or slightly brownish apically, incurved. Thalline rim margin moderately thick to thick, becoming moderately wide, roundish to slightly irregular, predominantly entire to slightly split, incurved. Proper exciple becoming apically free, moderately thick to thick, hyaline to pale yellowish internally, (pale)brownish to yellowish-brown marginally, apically sometimes darkish-gray, sometimes ±distinctly amyloid at the

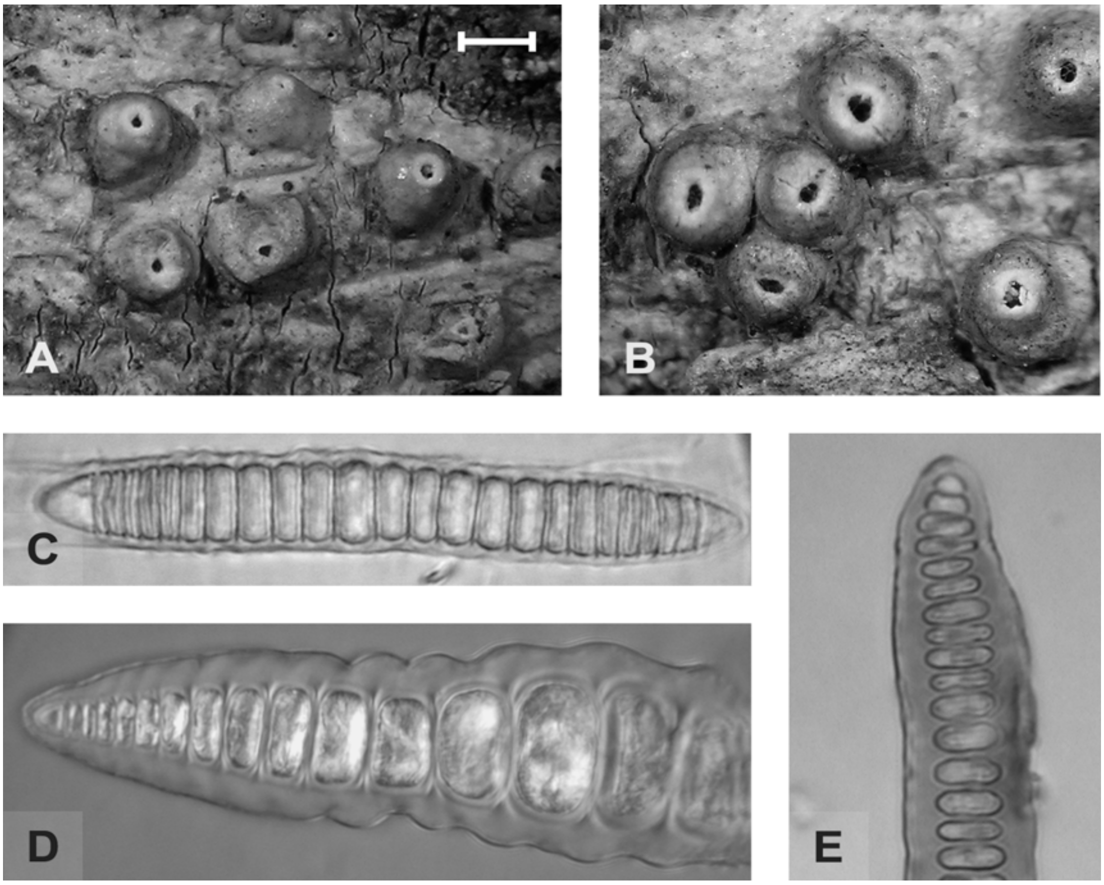

Fig. 146. *Thelotrema nostalgicum*: ascomata (**A, B**), immature ascospore (**C**), ascospore detail (**D**) and ascospore detail showing amyloid reaction (**E**). A.-E.: *Hale 50356.* Bar= A: 0.75 mm; B: 0.7 mm; C: 10 µm; D: 7 m; E: 12 µm.

base. Hymenium up to c. 300 µm high, non-inspersed, distinctly conglutinated, paraphyses ±parallel, unbranched, tips slightly thickened, lateral paraphyses present, conspicuous, up to c. 40 µm long, columellar structures absent. Epihymenium moderately thin to thin, hyaline, often with grayish granules. Asci 2-4-spored, tholus moderately thick to thick, thinning with maturity. Ascospores large to very large, transversely septate, cell walls thick to very thick, sometimes with a distinctly crenate to ±irregular outline, non-halonate, hyaline, predominantly faintly to moderately amyloid, cylindrical to fusiform or bifusiform, ends roundish to narrowed-roundish, loci regular, roundish, subglobose to lentiform or oblong, endcells hemispherical, septae moderately thin to moderately thick, regular, 80-240 x 10-25 µm with 16-38 loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish-brown, C-, PD+ orange-red; containing fumarprotocetraric (major) and protocetraric (major to trace) acids.

ECOLOGY AND DISTRIBUTION – Fide Kalb (2001), *Thelotrema nostalgicum* occurs on tree bark and in Australia is restricted to subtropical rainforests at altitudes ranging from 900 to 1000 m. It is a very rare species occurring in the Queensland/New South Wales border region. This is the first report for Australia. Besides Australia, it is was reported from Sri Lanka indicating a palaeo(sub)tropical distribution.

NOTES – This taxon is characterized by distinctly emergent ascomata with rather indistinctly free proper exciple, usually very large, transversely septate, hyaline, amyloid ascospores with conspicuously thick cell walls and the presence of protocetraric acid chemosydrome compounds. It is very similar to *T. nureliyum*, but is distinguished by more distinctly emergent ascomata with less distinctly free proper exciple, slightly larger ascospores that occur by two to four per ascus (ascospores 4-8 per ascus with up to 220 x 25 µm with up to 35 loci in *T. nureliyum*) and by the presence of protocetraric acid chemosydrome compounds (secondary compounds absent in *T. nureliyum*). In Australia the species is only known from two collections from the Lamington National Park (reported by Kalb, 2001), which, however, were not available for study.

SPECIMENS EXAMINED – Sri Lanka, Nuwara Eliya, *Hale 50356* (US).

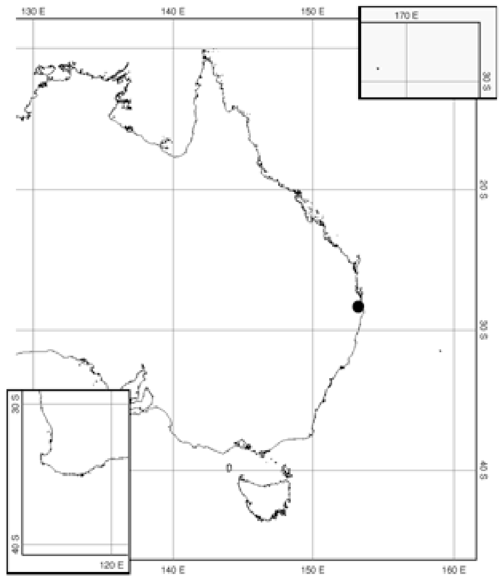

Fig. 147. Australian distribution of *T. nostalgicum*.

Thelotrema nureliyum Hale

Bull. Brit. Mus. nat. Hist. (Bot.) 8: 261 (1981). Type: Sri Lanka, Central Province, *Hale 50292* (US-holotype, not seen).

ILLUSTRATION – Fig. 148.

Thallus variable, predominantly epi- to slightly hypophloedal, moderately thin to moderately thick, up to c. 300 µm high, (pale) greenish gray to (pale) olive or yellowish gray. Surface predominantly dull, smooth to roughened, sometimes porous, continuous to more often distinctly or strongly verruculose, sometimes forming subglobular, isidia-like structures, distinctly to strongly fissured. Thallus covered by a usually thin, ±continuous protocortex up to c. 25 µm thick. Algal layer well developed, continuous, calcium oxalate crystals abundant, predominantly small, scattered or clustered. Vegetative propagules not seen, isidia-like structures sometimes present (see above). Ascomata ±conspicuous, predominantly large, up to c. 1.2 mm in diam., roundish to irregular-roundish, apothecioid, somewhat erumpent, solitary to marginally fused, becoming moderately to distinctly emergent, hemispherical to urceolate, with same surface as thallus or sometimes more distinctly verruculose. Disc often becoming partly to rarely entirely visible from surface, pale grayish to whitish, ±strongly pruinose. Pores relatively small to moderately small, up to c. 400 µm in diam., roundish to slightly irregular, entire to split, apical to entire proper exciple becoming visible from surface, often somewhat shrunken, whitish to off-white or slightly brownish apically, concolorous to pale brownish towards the base, incurved to erect to more rarely slightly recurved. Thalline rim margin moderately thin to thick, becoming moderately wide to gaping, roundish to slightly irregular, predominantly entire to split, sometimes lacerate or eroded, often distinctly layered, incurved to erect, concolorous with thallus, in layered margins inner layer(s) usually more bright. Proper exciple becoming entirely free, (moderately) thick, hyaline to pale yellowish internally, (pale)brownish to yellowish-brown marginally, apically usually dark-gray and covered by granules, often distinctly amyloid at the base. Hymenium up to c. 250 µm high, non-inspersed, distinctly conglutinated, paraphyses ±parallel, unbranched, tips distinctly thickened, lateral paraphyses present, conspicuous, up to c. 40 µm long, columellar structures absent. Epihymenium thick to very thick, hyaline, with grayish to dark gray granules and moderately small crystals. Asci 4-8-spored, tholus (moderately) thick, thin when mature. Ascospores variable, moderately large to very large, transversely septate, very rarely with a single longitudinal septum, cell walls thick to very thick, usually with a distinctly crenate to ±irregular outline, non-halonate, hyaline, becoming faintly yellowish when decayed, predominantly faintly to moderately amyloid, cylindrical to fusiform or sometimes bifusiform, ends roundish to narrowed-roundish, loci regular, roundish, subglobose to lentiform or oblong to rarely biconcave, end cells hemispherical, septae moderately thin to moderately thick, regular, 60-220 x 10-20 µm with 12-35 (x 2) loci. Pycnidia not seen, fide Matsumoto & Deguchi (1999) present, immersed with dark pore area, conidia oblong, up to 2.4 x 0.8 µm.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

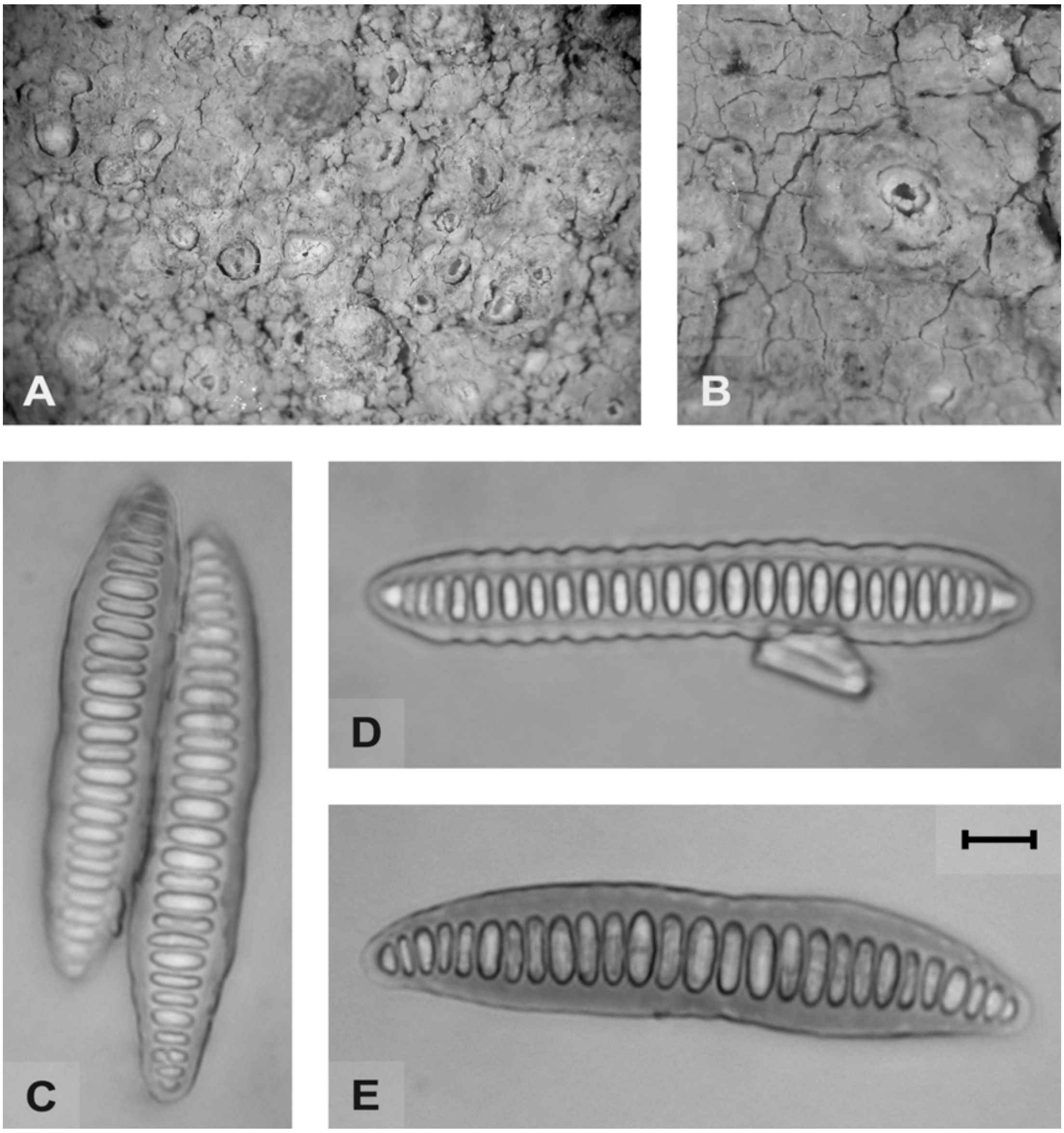

Fig. 148. *Thelotrema nureliyum*: growth habit (**A**), ascomata (**B**), ascospores (**C, D**) and ascospore showing amyloid reaction (**E**). A., C., E.: *Lumbsch & Mangold 19108 h*; B., D.: *Lumbsch & Mangold 19174 x*. Bar= A: 2 mm; B: 1.5 mm; C: 15 µm; D: 10 µm; E: 12 µm.

ECOLOGY AND DISTRIBUTION – *Thelotrema nureliyum* was collected in Australia on tree bark in (sub)tropical to warm-temperate rainforests and more rarely in wet sclerophyll forests in elevations ranging from 80 to 1500 m (mostly between c. 600 and 1000 m). It is common and widespread in eastern Australia, occurring from northern Queensland to south-central New South Wales and Lord Howe Island. This is the first report for Australia. This paleotropical species has been recorded from India (Patwardhan & al., 1985), Sri Lanka and Japan (Matsumoto, 2000).

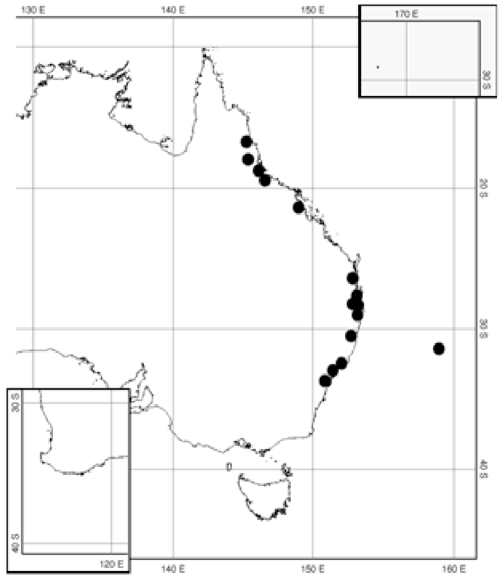

Fig. 149. Australian distribution of *T. nureliyum*.

NOTES – *Thelotrema nureliyum* belongs to the *T. subtile*-group and is characterized within this group by a thick, fissured and often strongly verruculose thallus, large ascomata with distinctly free proper exciple, and large, transversely septate, hyaline, ±weakly amyloid ascospores that usually have a conspicuously thick cell wall. *Thelotrema diplotrema* has similar ascospores, see under that species for differences. Among *Thelotrema* species with transversely septate ascospores only *T. gallowayanum* (ascospores brown with distinctly tapered ends, up to 400 µm long) has distinctly larger ascospores. *Thelotrema nostalgicum* has only slightly larger (up to 240 µm) ascospores but the asci are 2-4-spored (for further differences see under that species).

SPECIMENS EXAMINED – Australia, Queensland: Thornton Range, CREB rd. (to Cooktown), about 5 km in from Daintree River crossing, NW of Mossman, *Hale 831527* (US). Mt. Windsor logging area, E of old Forestry Camp, NW of Mossman, *Hale 832329, 832474* (US). Mt. Lewis Rd. 10.5 km N from Kennedy Hwy., W of Mossman, *Hale 830678, 830845* (US). Bellenden Ker: 1889, *Bailey '545'* (BRI); Centre peak, 7 km W of Bellenden Ker, *A. & M. Aptroot 22485, 22499, 22502, 22520* (ABL). Atherton Tablelands: Davies Creek Rd. 17 km S of Kennedy Hwy., S of Davies Creek Falls NP., E of Mareeba, *Hale 832090* (US); Plath Rd. logging head, 9 km W of Plath Rd., off Kennedy Hwy, Herberton Range, S of Atherton, *Hale 831942, 832088, 832100, 832438* (US); Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Lumbsch & Mangold 19151 zb, Mangold 30 zk, zl, zp, zq, zu* (F). Dawson logging area, State Forest Reserve 605, 24 km S of Koombooloomba turnoff, WSW of Tully, *Hale 832651, 832653* (US). Culpa logging area, 13 km from Koombooloomba rd. turnoff, SE of Tully Falls, *Hale 832383, 832552* (US). Tully Gorge NP., *Ewers 7887* (CANB). 20 km on the Kirrama Forest Rd., W of Kennedy, *Hale 830253* (US). Crystal Creek NP., Paluma, *Rambold 4779* (M). Mt. Spec NP., Ridge on the Loop, on the Paluma Road, WNW of Townsville, *Hale 830716, 832368, 832422, 832548, 832763* (US). Eungella NP.: Along Broken River, *Lumbsch & Mangold 19100 k, y* (F); Trail from Broken River station to rainforest, *Lumbsch & Mangold 19108 h, j* (F); Rd. to rainforest at NP. margin, *Lumbsch & Mangold 19110 b* (F). Kondalilla Falls, SW of Nambour, *Hale 831987* (US). Maleny Range, Mary Cairn Cross Park about 6 km S of Maleny, *Hafellner 16676* (GZU), *Hale 831460, 831720* (US). Kenilworth SF., SW of Kenilworth, *Hale 831687* (US). Booloumba Creek SF., SW of Kenilworth, *Hale 831253* (US). Amama SF., SW of Kenilworth, *Hale 830303, 831191, 832517* (US). D'Anguilar Range NW of Brisbane, W of Mt. Glorious township, *Hafellner 16974* (GZU). Mt. Mee SF, near Mt.Mee, N of Brisbane, *Hafellner 16920* (GZU), *Rogers 2418, 2499* (BRI), *2498* (BRI, GZU), *Hale 53553, 53576, 53581, 53600, 53621, 53641, 58664, 58669, 58696, 58672, 58680, 830837, 83-2370, 831271, 831610, 832366, 832407* (US). C. 10 km NE Killarney, *Hale 58836* (US). Carabeen Nature Refuge, 45 km E of Warwick, *Lumbsch & Mangold 19174 i, x, 19175 i* (F). Head of Teviot Brook, NE of the Head, Boonah rd., *Hale 59481, 59482* (US). 13 km N of O'Reilly's on rd. to Lamington NP., *Hale 831848, 831916, 832077, 832371, 832372, 832420, 832750* (US). Lamington NP.: Mc Pherson Range: Binna Burra, Track from Car Park to Tullawallal, *Lumbsch & Dickhaeuser 11011 f* (F), Duck Creek Rd., *K. & A. Kalb 34273* (hb. Kalb); Python Rock Track, *Hale 830941, 831317, 832081, 832699* (US); O'Reillys Guesthouse, *K. & A. Kalb 21537, 21544* (hb. Kalb); Main Border Track out of O'Reillys, *Hale 830963, 832268* (US); Moran Falls, *Tibell 12682 a* (UPS). New South Wales: Mt. Warning NP.: *Hale 831869, 832373, 832374, 832439* (US); Track from summit to parking lot, *Mangold 19 i, m* (F). Lions Tourist Rd. nr. Queensland border, N of Waingaree, *Hale 830836, 832461* (US). Border Ranges NP., NE of Wiangaree, Brindle Creek, *Hafellner 19364* (GZU). Nightcap NP., Mt. Nardi/Mt. Matheson Track, *Mangold 22 c, zc* (F). Nightcap Forest Drive, W of Mullumbimby: Gibbergunyah Roadside Reserve, Whian Whian SF., *Hale 830122* (US); Big Shrub Flora Reserve, *Hale 831378* (US). Big Shrub, Richmond River, Jul. 1894, *Wilson* s.n. (NSW-153760, -539416). Cattle Creek SF., Briggsvale, 12 km NNE of Dorrigo, *Verdon 3837* (CANB, H). Dorrigo NP., Never Never Picnic Area and Rosewood Creek Track, *Mangold 24 l* (F). Doyles River SF. on Oxley Hwy. 95 km SE Walcha, *Hale 58582, 58678, 58893* (US). Bulahdelah District, Myall River SF., E von Stroud, Jarrah Rd, *Kalb & Filson 17930, 17957* (hb. Kalb). Along Mill Creek, c. 50 km NW von Sydney, *Kalb & Archer 33839* (hb. Kalb). Hornsby, Sept. 1897, *Wilson* s.n. (NSW-539363, -603866). Near Blackheath, Blue Mountains, *Hale 58575, 58583, 58599, 58611, 58659* (US). Below Katoomba Falls-trail to Giant Stairway, Katoomba, *Hale 58719* (US). Royal NP., Bola Creek, E of Waterfall, *K. & A. Kalb 20555, 21584, 21731* (hb. Kalb). Lord Howe Island, Track from Smoking Tree Ridge to Rocky Run, *Elix 42459* (CANB). Sri Lanka: Central Province, *Hale 50268* (US). Sabaragamuwa Province, *Hale 51208* (US).

Thelotrema oleosum Mangold spec. nov. ined.

Type: Australia, New South Wales, Dorrigo NP., Sassafras Creek Track, *Mangold 25 m* (CANB-holotype, NSW-isotype).

ETYMOLOGY – The epithet refers to the inspersed hymenium of the species (from lat. *oleosus* =oily).

ILLUSTRATION – Fig. 150.

Thallus epi- to hypophloedal, moderately thin to moderately thick, up to c. 250 µm high, greenish-gray to (pale) olive, with a distinct reticulate pattern. Surface dull to slightly shiny, smooth, usually distinctly verrucose to verruculose, ±fissured. Thallus cover variable, often with an incontinuous to continuous true cortex consisting of periclinal hyphae up to c. 30 µm thick, sometimes cortex structures absent or covered by an incontinuous protocortex. Algal layer moderately well developed, often incontinuous due to crystal inclusions, calcium oxalate crystals abundant, small to large, often in clusters or more rarely scattered. Vegetative propagules not seen. Ascomata inconspicuous, large, up to 1.5 mm in diam., roundish to irregular in fused ascomata, perithecioid, solitary to marginally fused, immersed to emergent, then hemispherical to somewhat subglobose. Disc not visible from surface. Pores small, up to c. 150 µm, roundish to more rarely roundish-irregular, entire, upper parts of proper exciple usually visible from surface, fused to free, whitish to grayish, rarely slightly shrunken, incurved. Thalline rim margin roundish to roundish-irregular, small, entire, moderately thin to moderately thick, incurved, concolorous with thallus to pale brownish. Proper exciple fused, becoming apically detached in older stages, moderately thin, hyaline internally, pale yellowish and usually with substrate particles incorporated marginally, apically (dark-)brown to more rarely slightly carbonized, non-amyloid. Hymenium up to c. 400 µm high, distinctly inspersed, strongly conglutinated, paraphyses ±bent and wavy, interwoven, unbranched, tips unthickened to slightly thickened, lateral paraphyses present, conspicuous, up to c. 30 µm long, appearing coarse, columellar structures absent. Epihymenium indistinct, hyaline, without granules. Asci 1-spored, tholus absent, often with somewhat thickened lateral ascus walls in younger stages. Ascospores (very) large, densely eumuriform, cell walls and endospore thin, often with a very thin, indistinct halo, becoming grayish to brownish in late maturity, dark brown in depauperate ascospores, ±distinctly amyloid, predominantly in hyaline stages, oblong to fusiform, with roundish to narrowed-roundish ends, loci small, roundish to somewhat angular, predominantly irregular, transverse septae thin, ±distinct, regular to slightly irregular, 120-250 x 30-50 µm with multiple loci. Pycnidia not seen.

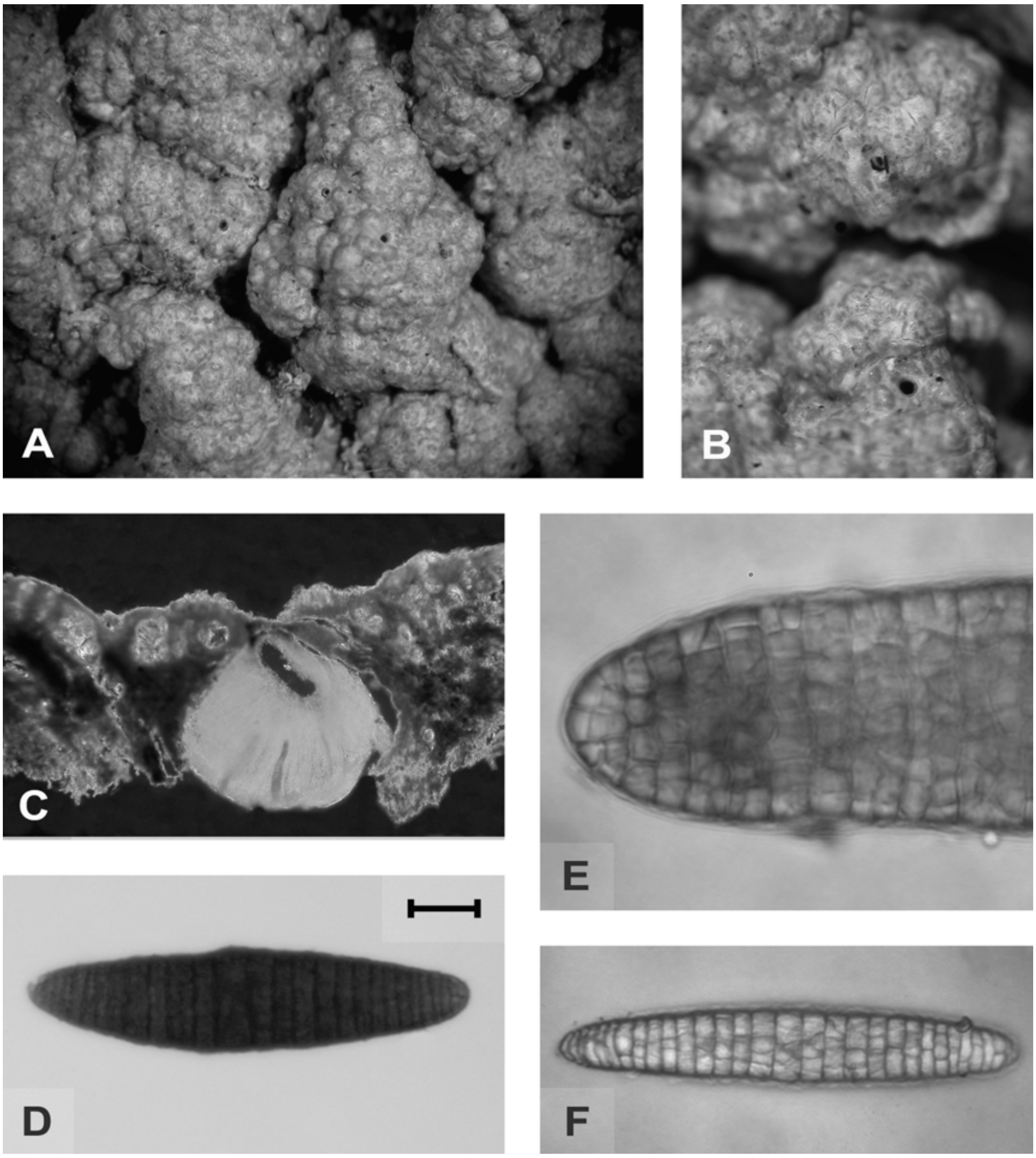

Fig. 150. *Thelotrema oleosum*: growth habit (**A**), ascomata (**B**), ascoma and thallus section (**C**), ascospore showing amyloid reaction (**D**), detail of ascospore (**E**) and younger ascospore (**F**). A.-F.: CANB-holotype. Bar= A: 1.5 mm; B: 1 mm; C: 400 µm; D, F: 30 µm; E: 10 µm.

CHEMISTRY – Thallus K-, C-, PD-; no compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Thelotrema oleosum* grows on tree bark in (sub)tropical rainforests in altitudes ranging from 50 to 1130 m. It is rare but wide-spread known from northern and southern Queensland and the Queensland/ New South Wales border region.

NOTES – This new species is characterized by a verrucose to verruculose thallus with reticulate pattern due to the abundance of calcium oxalate crystals, perithecioid ascomata with a fused to apically free proper exciple, inspersed hymenium, distinct, coarse lateral paraphyses, monosporic asci with large, eumuriform, brownish, amyloid, thin-walled ascospores and the absence of secondary metabolites. A similar species is *T. saxicola*, see under that species for differences. *Thelotrema porinaceum* is also similar, but can be readily distinguished by the presence of norstictic acid and the non-amyloid ascospores.

SPECIMENS EXAMINED – Australia, Queensland: Atherton Tablelands, Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Lumbsch & Mangold 19151 x* (F). Culpa logging area, 13 km from Koombooloomba rd. turnoff, SE of Tully Falls, *Hale 830718* (US). Mt. Spec NP., Ridge on the Loop, on the Paluma Rd., WNW of Townsville, *Hale 831919, 832396* (US). Wooroi State Forest Park, W of Teewantin, *Hale 831957* (US). 13 km N of O'Reilly's on rd. to Lamington NP., S of Brisbane, *Hale 830656, 831928* (US). Lamington NP., Main Border Track out of O'Reillys, *Hale 831509* (US). New South Wales, Dorrigo NP., Never Never Picnic Area and Rosewood Creek Track, *Mangold 24 a* (F).

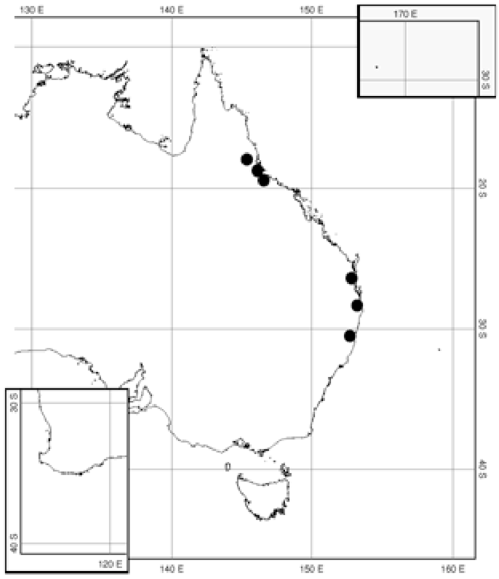

Fig. 151. Australian distribution of *T. oleosum*..

Thelotrema pachysporum Nyl.

Bull. Soc. Linn. Normandie 2(2): 72 (1868). *Phaeotrema pachysporum* (Nyl.) Zahlbr., Cat. Lich. Univ. II: 609 (1923). Type: New Caledonia, *Pancher* s.n. (H-Nyl.22747-holotype).

Thelotrema exalbidum Stirt., Proc. Phil. Soc. Glasgow 13: 184 (1881). *Leptotrema exalbidum* (Stirt.) Zahlbr., Cat. Lich. Univ. 2: 634 (1923). Type: India, Assam, 03. Feb. 1879, *Watt* s.n. (BM!-lectotype, selected by Hale [1974: 29]; GLAM!-isolectotype).

Thelotrema galactinum Vain., Dansk Bot. Ark. 4(11): 24 (1926). *Phaeotrema galactinum* (Vain.) Zahlbr., Cat. Lich. Univ. 8: 245 (1932). Type: Mexico, "Malvapam" (=Maloapam), *Liebmann 7712* (C!-lectotype, selected by Hale [1974: 29]).

Thelotrema limae Vain., Boletim Soc. Broteriana, sér. 2, 6: 150 (1929). *Phaeotrema limae* (Vain.) Zahlbr., Cat. Lich. Univ. X: 216 (1939). Type: Mozambique, Palma, 1916, *A. Pires de Lima 38* (TUR-Vain. 34808-holotype).

Thelotrema palmense Vain., Boletim Soc. Broteriana, sér. 2, 6: 150 (1929). *Phaeotrema palmense* (Vain.) Zahlbr., Cat. Lich. Univ. X: 216 (1939). Type: Mozambique, Palma, 1916, *A. Pires de Lima 78* (TUR-Vain. 34810-lectotype, selected by Salisbury [1972: 270]).

ILLUSTRATION – Fig. 152.

Thallus predominantly to entirely hypophloedal, up to c. 80 µm high, pale gray to pale yellowish-gray. Surface dull to rarely slightly shiny, rough, continuous, unfissured to sometimes slightly fissured. Cortex structures absent. Algal layer incontinuous and poorly developed, calcium oxalate crystals abundant, small. Vegetative propagules not seen. Ascomata inconspicuous, (moderately) large, up to c. 1 mm in diam., apothecioid, roundish, solitary, immersed to usually ±emergent, predominantly hemispherical. Disc usually partly visible from surface, grayish, coarsely pruinose. Pores moderately wide to gaping, up to c. 700 µm in diam., roundish to slightly irregular, apical to upper proper exciple visible from surface, free, predominantly entire to rarely slightly jagged, whitish to off-white, predominantly incurved, sometimes slightly shrunken. Thalline rim margin moderately thin, roundish, entire to slightly split, in older ascomata often becoming eroded, concolorous with thallus to brownish in eroded ascomata due to protruding substrate layer, thalline rim concolorous to grayish brown in specimen with thinner thallus, with same surface as thallus, incurved. Proper exciple free, moderately thin, hyaline internally, yellowish-brown to grayish-brown or dark-brown marginally, sometimes with incorporated small calcium oxalate crystals, rarely faintly amyloid at the base. Hymenium up to c. 200 µm high, non-inspersed, moderately conglutinated, paraphyses slightly bent, slightly interwoven, unbranched, tips slightly thickened, somewhat irregular, lateral paraphyses present, sometimes inconspicuous, up to c. 25 µm long, columellar structures absent. Epihymenium moderately thick, hyaline, with grayish to brownish granules, sometimes small crystals and remnants of deceased ascospores. Asci 4-8-spored, tholus thick, moderately thick at maturity. Ascospores moderately small to moderately large, transversely septate, very rarely with a single, thin longitudinal septum, cell walls thick to very thick, halonate, brown, moderately to weakly amyloid, clavi- to fusiform, with narrowed-rounded to subacute ends, loci roundish, predominantly oblong to lentiform, septae moderately thin to moderately thick, regular, 30-75 x 10-15 µm with 8-18(20)x(2) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC (results often falsified due to contamination by host substrates).

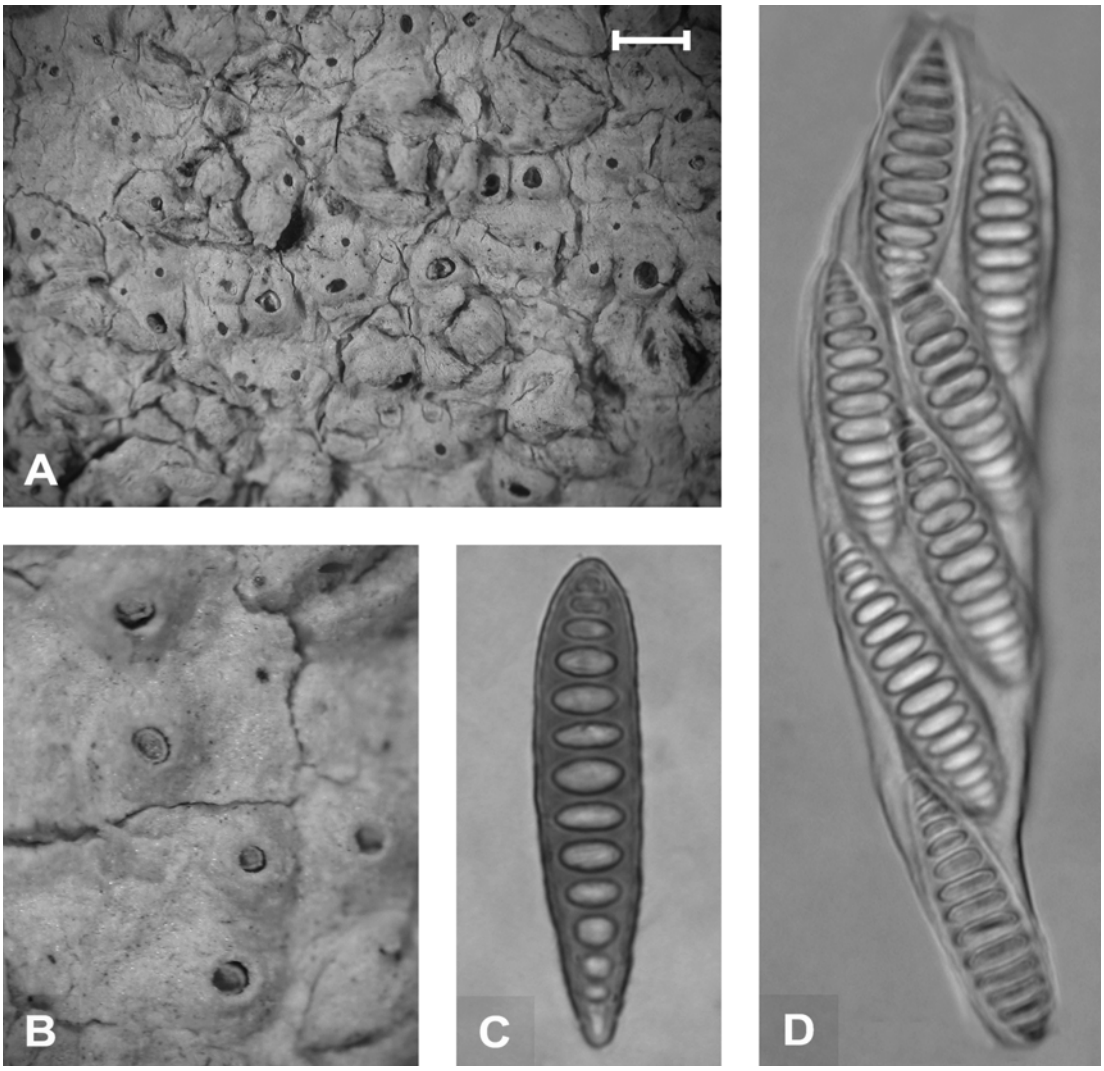

Fig. 152. *Thelotrema pachysporum*: growth habit (**A**), ascomata (**B**), mature ascospore (**C**) and younger ascosporez (**D**). A.-D.: *Stevens 4109*. Bar= A: 1.5 mm; B: 1 mm; C: 10 µm; D: 12 µm.

ECOLOGY AND DISTRIBUTION – *Thelotrema pachysporum* grows on bark in mangroves and sclerophyll forests, grasslands or rarely rainforests. The species was collected in altitudes ranging from sea level up to 780 m. It is a moderately common and wide-spread species in the north-western Northern Territory and Queensland. This is the first report for Australia. It has previouly been recorded from the Neotropics (Frisch, 2006), New Caledonia, India and Africa, indicating a pan(sub)-tropical distribution.

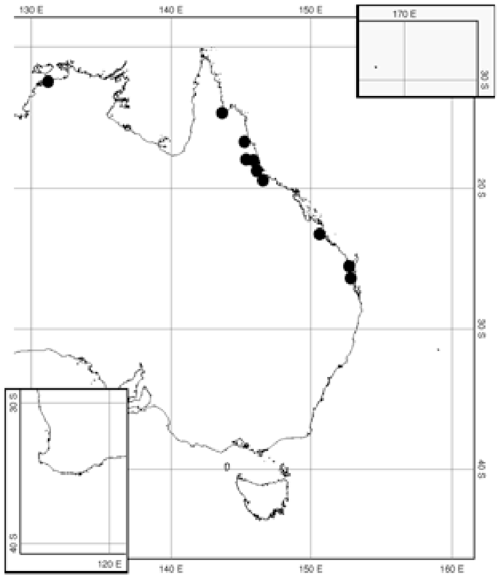

Fig. 153. Australian distribution of *T. pachysporum*.

NOTES – This taxon is characterized by a thin, ecorticate thallus, large ascomata with free proper exciple, moderately large, transversely septate, thick-walled, brown ascospores with roundish loci and the absence of secondary compounds. Besides *T. lacteum* (see below) the only similar species is *T. rockii* from Hawaii, which is distinguished by a higher hymenium (up to 250 µm), larger ascospores (up to 85 µm long) with a weak amyloid reaction (non-amyloid to faintly amyloid in immature stages) and the occurrence of the stictic acid chemosyndrome. Unfortunately the type of *T. pachysporum* was not available for study, however, Frisch (2006) provided a detailed description. Authors published different interpretations of the taxonomy of this species. Frisch (2006) considered *T. pachysporum* as a distinct species from the similar *T. lacteum* (for differences see under that species) where it was recently synonymized by Hale (1981). Salisbury (1972) erroneously reported transversely septate ascospores in the FH-Tuck. type of *T. lepa-dodes* (see also Hale, 1978), and consequently placed several names synonymous which belong to *T. pachysporum* (*T. exalbidum*, *T. limae* and *T. pal-mense*). Hale (1981) referred to additional syno-nyms for *T. lacteum* in his publication (Hale, 1974) for *Phaeotrema disciforme* (=*T. monosporum*), where three names are listed: *T. exalbidum* and *T. galactinum* (= *T. pachysporum* syn. nov.), and *T. aquilinum* (= *T. monosporum*).

SPECIMENS EXAMINED – Australia, Northern Territory: 7.5 km E of Darwin, 2.5 km N of Landing Quarantine station, *Thor 5926* (S). 42.5 km ESE of Darwin, Black Jungle, *Thor 5779* (S). Queensland: At Musgrave, on Peninsula Developmental Rd., Cape York Peninsula, *Hale 831172* (US). Cape Tribulation Area, Myall Beach, *Lumbsch & Mangold 19158 l, 19162 d, e, j, k* (F). Cooktown Rd., 3 km NW of Mt. Molloy, *Elix & Streimann 17163* (CANB). Ravenshoe SF., Culpha Ck. Catchment, Cardwell Range, 41 km SE of Ravenshoe, *Elix & Streimann 16091* (CANB). Butchers Hill Property, 6 km from homestead, *Stevens 4109* (BRI). Babinda Boulders, *Lumbsch & Guderley 11151 m* (F). Cape Cleveland NP., E of Townsville, *Hale 831747* (US). First Turkey, Mt. Archer Environmental Park, 7 km NE of Rockhampton, *Elix 34535* (B, CANB). Tandora, about 25 km ENE of Maryborough, *Hafellner 18267, 18269* (GZU). Imbil SF., 6 km NW of Imbil, *Rogers 2536* (BRI).

Thelotrema polythecium Nagark., Sethy & Patw.

Mycotaxon 28: 195 (1987). Type: India, Andaman Islands, North Andaman, Mayabandar Range, *Nagarkar & Patwardhan 852793* (AMH-holotype, US-isotype - not seen).

ILLUSTRATION – Fig. 154.

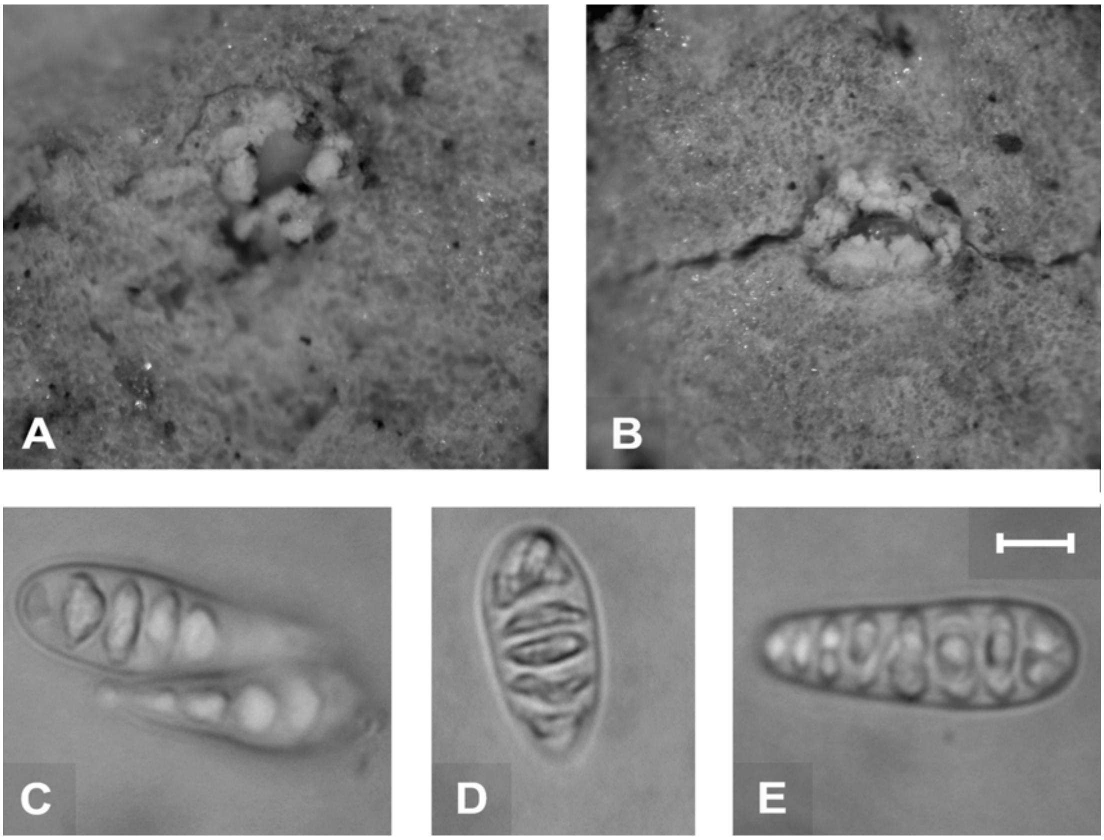

Fig. 154. *Thelotrema polythecium*: ascomata (**A, B**) and ascospores (**C-E**). A.-E.: *Hale 69145*. Bar= A: 0.25 mm; B: 0.2 mm; C: 3 µm; D: 4 µm; E: 6 µm.

Thallus hypophloedal, pale greenish-gray. Surface dull to slightly glittering, porous due to visible substrate structure, continuous, unfissured. Cortex structures absent. Algal layer poorly developed, incontinuous, calcium oxalate crystals not seen. Vegetative propagules not seen. Ascomata inconspicuous, moderately large, up to c. 500 µm in diam., roundish to somewhat irregular in fused ascomata, becoming apothecioid to somewhat chroodiscoid in older stages, erumpent, solitary to marginally fused, sometimes clustered in small groups, immersed. Disc becoming partly to rarely entirely visible from surface, pale yellowish to pale flesh-colored, epruinose. Pores becoming wide to gaping, up to c. 400 µm in diam., roundish to irregular, split, proper exciple not visible from surface. Thalline rim margin (moderately) thick, lacerate to coarsely squamose, sometimes slightly layered, whitish to off-white, incurved to somewhat erect in outer parts. Proper exciple fused, moderately thin to moderately thick, often indistinct due to incorporated substrate layers, hyaline internally, pale yellowish-gray marginally, non-amyloid. Hymenium up to c. 90 µm high, non-inspersed, weakly conglutinated, paraphyses parallel, predominantly straight, unbranched, tips unthickened to slightly thickened, lateral paraphyses present, inconspicuous, up to c. 20 µm long, often not clearly separated from proper exciple, columellar structures absent. Epihymenium indistinct, hyaline to slightly grayish, without granules or with fine hyaline to pale grayish granules. Asci 8-spored, tholus thin, not visible at maturity. Ascospores small, (sub-)muriform, cell walls moderately thin, endospore moderately thick, with thin halo, hyaline, non-amyloid, young ascospores claviform, becoming oblong to roundish-claviform at maturity with roundish to narrowed-roundish ends, loci small, distinctly angular and irregular in younger stages, roundish to slightly angular and subglobose to oblong to somewhat irregular at maturity, with same shaped to hemispherical (or in young stages conical) end cells, transverse septae moderately thick, distinct, regular, 17-25 x 6-9 µm with 6-9 x 1-3(4) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Thelotrema polythecium* is known in Australia from one collection on tree bark in a tropical rainforest at an unknown altitude in northern Queensland. This is the first report for Australia of a species that was previously only known from the Andaman Islands.

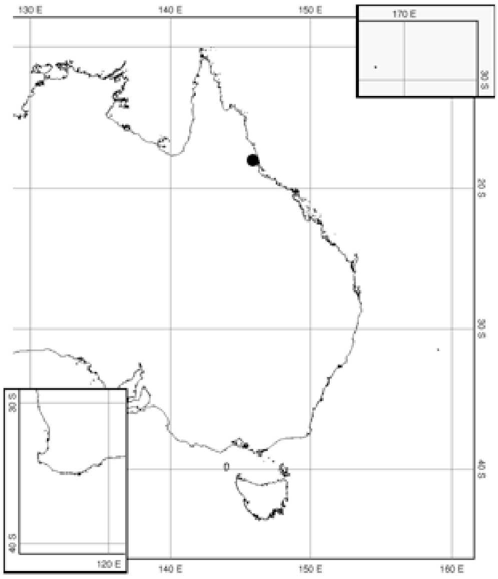

Fig. 155. Australian distribution of *T. polythecium*.

NOTES – Although the type material of this taxon was not available for study, the singular Australian specimen agrees well with to the original description of *T. polythecium* (Nagarkar & al., 1987). It has an hypophloedal, ecorticate thallus, somewhat chroodiscoid ascomata with a bright, lacerate to coarsely squamulose margin, typical, small, (sub-)muriform, hyaline, non-amyloid ascospores with distinctly thickened endospore and lacks secondary compounds. *Thelotrema subadjectum* and *T. cyphelloides* are similar; see there for differences.

The generic position of *T. polythecium* is uncertain. The ascospores are similar to the *O. clandestina*-group, however, the lack of carbonization and the presence on lateral paraphyses differentiate it from that species group. The hymenium and with some respects the excipular structures as well as the thalline rim morphology are similar to *Topeliopsis*, the immersed, ±chroodiscoid ascomata and the lack of an amyloid reaction of the ascospores, on the other hand resemble *Chapsa*. Molecular data will be necessary to re-evaluate the generic placement of this species.

SPECIMENS EXAMINED – Australia, Queensland: Wooroonooran NP. ("Bartle Frere NP."), Trail head, *Hale 69145* (US).

Thelotrema porinaceum Müll.Arg.

Nuov. Giorn. Botan. Ital. 23: 130 (1891). *Myriotrema porinaceum* (Müll.Arg.) Hale, Mycotaxon 11: 134 (1980). Type: Japan, Awa, *Miyoshi 17* (G!-holotype).

ILLUSTRATION – Fig. 156.

Thallus corticolous or rarely saxicolous, predominantly episubstratic, (moderately) thick, up to c. 800 µm high, pale grayish-green to (pale) olive. Surface dull to shiny, smooth to rarely somewhat roughened, continuous to usually verruculose or verrucose, ±distinctly fissured. Cortex structures absent or covered by an incontinuous protocortex up to c. 20 µm thick. Algal layer variable, mostly continuous and well developed, sometimes discontinuous and poorly developed, calcium oxalate crystals abundant, large, scattered to clustered. Vegetative propagules not seen. Ascomata predominantly inconspicuous, (moderately) large, up to 1.2 mm in diam., roundish, solitary, perithecioid, immersed to more often ±distinctly emergent, then predominantly (verrucose-)hemispherical to rarely somewhat subglobose.

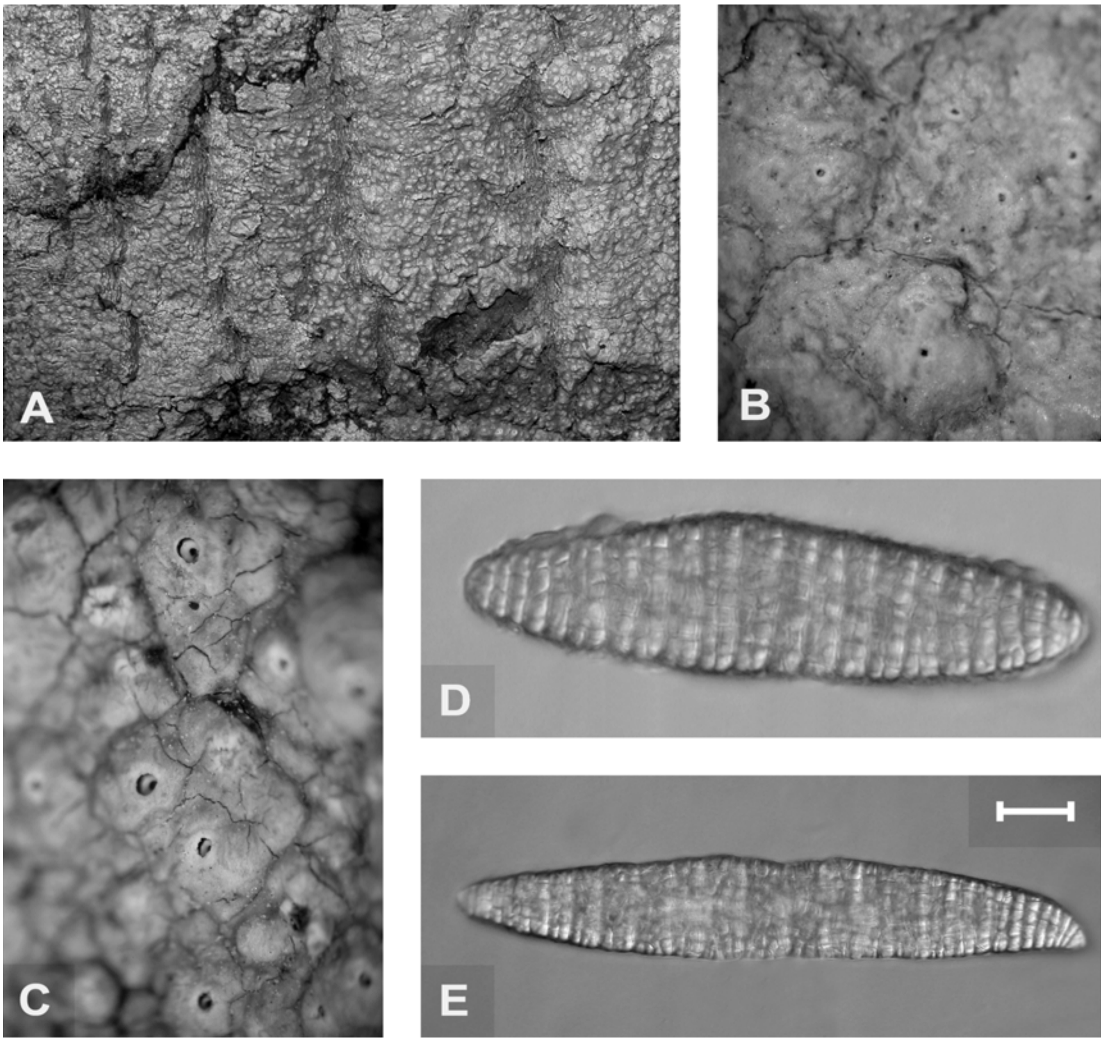

Fig. 156. *Thelotrema porinaceum*: growth habit (**A**), ascomata (**B, C**) and ascospores (**D, E**). A.: *Mangold 19 g*; B.: G-holotype; C.-E.: *Lumbsch & Mangold 19108 d*. Bar= A: 10 mm; B: 1 mm; C: 0.7 µm; D: 20 µm; E: 25 µm.

Disc not visible from surface. Pores tiny to small, up to c. 80 µm in diam., roundish, entire, apical proper exciple becoming visible from surface, forming a fused to entirely free inner pore margin, pore margin level with thallus to more often sunken, off-white to pale brownish, incurved. Thalline rim margin moderately thick, roundish, entire, concolorous with thallus or somewhat brighter, level with thalline rim or ±sunken, thalline rim not developed or not distinguishable from thallus in immersed ascomata, in emergent ascomata incurved, with same surface as thallus. Proper exciple fused to apically or in upper parts free, hyaline to pale yellowish internally, yellowish-gray to yellowish-brown marginally, ±distinctly amyloid at the base. Hymenium up to c. 400 µm high, either non-inspersed (strain I) or densely inspersed (strain II), moderately conglutinated, paraphyses thin, distinctly bent to curly, particularly towards the tips, parallel to slightly interwoven, unbranched, tips unthickened, lateral paraphyses present, usually inconspicuous,not conglutinated, up to c. 35 µm long, columellar structures absent. Epihymenium indistinct, hyaline, without granules or crystals. Asci 1- to very rarely 2-spored, tholus indistinct, lateral walls thickened, thin when mature. Ascospores (very) large, densely eumuriform, cell walls and endospore thin, non-halonate, hyaline, rarely pale yellowish in older stages, non-amyloid to faintly amyloid in mature spores, predominantly oblong-fusiform, often irregular in outline or bifusiform, straight to slightly bent, ends roundish to predominantly narrowed-roundish, loci angular to slightly roundish, predominantly irregular, transverse septae thin, becoming somewhat indistinct with age, regular to slightly irregular, 100-230 x 20-45 µm with multiple loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ orange-red, C-, PD-; containing norstictic (major) and connorstictic (minor to trace) acids.

ECOLOGY AND DISTRIBUTION – *Thelotrema porinaceum* occurs on bark or rarely siliceous rocks in tropical to warm-temperate rainforests and wet sclerophyll forests in altitudes ranging from 100-1200 m. This common and widespread species occurs along the east coast east of the Great Dividing Range from northern Queensland to southern New South Wales. It is also known from Sri Lanka (Hale, 1981) and Japan, being a paleosubtropical element.

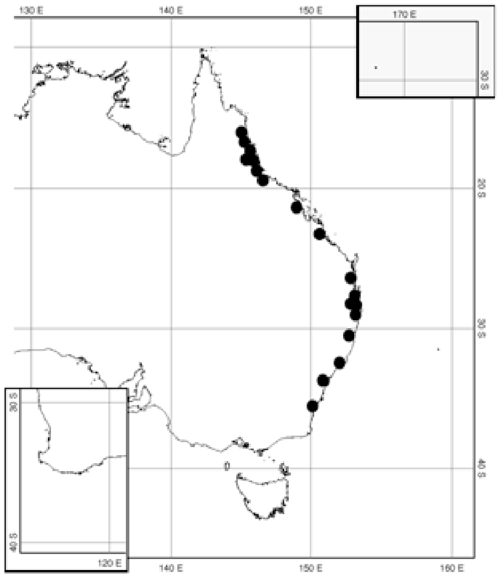

Fig. 157. Australian distribution of *T. porinaceum*.

NOTES – This taxon is readily distinguished by a thick, ecorticate thallus, perithecia, large eu-muriform, predominantly colorless ascospores and the norstictic acid chemosyndrome. A large group of otherwise identical specimens (over 100 collections in Australia, here referred to as strain II) differ from the type material and the remaining Australian samples (strain I) in a strongly inspersed hymenium. Since the nature of hymenial inspersion as a species delimiting character is not well understood this form is treated here as a strain within the species. Additional molecular data will be necessary to evaulate the taxonomic importance of this character. Similar, norstictic acid containing species include: *T. eungellaense* (for differences see under this species), *Myriotrema frustillatum*, *T. weberi* and *T. subweberi*. The latter two taxa, can be distinguished by a thinner thallus, distinctly apothecioid ascomata and thick-walled, distinctly amyloid ascospores. *Myriotrema frustillatum* lacks lateral paraphyses and is isidiate. Other similar species (particularly to the strain II specimen), with a different chemistry are *T. oleosum* and *T. saxicola*, see under these species for differences.

SPECIMENS EXAMINED – Strain I: Australia, Queensland: Cedar Bay NP., Track to Mt. Finnigan, *Streimann 57062A* (CANB). Thornton Range, NW of Mossman, *Hale 830965, 831306, 831405, 832135, 832362* (US). Mt. Windsor, NW of Mossman, *Hale 830620, 830658, 832448, 832560, 832710, 832711* (US). Daintree NP., Mossman sct., lower Mossman River, *Mangold 36 a, l* (F). Mt. Lewis Rd., W of Mossman, *Hale 831238, 831843, 831945* (US). Kuranda, 1893, *Wilson* s.n. (H). Davis Creek Rd., E of Mareeba, *Hale 830668* (US). Atherton Tablelands: Lake Tinaroo, *Lumbsch & Mangold 19125 d, p* (F); Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Lumbsch & Mangold 19148 m, 19151 w* (F); Souita Falls, *Lumbsch & Mangold 19155 t, 19156 d, g, h* (F); Plath Rd. logging head, Herberton Range, *Hale 64187, 830645, 830657, 830660, 830675, 831844* (US); Danbulla Forest Drive, *Hale 832304* (US); Mt. Hypipamee NP., *Hale 832678* (US); 13 km S of Ravenshoe on Tully Falls Rd., *Hale 830730, 832667, 832668* (US). Babinda Boulders, *Mangold 39 q, ze, zf* (F). Francis Range, NW of Innisfail, *Hale 832217* (US). Mt. Chalmynia logging area, W of Innisfail, *Hale 832347* (US). Culpa logging area, SE of Tully Falls, *Hale 830652, 832690* (US). Mt. Tyson track, 2 km W of Tully, *Streimann 45617* (CANB). Kirrima SF., Cardwell Range, *Elix 15686* (CANB). 8 km E of Wallaman Falls, W of Ingham, *Hale 830702, 832358* (US). Little Crystal Creek Falls-Mt. Spec NP., *Hale 831471* (US). Murray Falls, W of Kennedy, *Hale 831306, 831340, 831426, 831449, 831529* (US). Eungella NP.: Trail from Broken River station to rainforest, *Lumbsch & Mangold 19108 d, j* (F); Near Peases Lookout, *Hale 831422, 831755* (F). Softwood shrub near Yabba Rd., 6 km N of Jimna, *Rogers 2269* (BRI). Lamington NP.: O'Reillys Guesthouse, *K. & A. Kalb 21541* (hb. Kalb); Phyton Rock Track, *Hale 830630* (US). Carabeen Nature Refuge, 45 km E of Warwick, *Lumbsch & Mangold 19175 c* (F). New South Wales: Lions Tourist Rd., N of Waingaree, *Hale 830642* (US). NW part of Wiangaree Forest Drive, N of Kyogle, *Hale 831232, 831301, 831318, 832302* (US). Mt. Warning NP., *Mangold 19 p* (F). Dorrigo NP., *Mangold 26 a* (F). Dorrigo SF., *Hale 58738, 58750, 58770* (US). Doyles River SF., 95 km SE of Walcha, *Hale 58542, 58578, 58710* (US). Barrington Tops NP., NE von Scone, *K. & A. Kalb 18025* (hb. Kalb). Bulahdelah District, Myall River SF., *K. & A. Kalb 18051, 18063, 18065* (hb. Kalb). Trail along bank of Mill Creek, 50 km NW of Sydney, *K. & A. Kalb 27048* (hb. Kalb). Track by side of Magdala Creek, 1 km S of Springwood, *Archer P20* (HOB). Glenbrook Creek, SSE of Springwood, *K. & A. Kalb 21885, 21886* (hb. Kalb). Tianjara Falls, 30 km NW of Ulladulla, *Streimann 7857* (H, CANB).

Strain II: Australia, Queensland: Mt. Windsor logging area, NW of Mossman: near jct. rd. to old Forestry Camp and main rd., *Hale 830626, 830669* (US); E of old Forestry Camp, *Hale 830949, 832715* (US). Mt. Lewis Rd., 4 km N from Kennedy Hwy., W of Mossman, *Hale 832097* (US). End of Clohesy River Rd. c.16 km SE Kennedy Hwy., W of Cairns, *Hale 830638* (US). Atherton Tablelands: Lake Tinaroo, Downfall Creek Camping Area, *Lumbsch & Mangold 19123 m* (F); Lake Barrine NP., *Hale 831597* (US). Lake Eacham NP., *Mangold 29 t, bj* (F); Plath Rd. logging head, 9 km W on Plath Rd., off Kennedy Hwy, Herberton range, S of Atherton, *Hale 832157* (US); 18 km S of Atherton, Mt. Hypipamee, at Crater Lake, *Tibell 15431* (UPS); Area below crater, Mt. Hypipamee NP., *Hale 831913, 832221* (US); Tumoulin Rd., 5 km from turnoff to Ravenshoe, *Lumbsch & Mangold 19151 zb, Mangold 30 p* (F); Souita Falls, *Lumbsch & Mangold 19155 r* (F). State Forest area on Tully Rd., 1 km from jct. with S. Mission Beach Rd., S of Mission Beach, *Hale 831338, 831508, 831510, 831538, 831730, 831735* (US). 7.5 km E of Wallaman Falls, W of Ingham, *Hale 831941* (US). Dawson logging area, 24 km S of Koombooloomba turnoff, WSW of Tully, *Hale 830690, 830694, 832701* (US). Little Crystal Creek Falls-Mt. Spec NP., the falls on Paluma Rd., *Hale 831743* (US). Eungella NP.: Rosser Rd. entry point off Darymple rd., near Peases Lookout, *Hale 831250, 831436* (US). Waterpark Creek State Forest Park in Byfield SF., 24 km N of Yeppoon, *Hale 831511* (US). Amama State Forest Park, 6 km SW of Amamoor, S of Glympie, *Hale 832508* (US). Booloumba Creek SF., SW of Kenilworth, *Hale 831214* (US). Mt. Mee SF., nr. Mt. Mee, N of Brisbane, *Hale 58562, 58589, 58612, 58681, 58689, 832332* (US). Mt. Tennison Woods, near Mt. Glorious, *Rogers 694624/5* (BRI). Mt. Glorious: Brisbane SF., *K. & A. Kalb 34281* (hb. Kalb); Bennet Rd., *Rogers 8447, 8448* (BRI). D'Anguilar Range NW of Brisbane, W of Mt. Glorious township, *Hafellner 16980, 16986* (GZU). Upper Coomera, *Wilson* s.n. (NSW-539334, -539336). Cameron falls NP., *Elix 1127* (CANB). Cunninghams Gap NP., 50 km NE of Warwick, *Hale 66699, 831749, 831757, 831758* (US). Lions Tourist Rd. near Queensland border, N of Waingaree, *Hale 69161* (US). Head of Teviot Brook, NE of the Head, Boonah road, *Hale 59483* (US). Lamington NP.: Phyton Rock Track, *Hale 830653, 830979, 830984, 832642* (US); O'Reillys Guesthouse, *K. & A. Kalb 21526* (hb. Kalb); Moran Falls, *Tibell 12684* (UPS); Main Border Track out of O'Reillys, *Hale 832270* (US); Along Blue Pool Track, *Tibell 12668* (UPS); Along circular track, Foresters Camp, Lyrebird Lookout, Moonlight Crag, *Brownlie 1023644 pr. p.* (MEL). New South Wales: Tooloom NP., 23 km WSW of Woodenbong, *Streimann 60911A* (CANB). Lions Tourist Rd. near Queensland border, N of Waingaree, *Hale 830635, 830636, 830672, 830829, 830861, 830880, 831940, 831948, 831959, 832709, 832735, 832741, 832777* (US). Victoria Park Nature Reserve, SE of Lismore, S of Bruxner Hwy., *Hale 831333* (US). McPherson Range, Border Ranges NP., NE of Wiangaree, uppermost part of Gradys Creek, *Hafellner 16661* (GZU). NW part of Wiangaree Forest Drive, N of Kyogle, *Hale 831309, 831331, 831332* (US). Mt. Warning NP., W of Murwillumbah: *Hale 83041, 83054, 831613, 832069, 832694* (US); track from summit to parking lot, *Mangold 19 g, k, n, zc* (F). Tweed Range, Mebbin NP., 25 km SW of Murwillumbah, *Mangold 21 a* (F). Nightcap Forest Drive, W of Mullumbimby: Whian Whian SF., *Hale 830116, 830120, 830123, 831219, 831737* (US); Big shrub Flora Reserve, *Hale 831299, 831404* (US). Nightcap NP., Mnt. Nardi/Mnt. Matheson Track, *Mangold 22 e, v, z, za* (F). Cambridge Plateau Forest Drive, N of picnic area, Richmond Range SF., 30 km W of Casino, *Hale 830117, 830118, 831149, 831158, 831304, 831682, 832546* (US). Wollongbar, Jun. 1894, *Wilson* s.n. (NSW-539335, -539382). Big Shrub, Richmond River, Jul. 1894, *Wilson* s.n. (NSW-539337). Cattle Creek SF., Briggsvale, 12 km NNE of Dorrigo, *Verdon 3832* (B, US). Dorrigo NP., Sassafras Creek Track, *Mangold 25 j* (F).

Thelotrema porinoides Mont. & Bosch

in Miguel, F. A. W., Plant. Jungh. fasc. 4: 484 (1855). *Ocellularia porinoides* (Mont. & Bosch) Zahlbr., Cat. Lich. Univ. II: 599 (1923). *Thelotrema cavatum* var. *porinoides* (Mont.) Nyl., Mém. Soc. Bot. Cherbourg 5: 118 (1858). Type: Java, *Junghuhn* s.n. (L-lectotype, selected by Hale [1974b: 20]; FH-Tuck-, G!-, H-Nyl. 22732-, PC-, W-isolectotypes).

Thelotrema albidiforme Leight., Trans. Linn. Soc. London 27: 170 (1869). *Ocellularia albidiforme* (Leight.) Zahlbr., Ann. Mycol. 14: 50 (1916). Type: Sri Lanka, *Thwaites 19* (BM!-holotype; H-Nyl.22733-, PDA-isotypes).

Thelotrema exanthismocarpum Leight., Trans. Linn. Soc. London 27: 169 (1869). *Ocellularia exanthismocarpa* (Leight.) Zahlbr., Cat. Lich. Univ. II(4): 590 (1923). Type: Sri Lanka, *Thwaites 97* (BM!-lectotype, selected by Hale [1974: 21]).

Thelotrema obovatum Stirt., Trans. Glasgow Soc. of Field Natural. 1: 21 (1873). *Ocellularia obovata* (Stirt.) Müll. Arg., Bull. Herb. Boissier 2, append. 1: 74 (1894). Type: New Zealand, Wellington, *Buchanan 57b* (GLAM!-lectotype, selected by Galloway [1985: 576]; BM!-isolectotype).

Ocellularia platychlamys Müll. Arg., Bull. Herb. Boissier 3: 313 (1895). Type: Australia, Queensland, Blackall Range, Eumundi ['Emundi'], *Bailey* s.n. (G!-lectotype, here selected).

Thelotrema homothecium Vain., Ann. Acad. Sci. Fenn. A 15(6): 190 (1921). *Ocellularia homothecia* (Vain.) Zahlbr., Catal. Lich. Univ. 2: 593 (1923). Type: Philippines, Irosin, *Elmer 14852* pr.p. (TUR-Vain.-holotype, US!-isotype).

[For additional synonyms see Frisch, 2006.]

ILLUSTRATION – Fig. 158.

Thallus predominantly hypophloedal, very thin, epiphloedal parts (usually in ascomata area) up to c. 30 µm high, in shades of grayish-green. Surface dull to slightly shiny, smooth to roughened due to protuberant substrate, continuous to slightly verruculose, unfissured (sometimes appearing fissured due to substrate structure), covered by continuous to incontinuous protocortex, up to c. 30 µm thick. Algal layer variable, well developed, continuous to incontinuous, occurrence of calcium oxalate crystals variable, usually frequent, small to large, often clustered. Vegetative propagules not seen. Ascomata ±conspicuous, (moderately) large, up to c. 900 µm in diam., roundish, apothecioid, sessile, solitary to sometimes fused, usually distinctly emergent, rarely subglobose with constricted base to more often hemispherical to broad-cylindrical or cone-shaped with flattened apex. Disc not visible from surface to sometimes becoming partly visible, pale grayish, distinctly pruinose. Pores small to moderately wide, up to c. 300 µm in diam., roundish, entire to split, proper exciple entirely to apically visible from surface, free, apically bright, darker towards the base, incurved to slightly erect, sometimes slightly shrunken. Thalline rim margin thick, ±roundish, entire to split to lacerate or eroded, often slightly to distinctly layered, incurved to erect, mostly whitish or brighter than thallus, sometimes slightly pruinose, thalline rim surface often irregular-verrucose to verruculose. Proper exciple free, ±thin, hyaline internally, grayish-brown marginally, often covered by grayish granules, non-amyloid to faintly amyloid at the base. Hymenium up to c. 220 µm high, non-inspersed, moderately conglutinated, paraphyses interwoven, unbranched, tips slightly thickened, lateral paraphyses present, conspicuous, up to c. 40 µm long, columellar structures absent. Epihymenium thick, hyaline, with grayish to brownish granules and small crystals. Asci 8-spored, tholus (moderately) thick, not visible at maturity. Ascospores typical, variable in size, moderately small to large, transversely septate, cell walls very thick, thinly halonate, hyaline, strongly amyloid, oblong-fusiform to sometimes oblong-claviform, ends narrowed-roundish to more rarely subacute, loci roundish to slightly angular in younger stages, subglobose to predominantly lentiform, end cells ±conical, septae moderately thin to thick, regular, 40-150(170) x 15-22 µm with 14-26(28) loci. Pycnidia not seen, reported by Frisch 2006, see there for description.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing constictic, stictic (majors), hypostictic (minor), hypoconstictic, cryptostictic and α-acetylhypoconstictic (traces) acids.

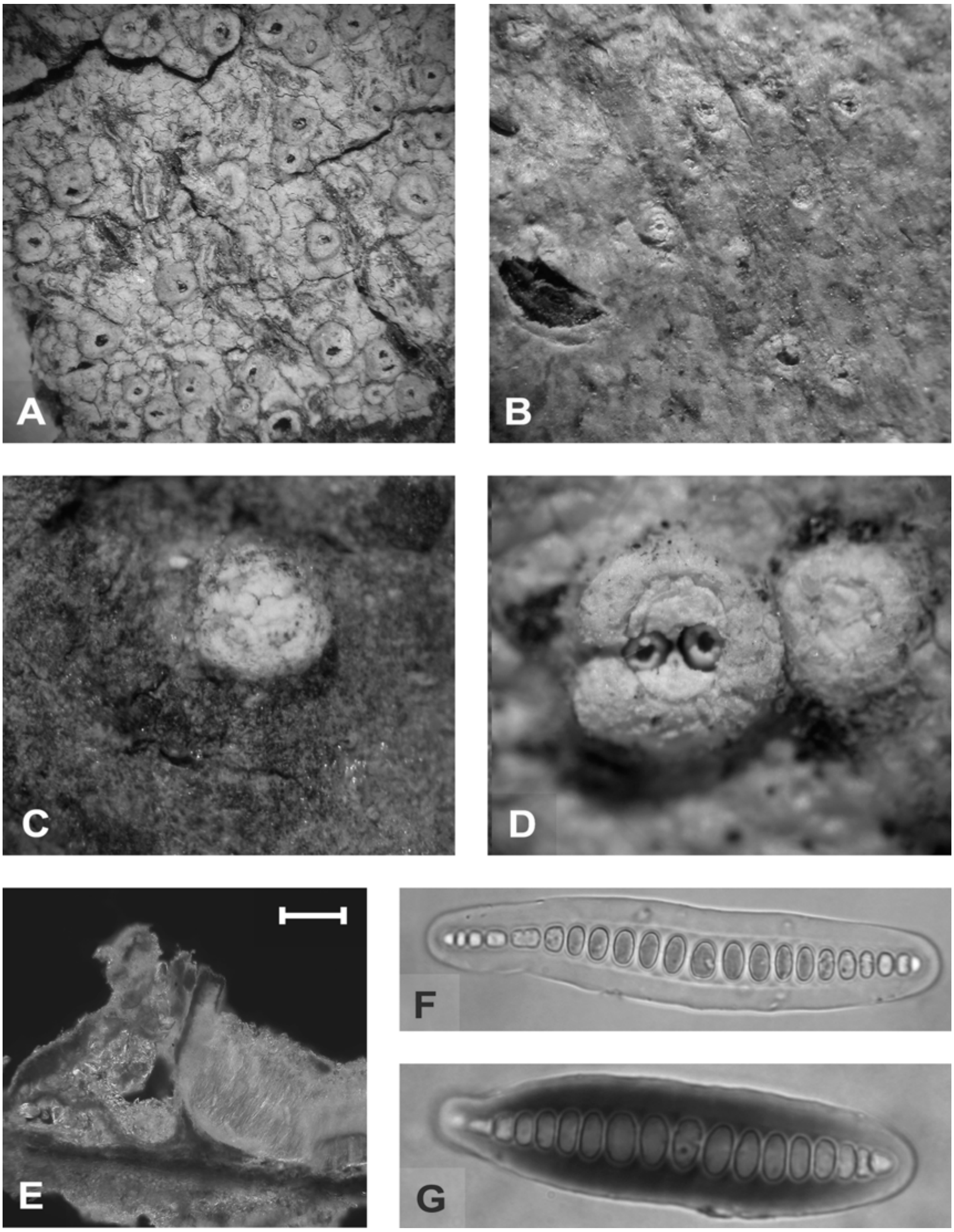

Fig. 158. *Thelotrema porinoides*: growth habit (**A, B**), ascomata (**C, D**), ascoma section (**E**), ascospore (**F**) and ascospore showing amyloid reation (**G**). A.: GLAM-lectotype of *T. obovatum*; B.: US-isotype of *T. homothecium*; C., F., G.: *Lumbsch & Mangold 19153 w*; D.: *Lumbsch & Mangold 19113 s*; E.: *Lumbsch & Mangold 19156 b*. Bar= A: 1 mm; B: 0.85 mm; C: 0.4 mm; D: 0.35 mm; E: 100 µm; F: 13 µm; G: 11 µm.

ECOLOGY AND DISTRIBUTION – *Thelotrema porinoides* grows on tree bark in (sub)tropical rainforests in altitudes ranging from 60 to 1000 m. This moderately common and wide-spread species, occurs along the east coast of Queensland. The pantropical species is also recorded from Hawaii (as *T. multilocularis* – Zahlbruckner, 1912), the Neotropics (Hale, 1978b), Africa (Frisch, 2006), India (Hale, 1981), Sri Lanka, Japan (Matsumoto, 2000), Philippines, Borneo (Sipman, 1993), Java, Solomon Islands (Hale, 1981) and New Zealand.

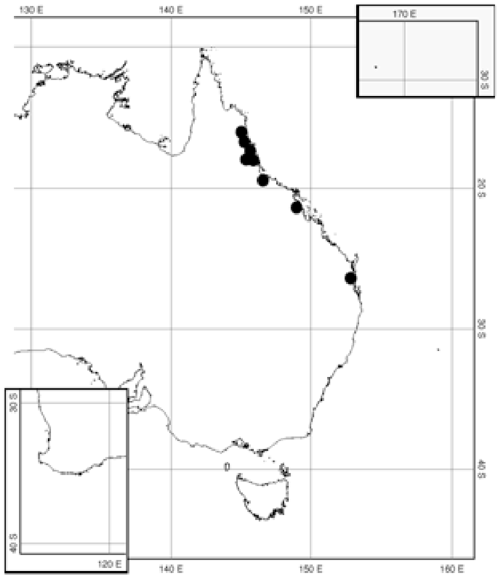

Fig. 159. Australian distribution of *T. porinoides*.

NOTES – This taxon is characterized by a hypophloedal thallus, ±conspicuous, emergent ascomata with free proper exciple and a bright, usually split to lacerate and often layered thalline rim margin, transversely septate, hyaline, thick-walled, strongly amyloid ascospores and the presence of the stictic acid chemosydrome. Among *Thelotrema* species with transversely septate ascospores and stictic acid, it is characterized by large ascospores. *Thelotrema agasthiensis* from India (type not seen, fide Nagarkar & al. 1988 with ascospores up to 120 µm long with up to 30 loci), is similar and probably conspecific with *T. porinoides*. *Thelotrema capetribulense* (ascospores up to 50 µm with up to 14 loci) differs in having a thicker, distinctly verrucose thallus and less intensely amyloid, claviform ascospores. Further morphologically similar, but chemically differing species include *T. nureliyum* (secondary compounds absent) and *T. nostalgicum* (protocetraric acid chemosyndrome). Both species are further distinguished by larger ascospores.

SPECIMENS EXAMINED – Australia, Queensland: Big Tableland, 26 km S of Cooktown, *Elix 17251* (CANB). Near Cedar Bay NP., on rd. to Cooktown, *Mangold 34 b* (F). Cape Tribulation area, near Cape Tribulation Store, *Mangold 33 o* (F). Daintree NP., Mossman Gorge Section, near Rex Creek Swing Bridge, *Mangold 35 r* (F). End of Clohesy River Rd. 16 km SE Kennedy Hwy., W of Cairns, *Hale 832265* (US). Crystal Cascades, 5 km W of Cairns, *Lumbsch & Mangold 19118 e* (F). Goldsborough Valley State Forest Park, SW of Gordonvale, *Hale 831973* (US). Atherton Tablelands: Millaa Millaa falls, *Lumbsch & Mangold 19137 i* (F); 2 km N of S. Johnstone Forestry Camp, SE of Millaa Millaa, *Hale 832252* (US); Souita Falls, *Lumbsch & Mangold 19153 k, w, x, 19155 b, w, 19156 b* (F). Babinda Boulders, NW of Babinda: *Hale 831487* (US); *Mangold 39 zg* (F). Mt. Spec NP., Ridge on the Loop, on the Paluma Rd., WNW of Townsville, *Hale 830936* (US). Eungella NP., Finch Hatton Gorge, *Lumbsch & Mangold 19113 s* (F).

Thelotrema pseudosubtile Mangold spec. nov. ined.

Type: Australia, Queensland, Crystal Cascades, 5 km W of Cairns, *Lumbsch & Mangold 19117 k* (CANB-holotype, BRI-isotype).

ETYMOLOGY – The epithet refers to the similarities of the new species to *T. subtile*.

ILLUSTRATION – Fig. 160.

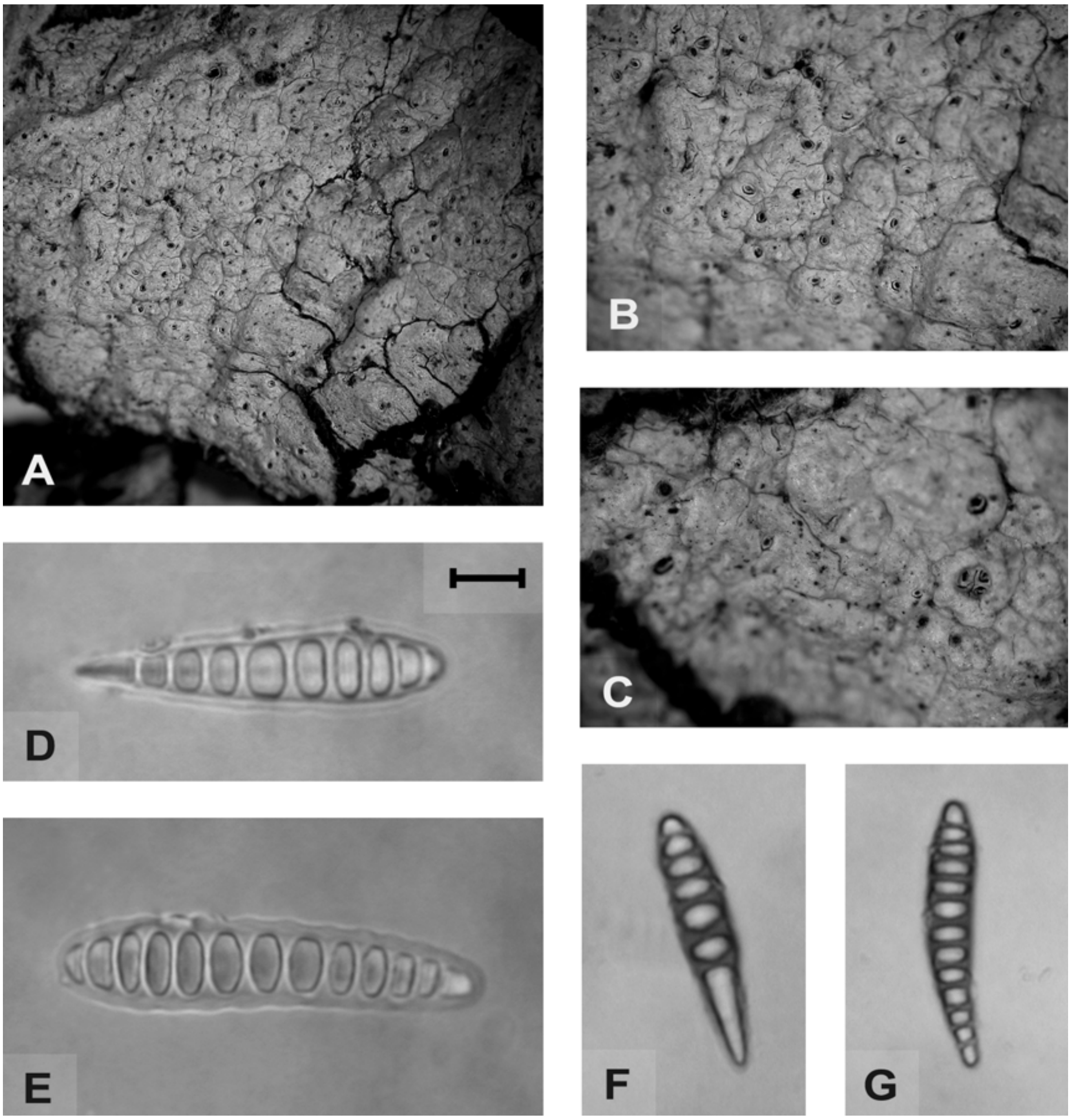

Fig. 160. *Thelotrema pseudosubtile*: growth habit (**A, B**), ascomata (**C**), ascospores (**D, E**) and ascospores showing amyloid reaction (**F, G**). A.-G.: CANB-holotype. Bar= A: 1 mm; B: 0.5 mm; C: 0.3 mm; D, E: 7 µm; F: 12 µm; G: 15 µm.

Thallus epi- to hypophloedal, predominantly thin, up to c. 200 µm high, pale yellowish gray to pale olive. Thallus dull to slightly shiny, smooth, continuous to ±distinctly verrucose to verruculose, slightly to distinctly fissured. Thallus cover variable, thallus covered by an incontinuous to continuous protocortex, up to c. 20 µm thick, sometimes becoming distinctly conglutinated forming a true cortex of periclinal hyphae up to 40 µm thick. Algal layer moderately well developed, continuous, calcium oxalate abundant to sometimes sparse, predominantly small to more rarely large, often clustered. Vegetative propagules not seen. Ascomata inconspicuous, predominantly small to rarely moderately large, up to c. 300(600) µm in diam., roundish, apothecioid, sessile, solitary to marginally or entirely fused, predominantly ±immersed to slightly emergent, flattened-hemispherical, with same surface as thallus. Disc often becoming partly visible from surface, grayish to pale flesh-colored, epruinose to slightly pruinose. Pores (moderately) small, up to c. 150(250) µm in diam., roundish to slightly irregular, predominantly entire to slightly split, proper exciple always apically to very rarely entirely visible from surface, sometimes somewhat shrunken, whitish to off-white, pale brownish towards the base, predominantly incurved. Thalline rim margin (moderately) thin, becoming moderately wide to rarely gaping with age, roundish to irregular-roundish, predominantly entire to rarely slightly split, predominantly incurved to more rarely somewhat erect, concolorous with thallus or indistinctly brighter. Proper exciple becoming partly free to free, predominantly thin, hyaline to pale yellowish internally, brownish or grayish-brown marginally, apically often dark-brown, sometimes with substrate inclusions, often amyloid at the base. Hymenium up to c. 150 µm high, non-inspersed, distinctly conglutinated, paraphyses moderately interwoven, unbranched to sometimes slightly branched, tips moderately thickened, lateral paraphyses present, predominantly inconspicuous, up to c. 20 µm long, columellar structures absent. Epihymenium variably thick, hyaline to sometimes brownish with age, with grayish granules and small crystals. Asci 2-8-spored, tholus (moderately) thick, thin when mature. Ascospores small to moderately large, transversely septate, very rarely with a single longitudinal septae, cell walls (moderately) thick, often with distinctly crenate surface, thinly halonate, hyaline, faintly to distinctly amyloid, sometimes oblong to fusiform or predominantly clavate, ends roundish to acute, loci roundish to somewhat angular, rarely subglobose to more often lentiform or slightly irregular, end cells hemispherical to conical, septae moderately thick to moderately thin, regular to irregular, 25-60 x 6-9 µm with 7-16 (x 2) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Thelotrema pseudosubtile* grows on tree bark predominantly in (sub)tropical to warm-temperate rainforests, rarely in wet sclerophyll forests in altitudes ranging from sea level to 950 m. It is common and wide-spread occurring in Queensland and New South Wales (incl. Lord Howe Island). It is currently only known from Australia.

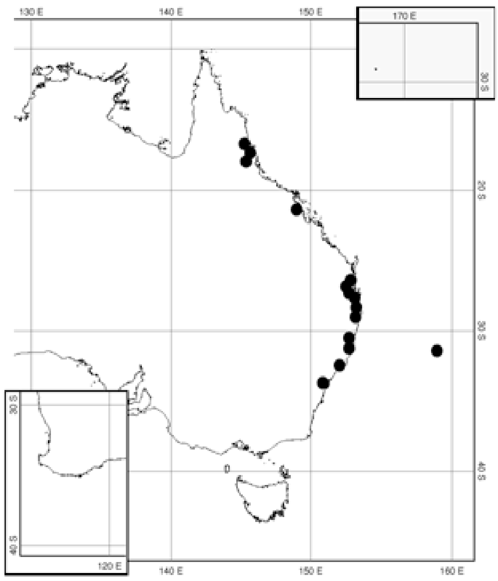

Fig. 161. Australian distribution of *T. pseudosubtile*.

NOTES – This new species is characterized by a thin thallus, predominantly immersed or indistinctly emergent, small apothecia with free proper exciple, medium-sized, transversely septate, weak to moderately amyloid ascospores that are hyaline throughout their entire development, have a crenate surface and are often clavate, and the absence of secondary compounds. It is similar to the tempertae *T. subtile*, which, however, can be distinguished by the more distinctly emergent apothecia and ascospores that become brown at age. *Thelotrema diplotrema* is also similar, but differs by a less compact, sometimes roughened thallus surface, more distinctly emergent ascomata with a usually less distinctly free proper exciple and larger ascospores (up to 100 µm long with up to 22 loci) with thicker cell walls that lack a distinctly crenate surface.

SPECIMENS EXAMINED – Australia, Queensland: Cape Tribulation Area: Myall Beach, *Mangold 31 u* (F); track to Cape Tribulation Beach, *Mangold 32 t* (F); 4.5 km on Buchanan [Creek] Rd., *Hale 831723* (US). Km 45 on Mt. Windsor Rd., NW of Mossman, *Hale 831722* (US). Mt. Lewis Rd. 4 km N from Kennedy Hwy., W of Mossman, *Hale 832737* (US). Manchans Beech, few km N of Cairns, *K. & A. Kalb 20046* (hb. Kalb). W of Palm Cove, c. 25 km N of Cairns, *K. & A. Kalb 19949* (hb. Kalb). Crystal Cascades, 5 km W of Cairns, *Lumbsch & Mangold 19117 k* (F). Atherton Tablelands: Lake Tinaroo, Downfall Creek Camping Area, *Lumbsch & Mangold 19125 j, h* (F); 10 km S of Ravenshoe on Tully Falls Rd., *Hale 830731* (US); 1-2 km N of Murray Falls, W of Kennedy, *Hale 831342, 831648, 832533* (US). Eungella NP., along Broken River, *Lumbsch & Mangold 19100 y*

(F). Cape Hillsborough NP., NW of Mackay, *Hale 831356, 831701* (US). Wooroi State Forest Park, W of Tewantin, *Hale 830999, 832080* (US). Booloumba Creek SF., SW of Kenilworth, *Hale 831367* (US). 6 km N of Jimna, *Tibell 12797* (UPS). Bunya Mts.: On the rd. from the ridge to Maidenwell, 1.3 km NE of the intersection, *Hafellner 19349* (GZU); Mt. Bunya, Shire picnic area on southern NP. boundary, S of Park, *Hale 831411, 831419, 832472, 832500* (US); Mt. Mowbullan, *K. & A. Kalb 20254, 20268* (hb. Kalb). D'Anguilar Range NW of Brisbane, W of Mt. Glorious township, *Hafellner 16955, 16957* (GZU). Mt. Mee SF., near Mt. Mee, N of Brisbane, *Hale 58604* (US). Bennet Rd., Mt. Glorious, *Rogers 8449* (BRI). Sankeys Shrub, Brisbane, *Wilson* s.n. (NSW-539342). Goodna [SW of Brisbane], *Wilson* s.n. (NSW-539346). Lamington NP.: Python Rock Track, *Hale 832375* (US); Beechmont Range, Binna Burra, *K. & A. Kalb 19896* (hb. Kalb). New South Wales: Nightcap Forest Drive, 1 km W of Minyon Falls, N of Lismore, *Hale 832087, 832180, 832543* (US). Dorrigo NP., Never Never Picnic Area and Rosewood Creek Track, *Mangold 24 b, d, f* (F). Saltwater, E of Taree, *Elix 3997* (CANB). Sugar Creek Flora Reserve, Wallingat SF., 16 km SW of Forster, *Streimann 44230 a* (B, CANB). Bulahdelah District, Myall River SF., E of Stroud, Jarrah Rd., *Kalb & Filson 18044, 18046, 18049* (hb. Kalb). Trail along bank of Mill Creek, 50 km NW of Sydney, *K. & A. Kalb 34272* (hb. Kalb). Below Katoomba Falls, trail to Giant Stairway, Katoomba, *Hale 58731* (US). Royal NP., S of Sydney, Bola Creek, E of Waterfall, *K. & A. Kalb 21692, 21695, 21709* (hb. Kalb). Lord Howe Island: Goat House Cave, *Elix 42175* (CANB), *42265* (B, CANB); Smoking Tree Ridge, *Elix 42149* (B, CANB); Track from Smoking Tree Ridge to Rocky Run, *Elix 42429* (CANB); Track to Kims Lookout, *Elix 42393* (CANB).

Thelotrema rugatulum Nyl.

Bull. Soc. Linn. Normand. 2(7): 168 (1873). Type: Andaman Islands, 1867, *Kurz 57* (H-Nyl. 22495!-lectotype, selected by Hale [1972 in hb.]).

ILLUSTRATION – Fig. 163.

Thallus epi- to hypophloedal, (moderately) thin, up to c. 200 µm high, pale yellowish gray to more rarely pale grayish-green. Surface typical, dull to slightly shiny, usually smooth, sometimes the surface becoming partly eroded, then roughened to porous, rarely continuous to usually rugose and distinctly verrucose to slightly verrucose, ±fissured to areolate. Thallus cover variable, thallus predominantly covered by an ±incontinuous protocortex up to 25 µm thick, sometimes partly becoming distinctly conglutinated forming a true cortex of predominantly periclinal hyphae. Algal layer usually well developed, continuous to incontinuous, often interrupted by calcium oxalate crystals, calcium oxalate crystals very abundant, small to more often (very) large, often clustered. Vegetative propagules not seen. Ascomata variable, conspicuous to inconspicuous, moderately small to large, up to c. 1 mm in diam., ±roundish, peri- to apothecioid, erumpent to sessile, solitary to rarely marginally slightly fused, immersed to more rarely distinctly emergent, (verrucose-)hemispherical to more rarely (verrucose-)urceolate. Disc not visible from surface to rarely becoming partly visible, grayish, pruinose. Pores variable, small to wide to gaping, up to c. 800 µm in diam., predominantly smaller, usually up to 300 µm, roundish to roundish-irregular to irregular, proper exciple rarely entirely to more often only apically visible from surface, rarely entirely free to more often free only in the upper parts, usually off-white to whitish, often somewhat shrunken, predominantly entire to slightly split, in distinctly apothecioid specimen usually distinctly split, sometimes distinctly layered, incurved. Thalline rim margin ±roundish, small to gaping, predominantly entire to slightly split, sometimes slightly eroded, moderately thin to moderately thick, incurved, concolorous with thallus. Proper exciple apically free to rarely entirely free, moderately thin to moderately thick, with distinct, thick hyaline part internally, pale yellowish to yellowish-brown marginally, apically sometimes covered by grayish to rarely dark-gray granules, sometimes amyloid. Hymenium up to c. 250 µm high, non-inspersed, moderately conglutinated, paraphyses parallel or slightly interwoven, unbranched, tips slightly thickened, lateral paraphyses present, often inconspicuous, up to c. 25 µm long, columellar structures absent. Epihymenium predominantly indistinct, hyaline and without granules, sometimes thin with small grayish granules and small crystals. Asci 1(-2)-spored, tholus moderately thick to thin, not visible at maturity. Ascospores (very) large, densely eumuriform, cell walls and endospore (moderately) thin, often covered by a thin to moderately thick halo, hyaline, sometimes pale yellowish in old or decayed ascospores, faintly to more rarely distinctly amyloid, cylindrical to oblong-ellipsoid to broad-fusiform, with roundish to narrowed-roundish ends, loci roundish to angular, subglobular to irregular, transverse septae thin, distinct, usually very regular, 80-220 x 15-45 µm with multiple loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

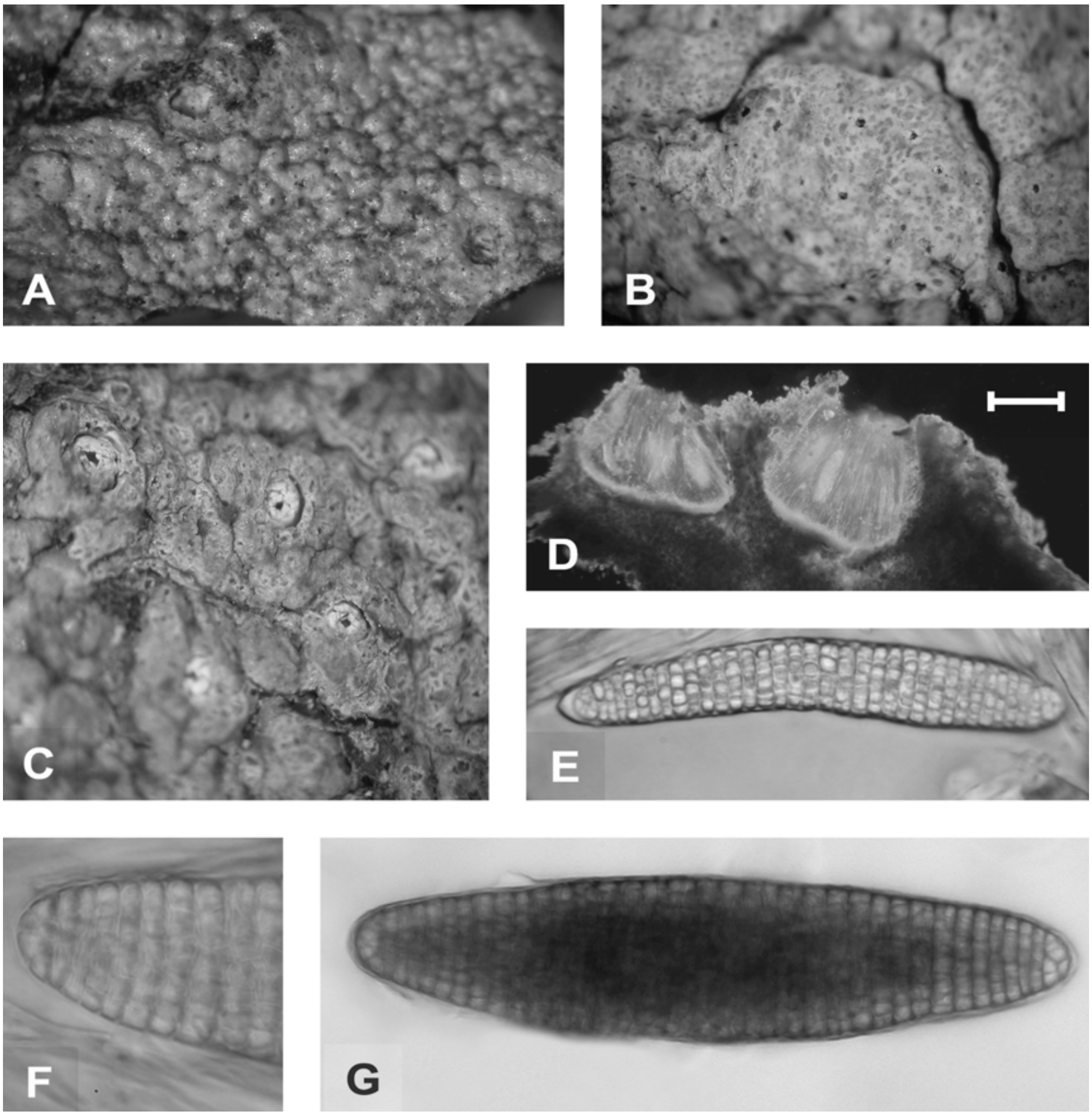

Fig. 162. *Thelotrema rugatulum*: growth habit (**A, B**), ascomata (**C**), ascoma section (**D**), ascospore (**E**), ascospore detail (**F**) and ascospore showing amyloid reaction (**G**). A.: H-lectotype; B., D.-G.: *Hale* 831727; C.: *Lumbsch & Mangold 19156 b*. Bar= A: 1 mm; B: 0.8 mm; C: 0.7 mm; D: 150 µm; E: 23 µm; F: 15 µm; G: 20 µm.

ECOLOGY AND DISTRIBUTION – *Thelotrema rugatulum* was collected in Australia on tree bark in (sub)tropical rainforests, rarely in mangroves, in altitudes ranging from sea level to 900 m. It is rare but wide-spread, ranging from northern Queensland to southern New South Wales. This is the first report for Australia and New Zealand (see below). Previously only known from the type locality in the Andaman Islands.

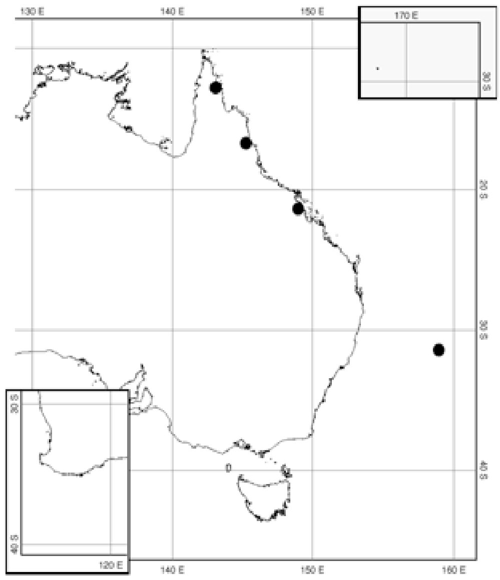

Fig. 163. Australian distribution of *T. rugatulum*.

NOTES – *Thelotrema rugatulum* has abundant calcium oxalate crystals in the thallus and due to that a distinctly verruculose surface. It is further characterized by ascomata with an indistinctly free proper exciple, large, densely eumuriform, thin-walled, hyaline, ±amyloid ascospores and the absence of secondary compounds. A similar species is *T. conveniens*, see under that species for differences. *Topeliopsis laceratula* is another similar species, which can be distinguished by the distinctly greenish, smooth, constantly corticate thallus, strongly split and layered ascoma margins, a fused proper exciple and strongly amyloid, thick-walled ascospores.

SPECIMENS EXAMINED – Australia, Queensland: Atherton Tablelands: Souita Falls, *Lumbsch & Mangold 19156 b* (F); Just S of hwy., 13 km E of jct. Kennedy Hwy. and Palmerston Hwy., E of Ravenshoe, *Hale 830847* (US); 10 km S of Ravenshoe on Tully Falls Rd., *Hale 832408* (US). Eungella NP., NP. side rd. nr. Peases Lookout, off Darymple rd., *Hale 831645, 831727* (US). N side of Lake Baroon Pocket, W of Montville, *Lumbsch & Mangold 19082 b* (F). Mt. Mee SF., 6 km NW of Forestry Office, NW of Mt. Mee, *Hale 831270, 832351* (US). New South Wales: Southern bank of Hawkesbury River, along Singleton Rd. at Paddys Bight, *K. & A. Kalb 34282* (hb. Kalb). New Zealand, South Island, Nelson, 25.10.2005, *Polly* s.n. (WELT).

Thelotrema saxatile C. Knight

Trans. and Proc. New Zealand Inst. 8: 327 (1876). *Leptotrema saxatile* (Knight) Müll. Arg., Bull. Soc. Bot. Belgique 31: 35 (1892). *Leptotrema monosporum* var. *saxatile* (Knight) Müll. Arg., Bull. Herb. Boissier 2(1): 75 (1894). Type: New Zealand, (?Wellington), 01.Feb.1882, *C. Knight* s.n. (WELT-hb. Knight[36: 12]-lectotype, selected by Galloway [1985: 577]; BM!-isolectotype).

Ascidium manosporum Knight, Trans. New Zealand Inst. 15: 355 (1883). *Leptotrema manosporum* (Knight) Müll. Arg., Bull. Herb. Boissier 2(1): 75 (1894). *Thelotrema manosporum* (Knight) Hellb., Bihang till Kgl. Svensk. Vetensk.-Akad. Handl. vol. 21, 3(13): 78 (1896) [the epithet is corrected to *A. monosporum* on the type annotation and Galloway (1985) uses this name, however, it was published as *A. manosporum*]. Type: New Zealand, (?Wellington), *C. Knight* s.n. (WELT-hb. Knight[37A: 1]!-lectotype, selected by Galloway [1985: 575 as *A. monosporum*]).

Thelotrema monosporoides Nyl., Lich. Nov. Zealand p. 76 (1888). *Thelotrema monosporum* Kremp. nom. illeg., Verhandl. zool.-bot. Gesellsch. Wien 26: 453 (1876) [non *Thelotrema monosporum* Nyl.]. *Leptotrema monosporoides* (Nyl.) Müll. Arg., Bull. Herb. Boissier 2(1): 75 (1894). *Ocellularia monosporoides* (Nyl.) Hale, Mycotaxon 11: 137 (1980). Type: New Zealand, (?Wellington), *C. Knight* s.n. (H-Nyl. 22708!-lectotype, selected by selected by Hale [1981: 314]; G-isolectotype).

Thelotrema monospermum Harris, Some Florida Lichens: 99 (1990). Type: U.S.A., Florida, Liberty County, *Harris 11399* (NY!-holotype).

ILLUSTRATION – Fig. 164.

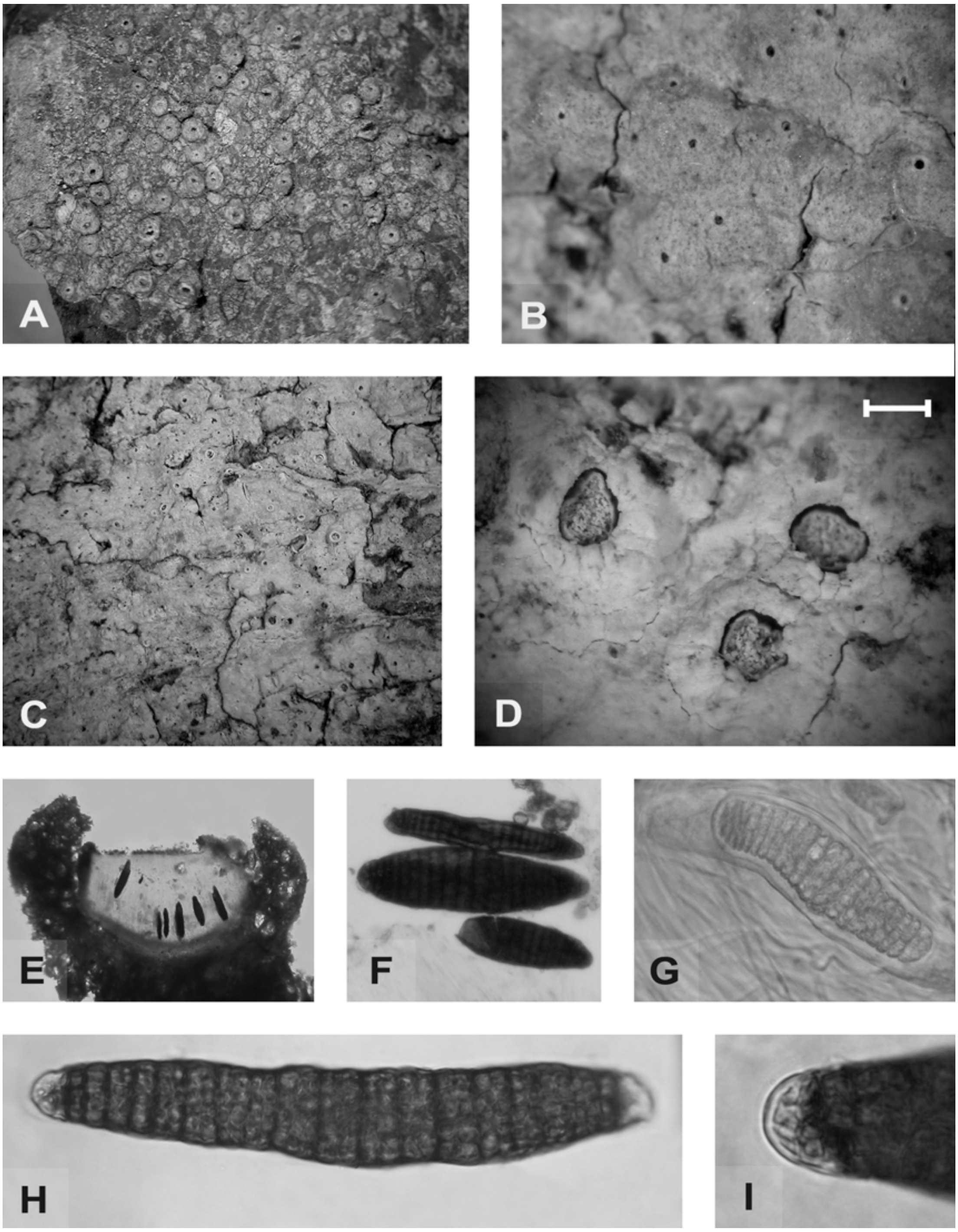

Fig. 164. *Thelotrema saxatile*: growth habit (**A, C**), ascomata (**B, D**), ascoma section (**E**), young, mature and over-mature ascospores (**F-H**) and ascospore detail (**I**). A., E.-G.: BM-isolectotype; B.: WELT-lectotype of *A. manosporum*; C.: NY-lectotype of *T. monospermum*; D.: *Mangold 32 v*. Bar= A: 2 mm; B: 1 mm; C: 2.5 mm; D: 0.5 mm; E: 175 µm; F: 40 µm; G: 25 µm; H: 18 µm; I: 12.5 µm.

Thallus variable, corticolous to rarely saxicolous, epi- to predominantly hypophloedal, epi- to somewhat endolithic in saxicolous specimen, moderately thin to moderately thick in saxicolous specimen, up to c. 300 µm high, pale yellowish-brown to pale grayish-green or whitish-gray. Surface variable, dull to somewhat glittering, predominantly smooth to rarely roughened, continuous to verrucose or verruculose, unfissured to fissured. True cortex usually absent, thallus predominantly covered by a continuous to incontinuous protocortex up to

25 µm thick, very rarely becoming distinctly conglutinated forming a thin true cortex of periclinal hyphae. Algal layer variable, well to poorly developed, continuous to incontinuous, calcium oxalate usually abundant, sometimes sparse, small to large, scattered or clustered. Vegetative propagules not seen. Ascomata variable, conspicuous to inconspicuous, moderately small to large, up to 800 µm in diam., ±roundish, peri- to predominantly apothecioid, usually sessile, solitary to marginally fused, immersed to more often ±distinctly emergent, (irregular-)hemispherical to more rarely urceolate to very rarely irregular-subglobose. Disc often becoming partly visible from surface, pale grayish to gray, moderately to strongly pruinose. Pores variable, small to wide to gaping, up to c. 600 µm, roundish to more often roundish-irregular to irregular, proper exciple entirely to apically visible from surface, entirely free, usually off-white to whitish, often shrunken, predominantly incurved to more rarely erect. Thalline rim margin thin to more often moderately thin to thick, roundish to irregular, small to gaping, entire to ±distinctly split to somewhat lacerate or eroded, incurved to sometimes erect, concolorous with thallus to brownish or more rarely brighter than thallus. Proper exciple ±free, moderately thin to moderately thick, hyaline to pale yellowish internally, yellowish-brown marginally, apically often brownish to dark-brown and covered by dark-gray granules, sometimes amyloid at the base. Hymenium up to c. 250 µm high, non-inspersed, moderately conglutinated, paraphyses parallel or slightly interwoven, unbranched, tips moderately to distinctly thickened, lateral paraphyses present, often inconspicuous, up to c. 20 µm long, columellar structures absent. Epihymenium variably thick, hyaline, usually with fine to coarse grayish granules and small crystals. Asci 1-2-spored, tholus usually thin or not visible. Ascospores (very) large, densely eumuriform, in immature stages often with distinctly thickened cell walls, at maturity cell walls and endospore predominantly (moderately) thin, non-halonate, brown at early maturity, in very large ascospores tips often remaining unpigmented, non-amyloid, cylindrical to oblong-ellipsoid, with roundish to narrowed-roundish ends, loci predominantly roundish to slightly angular, subglobular to somewhat oblong, transverse septae thin, distinct throughout development, regular, 70-180(200) x 15-40 µm with c. 24-46 x 2-10 loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Thelotrema saxatile* was collected in Australia on tree bark in (sub)tropical rainforests in altitudes ranging from sea level to 1100 m. It is a rare but wide-spread species occurring in northern and north-central Queensland and on Lord Howe Island (New South Wales). This is the first report for Australia. The distribution is not entirely clear, due to difficulties in the distinction from *T. monosporum* (see there). I have seen material from the U.S.A. and New Zealand

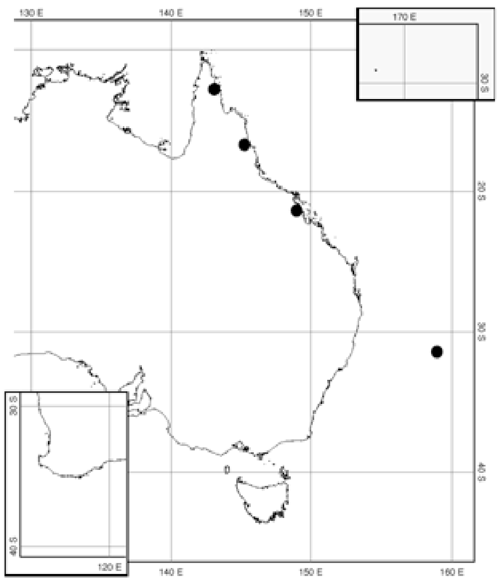

Fig. 165. Australian distribution of *T. saxatile*.

NOTES – *Thelotrema saxatile* is a morphologically variable species. It is characterized by the often dark, free exciple, single- to more rarely double-spored asci with large, densely eumuriform, brown, thick-walled immature and thin-walled mature, non-amyloid, predominantly cylindrical, never distinctly fusiform ascospores and the absence of secondary compounds. It has been considered conspecific with *T. monosporum* ever since Salisbury (1972). The circumscription of this similar taxon was always unclear and thus has caused many confusion. Supported by molecular data (Lumbsch & al., 2007) it could be shown that the taxa formerly merged under the name *T. monosporum* s. lat. can be assigned to three distinct lineages, viz. *T. monosporum* s. str., *T. lepadodes* and *T. saxatile*, which can be set apart by their ascospore morphologies. *Thelotrema saxatile* differs from *T. monosporum* by single- to more rarely 2-spored asci (up to four spores per ascus in *T. monosporum*) with distinctly larger, cylindrical ascospores and a thicker, more compact, often distinctly verrucose or verruculose thallus. Similar and probably synonymous to *T. saxatile* is *T. macrosporum* from Europe (Purvis & al., 1995). However, the type was not available for study. Another similar Australian *Thelotrema* that lacks chemistry and has large, muriform, brownish ascospores is *T. conveniens*. This species can be readily distinguished, however, by distinctly amyloid ascospores that become pigmented.

SPECIMENS EXAMINED – Australia, Queensland: Iron Range NP., York Peninsula, 31 km from western boundary on track to Portland Rds., *Hale 832628* (US). Cape Tribulation area, track to Cape Tribulation Beach, *Mangold 32 h, j, o, p, v* (F). Mt. Windsor, 5 km W of new Forestry Camp, NW of Mossman, *Hale 831953* (US). Eungella NP.: Along Broken River, *Lumbsch & Mangold 19104 a* (F); Finch Hatton Gorge, *Lumbsch & Mangold 19113 l* (F). New South Wales: Lord Howe Island, track to little Island, near Salmon Beach, *Elix 32664 a* (B).

Thelotrema saxicola (Vain.) Salisb.

Lichenol. 5: 269 (1972). Bas.: *Thelotrema lepadinum* ssp. *saxicola* Vain., Étud. Lich. Brésil 3: 77 (1890). *Leptotrema saxicola* (Vain.) Redgr., Arkiv för Bot. 28A, 8: 102 (1936). Type: Brazil, Minas Gerais, *Vainio* s.n. (Lich. Brasil. exsicc. 1173) (TUR-Vain. 26784!-holotype).

ILLUSTRATION – Fig. 166.

Thallus saxi- or corticolous, epilithic or epi- to hypophloedal, moderately thick, up to c. 400 µm high, grayish-green to pale yellowish. Surface dull to slightly shiny, smooth, rarely continuous to usually distinctly to strongly verrucose or verruculose, distinctly fissured to somewhat areolate. Thallus cover variable, predominantly covered by a continuous to incontinuous protocortex, sometimes becoming distinctly conglutinated, forming a true cortex of periclinal hyphae, up to c. 20 µm thick. Algal layer moderately well developed, ±continuous, calcium oxalate crystals sparse to moderately frequent, small to large and usually scattered. Vegetative propagules not seen. Ascomata predominantly inconspicuous, (moderately) large, up to c. 600 µm in diam., roundish, solitary to marginally fused, sessile, perithecioid, immersed to emergent, then predominantly (verrucose-) hemispherical or somewhat cylindrical (deceased, sterile ascomata sometimes resembling conspicuous, apothecioid ascomata). Disc not visible from surface. Pores predominantly very small, up to c. 50(100) µm in diam., roundish to slightly irregular, entire to slightly split, proper exciple margin sometimes visible from surface, fused to rarely slightly detached, whitish-translucent or pale to dark gray, flush with thalline rim margin or somewhat sunken. Thalline rim margin (moderately) thick, roundish, predominantly entire, concolorous with thallus or brighter, flush with thalline rim or slightly depressed, thalline rim incurved, with same surface as thallus. Proper exciple predominantly fused, moderately thin, hyaline internally, pale yellowish to yellowish-brown marginally, apically often dark-brown to slightly carbonized, in corticolous specimen often with an indistinct marginal layer of substrate material, sometimes slightly amyloid (reddish) to distinctly amyloid (purple) at the base. Hymenium up to c. 350 µm high, inspersed, distinctly conglutinated, paraphyses thin, ±interwoven, unbranched, straight to

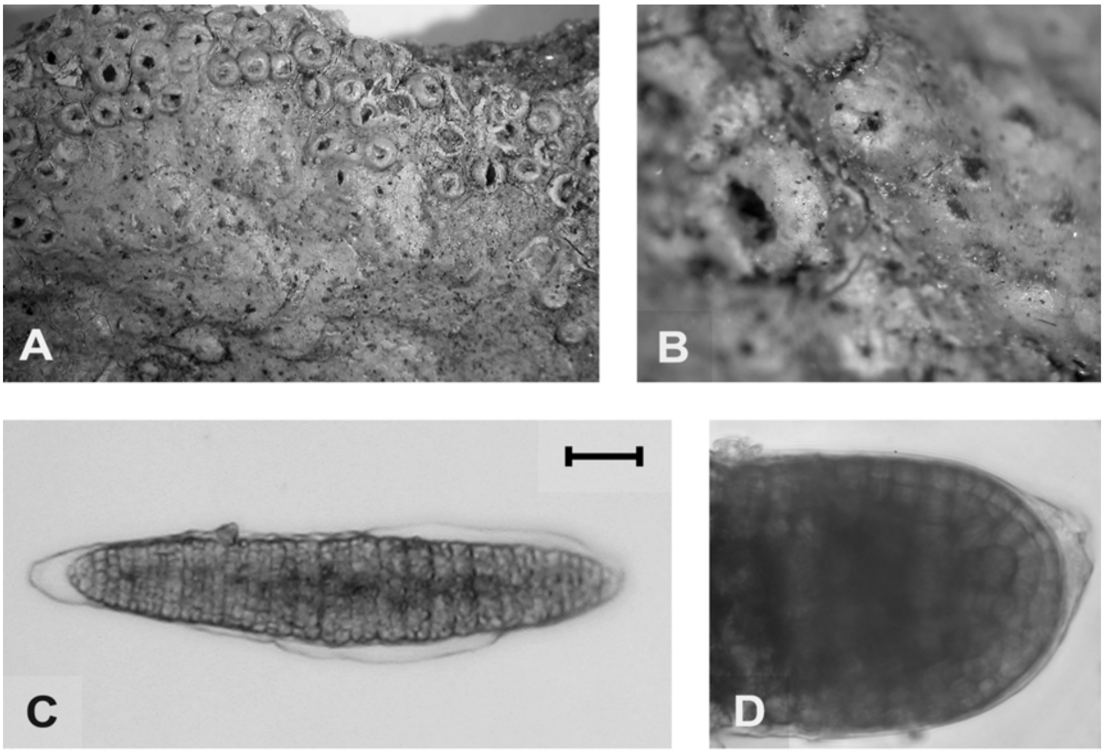

Fig. 166. *Thelotrema saxicola*: growth habit (**A**), ascomata (**B**), ascospore (**C**) and ascospore detail (**D**). A., B., D.: TUR-holotype; C.: *Hale 831753*. Bar= A: 1.2 mm; B: 0.3 mm; C: 30 µm; D: 8 µm.

somewhat bent, tips unthickened, lateral paraphyses present variably conspicuous, up to 40 µm long, columellar structures absent. Epihymenium indistinct, hyaline, without granules or crystals. Asci 1-spored, tholus thin, not visible at maturity. Ascospores predominantly very large, densely eumuriform, cell walls thin to slightly thickened, endospore absent, non-halonate, hyaline, becoming yellowish to brownish in late maturity, non-amyloid to usually weakly amyloid in older stages, predominantly oblong to more rarely somewhat fusiform with roundish to narrowed-roundish ends, loci small, roundish to slightly angular, subglobose to irregular, transverse septae thin, distinct in younger stages, becoming indistinct with age, ±regular, 150-250 x 30-50 µm with multiple loci. Pycnidia not seen.

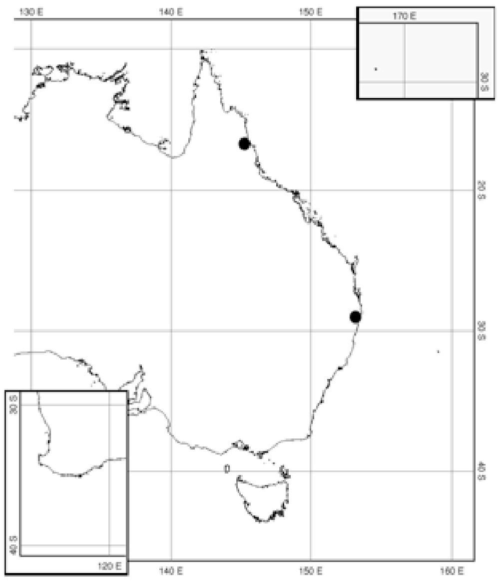

Fig. 167. Australian distribution of *T. saxicola*.

CHEMISTRY – Thallus K+ yellowish, C-, PD+ yellow; containing psoromic (major), 2'-0-de-methylpsoromic and subpsoromic (traces) acids.

ECOLOGY AND DISTRIBUTION – *Thelotrema saxicola* grows in Australia on tree bark in (sub-)-tropical rainforests. It is rare and disjunct in northern Queensland and northern New South Wales. This is the first report for Australia. Previously only known from Brazil.

NOTES – This species is recognized by perithecioid ascomata with an inspersed hymenium, lateral paraphyses and dark exciple, large, eumuriform, moderately pigmented asco-spores and the presence of the psoromic acid chemosydrome. *Thelotrema oleosum* is similar but differs in the absence of secondary metabolites. Further differences include more open-pored (pores up to 150 µm in diam.) ascomata with more distinctly detached proper exciple, asci with thickened lateral walls and ascospores that generally show a stronger amyloid reaction. Also similar is *T. porinaceum*, which can be readily distinguished by a thallus with an indistinct cortex, ascomata with more distinctly detached proper exciple, unpigmented ascospores, and the occurrence of norstictic acid.

SPECIMENS EXAMINED – Australia, Queensland: Km 45 on Mt. Windsor Rd., NW of Mossman, *Hale 832753* (US). New South Wales: Big Shrub Flora Reserve, Night Cap Forest Drive, W of Mullumbimby, *Hale 831402, 831680* (US). Cambridge Plateau Forest Drive, 1-3 km N of picnic area, Richmond Range SF., 30 km W of Casino, *Hale 831627* (US).

Thelotrema subadjectum Mangold spec. nov. ined.

Type: Australia, Queensland, Mt. Bunya, Shire picnic area to National Park boundary, south of park, *Hale 831440* (US-holotype).

ETYMOLOGY – The epithet refers to the similarities to *T. adjectum*.

ILLUSTRATION – Fig. 168.

Thallus predominantly hypophloedal, rarely a very thin epiphloedal part developing, up to c. 100 µm high, pale grayish to pale grayish-green. Surface dull to somewhat glittering, slightly pruinose to roughened, usually due to protuberate substrate surface, continuous, slightly fissured to unfissured. Cortex structures absent. Algal layer poorly to moderately well developed, ±continuous, calcium oxalate sparse, often lacking in major parts, ±small, often clustered. Vegetative propagules not seen. Ascomata inconspicuous, moderately small, up to c. 600 µm in diam., roundish, apothecioid, solitary to rarely marginally fused, usually distinctly immersed. Disc not visible from surface to very rarely somewhat visible, pale grayish to whitish, pruinose. Pores small, up to c. 150 µm in diam., roundish to roundish-irregular to irregular, entire to slightly split, apical proper exciple visible from surface, whitish, incurved, more rarely slightly shrunken. Thalline rim margin moderately thick, roundish, entire to slightly split, sometimes slightly funnel-shaped, concolorous with thallus to whitish. Proper exciple becoming free with age, thick, hyaline internally, pale brownish to grayish marginally, often with substrate particles incorporated, apically often covered by grayish granules, usually amyloid at the base and the marginal parts of the subhymenium. Hymenium up to c. 120 µm high, non-inspersed, moderately conglutinated, paraphyses parallel to slightly interwoven, unbranched, tips slightly thickened, lateral paraphyses present, conspicuous, up to c. 25 µm long, columellar structures absent. Epihymenium thin, hyaline, with fine to coarse grayish granules. Asci 8-spored, tholus thick, thin when mature. Ascospores (moderately) small, (sub-)muriform, cell walls moderately thick, endospore thick, distinctly halonate, hyaline, faintly amyloid, predominantly oblong to somewhat fusi- or claviform, with roundish to narrowed-roundish ends, loci roundish to slightly angular, subglobose or irregular to more often ±oblong, immature ascospores with large, conical end cells, otherwise hemispherical to conform with other loci, transverse septae (moderately) thick, distinct and regular, 25-35 x 8-10 µm with 10-14 x 1-4 loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

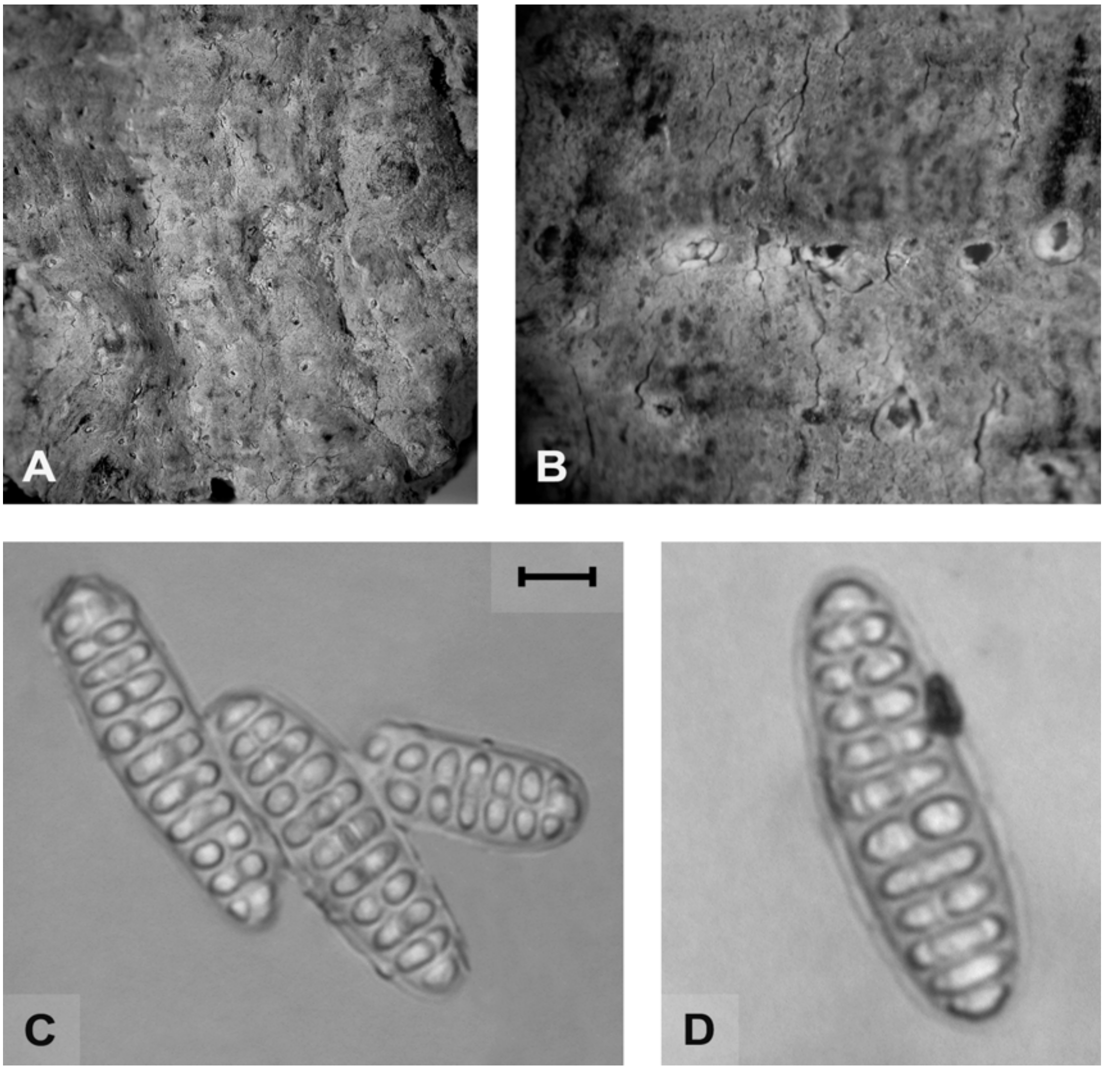

Fig. 168. *Thelotrema subadjectum*: growth habit (**A**), ascomata (**B**) and ascospores (**C, D**). A.-D.: US-holotype. Bar= A: 2 mm; B: 0.7 mm; C: 7 µm; D: 5 µm.

ECOLOGY AND DISTRIBUTION – *Thelotrema subadjectum* grows on tree bark in (sub)tropical rainforests. It is rare and currently only known in northern and southern Queensland.

NOTES – This new taxon is characterized by a hypophloedal, ecorticate thallus, immersed, small ascomata with a free bright proper exciple, moderately small, muriform, hyaline, weakly amyloid ascospores with thickened endospore and transverse septae, and the absence of secondary metabolites. It can be distinguished from the similar *T. adjectum* by a somewhat thinner thallus, never emergent ascomata with distinctly free and visible proper exciple, unlayered thalline rims and smaller ascospores (up to 80 µm long in *T. adjectum*). Also similar are *T. polythecium* and *T. cyphelloides*. *Thelotrema polythecium* is readily distinguished by

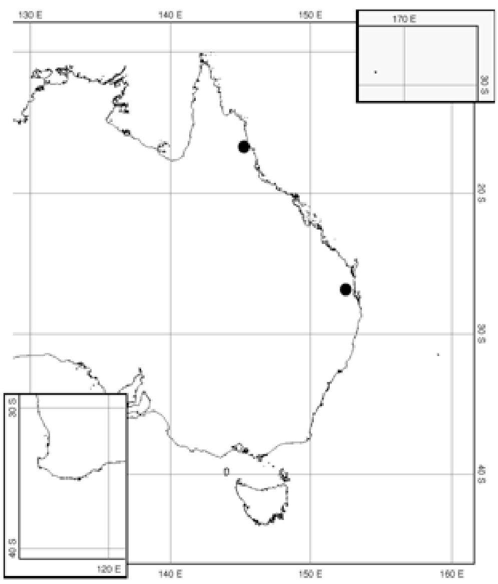

Fig. 169. Australian distribution of *T. subadjectum*.

ascomata with distinctly split margins and fused proper exciple and smaller, non-amyloid ascospores (up to 25 µm long with up to 9 x 4 loci). *Thelotrema cyphelloides* differs by having smaller ascospores (up to 27 µm long with up to 9 x 4 loci) and the presence of the stictic acid chemosyndrome.

SPECIMENS EXAMINED – Australia, Queensland, 5 km NW of Babinda, near bridge crossing Russell River, *Hale 831112* (US).

Thelotrema subtile Tuck.

Amer. J. Arts and Sci., ser. 2, 25: 426 (1858). *Ocellularia subtilis* (Tuck.) Riddle, Mycologia 15: 79 (1923). Type: U.S.A., Vermont, Brattleboro, 1851, *Frost 150 pr. p.* (FH-Tuck.!-lectotype, newly selected here[13]; FH-Tuck.!- [pr. p. as *Frost 96*], NY!-isolectotypes).

Ocellularia jugalis Müll.Arg., Bull. Herb. Boissier 3: 313 (1895). Type: Australia, Queensland, Sankeys Shrub [Brisbane], 1893, *Shirley 1836* (G!-holotype, BRI-'Shirley Book', p. 21, n. 35 [BRI-AQ721220]!-isotype).

ILLUSTRATION – Fig. 170.

Thallus epi- to hypophloedal, predominantly thin, up to c. 200 µm high, pale yellowish brown to pale grayish or tannish-gray. Surface dull to slightly shiny, smooth, continuous to more often ±distinctly verrucose to verruculose slightly fissured to unfissured. Thallus cover quite variable, predominantly an incontinuous protocortex present, up to c. 25 µm thick, sometimes becoming distinctly conglutinated forming a true cortex of periclinal hyphae. Algal layer variable, well to poorly developed, continuous to incontinuous, calcium oxalate abundant, small to large, scattered or clustered. Vegetative propagules not seen. Ascomata conspicuous, predominantly small to more rarely moderately large, up to c. 600 µm in diam., roundish to somewhat irregular, apothecioid, sessile, solitary to marginally or rarely entirely fused, predominantly ±distinctly emergent, hemispherical to urceolate or subglobose, with same surface as thallus or more distinctly verruculose. Disc usually becoming partly visible from surface in older ascomata, (dark)gray, ±distinctly pruinose. Pores small to moderately wide to rarely gaping, up to c. 400 µm in diam., roundish to irregular, entire to slightly split, proper exciple apically to more often entirely visible from surface, apically bright to brownish towards the base, sometimes shrunken, incurved to somewhat erect. Thalline rim margin thin to moderately thick, usually becoming wide to gaping, entire to split to more rarely somewhat eroded, roundish to irregular-roundish, predominantly incurved and concolorous with thallus. Proper exciple free, moderately thick, hyaline to predominantly pale yellowish internally, yellowish- to grayish-brown marginally, apically often dark-brown, sometimes with substrate inclusions, rarely amyloid at the base. Hymenium up to c. 150 µm high, non-inspersed, distinctly conglutinated, paraphyses parallel to slightly interwoven, unbranched to sometimes slightly branched, tips irregular, moderately thickened, lateral paraphyses present, usually inconspicuous, up to c. 25 µm long, columellar structures absent. Epihymenium variably thick, hyaline to sometimes brownish with age, usually with fine grayish-brown granules and small crystals. Asci 4-8-spored, tholus (moderately) thick, thin when mature. Ascospores

[13] Salisbury's (1972) type-selection (*Frost*, Reliquiae Tuckermanianae no. 140) consists of four collections (on bark of *Ace*r, *Betula* and *Fraxinus*), that are intermixed and shared in two capsules. One capsule is labeled "On Acer, Frost(96), 1836" (FH-213376), the other "Frost(150), 1851" (FH-213377). Obviously Tuckerman selected the latter sample (FH-213377) as the 'illustrative material' since it consists of a sheet with several pieces of two specimens glued on, and has descriptive notes and a drawing of an ascospore. It is also labeled as lectotype by Hale 1972 (unpublished). The specimen on the left (on *Fraxinus*) is the here selected lectotype. The specimen on the right (on *Betula*, determined as *T. suecicum* by Maass) is also *T. subtile*. Several pieces of this collection are also included in the first mentioned capsule (FH-213376) together with a specimen of *T. subtile* on *Acer* and a collection of *T. suecicum* (on *Betula*). A duplicate of the type collection is also deposited in NY.

moderately small, transversely septate, cell walls (moderately) thick, often with distinctly crenate surface, with thin halo, hyaline in young and mature stages, becoming distinctly (pale)brownish in over-mature or decayed ascospores, faintly to moderately amyloid, (oblong)fusiform to more often clavate, ends roundish to acute, loci roundish to slightly angular, rarely subglobose to more often lentiform, end cells hemispherical to conical, septae (moderately) thick, regular, 30-50 x 7-10 µm with 8-16 loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

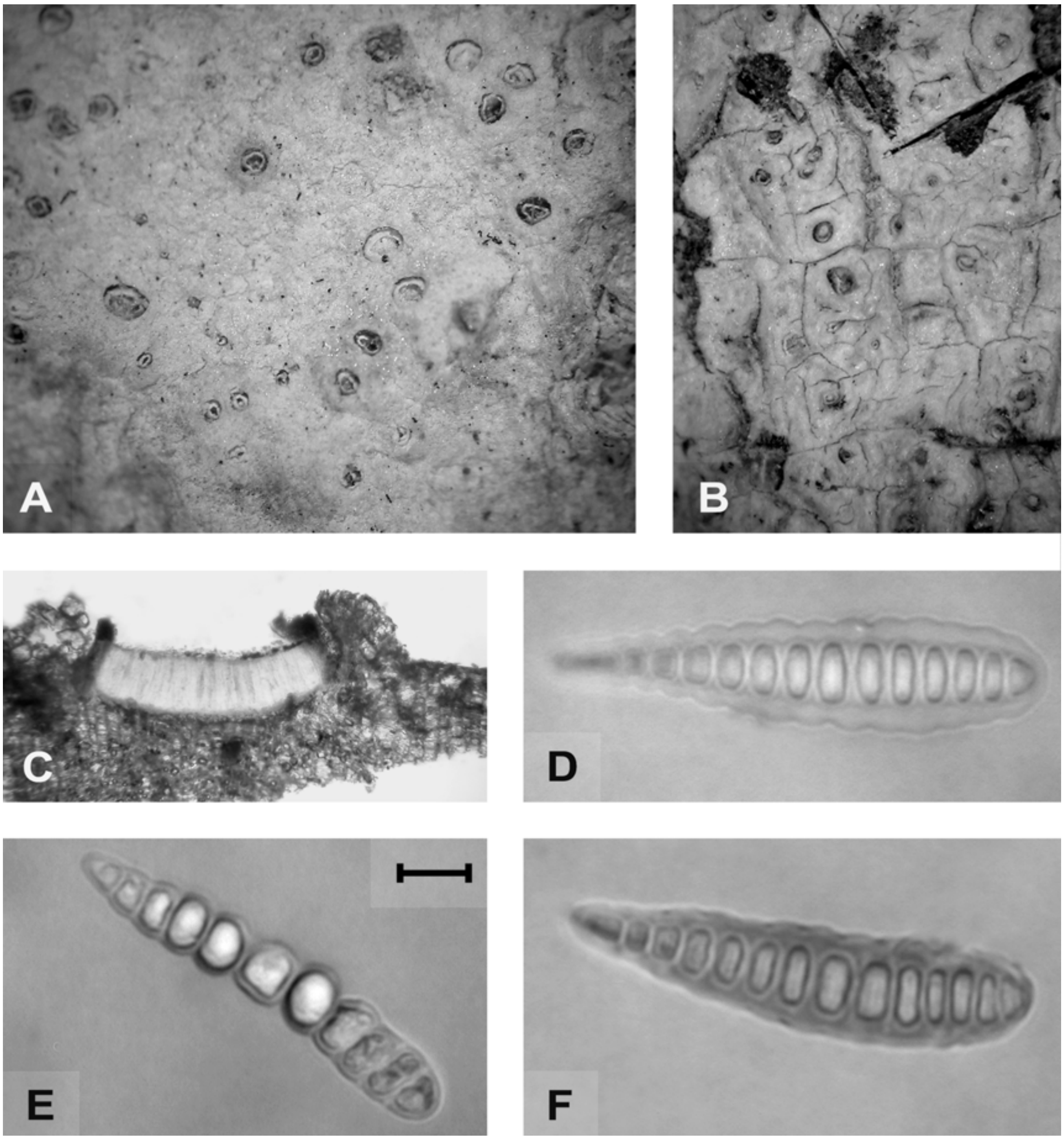

Fig. 170. *Thelotrema subtile*: growth habit (**A. B**), ascoma section (**C**), ascospores (**D, E**) and ascospore showing amyloid reaction (**F**). A., C., E.: FH-lectotype; B.: G-holotype of *O. jugalis*; D., F.: *Mangold 3 e*. Bar= A: 0.75 mm; B: 0.6 mm; C: 150 µm; D, F: 6 µm; E: 8 µm.

ECOLOGY AND DISTRIBUTION – *Thelotrema subtile* grows on bark in cool-temperate rainforests and wet sclerophyll forests, rarely in sub-tropics (see notes), in altitudes ranging from 250 to 500 m. It is rare in Australia, occurring in southern Queensland (see notes), southern Victoria and north-eastern Tasmania. It is also known from Hawaii (Salisbury, 1975), the Neotropics, Africa (Frisch, 2006), Japan (Matsumoto, 2000), Philippines (Salisbury, 1975), Java (ibid.), New Caledonia (ibid.) and New Zealand (ibid.), indicating a pantemperate to pan(sub)tropical distribution (see also below).

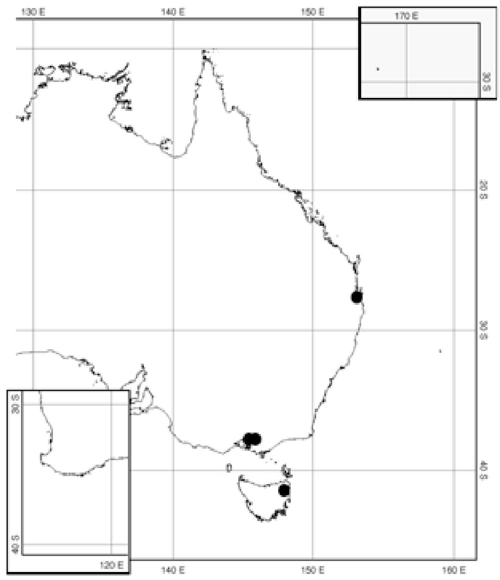

Fig. 171. Australian distribution of *T. subtile*.

NOTES – This species is characterized by a thin thallus, predominantly ±distinctly emergent, small apothecia with free proper exciple, moderately small, transversely septate, weak to moderately amyloid ascospores with a crenate surface, that are hyaline at maturity but become distinctly brown, and the absence of secondary compounds. Several similar species are known, however, *T. subtile* is distinguished from all members of *Thelotrema* with similar, hyaline, (moderately) small, transversely septate ascospores that lack secondary compounds by the pigmentation of the ascospores in the terminal phases of their development. The most similar *T. pseudosubtile* additionally differs by usually immersed or only slightly raised ascomata with less distinctly free proper exciple. *Thelotrema defossum* differs by distinctly smaller ascospores (predominantly up to 30 µm with up to 11 loci), for additional differences to *T. diplotrema* and *T. suecicum* see under these species. Two further similar Australian species, *T. circumscriptum* and *T. bicavatum*, differ by the presence of secondary compounds, see there for additional differences. Out of the here examined specimen only Shirley's collection from Brisbane (the type of *O. jugalis*) and one collection from South Carolina are originated in subtropical or warm-temperate climates, the type collection as well as all other Australian collections were made in cool-temperate areas. Thus, it is assumed that many of the specimens reported from the tropics are likely to be misidentified and probably are in fact one of the other similar taxa occurring in the tropics. Salisbury (1975) reports *T. subtile* based on a Wilson collection from New South Wales (also listed in Frisch, 2006), however, the two specimen in H are *O. wirthii*. A careful re-examination of the herbarium material is needed and the distribution of *T. subtile* is only tentative.

SPECIMENS EXAMINED – Australia, Victoria: Warburton, Dec. 1885, *Wilson '513'* (NSW-539393). Ferntree Gully: 28. Jan.1892, *Wilson* s.n. (NSW-539396); 23. Dec.1899, *Bastow* s.n. (MEL-724546). Ottway Ranges, 10 km N of Apollo Bay, *Mangold 3 e, j* (F). Ottway NP., 10 km W of Apollo Bay, *Mangold 1 d* (F). Tasmania: St. Marys, *Wilson* s.n. (NSW-539323). U.S.A.: Vermont, Brattleboro: '1851, *Frost 150*' (with lectotype, on *Betula*) (FH-213377 pr.p.); '1836, *Frost 96*' (with isolectotype, on *Acer*) (FH-213376 pr.p., WIS [as Reliq.Tuck.140]). South Carolina, *Ravenel* s.n. (Reliq.Tuck.141) (NY, WIS).

Thelotrema suecicum (Magn.) James

Lichenologist 9: 186 (1977). Bas.: *Ocellularia suecica* Magn., Bot. Not. 1937: 125 (1937). Type: Sweden, Bohuslän, 22. Jun.1936, *Magnusson* s.n. (Lich. sel. scandin. exs. n. 230) (BM!-lectotype, selected by James [1977: 186]; C!-, F!-isolectotypes).

Ocellularia bonplandiae var. *obliterata* Müll. Arg., Bull. Herb. Boissier 1: 54 (1893). Type: Australia, Victoria, Warburton, *Wilson 513* (G!-holotype, NSW!-isotype).

ILLUSTRATION – Fig. 172.

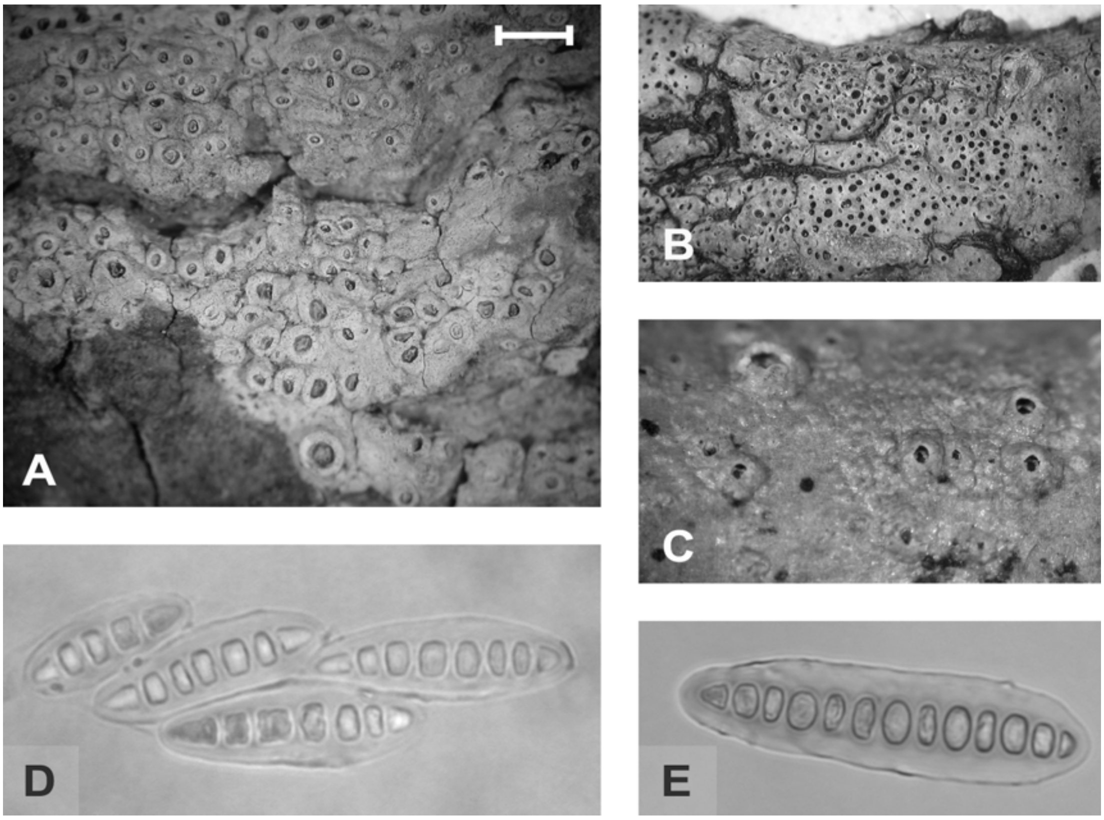

Fig. 172. *Thelotrema suecicum*: growth habit (**A, B**), ascomata (**C**) and ascospores (**D, E**). A.: *Mangold 3 p*; B.: G-lectotype of *O. bonplandiae* var. *obliterata*; C.: C-isolectotype; D.: *Hafellner 16634*; E.: *Kantvilas 670/90*. Bar= A: 1.2 mm; B: 2 mm; C: 0.6 µm; D: 10 µm; E: 8 µm.

Thallus epi- to hypophloedal, predominantly thin, up to c. 150 µm high, pale yellowish gray to pale grayish-green or olive. Surface dull to slightly shiny, smooth, continuous to ±distinctly verruculose, slightly fissured to unfissured. Thallus cover variable, predominantly an incontinuous protocortex present, up to c. 20 µm thick, sometimes becoming distinctly conglutinated forming a thin true cortex of periclinal hyphae Algal layer usually ±well developed and continuous, often becoming somewhat incontinuous due to calcium oxalate crystal inclusions, calcium oxalate crystals abundant, small to large, scattered to clustered. Vegetative propagules not seen. Ascomata conspicuous, predominantly small to more rarely moderately large, up to c. 700 µm in diam., roundish, apothecioid, sessile, solitary to sometimes marginally fused, rarely immersed to predominantly distinctly emergent, hemispherical to more rarely urceolate or subglobose, with same surface as thallus. Disc often becoming partly visible from surface, grayish, pruinose. Pores small to moderately wide to rarely gaping, up to c. 400 µm in diam., roundish to irregular, entire to split, apical to sometimes entire proper exciple visible from surface, often shrunken, apically bright, pale brownish towards the base, incurved to rarely somewhat erect. Thalline rim margin thin to moderately thick, entire to split to somewhat eroded, ±roundish, usually becoming wide to gaping, incurved to slightly erect, concolorous with thallus or yellowish to pale orange. Proper exciple free, (moderately) thin, hyaline to pale yellowish internally, yellowish to brownish marginally, apically covered by grayish granules, sometimes slightly amyloid at the base. Hymenium up to c. 130 µm high, non-inspersed, weakly conglutinated, paraphyses parallel to slightly interwoven, unbranched, tips moderately thickened, lateral paraphyses present, usually inconspicuous, up to c. 25 µm long, columellar structures absent. Epihymenium (moderately) thin, hyaline, with grayish granules and sometimes small crystals. Asci 8-spored, tholus (moderately) thick, thin at maturity. Ascospores typical, (moderately) small, transversely septate, cell walls thick from very young stages on to very thick at maturity, moderately thin to moderately thick halo, hyaline, non-amyloid to usually only very faintly amyloid, predominantly ellipsoid to broad-fusiform to more rarely broad-clavate, ends narrowed-roundish to more rarely subacute, loci roundish to angular, subglobose to cuboid or irregular, latitudinal as well as longitudinal elongate , end cells hemispherical to conical, septae (moderately) thick, ±irregular, 20-40(60) x 8-15 µm with 6-12(14) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – The species grows on tree bark predominantly in sub-tropical to cool-temperate rainforests, more rarely in wet sclerophyll forests and very rarely in tropical highland rainforest, in altitudes ranging from 20 to 1400 m. This common and wide-spread species occurs from northern Queensland to southern Victoria, and Tasmania. It is also known from North and South America (Purvis & al., 1995), Europe and New Zealand (Lumbsch & al., 2008) indicating a subcosmopolitan distribution.

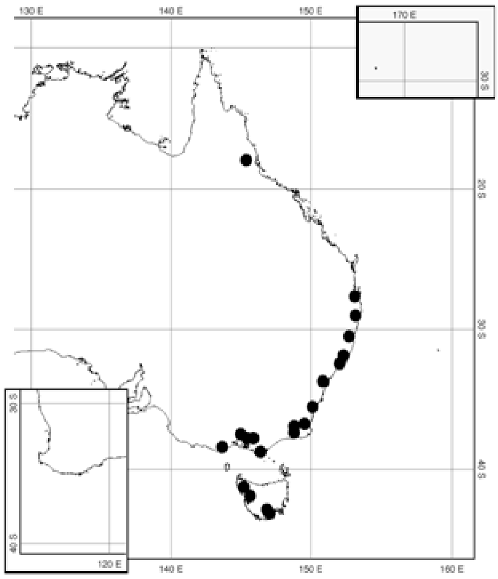

Fig. 173. Australian distribution of *T. suecicum*.

NOTES – *Thelotrema suecicum* is characterized a thin thallus, predominantly distinctly emergent, small apothecia with free proper exciple, moderately small, hyaline, transversely septate ascospores with thick cell walls, even in immature stages. The ascospores further show no or a very faint amyloid reaction, the loci are divided by thick septae, distinctly irregular formed and often longitudinal elongated. The ascospore sizes of the type and in most of the Australian specimens do not extend lengths of ±30 µm, however, in some collections, predominantly from Tasmania, several larger ascospores were found, in some cases reaching up to 60 µm with up to 14 loci. Two similar species are *T. defossum* and *T. subtile*. The (sub)tropical *T. defossum* can be readily distinguished by the moderately thin- to moderately thick-walled ascospores with regularly formed loci and thin septae. *Thelotrema subtile* is more difficult to distinguish, but the ascospores are more distinct amyloid, have less thickened cell walls that often show a crenate surface, larger loci and a brown pigmentation in deceased ascospores.

SPECIMENS EXAMINED – Australia, Queensland: Atherton Tablelands, Millaa Millaa near the falls, *M. & A. Aptroot 46167 h* (ABL). Brisbane, 1891, *Bailey* s.n. (G-10194/41). New South Wales: Mt. Warning NP., track from summit to parking lot, *Mangold 19 s* (F). Border Ranges NP.: McPherson Range, NE of Gradys Creek, *Hafellner 16634* (GZU); Tweed Range, NE of Wiangaree, The Oinnacle, *Hafellner 19171* (GZU). Track to Wrights Lookout, New England NP., 72 km E of Armidale, *Elix 33931* (CANB). Berrico Rd., Chichester SF., 21 km SW of Gloucester, *Elix 25022* (CANB). Mt. William, Barrington Tops NP., 30. Jun.1888, *Kantvilas* s.n. (NSW-221836). Mt. Wilson: *Ewers 3089* (CANB); Mt. Irvine Rd., 25 km NNE of Katoomba, *Streimann 31589* (CANB). Katoomba, Sept. 1889, *Wilson* s.n. (H). Monga SF./Monga NP.: 27 km SE of Braidwood, *Mangold 11 b* (F); 5 km S of Monga, along Mongarlowe River, *Kalb & Elix 21781, 21861* (hb. Kalb); ['Mongala River crossing Mongala State Forest'], 02. May 1986, *Everett* s.n. (NSW-539331). Brown Mt., c. 30 km SE of Nimmitabel, *Kalb & Elix 30435* (hb. Kalb). Victoria: Ellery Camp, 30 km SSW of Bendoc, *Elix 21441* (CANB). Gippsland ['Gypsland'], 1889, *C. French* s.n. (G-10194/48). Bonang rd., NE of Orbost, *Mangold 8 d, e* (F). Wilsons Promontory NP., on sealers cove hiking track, *Mangold 6 l* (F). Cumberland Falls, c. 19 km E of Marysville, *Filson 1035395* (MEL). Eastern Highlands, Black Spur: 20. Mar.1885, *Wilson* s.n. (MEL-1063643, NSW-539397, -539419); 1888, *Wilson* s.n. (NSW-539391, -539397); Jan. 1890, *Wilson* s.n. (NSW-153541). River Watts [Yarra Ranges], 1891, *Martin* s.n. (NSW-539414). Fern Tree Gully [E of Melbourne]: 28. Jan.1892, *Wilson* s.n. (NSW-539396); 23. Dec.1899, *Bastow* s.n. (MEL-26165). Dandy Hills, Melbourne ['Danndy Hills'], Jan. 1892, *Wilson* s.n. (NSW-603861). Mt. Macedon [NW of Melbourne], Dec. 1891, *Wilson* s.n. (NSW-603846). Ottway Ranges, 10-14 km N of Apollo Bay, *Mangold 3 p, 5 f* (F). Tasmania: 3.5 km W of Luina, *Kantvilas 332/89* (HO). Anthony Rd., *Kantvilas 185/91, 434/91, 222/99, 189/93* (HO). Cradle Mtn. Lake St Clair NP., Pelion Plains, 1 km SW of Pelion Hut, *Kantvilas 210/92* (HO). 3 km S of Teepookana, *Kantvilas 666/90, 670/90* (HO). Mt. Wellington, *Wilson* s.n. (NSW-539392). Warra Creek, 19. Jun.1996, *Kantvilas* s.n. (HO). W of Tahune Bridge, "Big Coupe - understorey island near 418 m.peg", in the Warra SST: *Kantvilas 222/99* (HO); 05. May 1998, *Kantvilas* s.n. (HO). Norway, Hordaland, *Gaarder 4365, 4366* (BG). U.S.A, Vermont, Brattleboro 1836, *Frost 96* (FH-213376 pr.p. [with isolectotype of *T. subtile*]).

Thelotrema thesaurum Mangold spec. nov. ined.

Type: Australia, Queensland, Dawson logging area, 24 km S of Koombooloomba turnoff, WSW of Tully, *Hale 832638* (US-holotype).

ETYMOLOGY – From lat. *thesaurus* (= treasure , store, hoard), the epithet refers to the ascomata of the new species with thick thalline rim and conspicuously large crystal aggregates.

ILLUSTRATION – Fig. 174.

Thallus epi- to hypophloedal, thin to moderately thick, up to c. 300 µm thick, yellowish-brown to pale olive. Surface waxy, smooth, ±verrucose, fissured. True cortex present, yellowish, consisting of irregular hyphae, up to c.50 µm thick. Algal layer continuous and well developed, calcium oxalate crystals abundant, in particular in ascocarp area, (very) large, solitary to more rarely in clusters. Vegetative propagules not seen. Ascomata conspicuous, (very) large, up to c. 2 mm in diam., roundish, peri- to indistinctly apothecioid, sessile, solitary to fused, emergent, subglobose to urceolate. Discs not visible from surface. Pores (moderately) small, up to c. 300 µm in diam., roundish to slightly irregular, apical to proper exciple visible from surface, free, predominantly entire to slightly split, whitish to off-white, predominantly incurved, usually ±shrunken. Thalline rim margin thick to very thick, roundish, entire to slightly split, in older stages usually becoming eroded, whitish to off-white and distinctly pruinose when eroded, thalline rim predominantly concolorous with thallus, with same surface as thallus, often distinctly fissured, incurved. Proper exciple free, moderately thin to moderately thick, hyaline to pale yellowish internally, yellowish-brown marginally, apically covered with grayish granules, non-amyloid to sometimes amyloid at the base. Hymenium up to c. 220 µm high, non-inspersed, moderately conglutinated, paraphyses ±bent, ±interwoven, tips slightly thickened and somewhat irregular, lateral paraphyses present, conspicuous, up to c. 30 µm long, columellar structures absent. Epihymenium moderately thick, yellowish-brown, with grayish to brownish granules. Asci (4)6-8-spored, tholus thick, thin when mature. Ascospores (moderately) large, densely eumuriform, cell walls and endospore (moderately) thin, non-halonate, hyaline to rarely pale yellowish with age, non-amyloid to faintly amyloid, oblong to ellipsoid with roundish to narrowed-roundish ends, loci roundish to angular, subglobose to irregular, transverse septae thin, regular to slightly irregular, becoming indistinct at late maturity, 60-120(130) x 20-30 µm with multiple loci. Pycnidia not seen.

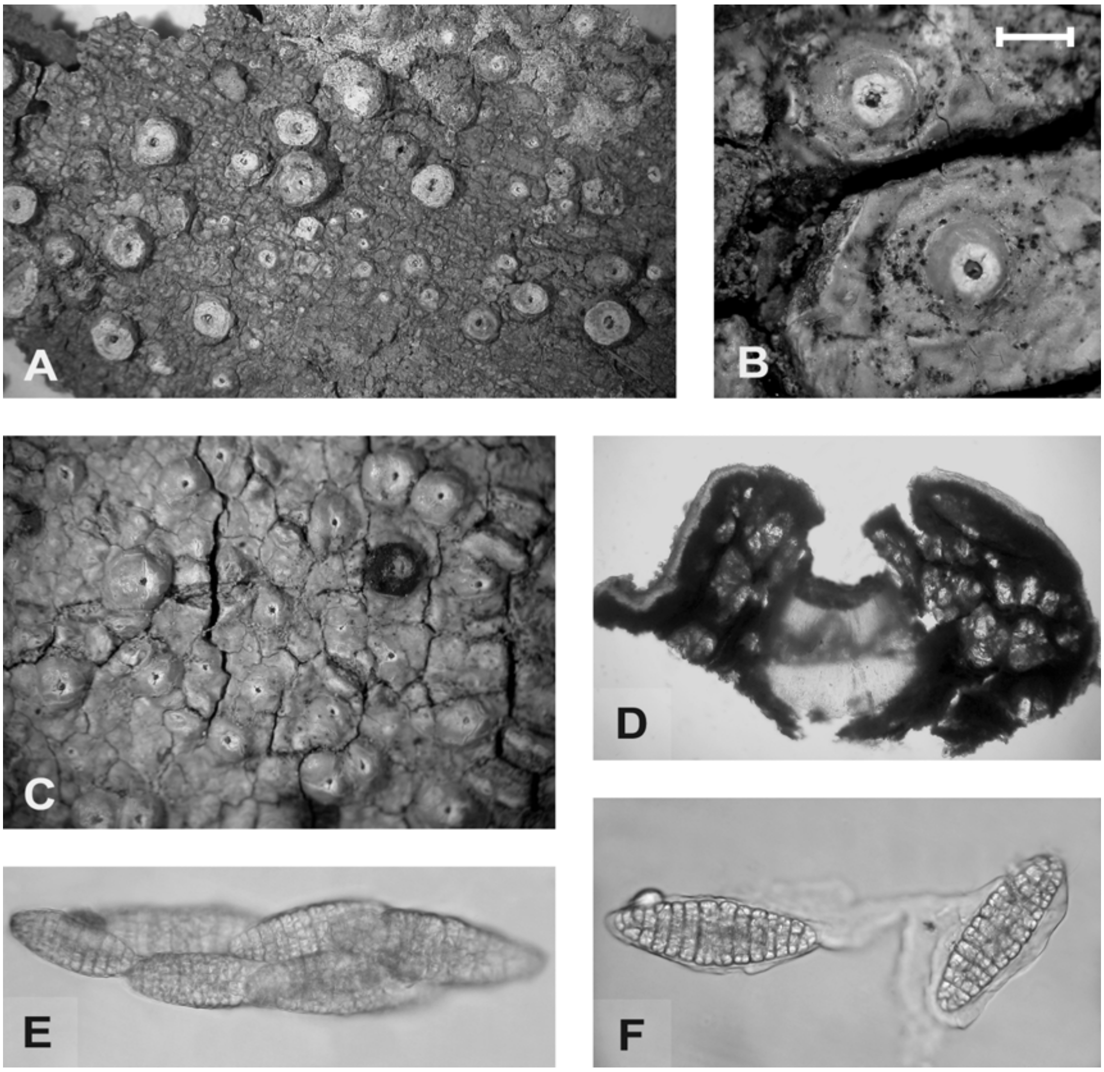

Fig. 174. *Thelotrema thesaurum*: growth habit (**A, C**), ascomata (**B**), ascoma section (**D**) and ascospores (**E, F**). A.: *Streimann 45596*; B.-F.: US-holotype. Bar= A: 2.5 mm; B: 0.75 mm; C: 1.5 mm; D: 125 µm; E: 35 µm; F: 30 µm.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing stictic, constictic (majors), cryptostictic, α-acetylconstictic, hypoconstictic and hypostictic (traces) acids.

ECOLOGY AND DISTRIBUTION – *Thelotrema thesaurum* grows on bark in tropical rainforests, predominantly in highlands, in altitudes ranging from 100 to 1100 m. It is rare, known only from northern Queensland.

NOTES – Characteristic for this taxon are the large, in older stages apically eroded and bright-pruinose ascomata with thick thalline rims with abundant, large calcium oxalate crystal inclusions. It is further characterized by a dark, waxy, corticate, ±verrucose thallus, large, eumuriform, thin-walled, hyaline, non- to faintly amyloid ascospores and the presence of the stictic acid chemosyndrome. It is similar to *T. leucophthalmum* and *T. cupulare*, both distinguished by more open-pored ascomata and smaller ascospores (see also under these species). Other similar, but chemically different Australian species include: *T. rugatulum* (nil), *T. eungellaense* and *T. porinaceum* (both norstictic acid). These taxa can be also easily distinguished by asci that do not have more than four spores.

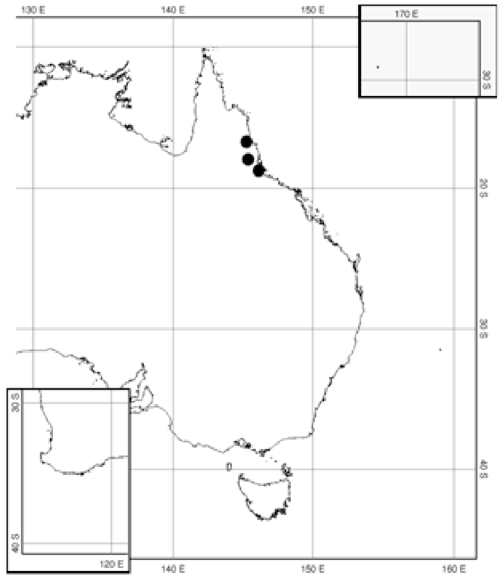

Fig. 175. Australian distribution of *T. thesaurum*.

SPECIMENS EXAMINED – Australia, Queensland: Thornton Range, CREB rd. (to Cooktown): *Stevens 19186* (GZU); 15 km N of the Daintree River crossing, *Hale 831017, 831622* (US); 5 km in from Daintree River crossing, *Hale 831523* (US). Mt. Windsor area, NW of Mossman: Km.45 on Mt. Windsor Rd., *Hale 831303, 831432* (US); 5 km W of new Forestry Camp, *Hale 832066, 832210, 832246* (US). Davies Creek Rd. 17 km S of Kennedy Hwy., S of Davies Creek Falls NP., E of Mareeba, *Hale 830998, 831054* (US). Mt. Tyson, 2 km WNW of Tully, *Streimann 45596* (CANB). Dawson logging area, 24 km S of Koombooloomba turnoff, WSW of Tully, *Hale 830280* (US).

Thelotrema triseptatum Mangold spec. nov. ined.

Type: Australia, Queensland, Atherton Tablelands, Herberton Range, *Hale 832261* (US-holotype).

ETYMOLOGY – The epithet refers to the characteristic three-septate ascospores of this taxon.

ILLUSTRATION – Fig. 176.

Thallus predominantly hypophloedal, very thin, epiphloedal parts up to 50 µm high, grayish. Surface dull to glittering, smooth to slightly roughened, continuous, unfissured to slightly fissured. Thallus covered by incontinuous protocortex up to 25 µm thick. Algal layer poorly developed, ±continuous, calcium oxalate crystals sparse, embedded in substrate, small to large. Vegetative propagules not seen. Ascomata inconspicuous, small, up to 300 µm in diam., roundish, apothecioid, solitary to marginally fused, distinctly immersed. Disc usually not visible from surface to rarely partly visible, pale flesh colored, epruinose. Pores small, up to c. 100 µm in diam., roundish to slightly irregular, upper parts of proper exciple visible from surface, free, entire to slightly split, off-white, incurved. Thalline rim margin moderately thick, entire to indistinctly split, roundish, often slightly sunken, concolorous with thallus, thalline rim not distinguishable from main thallus. Proper exciple free in the upper parts, thin, hyaline internally, yellowish-orange marginally, often with substrate layers incorporated, faintly amyloid (reddish). Hymenium up to c. 80 µm high, non-inspersed, distinctly conglutinated, paraphyses ±bent, interwoven, unbranched, tips thickened, lateral paraphyses present, inconspicuous, up to c. 10 µm long, columellar structures absent. Epihymenium indistinct, hyaline, without granules, with fine crystals. Asci 8-spored, tholus (moderately)

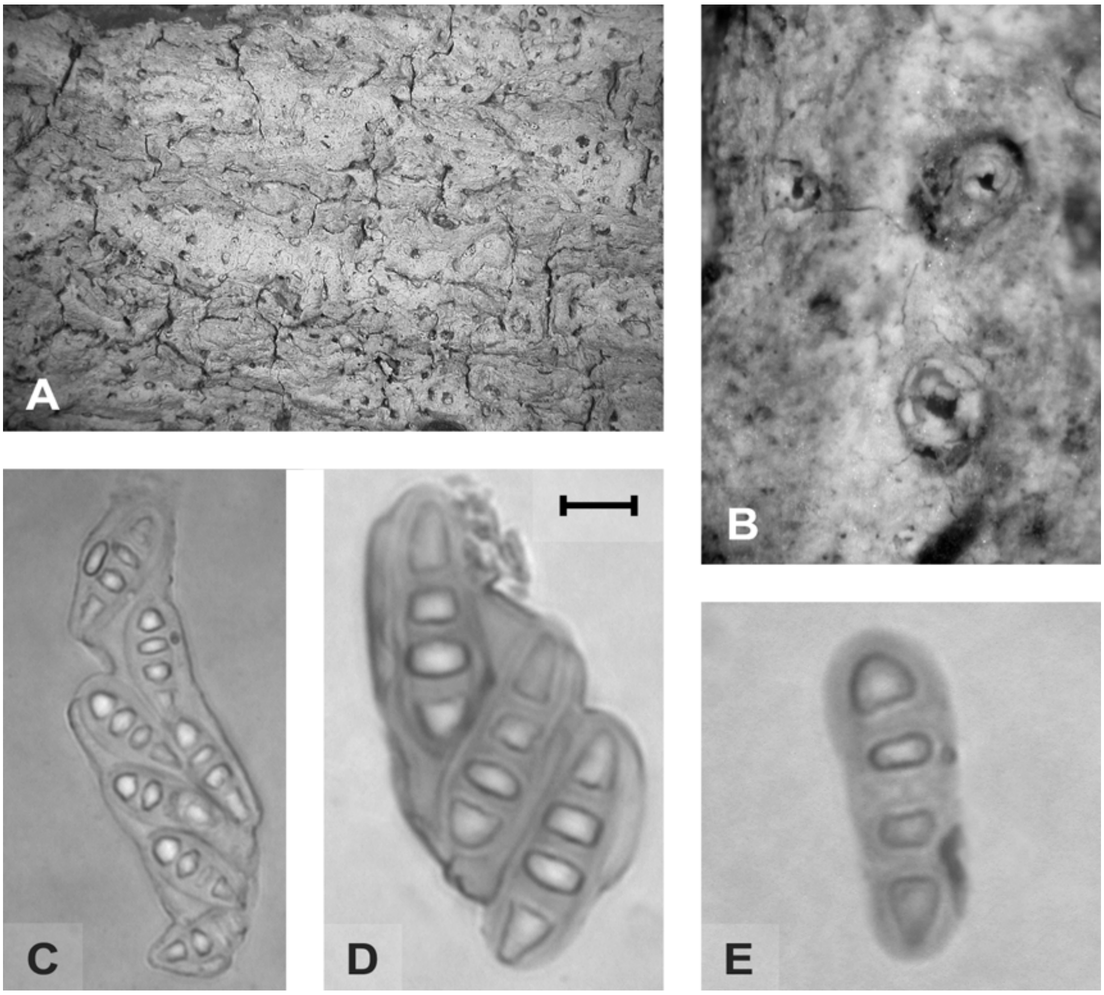

Fig. 176. *Thelotrema triseptatum*: growth habit (**A**), ascomata (**B**), ascospores (**C**) and ascospores showing amyloid reaction (**D, E**). A.-E.: US-holotype. Bar= A: 1.5 mm; B: 0.25 mm; C: 9 µm; D: 5 µm; E: 4 µm.

thick, moderately thin to moderatelt thick when mature. Ascospores uniform, small, transversely septate, cell walls thick, non-halonate, hyaline, moderately amyloid, fusi- to claviform, ends roundish to subacute, loci roundish to more often ±angular, predominantly (roundish)cuboid, end cells conical, septae (moderately) thick, regular, 15-20 x 6-7 µm with 4 loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish to brown, C-, PD+ orange; containing stictic (major) and hypoconstictic (trace) acids.

ECOLOGY AND DISTRIBUTION – The new species was collected on bark in a tropical rainforest at 1100 m. It is only known from northern Queensland.

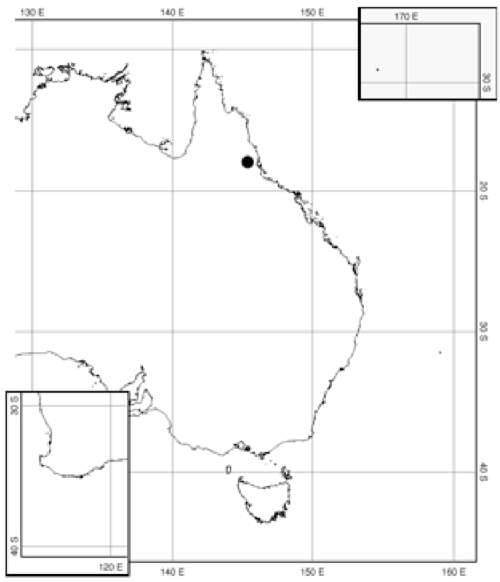

Fig. 177. Australian distribution of *T. triseptatum*.

NOTES – *Thelotrema triseptatum* is characterized by a hypophloedal, ecorticate thallus, small, distinctly immersed ascomata, small, uniform three-septate, hyaline, moderately amyloid ascospores with thickened cell walls and septae, and the stictic acid chemosyndrome. Similar stictic acid containing Australian species include *T. bicinctulum*, *T. alboolivaceum* and *T. porinoides*. *Thelotrema bicinctulum* is distinguished by a true cortex and larger ascospores (up to 30 µm long with up to 10 loci). *Thelotrema alboolivaceum* has similar ascospores that are slightly larger (up to 23 µm long with up to 6 loci) and is further distinguished by a true cortex and larger, distinctly emergent, wide-pored apothecia with entirely free exciple. *Thelotrema porinoides* differs by having larger ascospores (up to 140 µm, with up to 30 loci) with unthickened septae.

SPECIMENS EXAMINED – See type collection of this species.

***Thelotrema* sp. I**

ILLUSTRATION – Fig. 178.

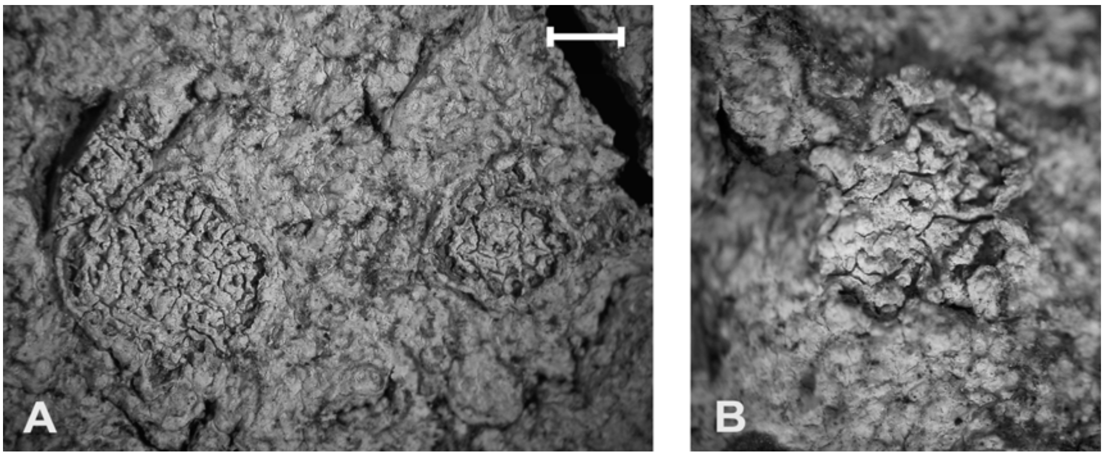

Fig. 178. *Thelotrema* sp. I: growth habit (**A**) and ascoma (**B**). A., B.: *Hale 831671*. Bar= A: 1 mm; B: 0.75 mm.

NOTES – A single collection from Eungella National Park contains protocetraric acid and has small, roundish-elongate, regenerating ascomata that are ±concentrically arranged in a roundish, stroma-like structure that is limited by an erect to recurved 'thalline rim'. The ascomata have a layered (true/inner) thalline rim that is superficially slightly pale-reddish pigmented, an uncarbonized, fused proper exciple with lateral paraphyses up to 30 µm long, an up to c. 100 µm high hymenium with distinctly straight and parallel paraphyses with unthickened tips, and small, hyaline, transversely septate, non-amyloid ascospores up to c. 20 x 6 µm in size with up to 6 loci (no mature ascospores seen). It is similar to *Gyrotrema sinuosa* (Sipman, 1992b; Frisch & Kalb, 2006) but differs in chemistry, the presence of lateral paraphyses, carbonization and smaller ascospores (hypoprotocetraric acid chemosyndrome, absent lateral paraphyses, carbonized proper exciple and ascospores up to 52 x 9 µm in size with up to 13 loci in *G. sinuosa*). *Thelotrema* sp. I lacks columellate structures and maybe be closer related to the *T. schizoloma*-group.

SPECIMENS EXAMINED – Australia, Queensland, Eungella NP., NP. side rd. near Peases Lookout, off Darymple rd., *Hale 831671* (US).

***Thelotrema* sp. II**

ILLUSTRATION – Fig. 179.

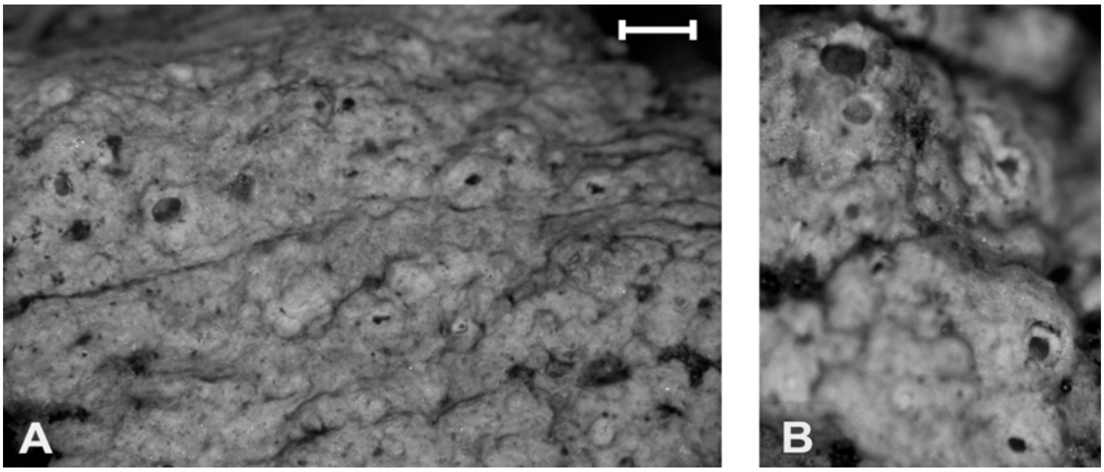

Fig. 179. *Thelotrema* sp. II: growth habit (**A**) and ascomata (**B**). A., B.: *Lumbsch & Mangold 19128 c*. Bar= A: 1 mm; B: 0.6 mm.

NOTES – A single collection from Atherton Tableland could not be assigned to any known taxon, however, it is refrained from describing a new species since the specimen is too scanty. It is characterized by a moderately thick, smooth and slightly verrucose to rugose thallus with a large amount of small, scattered calcium oxalate crystals and covered by an incontinuous protocortex. It has medium sized apothecia with entire margins that become wide to gaping with age, fused to apically slightly detached proper exciple, clear hymenium up to 150 µm high with distinct lateral paraphyses and small (12-22 x 5-10 µm), submuriform, hyaline, non-amyloid to slightly amyloid ascospores with thick cell walls and predominantly ±irregular, angular, 4-6(7) x 1-2(3) loci. No secondary compounds could be detected by TLC. *Chapsa kalbii* from Africa and the Neotropics (type collection not seen) is similar, but differs by a more thinly thallus with rough surface, ascomata with split and rugged to lobed thalline rims, a lower hymenium (up to 70 µm high) and ascospores with less thickened walls and more roundish loci.

SPECIMENS EXAMINED – Australia, Queensland, Atherton Tablelands, Curtain Fig Tree, *Lumbsch & Mangold 19128 c* (F).

***Thelotrema* sp. III**

ILLUSTRATION – Fig. 180.

NOTES – A single collection from Mossman Gorge (Northern Queensland) agrees well with the description for *Myriotrema flavolucens* from Venezuela, a species that is predominantly characterized by the presence of lichexanthone as the only secondary compound, immersed ascomata with layered margins and free proper exciple and small, hyaline, transversely septate, amyloid ascospores (Sipman, 1992). Unfortunately the type material of this taxon was not available for study. The Australian material is identical in the unusual chemistry and similar in its morphology and ascospores (up to 25 µm long). However, it differs by the presence of lateral paraphyses and an inspersed hymenium.

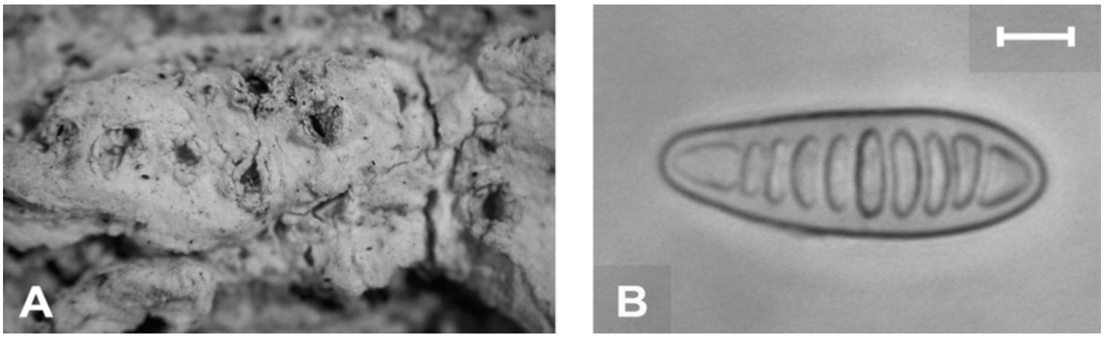

Fig. 180. *Thelotrema* sp. III: ascomata (**A**) and ascospore (**B**). A., B.: *Mangold 35 k*. Bar= A: 1 mm; B: 4 µm.

SPECIMENS EXAMINED – Australia, Queensland, Daintree NP., Mossman Gorge Section, near Rex Creek Swing Bridge, *Mangold 35 k* (F).

2. 9. 12. ***Topeliopsis*** Kantv. & Vezda Lichenologist 32: 347 (2000), emend. Kalb, Mycotaxon 79: 320 (2001). Type species: *Topeliopsis muscicola* Kantv. & Vezda [= *Topeliopsis muscigena* (Stiz.) Kalb].

THALLUS – Crustose, muscicolous, corticolous, lignicolous humicolous or saxicolous, epi- to hyposubstratic, predominantly evanescent to ±thin, up to c. 50-200 µm high, rarely ±thick, up to c. 500 µm high, grayish to greenish or olive with yellow, brown or white tones. Surface dull to shiny or ceraceous, smooth to rarely rough or pruinose, continuous to rugose or verruculose, unfissured to rarely fissured or rimose. Prothallus absent or thin to indistinct and brownish. Thallus predominantly covered by an up to c. 10-30 µm thick, continuous to discontinuous protocortex, often becoming partly distinctly conglutinated forming a true cortex of irregular to periclinal hyphae to rarely without cortical structures or covered by a distinct, continuous, hyaline to yellowish true cortex consisting of periclinal to irregular hyphae up to c. 50 µm thick. Algal layer continuous to discontinuous, poorly to well developed, calcium oxalate crystals absent to abundant, small to large, scattered or clustered. Distinct medulla layer absent. Vegetative propagules are not known for the genus.

ASCOMATA – Conspicuous to rarely inconspicuous, predominantly (moderately) large, up to c. 0.6-1.2 mm in diam., predominantly roundish to rarely slightly irregular, peri- to apothecioid, sessile to erumpent, solitary to slightly fused, non-regenerating, immersed to distinctly emergent, then hemispherical, urceolate or subglobose. Disc usually not visible from surface to partly visible, flesh-colored to brownish or grayish, rarely with red or orange tones, epruinose to rarely slightly pruinose. Pores predominantly tiny to wide, up to c. 100-600 µm in diam., predominantly ±irregular, ragged or distinctly star-shaped, rarely roundish, particularly in older ascomata, pore margin entire to ±split, proper exciple predominantly not visible from surface and pore margin formed by thalline rim, rarely becoming apically visible from surface, particularly in older or apically eroded ascomata, fused to rarely slightly detached, pale brown to reddish-brown to rarely whitish, grayish or pale yellowish, incurved. Thalline rim margin thin to thick, distinctly split to coarsely cracked, lobed, lacerate or eroded, thalline rim squamose to layered, often pruinose or exfoliating, whitish to off-white or concolorous with thallus, rarely with a reddish-brown base, incurved to erect. Proper exciple predominantly fused to apically exposed, moderately thick to very thick, rarely moderately thin, hyaline to pale yellowish internally, yellowish, orange, grayish or brownish marginally, rarely with substrate inclusions, apically sometimes more darkened and rarely covered by grayish granules, predominantly ±distinctly amyloid towards the base and the subhymenium to rarely non-amyloid. Subhymenium thin to thick, concolorous with proper exciple. Hymenium non-amyloid, discoid to usually ±cupular, up to c. 90-250(300) µm high, non-inspersed and clear in the Australian species (in *T. meridensis* inspersed), weakly to moderately, rarely strongly conglutinated. Paraphyses ±straight, parallel to slightly interwoven, unbranched, tips not thickened to slightly thickened. Lateral paraphyses present, conspicuous to rarely inconspicuous, not clearly separated from proper exciple, up to c. 15-40 µm long, columellar structures absent. Epihymenium indistinct to moderately thick, hyaline to sometimes brownish, egranulose to rarely granulose.

Asci 1-8-spored, non-amyloid, clavate, ascus walls not thickened, tholus thin to thick, not visible to thin at maturity. Ascospores uni- to quadriseriate, small to large, 12-210 x 4-55 µm, transversely septate to eumuriform. Cell walls thin to more often ±thick, smooth to sometimes ±distinctly crenate to irregular, endospore in muriform ascospores thin to moderately thick, rarely non-halonate to ±distinctly halonate, sometimes only in younger stages, hyaline to rarely yellowish to brown, predominantly distinctly amyloid, rarely non-amyloid; oblong to ellipsoid or (bi-) fusiform to cylindrical or bacillar-fusiform, sometimes distinctly bent; with roundish to subacute, rarely distinctly acute ends; with 4-32 x 0-8 or multiple loci, loci roundish to ±angular, subglobose, oblong, lentiform, cuboid or ±irregular, with hemispherical to conical end cells, transverse septae thin to moderately thick, distinct to often indistinct or vanishing with age in densely muriform ascospores, regular to irregular, in some species ascospores generating ascoconidia in terminal stages (see below).

PYCNIDIA – Not known for the genus, in *T. elixii* and *T. muscigena* old ascospores generating ascoconidia, oblong-irregular to bacilliform up to c. 4-7 x 1 µm.

CHEMISTRY – Stictic acid chemosyndrome compounds present or absent.

ECOLOGY AND DISTRIBUTION – The Australian *Topeliospsis* spp. were collected on epiphytic mosses, tree bark, dead wood and siliceous rock, rarely from peaty soil or plant debris, in altitudes ranging between 20 and 1500 m. The majority of species is found in rainforests and wet sclerophyll forests or in several forms of (sub)alpine woodlands and moorlands, in predominantly sub-tropical to cool-temperate, rarely tropical climates of Pacific northern Queensland to southern Victoria and Tasmania. As currently known, six of the 11 species known in Australia are endemic (*T. acutispora, T. darlingtonii, T. decorticans, T. elixii, T. kantvilasii, T. tasmanica*), one is subantarctic (*T. subdenticulata*), three are paleotropical to paleotemperate (*T. laceratula, T. muscigena, T. pseudoexanthismocapa*) and one pantemperate (*T. azorica*).

NOTES – This genus was introduced (Kantvilas & Vezda, 2000) with three species, characterized by sessile, exfoliating, perithecioid ascomata with a fused, pale to dark-brown or carbonized, cupular exciple, distinct lateral paraphyses and large, eumuriform, thin-walled, non-amyloid ascospores. Later, the genus was revised to its present circumscription (Kalb, 2002). According to the uncarbonized type species *T. muscigena,* which has ascospores with ±thickened walls (at least in younger stages), *Topeliopsis* was restricted to non-carbonized taxa with ascospores of the 'thick-walled-type' and several species were added (ibid., Frisch & Kalb, 2006a). Additionally, two species with a distinctly dark and carbonized proper exciple were excluded (Kalb, 2002) and are now placed in a separate genus (*Melanotopelia rugosa, M. toensbergii*). One of the newly added species (Frisch & Kalb, 2006a), *T. darlingtonii*, differs in having rather *Thelotrema*-like, erumpent ascomata with a less distinctly fused apical proper exciple and non-amyloid ascospores. However, in my observations, various species showed a heterogeneous habitus according to the nature of the host substrate. For example in *T. azorica*, when muscicolous or saxicolous specimens have sessile, distinctly emergent, urceolate ascomata, whereas in specimen growing on soft wood the ascomata are erumpent, hemispherical and semi-emergent. Further, the ascospores in the examined collections of *T. muscigena* are often found ±distinctly pigmented. Consequently, I suggest to also accept species that differ from *Topeliopsis* s. str., characterized by sessile, ±urceolate, fissured to eroded ascomata and hyaline to brown, amyloid ascospores, and also accept species with *Thelotrema*-like ascomata (as described above) and non-amyloid ascospores. Characters found in all taxa include a thick, rather pallid proper exciple with indistinctly separated, ±conspicuous lateral paraphyses and straight, parallel to only slightly interwoven paraphyses with never distinctly thickened tips. Similar are the members of the *L. schizoloma*-group and the genera *Chapsa, Melanotopelia, Pseudoramonia* and *Thelotrema*. The latter is distinguished by ascomata with different and ±distinctly free proper exciple, for differences to the other genera and the *L. schizoloma*-group see there.

In the extended molecular phylogenic analysis (see also part 3) *Topeliopsis* s. str. forms a well supported monophyletic group, however, *T. meridensis*, which morphologically differs by an inspersed hymenium and a rather dark proper exciple, clusters with species of *Chapsa* and *Thelotrema*, the generic placement of this species needs further study.

Species descriptions:

Topeliopsis acutispora Kalb

Mycotaxon 79: 320 (2001). Type: Australia, Queensland, Cunninghams Gap NP., *K. & A. Kalb 21901* (CANB!-holotype, hb. Kalb!-isotype [as n. *21900*]).

ILLUSTRATION – Fig. 181.

Thallus predominantly muscicolous, often overgrowing adjacent debris and bark or exclusively corticolous, very thin to thin, c. up to 80µm thick, mainly episubstratic, in corticolous specimen partly hypophloedal, pale gray to grayish-green, appearing darker when growing on dark substrate. Surface dull to shiny, smooth, continuous to verruculose, unfissured. Thallus predominantly covered by an incontinuous protocortex up to c. 30µm thick, sometimes becoming distinctly conglutinated, forming a true cortex of irregular hyphae. Algal layer variable, mostly incontinuous and poorly developed, in corticolous specimen sometimes continuous and well developed, calcium oxalate crystals usually abundant and of variable size, scattered or in clusters. Vegetative propagules not seen. Ascomata conspicuous, (moderately) large, up to c. 1 mm in diam., roundish, peri- to apothecioid, sessile, predominantly solitary, in corticolous specimen moderately emergent and hemispherical, otherwise distinctly emergent and subglobose to urceolate. Disc usually not visible from surface, rarely becoming partly visible, pale flesh-colored, epruinose. Pores small to moderately wide, rarely gaping, up to c. 300 µm in diam., usually ragged and ±irregular star-shaped, with distinctly split, incurved pore margin, proper exciple not visible from surface, in strongly eroded ascomata proper exciple margin becoming visible, then pore roundish to somewhat irregular with ±entire, incurved, pale brownish to reddish-brown margin. Thalline rim margin thin to moderately thick, with same color and structure as rest of thalline rim, thalline rim lacerate, coarsely pruinose to squamulose, often eroded, somewhat exfoliating with age and becoming slightly layered, conspicuously off-white to whitish. Proper exciple predominantly fused, sometimes tips becoming exposed, thick, hyaline to pale yellowish internally, (pale)orange to reddish-brown marginally, usually distinctly amyloid towards the base and subhymenium. Hymenium up to c. 200 µm high, non-inspersed, moderately conglutinated, paraphyses unbranched, ±straight, parallel to slightly interwoven with unthickened to slightly thickened tips, lateral paraphyses present, not clearly separated from exciple, conspicuous, up to c. 30 µm long, columellar structures absent. Epihymenium indistinct, hyaline, without granules. Asci 8-spored, tholus moderately thick, thin when mature. Ascospores (moderately) large, transversely septate, rarely with a single longitudinal septum, cell walls thick to very thick, in younger ascospores distinctly halonate, hyaline, strongly amyloid, ±distinctly bent, bacillar-fusiform, with narrowed-rounded to (sub)acute ends, loci angular in younger stages, becoming roundish, subglobose to slightly lentiform to oblong with hemispherical to conical end cells, septae moderately thin, regular, 50-130(150) x 10-15 µm with 19-32 loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

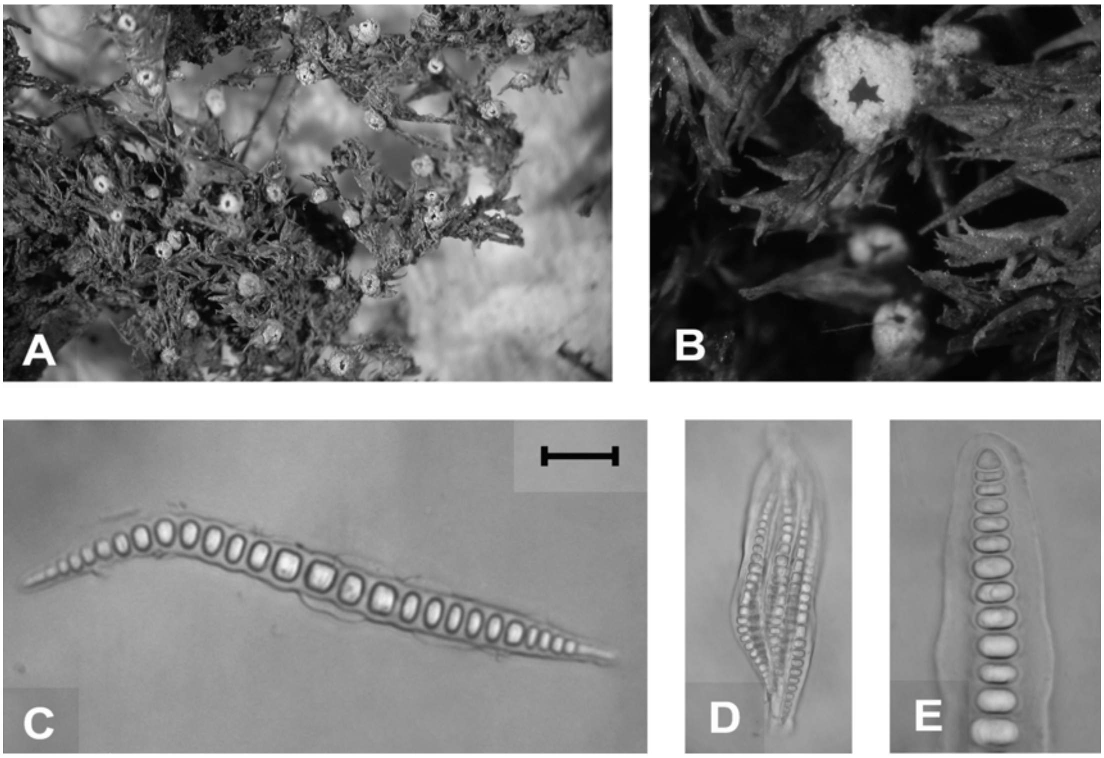

Fig. 181. *Topeliopsis acutispora*: growth habit (**A**), ascomata (**B**), ascospores (**C, D**) and ascospore detail (**E**). A.-D.: CANB-holotype; E.: *Streimann 36551*. Bar= A: 2.5 mm; B: 0.5 mm; C: 12.5 µm; D: 40 µm; E: 8 µm.

ECOLOGY AND DISTRIBUTION – *Topeliopsis acutispora* grows on epiphytic mosses, more rarely on tree bark or dead wood in warm temperate highland rainforests, cool temperate rainforests or wet sclerophyll forests in altitudes ranging from 50 to 1300m. It is common and wide-spread occurring from the Queensland/New South Wales border region to eastern Victoria and southern Tasmania and is endemic to Australia.

NOTES – This taxon is characterized by a *Topeliopsis*-like habitus, large, transversely septate, thick-walled, hyaline, amyloid ascospores and the lack of secondary compounds. It is similar to *T. subdenticulata* but differs in ascospore morphology. Although smaller ascospores fall within the range of *T. subdenticulata* and a thorough examination of several ascospores per specimen is needed for a reliably determination, the ascospores of *T. subdenticulata* never exceed 110 µm in length and do not have more than 25 loci. The ascospores in *T. subdenticulata* further appear to be more distinctly fusiform and less distinctly bent and the shape of loci tend to be stronger prolate, whereas the loci in *T. acutispora* ascospores are slightly angular. These differences are constant in all specimen examined, and no intermediate stages could be found. *Topeliopsis patagonica* from southern America is also similar, it is distinguished by slightly larger ascospores (up to 160 µm long) with more roundish ends, ascomata with smaller (up to 200 µm in diam.), distinctly dark pores and the presence of the stictic acid chemosydrome. Also similar is *T. pseudoexanthismocarpa*, for differences see under that species.

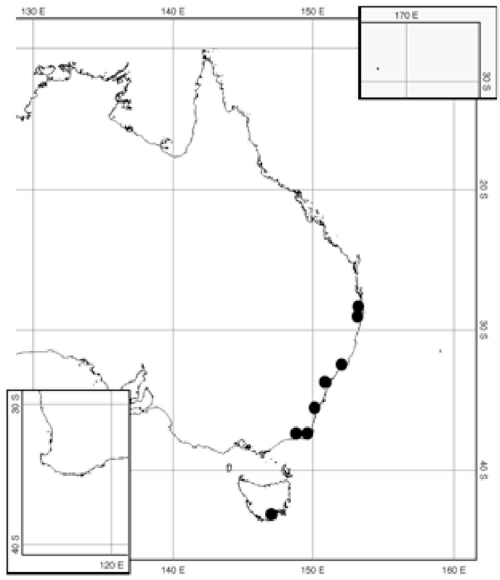

Fig. 182. Australian distribution of *T. acutispora*.

SPECIMENS EXAMINED – Australia, Queensland: Carabeen Nature Refuge, 45 km E of Warwick, *Lumbsch & Mangold 19175 d* (F). Lamington NP., 9 km S of Beechmont, Tullawallah, *Tibell 12741* (UPS). New South Wales: Border Ranges NP., Tweed Range, Brindle Creek Rd., along Tweed Range Scenic Drive, between The Pinnacle Lookout and Bar Mt., *Wedin 3648* (UPS). New England NP., along fire trail from Park Entrance, *Wedin 3606* (UPS). 35 km WSW Gloucester, Barrington Tops NP., Gloucester Tops, along Beech Forest Walk, *Wedin 3498* (UPS). Mt. Wilson - Mt. Irvine Rd., 25 km NNE of Katoomba, *Streimann 31601* (CANB). 5,4 km ESE of Katomba, Valley of Waters Creek, *Tibell 12243* (UPS). Illawarra Hwy., Macquarie Pass, 6 km NE of Robertson, *Thor 4788* (UPS). Monga NP., 27 km SE of Braidwood, *Mangold 11 o, u, v* (F). Mongarlowe River, Picnic area and river walk, *Mangold 13 f* (F). Misty Mountain Rd., 23 km NW of Batemans Bay: Currowan SF., *Elix 22746* (CANB); Buckenbowra SF., *Wedin 3255* (UPS). Victoria: Drummer Creek, Drummer River Forest Reserve, 10 km E of Cann River settlement, *Streimann & Pocs 65313* (B, CANB). Croajingolong NP., Double Creek Nature Walk, *Mangold 9 c* (F). Hensleigh Rd., 10,5 km SE of Bendoc, *Elix 24106* (CANB). Result Creek, Bendoc-Orbost Rd., 13 km SW of Bendoc, *Streimann 36551* (CANB). Errinundra NP.: 13 km SW Bendoc, along Gap Rd., at Result Creek, *Wedin 3361* (UPS); 30 km SSW Bendoc, Ellery Camp, Sassafras Creek side, *Wedin 3386* (UPS). East Gippsland, Bonang rd., NE of Orbost, *Mangold 8 k* (F). Arte River, 30 km NE of Orbost: *Elix 24247* (B); Glen Arte, *Wedin 3415* (UPS). Bemm River, Princes Hwy., 8 km SSW of Club Terrace, *Elix & Streimann 19489* (B, CANB). Tasmania: Tahune picnic area along Huon river, 15 km W of Geeveston, 50 km WSW of Hobart, *A. & M. Aptroot 23063* (ABL).

Topeliopsis azorica (P. James & Purvis) Mangold comb. nov. ined.

Bas.: *Ramonia azorica* P. James & Purvis, Arquipelago 11A: 11 (1993). Type: Azores, Faial, 14. Apr.1992, *Purvis & P. James* s.n. (AZ-holotype, BM!-isotype).

ILLUSTRATION – Fig. 183.

Thallus corticolous, saxicolous or muscicolous, variable due to different substrate structures, in saxicolous specimen very thin to incontinuous, predominantly endolithic, up to c. 50 µm high in ascomata area, otherwise very thin to thin, up to 100(150) µm high, epi- to hyposubstratic, grayish to greenish- or yellowish-gray. Surface dull to rarely slightly shiny, smooth to roughened, continuous to coarsely pruinose, unfissured to slightly fissured, often appearing distinctly fissured to areolate due to substrate structure. Thallus cover variable, predominantly covered by incontinuous protocortex up to 25 µm thick, rarely becoming distinctly conglutinated forming a true cortex of irregular to periclinal hyphae. Algal layer

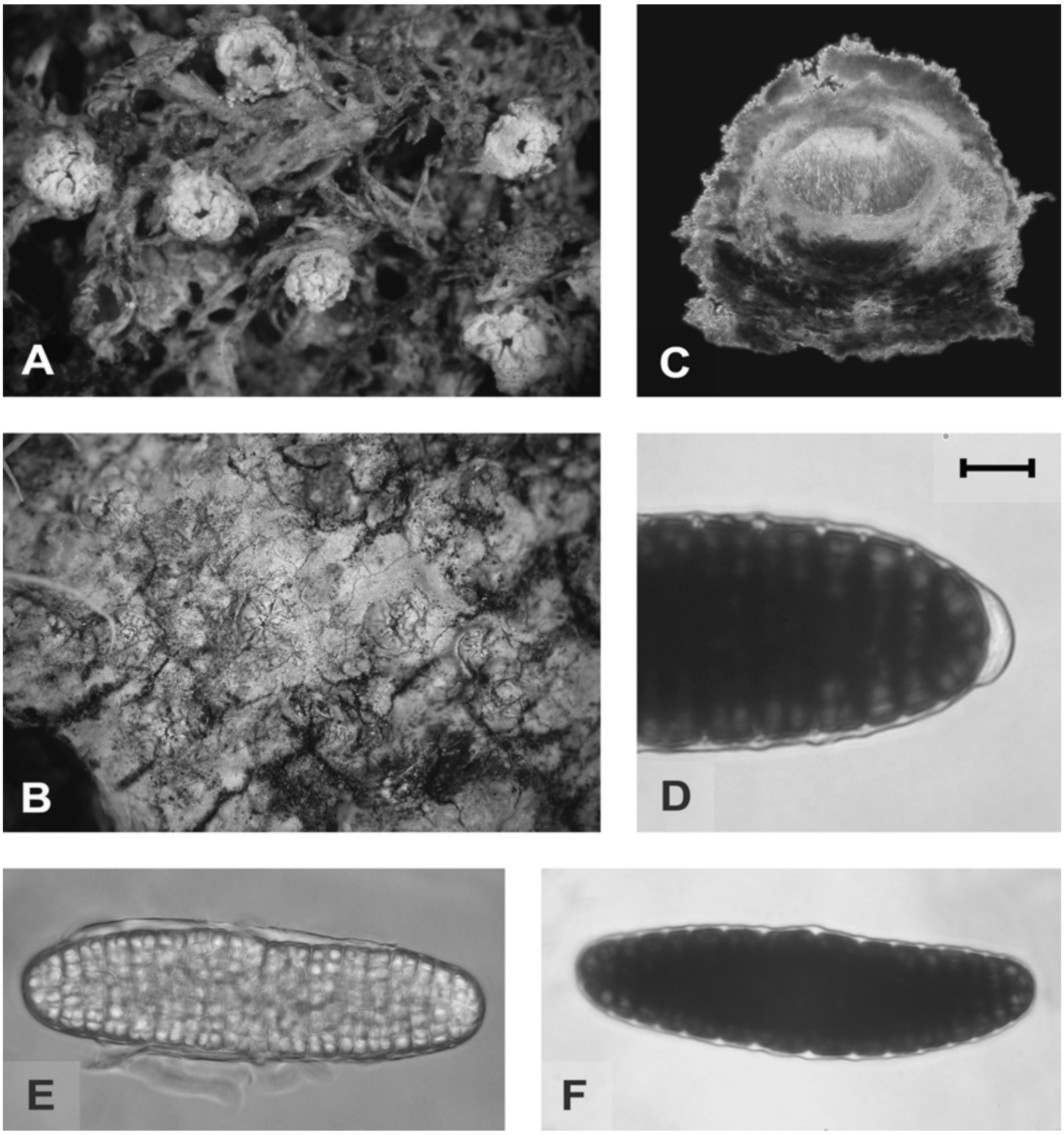

Fig. 183. *Topeliopsis azorica*: growth habit (A, B), ascoma section (C), ascospore detail showing amyloid reaction (D), ascospore (E) and ascospore showing amyloid reaction (F). A., E.: BM-isotpe; B., D., F.: *Messuti & de la Rosa 4754*; C.: *Messuti 4485*. Bar= A: 0.7 mm; B: 1 mm; C: 150 µm; D: 12.5 µm; E, F: 25 µm.

variable, predominantly ±incontinuous and poorly developed in some specimen patches of distinct and well developed algal layers areas present, calcium oxalate crystals not seen. Vegetative propagules not seen. Ascomata ±variable due to substrate structures, conspicuous to inconspicuous, moderately large, up to c. 800 µm in diam., roundish, perithecioid when young, becoming apothecioid with age, sessile to somewhat erumpent, solitary to marginally fused, distinctly emergent when growing on rock, mosses or hard bark, depressed-subglobular to (depressed-)urceolate, on soft bark only slightly emergent, hemispherical. Disc not visible from surface, rarely becoming partly visible, pale flesh-colored, epruinose to slightly pruinose. Pores small to moderately wide, up to c. 300 µm in diam., irregular to more rarely distinctly star-shaped, pore margin split, proper exciple not visible from surface. Thalline rim margin coarsely cracked to lacerate, thalline rim apically coarsely squamose to somewhat pruinose, whitish to off-white, in semi-emergent ascomata also concolorous with thallus, ±exfoliating, incurved to slightly erect at pore area, erect to recurved and lobed towards the margins. Proper exciple fused, thick, hyaline internally, pale yellow to pale yellowish-brown marginally, usually slightly to distinctly amyloid in internal exciple and subhymenium. Hymenium up to c.180 µm high, non-inspersed, moderately conglutinated, paraphyses straight, distinctly parallel, unbranched, with unthickened tips, lateral paraphyses present, conspicuous, not clearly separated from proper exciple, up to c. 30 µm long, columellar structures absent. Epihymenium indistinct and hyaline, sometimes with sparse, very small calcium oxalate crystals. Asci 1- to more rarely 2-spored, tholus moderately thin in young asci, not visible with maturity. Ascospores large, eumuriform, cell walls moderately thickened, endospore (moderately) thin, in younger stages with thin halo, hyaline, distinctly amyloid, in certain stages of maturity opaque amyloid, cell wall and endospore remaining non-amyloid, predominantly cylindrical to more rarely roundish-fusiform to very rarely roundish-bifusiform or reniform, with roundish to more rarely slightly narrowed-roundish ends, loci moderately large, roundish to somewhat angular, roundish-cuboid to irregular, transverse septae thin, distinct, regular, 70-160 x 15-45 µm with multiple loci. Pycnidia not seen.

CHEMISTRY – Strain I: Thallus K+ yellowish to brown, C-, PD+ orange; containing stictic (major), α-acetylconstictic (major to trace), hypoconstictic, hypostictic (minors to traces), cryptostictic and hyposalazinic (traces) acids. Strain II: Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – This species was collected in Australia on siliceous rock in a warm-temperate rainforest at c. 700 m. (In Argentina it was collected on *Nothofagus* bark) It is rare in Australia known only from south-central New South Wales. This is the first report for Australia. It was described from the Azores and has since been recorded from Scotland[14] and Argentina (Lumbsch & al., 2008).

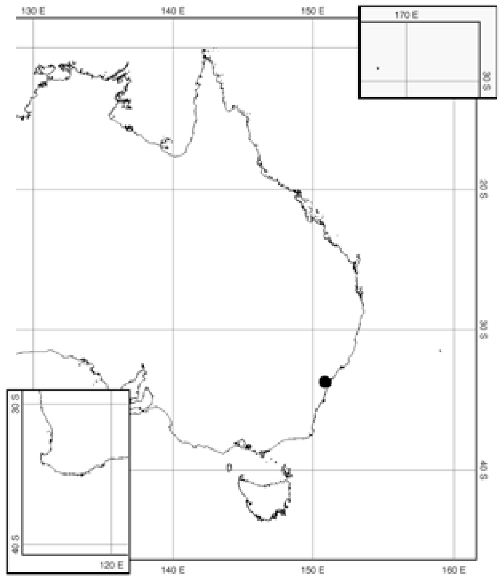

Fig. 184. Australian distribution of *T. azorica*.

NOTES – *Topeliopsis azorica* has a variable habitus. The Australian specimen has an almost evanescent thallus, in contrast, the corticolous collections from the Azores and Argentina have a distinct thallus. The ascomata in the specimens growing on rock as well as on bryophytes show a characteristic *Topeliopsis*-like morphology, with distinctly emergent, subglobose to urceolate, bright apothecia, whereas the specimen from Tierra del Fuego and parts of the Azores collections growing on soft bark show only slightly raised and comparably inconspicuous apothecia that are in some parts ±concolorous with the thallus. The specimens share several characters, such as large, hyaline, usually cylindrical ascospores with large loci and distinct transverse septae, a distinct to strong amyloid reaction, moderately thick, non-amyloid cell-walls, and a short hymenium. Hence they are included in a single species. Similar species include *T. elixii*, *T. muscigena* and *T. laceratula*. *Topeliopsis muscigena* can be distinguished by ascomata with reddish-brown bases, slightly larger, entirely amyloid ascospores that turn brownish with age

[14] The record from Scotland is not published in literature but is listed in the online archive for Scottish biodiversity (www.biodiversityscottland.gov.uk) by an unknown author.

and generate ascoconidia. For differences to *T. elixii* and *T. laceratula* see under these species.

SPECIMENS EXAMINED – Strain I: Argentina: Neuquen, *Messuti & de la Rosa 4754* (BCRU).
Strain II: Australia, New South Wales, Valley of Waters, 5 km E of Katoomba (Blue Mnts. area), *Thor 6114, 6123* (S). Europe, Azores, Pico: S of Santa Luzia, 11. Jun.1978, *James* s.n. (BM); Lagoa do Caiado, 13. Jun.1978, *James* s.n. (BM). Argentina, Tierra del Fuego, Sierra Alvear, *Messuti 4485* (BCRU).

Topeliopsis darlingtonii Frisch & Kalb

Lichenologist 38: (2006a). Type: Australia, Queensland, Darlington Range, *Kalb 33979* (CANB!-holotype; hb. Kalb-, hb. Frisch-isotypes).

ILLUSTRATION – Fig. 185.

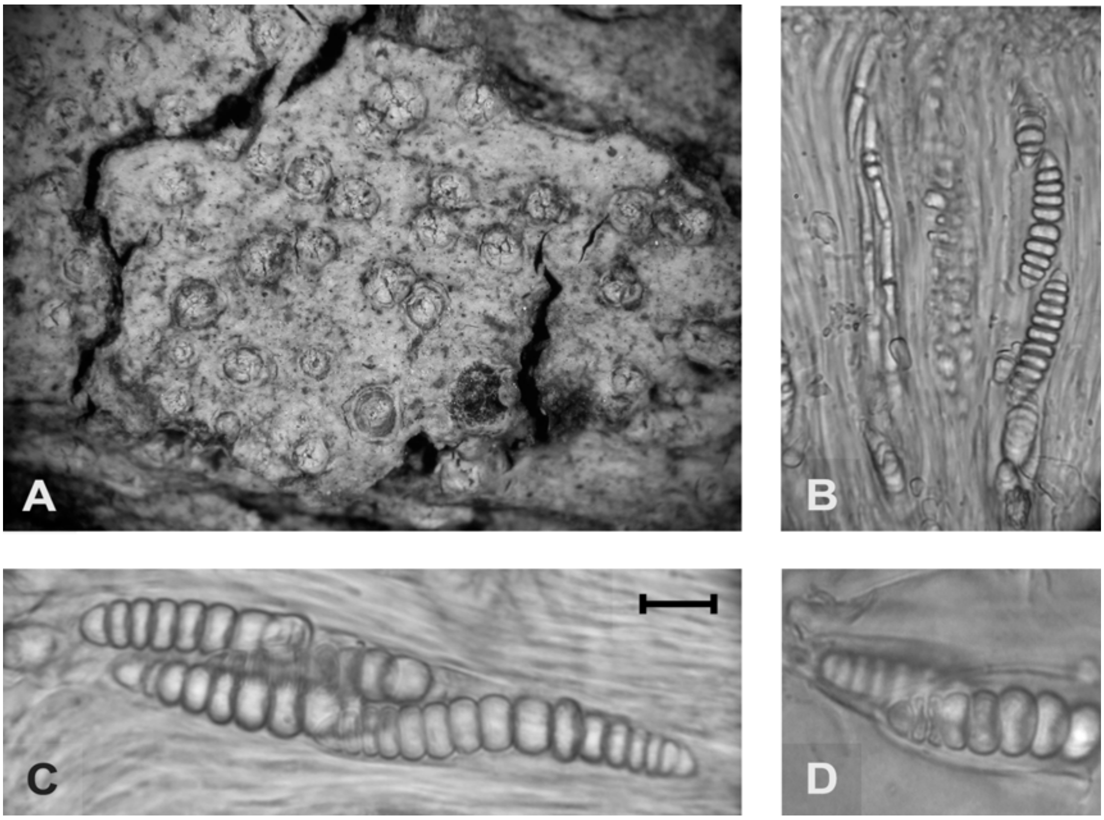

Fig. 185. *Topeliopsis darlingtonii*: growth habit (**A**), ascospores (**B, C**) and ascospore detail (**D**). A.-D.: CANB-holotype. Bar= A: 1 mm; B: 25 µm; C: 12 µm; D: 7 µm.

Thallus corticolous, (moderately) thin, up to 100 µm high, epi- to hypophloedal, pale yellowish-gray. Surface slightly shiny, smooth, continuous to slightly verruculose, unfissured. Thallus predominantly covered by a ±continuous protocortex up to c. 25 µm thick, in some parts becoming distinctly conglutinated forming a true cortex of predominantly irregular hyphae. Algal layer incontinuous and poorly developed, calcium oxalate crystals not seen. Vegetative propagules not seen. Ascomata inconspicuous, moderately large, up to c. 700 µm in diam., roundish, peri- to apothecioid, erumpent, solitary to marginally fused, immersed to moderately emergent, then irregularly depressed-hemispherical to irregularly depressed-urceolate. Disc not visible from surface to rarely partly visible, grayish to pale grayish-brown, epruinose to slightly pruinose. Pores tiny to (moderately) small, up to c. 100 µm in diam., predominantly irregular, pore margin entire to slightly split, incurved, proper exciple usually not visible from surface, in more open ascomata becoming partly visible, entire to slightly split, whitish, incurved. Thalline rim divided in two sections, inner parts coarsely cracked and (moderately) thick, lacerate and slightly layered, predominantly incurved, sometimes becoming slightly erect towards outer margins, off-white to whitish, outer parts resembling the 'true' thalline rim formed by main thallus, often indistinct and eroded or fused with inner thalline rim parts, coarsely cracked, incurved to erect, concolorous with thallus. Proper exciple predominantly fused, tips sometimes becoming ±free, thin to moderately thick, hyaline internally, pale yellowish to pale brownish marginally, apically covered by grayish granules, often with substrate particles incorporated, ±amyloid towards the base and subhymenium. Hymenium up to c. 150 µm high, non-inspersed, moderately conglutinated, paraphyses ±straight, parallel to slightly interwoven with unthickened to slightly thickened tips, lateral paraphyses present, not clearly separated from exciple, inconspicuous, up to c. 25 µm long, columellar structures absent. Epihymenium indistinct to thin, hyaline, without or with few grayish granules. Asci 8-spored, tholus moderately thick, thin when mature. Ascospores moderately small to moderately large, transversely septate, cell walls (moderately) thin, often with thin halo, hyaline, non-amyloid to moderately amyloid (fide Frisch & Kalb, 2006a), oblong to fusiform, with narrowed-roundish to subacute ends, loci relatively large, roundish to slightly angular, lentiform to oblong, septae moderately thin, irregular, 35-60 x 6-10 µm with 10-16 loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellow, C-, PD+ orange; containing stictic (major), constictic, α-acetylconstictic and consalazinic (minors) acids.

ECOLOGY AND DISTRIBUTION – *Topeliopsis darlingtonii* grows on bark in a subtropical rainforest ('cool-temperate submontane rainforest' - fide Frisch & Kalb, 2006a) at 980 m. It is only known from southern Queensland.

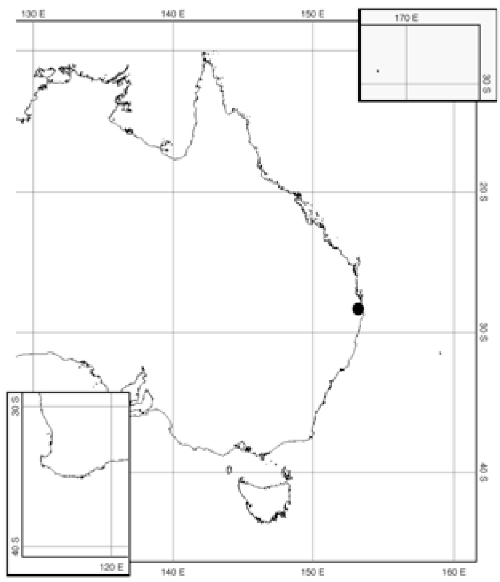

Fig. 186. Australian distribution of *T. darlingtonii*.

NOTES – It is characterized by only moderately emergent ascomata with coarsely split and moderately layered thalline margin, medium-sized, transversely septate, hyaline, thin-walled, non-amyloid (to weakly amyloid?) ascospores with relatively large and somewhat irregular loci and the stictic acid chemosyndrome. No similar species of Topeliopsis is known from Australia, the most similar species in Australia is the tropical *Thelotrema capetribulense*, which differs by a thicker, strongly verrucose/verruculose thallus surface, ascomata with distinctly free proper exciple, and thick-walled, clavate ascospores with smaller loci. The southern South American *T. patagonica* is another stictic acid containing *Topeliopsis* with transverse septate ascospores, this taxon is readily distinguished by larger ascospores (up to 150 µm long). In contrast to the original species description (ibid.), I could not find an amyloid reaction of the ascospores and the exciple was found to be apically ±detached in several ascomata.

SPECIMENS EXAMINED – Australia, Queensland, Darlington Range, *K. & A. Kalb* 33980 (hb. Kalb).

Topeliopsis decorticans (Müll. Arg.) Frisch & Kalb

Lichenologist 38: 44 (2006). Bas.: *Thelotrema decorticans* Müll. Arg., Bull. Herb. Boissier 1: 54 (1893). Type: Australia, Victoria, Black Spur, 1888, *Wilson '514'* (G-lectotype, here selected; NSW!-isolectotype [see also notes]).

Topeliopsis corticola Kalb, Mycotaxon 79: 322 (2001). Type: Australia, New South Wales, Blue Mnts. NP., Mnt. Wilson, *K. & A. Kalb 20462* (CANB!-holotype).

ILLUSTRATION – Fig. 187.

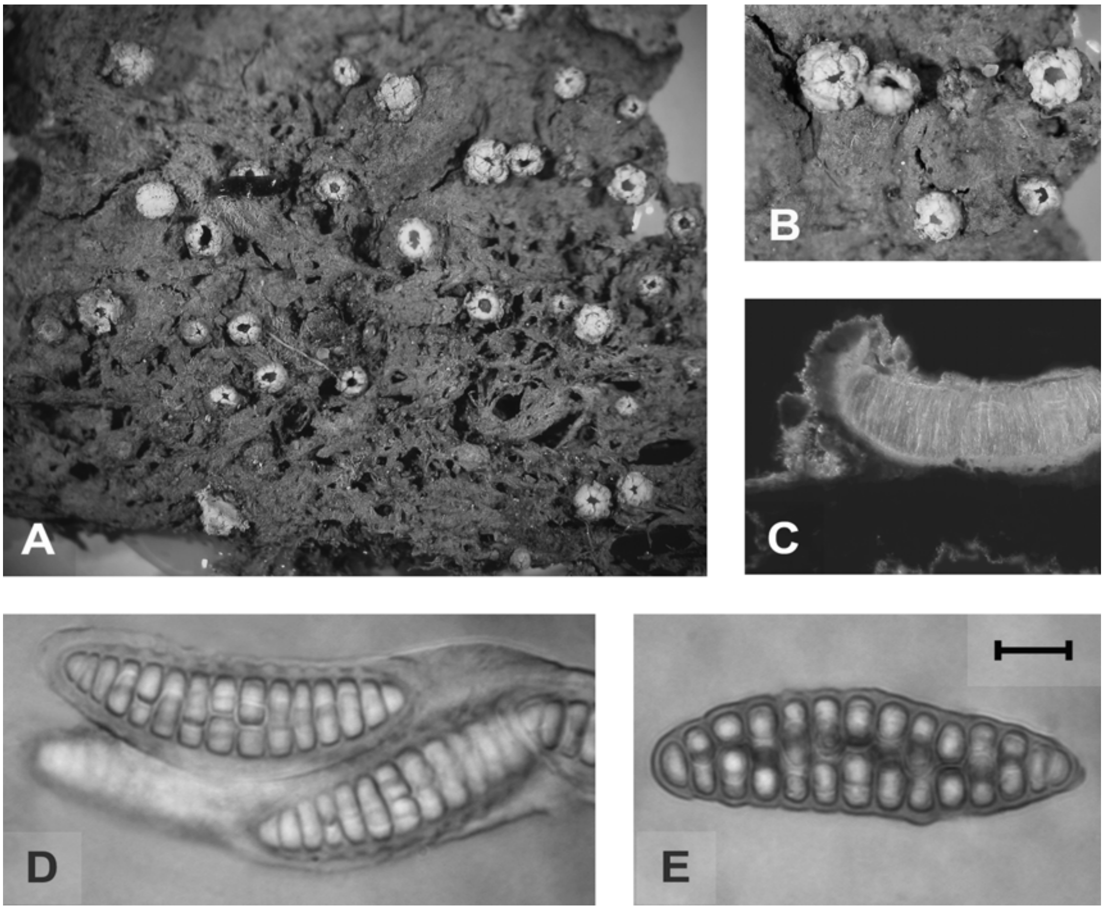

Fig. 187. *Topeliopsis decorticans*: growth habit (**A**), ascomata (**B**), ascoma section (**C**); ascospores (**D**) and ascospore showing amyloid reaction (**E**). A.-E.: *Mangold 5 j.* Bar= A: 1.5 mm; B: 1 mm; C: 175 µm; D, E: 12 µm.

Thallus predominantly muscicolous, rarely lignicolous, corticolous or saxicolous, thin to more rarely moderately thin, up to c. 150 µm high, epi- to hyposubstratic, predominantly (pale)olive. Surface dull to slightly shiny, smooth, continuous to rarely somewhat verruculose, unfissured. Thallus cover variable, often incontinuous true cortex present, up to c. 30 µm thick, moderately dense, formed of highly conglutinated periclinal to irregular hyphae, sometimes uncovered or with incontinuous protocortex up to c. 20 µm thick. Algal layer continuous, well developed, calcium oxalate crystals lacking or very sparse, small, clustered. Vegetative propagules not seen. Ascomata conspicuous, moderately small to large, up to c. 1 mm in diam., roundish, perithecioid when young, becoming apothecioid with age, sessile, solitary to marginally slightly fused, predominantly distinctly emergent, subglobular when young, becoming urceolate to more rarely depressed-urceolate with age. Disc usually not visible from surface, sometimes becoming partly visible, pale flesh-colored, epruinose. Pores small to moderately wide, rarely gaping, up to c. 500 µm in diam., irregular to star-shaped with split pore margin in younger ascomata, in older ascomata often roundish with entire pore margin, proper exciple not visible from surface. Thalline rim margin coarsely cracked to slightly lacerate, in older ascomata often becoming ±entire and smooth, thalline rim apically coarsely squamose to somewhat pruinose, whitish to off-white, incurved. Proper exciple fused, thick, hyaline internally, pale yellowish to grayish marginally, internal exciple and subhymenial layers usually slightly to distinctly amyloid. Hymenium up to c. 200 µm high, non-inspersed, moderately conglutinated, paraphyses straight, distinctly parallel, unbranched, with unthickened tips, lateral paraphyses present, conspicuous, not clearly separated from proper exciple, up to c. 35 µm long, columellar structures absent. Epihymenium indistinct, hyaline, without granules or crystals. Asci 8-spored, tholus moderately thick in young asci, thin or not visible at maturity. Ascospores moderately small to moderately large, eumuriform, cell walls (moderately) thick, sometimes with crenate surface, endospore moderately thin to moderately thick, often with thin halo, hyaline, moderately to strongly amyloid, predominantly roundish-fusiform to reniform, rarely cylindrical, with roundish to narrowed-roundish ends, loci large, roundish to somewhat angular, subglobose to roundish-cuboid or slightly oblong, transverse septae thin to moderately thick, distinct, regular to slightly irregular, 30-70 x 10-25 µm with 8-16 x 1-6 loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – The species grows on epiphytic mosses, more rarely on wood, tree bark or on siliceous rock in warm to cool-temperate rainforests and wet sclerophyll forests in altitudes ranging from 20 to 1500 m. It is common and wide-spread occurring from north-central New South Wales to southern Victoria and in Tasmania and is currently not known from outside Australia.

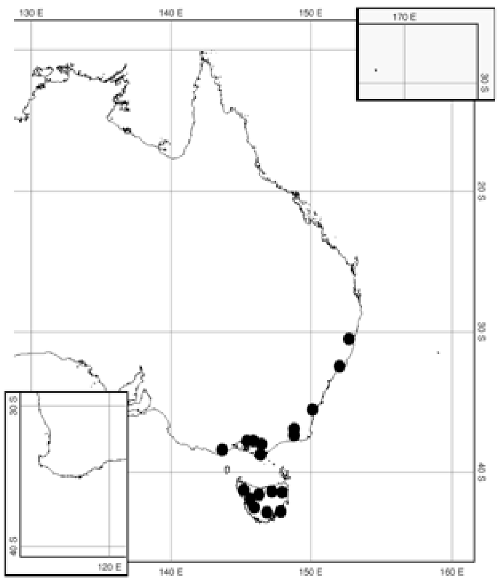

Fig. 188. Australian distribution of *T. decorticans*.

NOTES – *Topeliopsis decorticans* is characterized by a *Topeliopsis*-like habitus, 8-spored asci with medium-sized, muriform, hyaline, thick-walled, amyloid ascospores and the absence of secondary compounds. Other *Topeliopsis* species with muriform ascospores have distinctly larger ascospores and 1-2-spored asci.

The type in G was not available for study and thus the lectotype here selected is based on the duplicate in NSW dated from 1888. The collection mentioned in Müller's original description is specified with "ad Black Spur: Wilson, n. 514", however, in NSW five different collections exist labeled 'Wilson 514' (dated 20., 21. and 23. March 1885, 1888 and January 1890). In recent publications (Galloway, 1985; Kantvilas & James, 1991; Frisch & Kalb 2006) no lectotype was selected, and the type in G is noted as holotype (in Galloway without date, in Kantvilas & James dated 1888, in Frisch & Kalb dated 1892). Since Kantvilas & James (1991) is the first publication that mentions the type collection with date, this specimen is selected as lectotype.

SPECIMENS EXAMINED – Australia, New South Wales: 35 km WSW Gloucester, Barrington Tops NP., Gloucester Tops, along Beech Forest Walk, *Wedin 3483* (UPS). New England NP.: E of Armidale, Point Lookout, *Weber & McVean L-49337* (CANB); Weeping Rocks Track, 34 km SW of Dorrigo, *Streimann 65182* (CANB). Monga SF., Forest River Rd., 5 km S of Monga, *Elix 30243* (CANB). Monga NP., 27 km SE of Braidwood, *Mangold 11 c, t* (F). Victoria: Hensleigh Creek Rd., 18 km SSE of Bendoc, *Elix & Streimann 21945* (CANB). Hammonds Rd., Errinundra NP., 19 km SSW of Bendoc, *Elix 24170* (CANB). Arte River, 30 km NE of Orbost, *Elix 24241* (CANB). Bonang Rd., NE of Orbost, *Mangold 8 l* (F). Along Stony Creek, Colquhoun SF., 9 km E of Lakes Entrance, *Elix 5364* (CANB). Snowfields, Baw Baw NP., Mt. Erica car park at start of walking track to Mt. Erica summit, *Ford 2075896* (MEL). Korumburra, *Wilson s.n.* (NSW-603830). Wilson Promontory NP., Windy Saddle, *Mangold 7 a* (F). Bellell Creek, Marysville to Matlock rd., c. 3 km E of Lake Mountain turnoff, *Filson 1048951* (MEL). Black Spur: 1885, *Wilson '514'* (NSW-603828); Jan. 1890, *Wilson '514'* (NSW-603829). Warburton, Dec. 1885, *Wilson s.n.* (NSW-603832). Sassafras, *Wilson* s.n. (NSW-603834). Ferntree Gully [W of Melbourne], Jan. 1892, *Wilson* s.n. (NSW-603833), 23. Dec.1899, *Bastow* s.n. (MEL-26207, -724548). Ottway Range, 14 km N of Apollo Bay, *Mangold 5 i, j* (F). Tasmania: Mt. Victoria Forest Reserve, along trail from Mt. Albert Rd., *Wedin 3086* (UPS). Mt. Victoria Track, 08. Dec.1981, *Kantvilas* s.n. (BM-761893). Little Rapid River, 19. Feb.1982, *Kantvilas s.n.* (BM-761924). Anthony Rd.: Near turnoff to power station, *Kantvilas 191/90* (HO); Near Lake Sandra Track, *Kantvilas 40/89* (HO). 3 km S of Teepookana, *Kantvilas 604/90* (HO). King William Saddle, 14 km SW of Derwent Bridge, *Elix 26914* (CANB). Olga River at Line 7, *Kantvilas 173/90* (GZU, HO). Styx River Valley, 27. Nov.1981, *Kantvilas s.n.* (BM-761886). 13 km W of Hobart, Mt. Wellington, Myrtle forest, *Tibell 11002* (UPS). W of Tahune Bridge: In the Warra SST, Coupe WR 0081, *Kantvilas 69/03* (HO); "Big Coupe", in the Warra SST, *Kantvilas 218/98* (HO). Lyrebird Saddle around Mystery Creek, 5 km W of Lune River, 70 km SSW of Hobart, *A. & M. Aptroot 23193* (ABL). Adamsons Rd. near Strathblane, 04. Dec.1981, *Kantvilas s.n.* (BM-761889). Bun Hill, Forestier Peninsula, *Kantvilas 378/89* (HO).

Topeliopsis elixii Frisch & Kalb

Lichenologist 38: 40 (2006a). Type: Australia, Queensland, Darlington Range, *Kalb 33979* (CANB!-holotype; hb.Kalb-, hb.Frisch-isotypes).

ILLUSTRATION – Fig. 189.

Thallus muscicolous to partly corticolous, thin, up to 100 µm high, predominantly episubstratic, pale yellowish-gray. Surface slightly shiny, smooth, continuous to slightly verruculose, non-fissured. True cortex present, up to c. 25 µm thick, continuous to incontinuous, consisting of periclinal hyphae. Algal layer continuous and well developed, calcium oxalate crystals not seen (fide Frisch & Kalb [2006a] present, forming a basal layer). Vegetative propagules not seen. Ascomata inconspicuous, moderately large, up to c. 800 µm in diam., roundish, apothecioid, erumpent, solitary, emergent, predominantly (depressed-)urceolate. Disc partly visible from surface, pale flesh-colored to reddish-brown, slightly pruinose. Pores becoming wide to rarely somewhat gaping, up to c. 500 µm in diam., irregular in younger ascomata, becoming ±roundish, at first opening as irregular cracks, in older ascomata with coarsely split to eroded pore margin, proper exciple not visible from surface. Thalline rim coarsely cracked to somewhat lobed, lacerate to eroded, often becoming slightly pruinose, concolorous with thallus or slightly brighter. Proper exciple fused, tips becoming somewhat exposed if thalline rim is strongly eroded, thick, not clearly separated from thalline margin, hyaline internally, grayish-brown marginally, ±amyloid towards the base and subhymenium. Hymenium up to c. 200 µm high, non-inspersed, moderately conglutinated, paraphyses ±straight, unbranched, parallel to slightly interwoven with unthickened to slightly thickened tips, lateral paraphyses present, not clearly separated from proper exciple, inconspicuous, up to c. 20 µm long, columellar structures absent. Epihymenium thin to moderately thick, hyaline, with grayish-brown granules. Asci 1-spored, tholus moderately thick to thin, not visible at maturity. Ascospores large, densely eumuriform, cell walls (moderately) thin, endospore thin, in younger stages with thin halo, hyaline, distinctly amyloid, oblong to ellipsoid with roundish to narrowed-roundish ends, loci roundish to

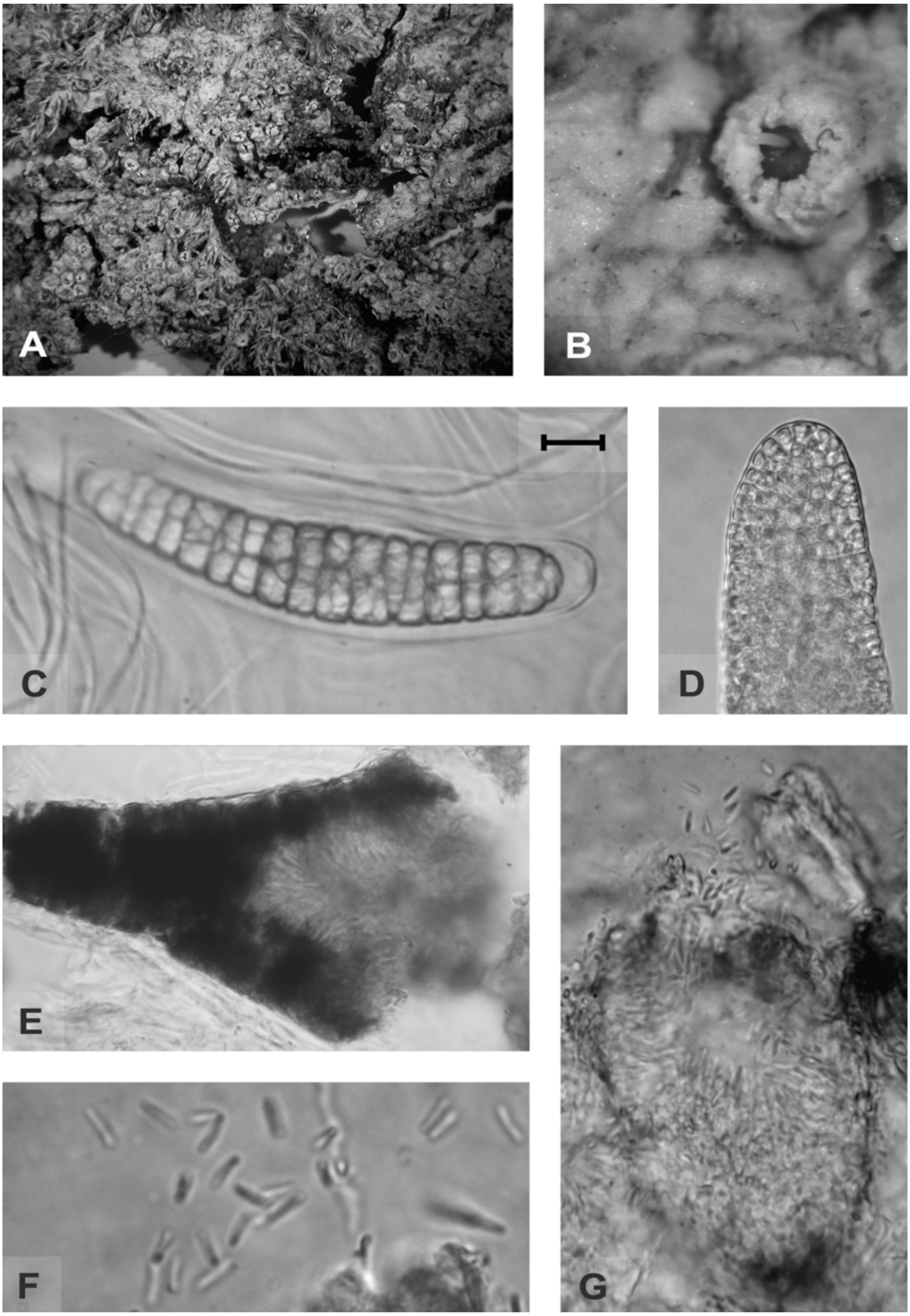

Fig. 189. *Topeliopsis elixii*: growth habit (**A**), ascoma (**B**), young ascospore (**C**), ascospore detail (**D**); ascoconidia producing ascospores (in E. showing amyloid reaction) (**E, G**), and conidia (**F**). A.-G.: CANB-holotype. Bar= A: 3 mm; B: 0.3 mm; C: 12.5 µm; D, G: 20 µm; E: 25 µm; F: 10 µm.

slightly angular, predominantly irregular, transverse septae only distinct in younger stages, thin and ±regular, becoming irregular, then vanish, finally developing ascoconidia (see below). 110-180 x 20-55 µm with multiple loci. Pycnidia not seen, ascoconidia developing in old ascospores, bacilliform, up to c. 7 x 1 µm.

CHEMISTRY – Thallus K+yellow, C-, PD+orange; containing hypoconstictic, hyposalazinic (majors), hypostictic (minor) and α-acetylconstictic (trace) acids.

ECOLOGY AND DISTRIBUTION – *Topeliopsis elixii* was collected on epiphytic mosses and adjacent tree bark in a subtropical rainforest ('cool-temperate submontane rainforest' - fide Frisch & Kalb, 2006a) at 980 m. It is only known from southern Queensland.

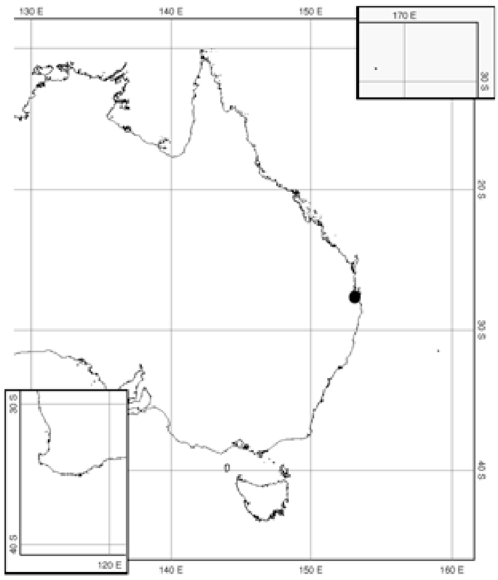

Fig. 190. Australian distribution of *T. elixii*.

NOTES – This species is characterized by open, predominantly flattened-subglobose ascomata with visible, pruinose, flesh-colored discs and lacerate-eroded margins, large, eumuriform, hyaline, amyloid ascospores that form ascoconidia, and the presence of hypoconstictic and hyposalazinic acids as major constituents. Ascoconidia also occur in the similar *T. muscigena*, which lacks secondary compounds and has larger (up to 210 µm), often slightly brownish ascospores. Other similar taxa include *T. azorica*, *T. tasmanica* (both known from Australia) and *T. novae-zealandiae* (known from Sri Lanka and New Zealand) which are all distinguished by a different chemistry. *Topeliopsis azorica* morphologically can be distinguished by slightly smaller ascospores (up to up to 160 µm) with larger loci and the lack of ascoconidia. *Topeliopsis tasmanica* and *T. novae-zelandiae* are readily distinguished by smaller (in both taxa up to 100 µm long), non- to faintly amyloid ascospores in 1-spored asci.

SPECIMENS EXAMINED – Australia, Queensland, Darlington Range, *K. & A. Kalb 33980* (hb. Kalb).

Topeliopsis kantvilasii Mangold spec. nov. ined.

Type: Australia, Tasmania, Mt. Field NP., Lake Dobson, *Kantvilas & James 650/81* (BM-holotype, BM-isotype).

ETYMOLOGY – This species is dedicated to the Australian lichenologist Gintaras Kantvilas.

ILLUSTRATION – Fig. 191.

Thallus lignicolous, thin to very thin, up to 100 µm high, hypo- to more rarely episubstratic, pale whitish- to yellowish-gray. Surface dull to slightly glittering, smooth, continuous, unfissured. Thallus covered by an incontinuous protocortex up to c. 20 µm thick. Algal layer incontinuous and poorly developed, calcium oxalate crystals not seen. Vegetative propagules not seen. Ascomata conspicuous, moderately large, up to c. 800 µm in diam., roundish, perithecioid when young, becoming apothecioid with age, erumpent, solitary to slightly marginally fused, immersed to somewhat emergent, then irregularly flattened-urceolate. Disc

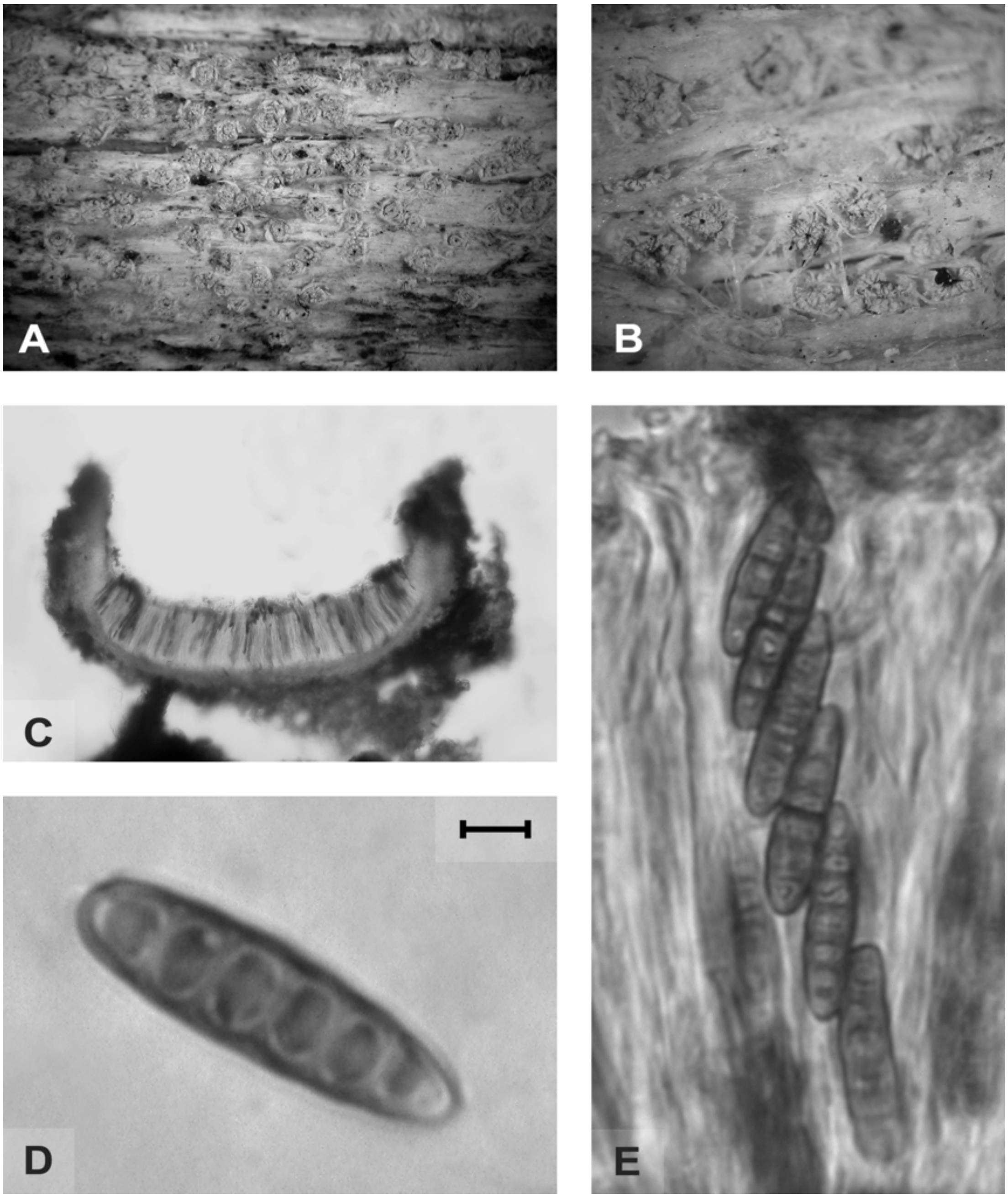

Fig. 191. *Topeliopsis kantvilasii*: growth habit (**A**), ascomata (**B**), ascoma section (**C**) and ascospores (**D, E**). A.-E.: BM-holotype. Bar= A: 1.75 mm; B: 0.8 mm; C: 100 µm; D: 3 µm; E: 7 µm.

usually not visible from surface, rarely becoming partly visible, dark-gray, pruinose. Pores predominantly tiny to small, rarely becoming moderately wide, up to c. 100(200) µm in diam., roundish to somewhat irregular, radiate split, pore margin area formed by apical proper exciple, pale yellowish to more rarely slightly grayish, incurved, proper exciple otherwise not visible from surface. Thalline rim thick, lacerate, often becoming eroded, sometimes slightly layered, concolorous with thallus to more often pale yellowish, ±exfoliating, incurved to erect internally, recurved in outer thalline rim layers. Proper exciple predominantly fused, tips becoming exposed due to erosion of thalline rim margin, (moderately) thick, hyaline to pale yellowish internally, yellowish to (pale) orange marginally, apically often brownish, slightly amyloid (reddish) in upper parts, more distinctly amyloid towards the base and subhymenium (purple). Hymenium up to c. 90 µm high, non- inspersed, moderately conglutinated, paraphyses unbranched, ±straight, parallel to slightly interwoven with unthickened to slightly thickened tips, lateral paraphyses present, often not clearly separated from hymenium, conspicuous, up to c. 25 µm long, columellar structures absent. Epihymenium indistinct to thin, hyaline, in older ascomata with ±coarse grayish-brown granules, sometimes covered/intermixed with released ascospores. Asci 8-spored, tholus thin to absent. Ascospores small, transversely septate, in older stages loci sometimes becoming indistinctly longitudinally divided, cell walls (moderately) thick, non-halonate, soon becoming brownish to grayish-brown, non-amyloid to weakly amyloid, oblong to fusiform to somewhat claviform, with rounded to narrowed-roundish to more rarely subacute ends, loci large, becoming small and indistinct in older ascospores, roundish to angular, subglobose to oblong to irregular, septae moderately thin to moderately thick, ±irregular, 12-22 x 4-6 µm with 4-8 (x2) loci. Pycnidia not seen.

CHEMISTRY – Thallus K+yellow, C-, PD+orange; containing stictic (major), constictic (minor), α-acetylhypoconstictic and cryptostictic (traces) acids.

ECOLOGY AND DISTRIBUTION – *Topeliopsis kantvilasii* grows on dead wood in cool-temperate subalpine rainforests and other forms of montane woodland in altitudes ranging from 1030 to 1230 m. It is only known from western-central Tasmania.

Fig. 192. Australian distribution of *T. kantvilasii.*

NOTES – This new species is readily distinguished from the currently known taxa in *Topeliopsis* by small, brown, transversely septate ascospores. It is further characterized by its yellowish, distinctly lacerate ascomata and the presence of the stictic acid chemosyndrome. A similar species is the tropical *Chapsa platycarpa*, which is distinguished by a corticate thallus and larger, *Geaster*-like ascomata (up to 2 mm in diam.) with distinctly free proper exciple. *Topeliopsis kantvilasii* is another atypical *Topeliopsis* species, resembling the taxa *T. darlingtonii* (with layered thalline rim and apically free proper exciple) or *T. tasmanica* (with non-amyloid ascospores), and is included in the genus only tentatively.

SPECIMENS EXAMINED – Australia, Tasmania: Lake Dobson, Mt. Field NP., *Elix 40010* (CANB). Walls of Jerusalem NP.: Lake Tyre, *Kantvilas 124/87* (HO); 0.5 km NW of The Temple, *Kantvilas 120/87* (HO).

Topeliopsis laceratula (Müll. Arg.) Mangold comb. nov. ined.

Bas.: *Thelotrema laceratulum* Müll. Arg., Flora 70: 399 (1887). Type: Australia, Trinity Bay (Cairns area), *Sayer* s.n. (G!-lectotype, here selected).

ILLUSTRATION – Fig. 193.

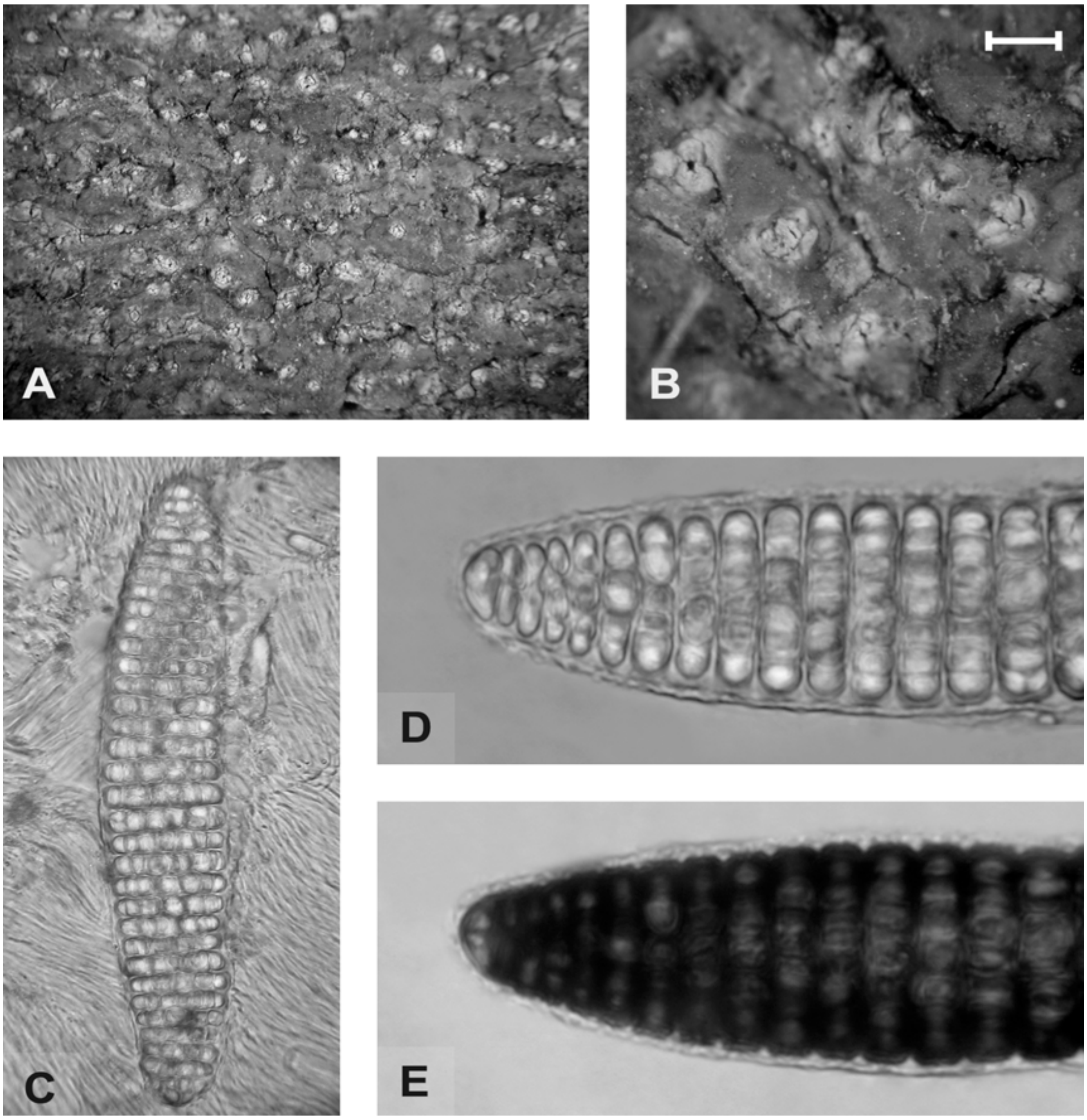

Fig. 193. *Topeliopsis laceratula*: growth habit (**A**), ascomata (**B**), ascospore (**C**), ascospore detail (**D**) and same ascospore detail showing amyloid reaction (**E**). A., B.: G-lectotype; C.-E.: *Lumbsch & Mangold 19132 k*. Bar= A: 2 mm; B: 0.8 mm; C: 17.5 µm; D, E: 10 µm.

Thallus epi- to hypophloedal, (moderately) thin, up to c. 200 µm high, dark to pale olive. Surface ceraceous, smooth, continuous to rugose, ±fissured. True cortex present, thick, up to 50 µm thick, yellowish, continuous, consisting of predominantly irregular hyphae, sometimes with substrate inclusions. Algal layer well developed, continuous, calcium oxalate very abundant, small to large, often clustered, predominantly found in hypophloedal parts. Vegetative propagules not seen. Ascomata often conspicuous, moderately small to moderately large, up to c. 600(800) µm in diam., roundish to somewhat irregular, peri- to more rarely apothecioid, erumpent, solitary to sometimes fused, immersed to slightly emergent, then hemispherical. Disc not visible from surface. Pores tiny to (moderately) small, up to c. 200 µm in diam., roundish to roundish-irregular or irregular, entire to more often split, proper exciple not visible from surface. Thalline rim margin thick to very thick, roundish to irregular, lacerate to coarsely squamose and layered, whitish to off-white to brownish due to protuberant substrate, incurved, outer thalline rim concolorous with thallus, often erect to slightly recurved. Proper exciple fused, moderately thin to moderately thick, hyaline to pale yellowish internally, brownish to grayish marginally, non-amyloid. Hymenium up to

c. 200 µm high, non-inspersed, weakly conglutinated, paraphyses parallel, unbranched, tips unthickened to slightly thickened, lateral paraphyses present, inconspicuous, short, up to c. 15(25) µm long, not clearly separated from proper exciple, columellar structures absent. Epihymenium indistinct, hyaline, without granules or crystals. Asci 1(-2)-spored, tholus moderately thick, thin when mature. Ascospores (moderately) large, eumuriform, cell walls (moderately) thick, endospore moderately thin to moderately thick, covered by a thin, sometimes irregular halo, hyaline, loci strongly to opaque amyloid, cell walls and endospore non-amyloid, fusiform to bifusiform, with narrowed-roundish to more rarely subacute ends, loci usually large, roundish to slightly angular, subglobular to irregular, transverse septae (moderately) thin, distinct, regular, 70-160(170) x 20-35 µm with 20-30 x 1-8 loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Topeliopsis laceratula* was collected in Australia on tree bark in tropical rainforests in altitudes ranging from 60 to 1000 m. It is a common species occurring in northern to north-central Queensland. Besides Australia it is recorded from India (Patwardhan & Kulkarni, 1977) and Sri Lanka (newly reported here), having a paleotropical distribution.

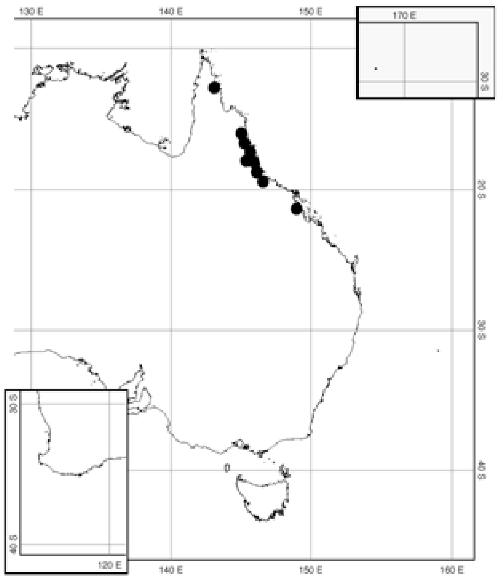

Fig. 194. Australian distribution of *T. laceratula*.

NOTES – This taxon is characterized by the usually dark thallus with a waxy surface due to a thick true cortex that forms a distinct contrast to the bright, ±immersed ascomata with lacerate margins and small pores. Further it has large, eumuriform, hyaline ascospores with thick cell walls. The endospore remains hyaline in iodine, whereas the loci show a strong amyloid reaction in iodine. A similar species is *T. azorica*, it can be readily distinguished by a bright thallus that usually lacks a distinct, well developed cortex. Two similar *Thelotrema* species are *T. rugatulum* and *T. adjectum*, for differences see under these species. *Topeliopsis laceratula* as well as *T. pseudoexanthismocarpa* (with transversely septate ascospores) are two tropical, corticolous members of *Topeliopsis* that have a ±thick and distinctly corticate thallus. However, both taxa agree well with the genus in all crucial characters.

SPECIMENS EXAMINED – Australia, Queensland: Iron Range NP., 2 km from western boundary on track to Portland Rds., *Hale 832409* (US). Near Cedar Bay NP., rd. to Cooktown, *Mangold 34 g* (F). Thornton Range, CREB rd. (to Cooktown), about 5 km in from Daintree River crossing, NW of Mossman, *Hale 832230* (US). Daintree NP., Mossman Gorge Section, near Rex Creek Swing Bridge, *Mangold 35 zr* (F). Near Lake Placid, S of Kuranda, *K. & A. Kalb 21299* (hb. Kalb). Crystal Cascades, 5 km W of Cairns, *Lumbsch & Mangold 19120 c, i* (F). Atherton Tablelands: Lake Eacham NP., track around lake, *Hale 831734* (US); Malanda Falls, *Lumbsch & Mangold 19132 k* (F); Zillie Falls, Falls Rd. NE of Millaa Millaa, *Hale 831614, 831710* (US); Millaa Millaa falls, *Lumbsch & Mangold 19139 s* (F). About 5 km NW of Babinda at the bridge crossing of the Russell River, *Hale 831104* (US). Babinda Boulders, NW of Babinda: *Hale 831676* (US), *Mangold 39 h, j, n, p, z* (F). Francis Range, Woopen Creek Rd., 25 km in from Bruce Hwy., NW of Innisfail, *Hale 832070, 832216, 832403* (US). 4.5 km E of Cardstone on Tully River Rd. to Kareeya Power Station, W of Tully, *Hale 830736, 831972* (US). Mt. Spec NP., Ridge on the Loop, on the Paluma Rd., WNW of Townsville, *Hale 830705* (US). Eungella NP., Rosser Rd. entry point off Darymple rd., near Peases Lookout, *Hale 831395, 832528* (US). Sri Lanka, Sabaragamuwa, Adams Peak, N of Gilimale, *Hale 46391* (US).

Topeliopsis muscigena (Stiz.) Kalb

Mycotaxon 79: 322 (2001). Bas.: *Thelotrema muscigenum* Stiz., Jahresber. St. Gall. nat. wiss. Ges. 1888/89: 247 (1890). Type: South Africa, Cape Province, Aug. 1887, *McOwan* s.n. (Z-holotype; H-Nyl.-22438-, PRE-isotypes).

Topeliopsis muscicola Kantv. & Vezda, Lichenologist 32: 348 (2000). Type: Australia, Tasmania, Quamby Bluff, *Kantvilas 202/85* (HO!-holotype, hb. Vezda-isotype).

Thelotrema indicum Hale, Mycotaxon 3: 177 (1975). Type: India, Tamil Nadu, *Hale & Patwardhan 40185* (US!-holotype, BSI-isotype).

ILLUSTRATION – Fig. 195.

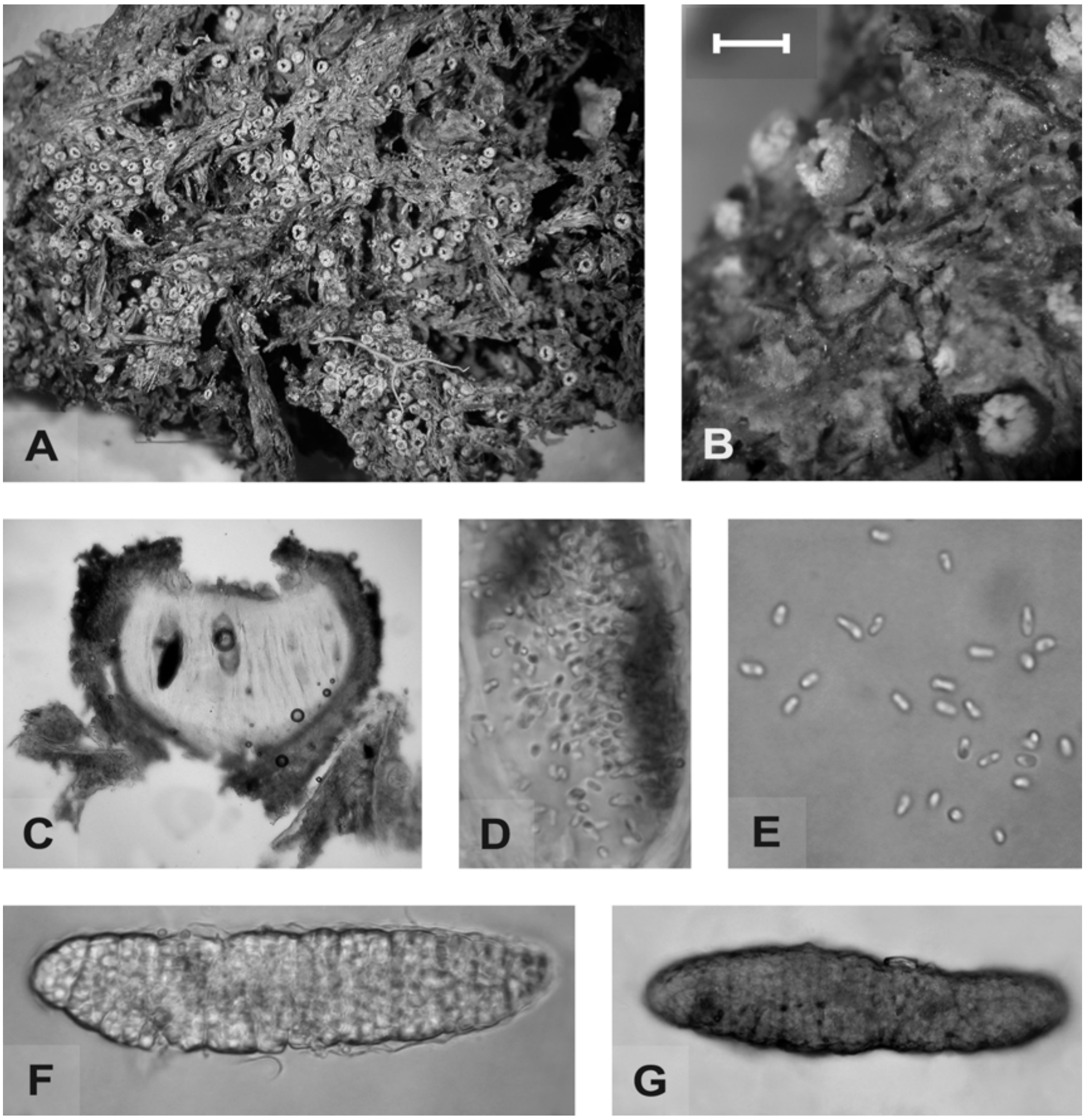

Fig. 195. *Topeliopsis muscigena*: growth habit (**A**), ascomata (**B**), ascoma section (**C**), ascoconidia producing ascospore (**D**), conidia (**E**) and ascospores (**F, G**). A., C., D.: HO-holotype of *T. muscicola*; B.: *Streimann 42836*; E.: *Tibell 11447*; F., G.: *Mangold 5 d*. Bar= A: 3 mm; B: 0.7 mm; C: 125 µm; D: 10 µm; E: 5 µm; F: 25 µm; G: 35 µm.

Thallus predominantly muscicolous, rarely lignicolous, corticolous or saxicolous (fide Kantvilas & Vezda, 2000), thin to more rarely moderately thin, up to c. 150 µm high, epi- to hyposubstratic, pale yellowish gray to grayish green or (pale)olive. Surface dull to slightly shiny, smooth, continuous to somewhat verruculose, unfissured. Thallus cover variable, often true cortex present, continuous to incontinuous, up to c. 20 µm thick, consisting of periclinal hyphae, sometimes cortex structures absent or with incontinuous protocortex up to c. 10 µm thick. Algal layer variable, poorly to well developed, incontinuous to continuous, calcium oxalate crystals not seen. Vegetative propagules not seen. Ascomata conspicuous, moderately small to moderately large, up to c. 700 µm in diam., roundish, perithecioid when young, becoming apothecioid with age, sessile, solitary to marginally slightly fused, distinctly emergent, subglobular in younger stages, becoming urceolate with age. Disc not visible from surface to sometimes becoming partly visible, flesh-colored in younger ascomata, pale to dark brownish-gray in older ascomata, epruinose. Pores small to moderately wide, rarely gaping, up to c. 500 µm in diam., irregular to star-shaped, pore margin split, proper exciple not visible from surface. Thalline rim margin coarsely cracked to slightly lacerate, thalline rim apically coarsely squamose to somewhat pruinose, whitish to off-white, incurved, base smooth, ±cylindrical, conspicuously reddish-brown. Proper exciple fused, thick, hyaline to pale yellowish internally, pale yellowish-brown marginally, apically sometimes dark-brown, internal exciple and subhymenium usually slightly to distinctly amyloid. Hymenium up to c. 250(300) µm high, non-inspersed, moderately conglutinated, paraphyses straight, distinctly parallel, unbranched, with unthickened to slightly thickened tips, lateral paraphyses present, inconspicuous, not clearly separated from proper exciple, up to c. 30 µm long, columellar structures absent. Epihymenium indistinct and hyaline in younger stages, becoming (moderately) thick in older ascomata, brownish, without granules, rarely with some sparse, very small crystals. Asci 1- to rarely 2-spored, tholus moderately thick, becoming thin or not visible at maturity. Ascospores (very) large, densely eumuriform, cell walls in younger stages somewhat thickened, (moderately) thin at maturity, endospore thin, with (moderately) thin halo, hyaline in younger stages, becoming yellowish to pale brown at late maturity, mature ascospores distinctly to strongly or opaque amyloid, cylindrical to roundish-fusiform with roundish to slightly narrowed-roundish ends, loci ±small, predominantly roundish to slightly angular, subglobose to irregular-subglobose, transverse septae thin, distinct and ±regular in younger stages, becoming irregular and vanish with age, finally ascospores dissolving internally, generating ascoconidia (see below), 100-210 x 20-55 µm with multiple loci. Pycnidia not seen, old ascospores generating ascoconidia, oblong-irregular up to c. 4 x 1 µm.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – This species was collected in Australia on epiphytic bryophytes, more rarely on wood or tree bark and on rocks (fide Kantvilas & Vezda, 2000) in various habitats ranging from cool-temperate rainforests to wet sclerophyll forests to several forms of (sub)alpine to coastal heath- or moorlands and shrubs in altitudes ranging from 40 to 1080 m. It is a moderately common species occurring in southern Victoria and Tasmania. It was also recorded from Africa, India and New Zealand (ibid.).

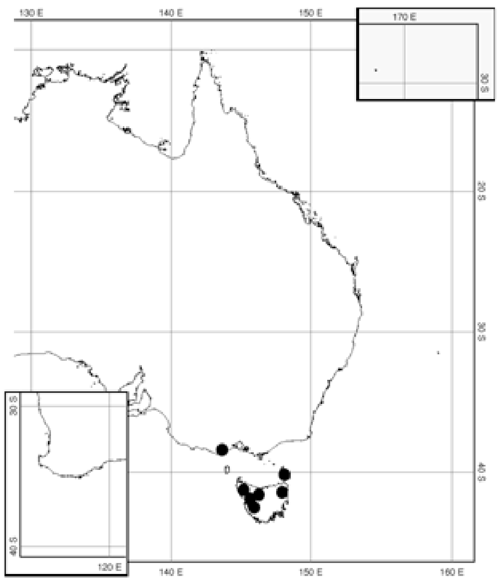

Fig. 196. Australian distribution of *T. muscigena*.

NOTES – *Topeliopsis muscigena* is characterized by a typical *Topeliopsis* habitus with ascomata with smooth, cylindrical, reddish-brown base, single- to rarely double-spored asci with large, eumuriform, thin-walled, hyaline to brownish, amyloid ascospores that generate ascoconidia and the absence of secondary compounds. In thelotrematoid lichens, ascoconidia are thus far only known in *Topeliopsis*, another species with ascoconidia is *T. elixii*, for differences see under that species. Two other similar members of *Topeliopsis* with large, muriform, but always hyaline ascospores are known in Australia: *T. tasmanica*, which is readily distinguished by smaller (up to 100 µm), non-amyloid ascospores and the stictic acid chemosydrome and *T. azorica* (see under that species for differences). Also similar is *Thelotrema tuberculiferum* known from the Lesser Antilles and India. It differs by larger, perithecioid ascomata with thick, eroded-pruinose than split or squamose thalline rims with abundant calcium oxalate crystal inclusions and hyaline ascospores. As far as it could be judged from the examination of the poor type material in TUR-Vain., *T. tuberculiferum* is very close to *Topeliopsis*, however, no taxonomical consequences are proposed here until more specimens can be studied.

SPECIMENS EXAMINED – Australia, Victoria: Ottway Ranges, Skene Creek-Colac rd., 13 km ENE of Apollo Bay, *Streimann 42836* (B, CANB); 14 km N of Apollo Bay, *Mangold 5 d, i* (F). Tasmania: Ben Lomond NP., 32 km E of Evandale, *Tibell 11447* (UPS). New Zealand, South Island, Canterbury, *Walker* s.n. (Vezda, Lich. Rar. Exs. 459) (GZU). India, Tamil Nadu, *Hale 50616* (US).

Topeliopsis pseudoexanthismocarpa (Mont. & Bosch) Mangold comb. nov. ined.

Bas.: *Ocellularia pseudoexanthismocarpa* Patw. & C. Kulk., Norw. J. Bot. 24: 130 (1977). *Thelotrema pseudoexanthismocarpum* (Patw. & C. Kulk.) Hale, Mycotaxon 11: 132 (1980). Type: India, Kerala, Anamalai Hills, *Nagarkar & Gole 76308* (AMH-holotype, US!-isotype).

ILLUSTRATION – Fig. 197.

Thallus predominantly epiphloedal to slightly hypophloedal, (moderately) thick, up to c. 500 µm high, pale yellowish- to greenish-brown to pale olive. Surface waxy, smooth, continuous to verrucose, unfissured to somewhat rimose. True cortex present, up to c. 50 µm thick, yellowish, consisting of predominantly periclinal to more rarely irregular hyphae. Algal layer continuous but poorly developed, calcium oxalate crystals very abundant, of variable size, scattered or in clusters. Vegetative propagules not seen. Ascomata conspicuous, variable throughout development, (moderately) large, up to c. 0.8 mm in diam., roundish to somewhat irregular, peri- to apothecioid, erumpent, solitary to marginally fused, immersed to distinctly emergent, then subglobose to urceolate. Disc not visible from surface. Pores tiny to small to more rarely moderately wide, up to c. 200(400) µm in diam., roundish to slightly irregular, pore margin entire to slightly split, incurved, proper exciple not visible from surface, inner thalline rim layer (see below) might be confused with proper exciple. Thalline rim divided in two sections, inner parts coarsely cracked and relatively thin at first, becoming thick, distinctly lacerate, slightly layered, ±exfoliating, off-white or brighter then thallus, outer parts resembling the 'true' thalline rim formed by main thallus, only distinct in younger ascomata, in older ascomata becoming eroded and/or fused with inner thalline rim parts, coarsely cracked, erect to recurved, concolorous with thallus. Proper exciple fused to rarely apically somewhat exposed, thick to very thick, hyaline to pale yellowish internally, yellowish-brown to reddish-brown marginally, non-amyloid. Hymenium up to c. 200 µm high, non-inspersed, weakly conglutinated, paraphyses unbranched, slightly bent, parallel to slightly interwoven with unthickened to slightly thickened tips, lateral paraphyses present, not clearly separated from exciple, conspicuous, up to c. 20 µm long, columellar structures absent. Epihymenium indistinct, hyaline, without granules. Asci 4- to 8-spored, tholus thick, thin when mature. Ascospores (very) large, transversely septate, cell walls thick to very thick, usually with a ±distinct crenate to slightly irregular surface, with thin halo predominantly in younger stages,

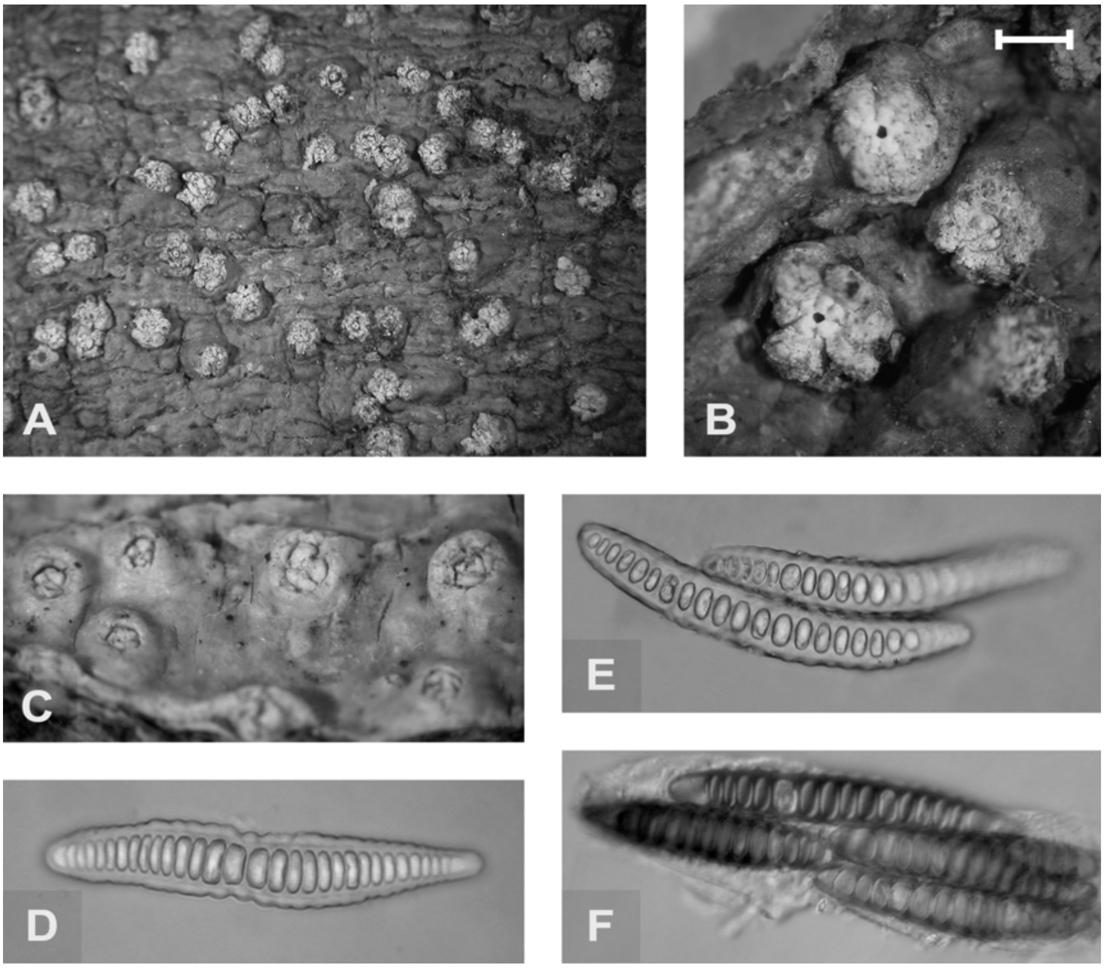

Fig. 197. *Topeliopsis pseudoexanthismocarpa*: growth habit (**A**), ascomata (**B, C**), ascospores (**D, E**) and ascospores showing amyloid reaction (**F**). A., B., D., E.: *Hale 831148*; C.: *Hale 831536*; F.: US-isotype. Bar= A: 1.25 mm; B: 0.5 mm; C: 0.6 mm; D, E: 20 µm; F: 23 µm.

hyaline, strongly amyloid, ±bent, bacillar-fusiform, with narrowed-rounded to subacute ends, loci angular in younger stages, becoming roundish, subglobose to more often lentiform or oblong with hemispherical to conical end cells, septae moderately thin, regular to slightly irregular, 100-200 x 10-20 µm with 12-30 loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Topeliopsis pseudoexanthismocarpa* grows on tree bark in tropical rainforests. This rare species is restricted to northern Queensland. This is a new record for Australia. Previously it was known from India and Sri Lanka (Hale, 1981), hence being a paleotropical element.

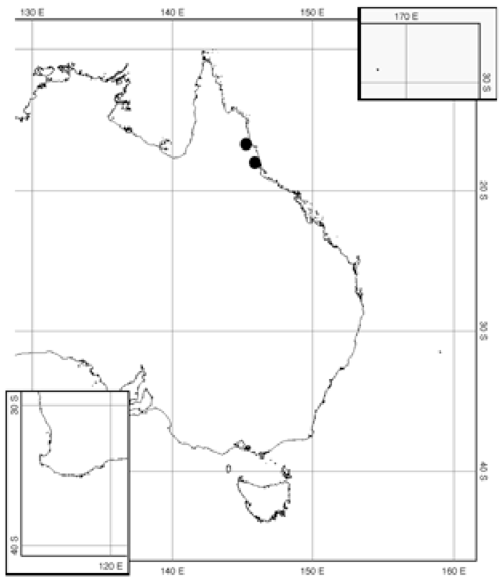

Fig. 198. Australian distribution of *T. pseudoexanthismocarpa*.

NOTES – This taxon is characterized by a thick, dark, waxy, distinctly corticate thallus, ascomata with bright, lacerate and two-parted margins, large, transversely septate, hyaline, thick-walled, amyloid ascospores and the absence of secondary products. *Thelotrema kamatii*, known from India and Sri Lanka, is probably a synonym, but the type material was not available for study. The two examined collections from Sri Lanka, identified and published under *T. kamatii* (*Hale 50098, 50166*; in Hale, 1981), belong to *T. pseudoexanthismocarpa*. A similar Australian species is *T. acutispora*, a temperate species that differs in a thin, ecorticate to indistinctly corticate thallus, sessile ascomata, and smaller ascospores (up to 130 µm long).

Topeliopsis pseudoexanthismocarpa is morphologically somewhat deviant from most members of *Topeliopsis*, but similar to species as *T. darlingtonii* or *T. laceratula* (see also under this species).

SPECIMENS EXAMINED – Australia, Queensland: Thornton Range, 5 km in from Daintree River crossing, NW of Mossman, *Hale 831536* (US). About 5 km NW of Babinda at the bridge crossing of the Russell River, *Hale 831148* (US). Sri Lanka, Kalutara district, *Hale 50098, 50166* (US).

Topeliopsis subdenticulata (Zahlbr.) Frisch & Kalb

Lichenologist 38: 44 (2006a). Bas.: *Ocellularia subdenticulata* Zahlbr., in Skottsberg (ed.), The Natural History of Juan Fernandez and the Easter Island 2, Botany: 329 (1924). *Thelotrema subdenticulatum* (Zahlbr.) Salisb., Lichenologist 5: 267 (1972). Type: Chile, Juan Fernandez Islands, Masafuera, *C. & I. Skottsberg* s.n. (W-holotype).

Topeliopsis vezdae Kalb, Mycotaxon 79: 323 (2001). Type: Australia, Queensland, Styx River SF., *Kalb & Williams 19199* (CANB!-holotype).

ILLUSTRATION – Fig. 199.

Thallus predominantly muscicolous, often overgrowing adjacent debris and bark or exclusively corticolous, very thin to thin, c. up to 60(100) µm high, mainly episubstratic, in corticolous specimen partly endophloedal, pale gray to grayish-green, appearing darker when growing on dark substrate. Surface dull to shiny, smooth, continuous to verruculose, unfissured. Thallus predominantly covered by an incontinuous protocortex up to c. 30 µm thick, sometimes becoming distinctly conglutinated, forming a true cortex of irregular hyphae. Algal layer variable, mostly incontinuous and poorly developed, in corticolous specimen sometimes continuous and well developed, calcium oxalate crystals usually abundant and of variable size, scattered or in clusters. Vegetative propagules not seen. Ascomata conspicuous, (moderately) large, up to c. 1.2 mm in diam., roundish, peri- to apothecioid, sessile, predominantly solitary, in corticolous specimen moderately emergent and hemispherical, otherwise distinctly emergent and subglobose to urceolate. Disc not visible from surface to rarely becoming partly visible, pale flesh-colored, epruinose. Pores small to moderately wide, rarely gaping, up to c. 400(600) µm in diam., usually ragged and irregular to star-shaped, pore margin distinctly split, incurved, proper exciple not visible from surface, in strongly eroded ascomata apical proper exciple becoming visible, roundish to somewhat irregular, ±entire, incurved, pale brownish to reddish-brown. Thalline rim margin thin to moderately thick, with same color and structure as rest of thalline rim, thalline rim lacerate, coarsely pruinose to squamulose, often eroded, somewhat exfoliating with age and becoming slightly layered, conspicuously off-white to whitish. Proper exciple predominantly fused, in eroded ascomata tips sometimes apically exposed, thick, hyaline to pale yellowish internally, (pale)orange to reddish-brown marginally, usually distinctly amyloid towards the base and subhymenium. Hymenium up to c. 150 µm high, non-inspersed, moderately conglutinated, paraphyses unbranched, ±straight, parallel to slightly interwoven with unthickened to slightly thickened tips, lateral paraphyses present, not clearly separated from exciple, conspicuous, up to c. 40 µm long, columellar structures absent. Epihymenium indistinct, hyaline, without granules or crystals. Asci 8-spored, tholus moderately thick, thin when mature. Ascospores (moderately) large, transversely septate, cell walls thick to very thick, often slightly crenate, in younger ascospores distinctly halonate, hyaline, strongly amyloid, ±bent, bacillar-fusiform to fusiform, with narrowed-rounded to subacute ends, loci angular in younger stages, becoming roundish, subglobose to lentiform with hemispherical to conical end cells, septae moderately thin, regular, 50-100(110) x 10-17 µm with 15-24(25) loci. Pycnidia not seen.

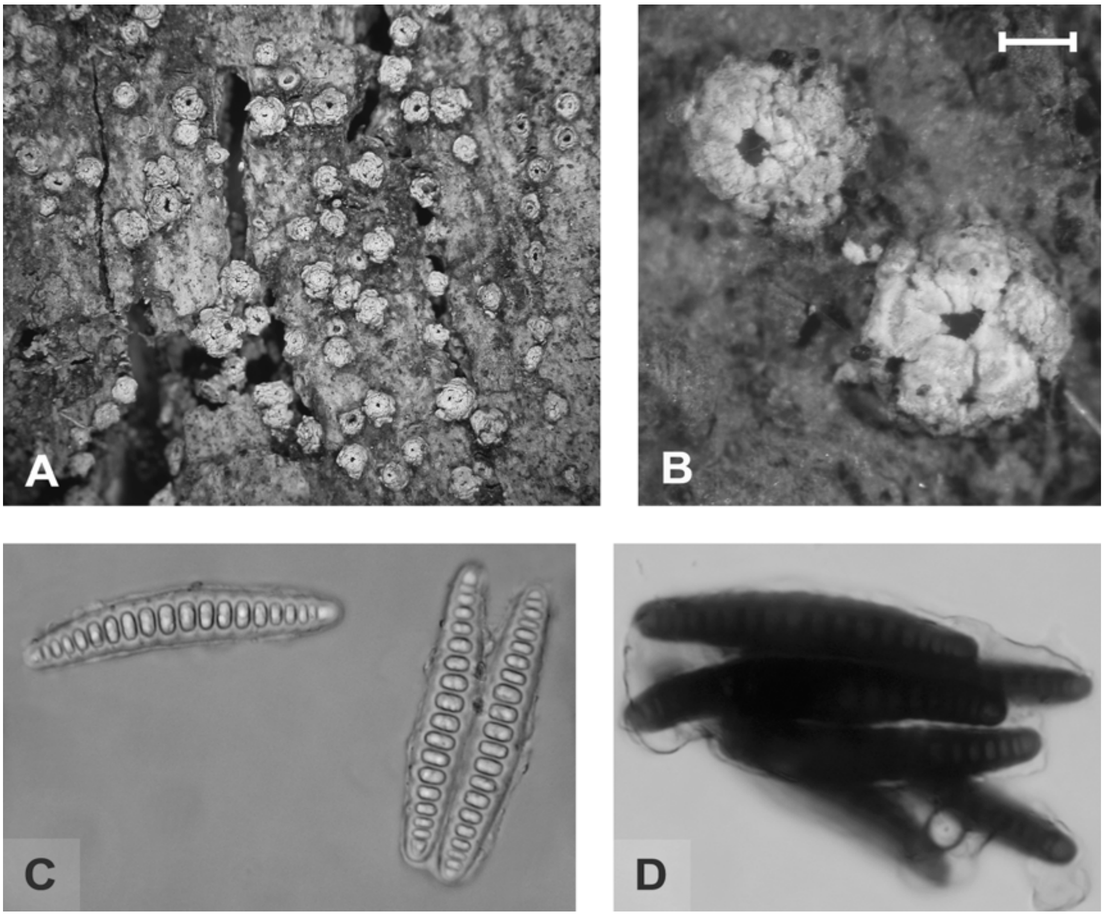

Fig. 199. *Topeliopsis subdenticulata*: growth habit (**A**), ascomata (**B**), ascospores (**C**) and ascospores showing amyloid reaction (**D**). A.: *Elix & Streimann 19875*; B.: *Wilson* s.n. (NSW-603831); C., D.: *Lumbsch 10974 f*. Bar= A: 2 mm; B: 0.4 mm; C, D: 20 µm.

CHEMISTRY – Thallus K-, C-, PD-; no secondary compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Topeliopsis subdenticulata* was collected in Australia predominantly on epiphytic mosses, more rarely on tree bark or dead wood in highland warm temperate rainforests, cool temperate rainforests or wet sclerophyll forests in altitudes ranging from 20 to 1150 m. It is a common and wide-spread temperate species occurring from northern New South Wales to southern Victoria and in Tasmania. Besides Australia it was reported from Chile and New Zealand (Salisbury, 1972) being a subantarctic element.

NOTES – This taxon is characterized by a typical *Topeliopsis*-like habitus, (moderately) large, transversely septate, thick-walled, hyaline, amyloid ascospores and the absence of secondary compounds. Kantvilas & James (1991) gave ascospore sizes up to 120 µm with 16-26 septa for *T. subdenticulata*, probably due to the circumstance that some of the Tasmanian collections examined where in fact *T. acutispora*, a very similar species that virtually differs only by larger ascospores. For a detailed description of differences see under that species. Another similar species is *T. darlingtonii*, which is readily distinguished by smaller ascospores (up to 60 µm long, with up to 16 loci) and the presence of the stictic acid chemosyndrome. The South American *T. patagonica* was considered conspecific with *T. subdenticulata* (Frisch & Kalb, 2005 as '*O. patagonica* Imshaug in ed.'), is here regarded as distinct based on larger ascospores (up to 150 µm long) and the presence of the stictic acid chemosyndrome. .

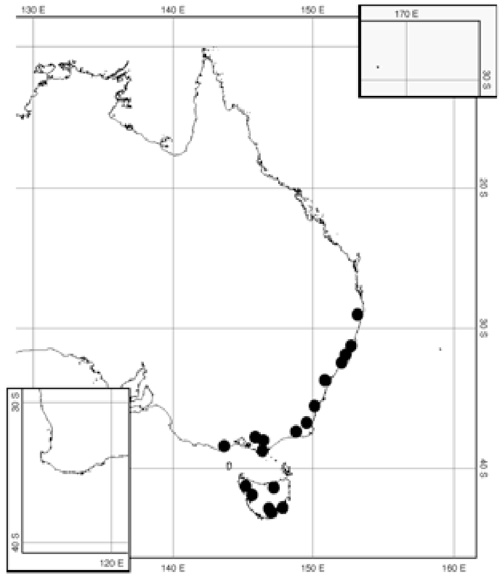

Fig. 200. Australian distribution of *T. subdenticulata*.

SPECIMENS EXAMINED – Australia, New South Wales: Mt. Warning NP., track from summit to parking lot, *Mangold 19 zd* (F). C. 1 km W of Mt. Banda Banda, *Kantvilas 488/88* (NSW). Burraga Swamp, Allyn River Forest Park, *Kantvilas 219/88* (NSW). Gloucester Tops, *Kantvilas 394/88* (NSW). Mt. Wilson - Mt. Irvine Rd., 25 km NNE of Katoomba, *Streimann 31597* (CANB). Monga NP., 27 km SE of Braidwood, *Mangold 11 e* (F). Rutherford Creek, 17 km SE of Nimmitabel, *Elix & Kalb 40850* (CANB). Victoria: East Gippsland: Result Creek, 13 km SW of Bendoc, *Elix & Streimann 19875* (CANB); Errinundra River West Branch, 20 km S of Bendoc, *Elix & Streimann 21966* (CANB); Errinundra NP., *Elix 24057 a* (B), *Elix 24058* (B, CANB), *24061*(CANB), *Elix & Streimann 19875* (CANB); Bonang rd., NE of Orbost, *Mangold 8 g* (F); Boggy Creek Gorge, near Nowa Nowa, *Filson 16707* (MEL). Eastern Highlands, Baw Baw region, 30. Apr.1999, *Ford* s.n. (MEL-2075898). Tarra Valley, *Ewers 6018* (CANB). Wilsons Promontory NP., on Sealers Cove hiking track, *Mangold 6 p* (F). Cement Creek Scenic Reserve, 6 km N of Warburton, *Lumbsch 10974 f* (F). Bellel Creek (near Maryville), 05. Oct.1983, *Kantvilas* s.n. (HO-113984). Black Spur, Jan. 1890, *Wilson* s.n. (S-L328). Ottway NP.: 14 km N of Apollo Bay, *Mangold 5 c, g* (F); 10 km W of Apollo Bay, *Mangold 2 c, e* (F). Tasmania: Near Nelson Bay River, *Kantvilas 629/84* (BM). Mt. Arthur, *Wilson* s.n. (NSW-603831). 6 km S of Warratah Hwy. jct. with the Murchison Hwy., *Hale 68729* (US). Anthony Rd., *Kantvilas 36/89, 196/91* (HO). Algonkian Mtn., *Kantvilas 134/90* (HO). Gordon Rd., c. 2 km N of Frodshams Pass, *Kantvilas 102/97* (HO). W of Tahune Bridge, Warra SST., 19. May 1999, *Kantvilas* s.n. (HO-503376). Buckland Military Training Area, S of Bluestone Tier, *Kantvilas 324/03* (HO). Ben Ridge Rd., *Kantvilas 1116/81* (BM). Bun Hill, Forestier Peninsula, *Kantvilas 339/89* (HO).

Topeliopsis tasmanica (Kantv. & Vezda) Mangold comb. et stat. nov. ined.

Bas.: *Chroodiscus australis* ssp. *tasmanicus* Kantv. & Vezda, Lichenologist 32: 334 (2000). *Chroodiscus macrocarpus* ssp. *tasmanicus* (Kantv. & Vezda) Galloway, Australas. Lichenol. 49: 17 (2001). Type: Australia, Tasmania, Mt. Geikie, *Kantvilas 196/98* (HO!-holotype).

ILLUSTRATION – Fig. 201.

Thallus muscicolous to humicolous, very thin to entirely hyposubstratic, up to c. 80(100) µm high (in ascomata area), colorless to pale gray. Surface dull, pruinose, continuous, unfissured. Cortex structures absent in main thallus, basal parts of ascomata covered by incontinuous protocortex up to 20 µm thick. Algal layer incontinuous and poorly developed in main thallus, algal cells scattered in thin layer of somewhat gelatinous hyphae or within the substrate, continuous and well developed in basal parts of ascomata, calcium oxalate crystals not seen. Vegetative propagules not seen. Ascomata conspicuous, (moderately) large, up to

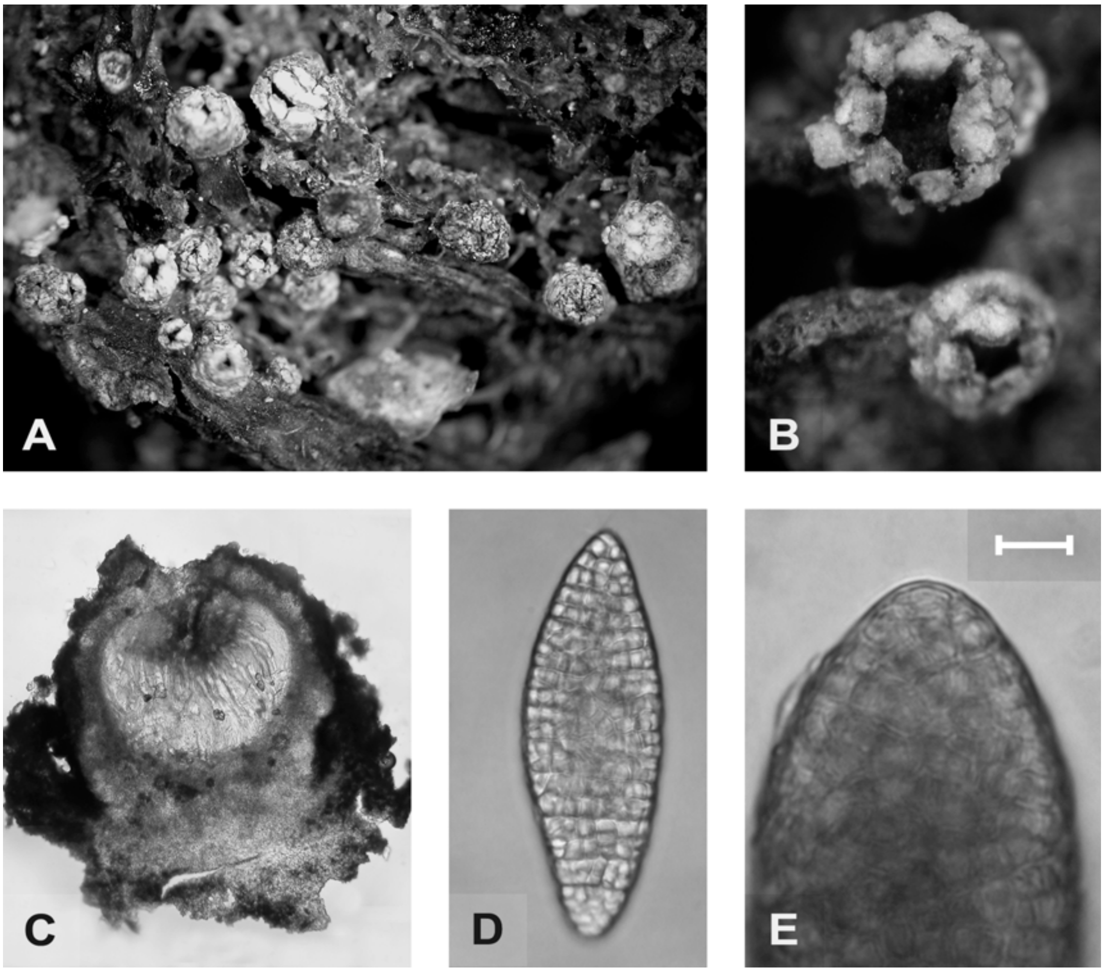

Fig. 201. *Topeliopsis tasmanica*: growth habit (**A**), ascomata (**B**), ascoma section (**C**), ascospore (**D**) and ascospore detail showing iodine accumulation (**E**). A.-E.: HO-holotype. Bar= A: 1 mm; B: 0.4 mm; C: 130 µm; D: 17 µm; E: 6 µm.

c. 1.2 mm in diam., roundish, perithecioid when young, becoming apothecioid, sessile, solitary to sometimes marginally fused, distinctly emergent, subglobose first, becoming (depressed-)urceolate. Disc partly visible from surface in older ascomata, orange-brown becoming dark grayish-brown with age, epruinose. Pores becoming wide with age, up to c. 500 µm in diam., irregular to more often star-shaped to somewhat roundish, at first opening as ±regularly radiating cracks, in older ascomata with deeply split and lobed pore margin, proper exciple not visible from surface. Thalline rim coarsely lacerate, distinctly lobed, often slightly layered, rarely somewhat eroded, formed of off-white to pale-brownish, slightly pruinose, coarse thallus bits, incurved to slightly erect with age. Proper exciple typical, fused, very thick, hyaline internally, pale yellowish to pale greenish-yellow marginally, weakly amyloid, pinkish, particularly towards the base and the subhymenium, subhymenium conspicuous, very thick, with same color as proper exciple. Hymenium up to c. 220 µm high, non-inspersed, strongly conglutinated, paraphyses straight, unbranched, parallel to slightly interwoven, tips unthickened to slightly thickened, lateral paraphyses present, not clearly separated from exciple, conspicuous, up to c. 40 µm long, columellar structures absent. Epihymenium moderately thick, orange-brown to brownish in older stages, without granules. Asci 2- to 4-spored, tholus thick, moderately thin when mature. Ascospores moderately large, densely eumuriform, cell walls and endospore thin, in younger stages with thin halo, hyaline, non-amyloid, ellipsoid to fusiform, with roundish to narrowed-roundish to more rarely subacute ends, loci roundish to angular, irregular, transverse septae thin, indistinct and irregular in younger stages, vanishing with full maturity, 50-100 x 20-35 µm with multiple loci. Pycnidia not seen.

CHEMISTRY – Not tested, fide Kantvilas & Vezda (2000) containing stictic (major), constictic, cryptostictic (minors), 'norstictic' [=hypostictic?] and 'menegazziaic' [=α-acetyl-hypoconstictic?] (traces) acids.

ECOLOGY AND DISTRIBUTION – *Topeliopsis tasmanica* was collected in Australia on bryophytes, peaty soil and plant debris over several kinds of rock of alpine reaches in alpine heathlands in altitudes ranging from 800 to 1080 m. It is a rare species occurring in south-western Tasmania and is currently only known from there.

Fig. 202. Australian distribution of *T. tasmanica*.

NOTES – This taxon is characterized by an evanescent to inconspicuous thallus, open, mainly subglobose to urceolate ascomata with ±visible, epruinose, ±brownish discs, regular star-shaped pores in younger stages that develop into lobed, incurved to somewhat erect margin in older ascomata. Further a thalline rim of coarse, bright, slightly pruinose thallus bits, a conspicuously thick proper exciple that reacts pink in iodine, moderately large, hyaline, non-amyloid, thin-walled, eumuriform ascospores in 2-4-spored asci and the presence of the stictic acid chemosyndrome. *Topeliopsis macrocarpa* known from Argentina and New Zealand is a similar species, it was treated as a subspecies of *T. tasmanica* by Kantvilas & Vezda (2000) and Galloway (2001). In the original description of *T. tasmanica* (Kantvilas & Vezda, 2000) the number of spores per ascus and the ascospore sizes are noted as the only relevant differences to '*C. australis* ssp. *australis*' (=*T. macrocarpa*). In contrast, I regard it as a distinct species based on differences in ascospore morphology, number of spores per ascus and additional morphological differences.*T. macrocarpa* has constantly single-spored asci with amyloid spores up to 150 µm long. Additionally the ascomata in *T. macrocarpa* differ by opening in irregular cracks, the thalline rim is more distinctly layered and consists of larger, more distinctly pruinose thallus pieces and the disc is never clearly exposed.

SPECIMENS EXAMINED – See type collection.

2. 9. 13. Species of uncertain taxonomic placement: ***Leptotrema schizoloma*-group**

NOTES – This species-group was first mentioned by Kantvilas & Vezda (2000) as “?Thelotremataceae species A” where it was listed as a single, highly variable taxon comparative to the newly introduced/revised genera with chroodiscoid, exfoliating apothecia (*Chroodiscus, Pseudoramonia, Topeliopsis*) from Tasmania. The study of the mentioned Tasmanian specimen and additional collections from the Australian mainland revealed, that the “species A” consists of two distinct taxa that where known and described as *Leptotrema schizoloma* and *Thelotrema guadeloupense* (see also under these species). Additionally, I found three closely affiliated new species from Australia (*T. parvizebrinum, T. subzebrinum, T. zebrinum*) and a Neotropical species (*T. refertum*), differing in transversely septate and submuriform ascospores respectively, and a similar Neotropical species (*T. cryptotrema*) containing the psoromic acid chemosyndrome and with muriform ascospores up to 80 µm long, which is otherwise close to *L. schizoloma*.

The group is characterized by erumpent, regenerating, peri- to apothecioid ascomata with a ±distinctly layered margin, an apically free proper exciple that is marginally dark-brown to ±distinctly carbonized and a usually concolorous subhymenium, distinct lateral paraphyses and a strongly conglutinated hymenium, distinctly straight and parallel paraphyses with predominantly not thickened tips. The asci and ascospores are heterogeneous. Several species have thickened ascus walls and lack a distinct tholus (otherwise a tholus is present), the ascospores are either hyaline or rarely slightly pigmented, non-amyloid or rarely distinctly amyloid, thin- or thick-walled. It is a conspicuously variable group with regards to the occurring secondary compounds, and a comparably high number of intraspecific chemotypes are found. Similar genera include *Melanotopelia*, *Thelotrem*a and *Topeliopsis*, the two latter are readily distinguished by a more pallid, never distinctly carbonized exciple, *Melanotopelia* differs by sessile, never distinctly fissured or layered ascomata.

I refrain from introducing a new genus for this group since further studies are needed to evaluate its systematic position. Preliminary molecular data could be gained for a single taxon, *T. zebrinum* (see part 3), which indicates a prominent, but poorly supported position in the molecular tree within the thelotremataceaen Graphidaceae.

Species descriptions:

"Thelotrema" guadeloupensis Hale

Phytologia 26: 416 (1973). Type: Guadeloupe, Parc National de Guadeloupe, *Hale 31633* (US! -holotype).

ILLUSTRATION – Fig. 203.

Thallus variable, thin to very thin, epi- to hypophloedal or partly entirely hypophloedal, up to c. 150 µm high, rarely pale yellowish-gray to more often pale grayish-green to (pale) olive. Surface dull to shiny, smooth, continuous to verrucose, often distinctly fissured. Thallus cover variable, usually covered by a continuous to incontinuous protocortex up to c. 20 µm thick, sometimes becoming distinctly conglutinated, forming a true cortex of irregular to periclinal hyphae. Algal layer continuous and well developed, calcium oxalate crystals sparse, small to large, predominantly clustered. Vegetative propagules not seen. Ascomata variable, usually inconspicuous, moderately large, up to c. 800 µm in diam., roundish, perithecioid to apothecioid at maturity, erumpent, solitary to more fused, regenerating, predominantly ±emergent, (irregular-)hemispherical to (irregular-)urceolate. Disc usually not visible from surface, rarely becoming partly visible, pale grayish, epruinose. Pores small to moderately wide to rarely wide, up to c. 300(400) µm in diam., roundish to irregularly angular, formed by apical margin of proper exciple, pore margin/visible part of proper exciple ±split, fused to indistinctly free, off-white to pale brownish, incurved. Thalline rim (moderately) thick, becoming distinctly layered with proceeding succession of ascomata generations, coarsely split to lacerate, more rarely somewhat eroded, (dark) brownish to blackish, ±distinctly contrasted by off-white layers, outer thalline rim concolorous with thallus, in distinctly layered thalline rims exfoliating, incurved to erect in inner layer(s), to erect to slightly recurved in outer layer(s), in un-layered thalline rims predominantly incurved. Proper exciple

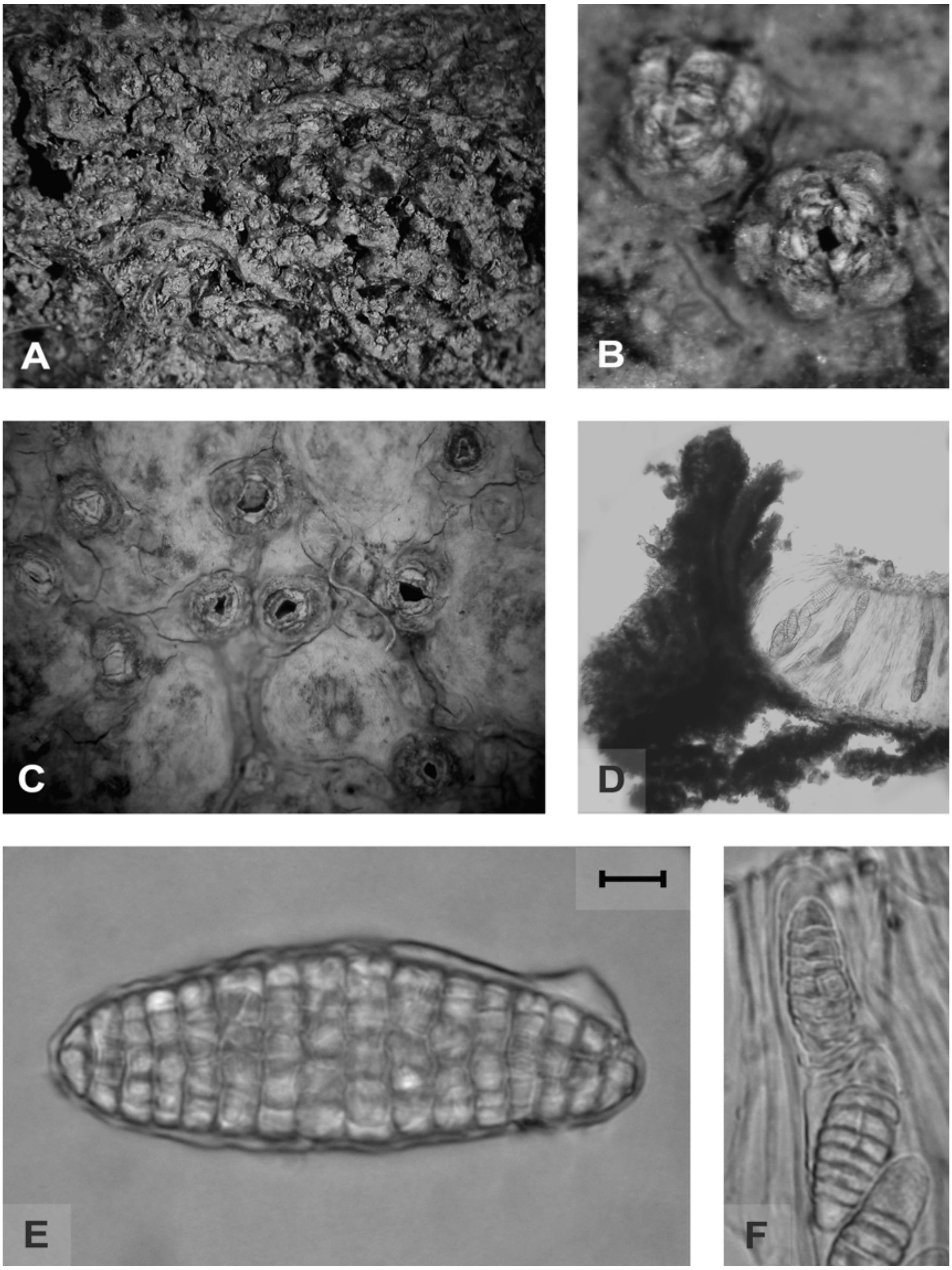

Fig. 203. *Thelotrema guadeloupensis*: growth habit (**A, C**), ascomata (**B**), ascoma section (**D**) and ascospores (**E, F**). A., E.: US-holotype; B.: *Kantvilas 572/92*; C.: *Kantvilas 552/88*; D.: *Wedin 3273*; F.: *A. & K. Kalb 20461*. Bar= A: 1.25 mm; B: 0.35 mm; C: 0.75 mm; D: 200 µm; E: 6.5 µm; F: 15 µm.

predominantly apically free, moderately thick, hyaline internally to (dark-)brown to carbonized marginally, usually with substrate inclusions, distinctly amyloid at the base. Hymenium up to c. 200 µm high, non-inspersed, strongly conglutinated, paraphyses straight to slightly bent, ±distinctly parallel, unbranched, tips unthickened, lateral paraphyses present, conspicuous, up to c. 30 µm long, true columella absent, columella-like structures sometimes present in newly developing ascomata generations (=raised subhymenial layer) or in fused ascomata, upper subhymenial layer dark-brown to carbonized, sometimes followed by a hyaline layer of newly developing hymenium. Epihymenium indistinct, hyaline, without granules or crystals. Asci 4 to 8-spored, tholus and lateral ascus walls (moderately) thick, thin when mature. Ascospores moderately small to moderately large, eumuriform, cell walls and endospore thin, non-halonate, hyaline, non-amyloid, predominantly ellipsoid to fusiform with narrowed-roundish to sub-acute ends, loci roundish to angular, predominantly roundish-cuboid to cuboid or irregular, transverse septae thin, distinct, regular, (20)30-60(70) x 10-25 µm with 8-20 x 1-8 loci. Pycnidia not seen.

CHEMISTRY – Strain I: Thallus K+yellow, C-, PD+orange; containing stictic (major), constictic (major to minor), and α-acetylhypoconstictic (trace) acids. Strain II: Thallus K-, C-, PD-; containing the 'cinchonarum unknown' compound (major), [dark-gray spot after charring, Rf 2/7/3 (solv. syst. A/B'/C)].

ECOLOGY AND DISTRIBUTION – *Thelotrema guadeloupensis* was collected in Australia on tree bark in warm- to cool-temperate, rarely sub-tropical highland rainforests in altitudes ranging from 500 to 1000 m. It is rare but wide-spread occurring in northern to southern New South Wales and in (south-)western Tasmania. This is the first report of the species from Australia. It was previously recorded from Tasmania as "spec. A" (Kantvilas & Vezda, 2000). So far it was only known from Guadeloupe.

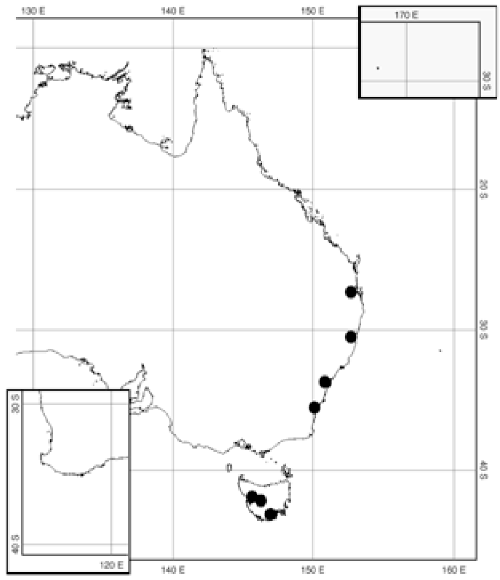

Fig. 204. Australian distribution of *T. guadeloupensis*.

NOTES – This taxon is readily distinguished by the regenerating, distinctly layered and carbonized ascomata (at least in older stages), medium-sized, muriform, thin-walled, hyaline, non-amyloid ascospores and the presence of either the stictic acid chemosyndrome or 'cinchonarum unknown'. It was treated and published under the provisional name 'Spec. A' (Kantvilas & Vezda, 2000), which also included *L. schizoloma*, a similar species that differs in larger ascospores (up to 130 µm long) in 1-4-spored asci. The only other known similar species is *T. zebrinum* that differs in having transversely septate ascospores.

SPECIMENS EXAMINED – Strain I: Australia: New South Wales: Dorrigo NP., Sassafras Creek Track, *Mangold 25 l* (F). Blue Mountains NP.: Mt.Wilson, *K. & A. Kalb 20461* (hb. Kalb); Near Blackheath, *Hale 58595* (US). Monga NP.: 18 km SE of Braidwood, *Wedin 3273* (UPS); 27 km SE of Braidwood, *Mangold 11 c, h, i, m, n, p, q, r* (F). Tasmania: Mt.Murchison, Anthony Rd., *Kantvilas 572/92* (HOB). Mt.Dundas Track, *Kantvilas 552/88* (B, HOB). Lake St.Clair NP., Cradle Mnt., Pelion Plains, *Kantvilas 217/92* (HOB).

Strain II: Australia, Tasmania: Mt.Murchison, Anthony Rd., *Kantvilas 239/93* (HOB). Walls of Jerusalem NP., Little Fisher River, *Kantvilas & James 463/84* (HOB). Mueller Rd., 3 km W of Styx Rd., *Kantvilas 646/84* (HOB).

"Thelotrema" parvizebrinum Mangold spec. nov. ined.

Type: Australia, Queensland, Mt. Chalmynia logging area, c. 15 km from Bruce Hwy, W of Innisfail, *Hale 832635* (US-holotype).

ETYMOLOGY – The epithet refers to the similar species *T. zebrinum* and the smaller ascomata and ascospores (from lat. *parvus* =small).

ILLUSTRATION – Fig. 205.

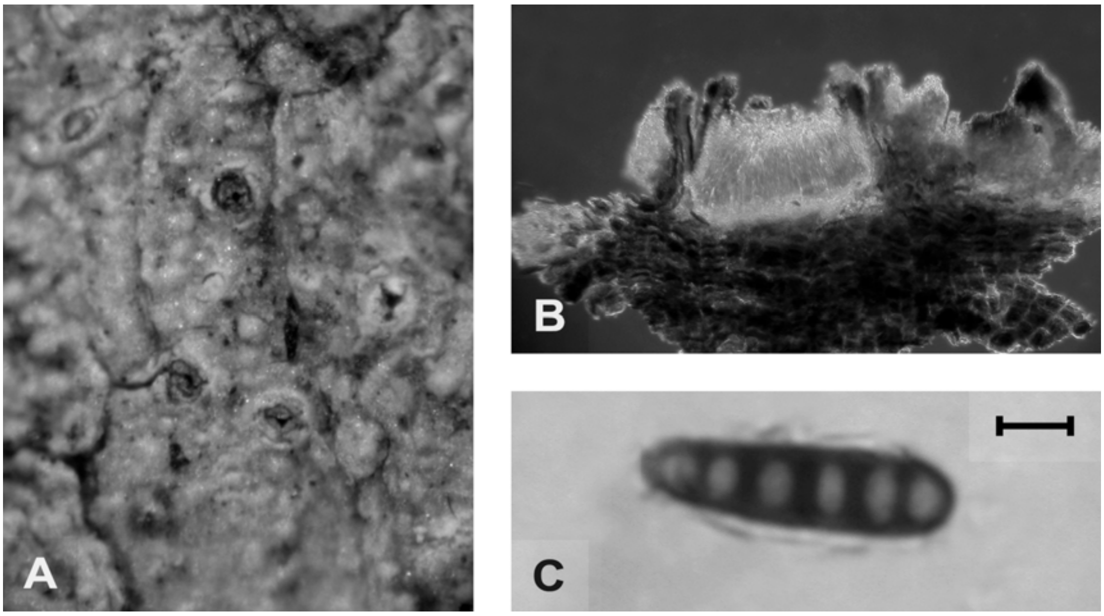

Fig. 205. *Thelotrema parvizebrinum*: growth habit (**A**), ascoma section (**B**) and ascospore showing amyloid reaction (**C**). A.-C.: US-holotype. Bar= A: 0.2 mm; B: 75 µm; C: 5 µm.

Thallus thin to moderately thick, epi- to hypophloedal, up to c. 200 µm high, rarely pale yellowish-gray to more often grayish-green to pale olive. Surface dull, smooth to slightly roughened, distinctly to strongly verruculose, fissured. Thallus covered by an incontinuous to more rarely continuous protocortex up to c. 20 µm thick. Algal layer continuous to somewhat incontinuous, well to moderately well developed, calcium oxalate crystals variable, sometimes sparse, usually frequent, in clusters, often also embedded in substrate tissue. Vegetative propagules not seen. Ascomata inconspicuous, small, up to c. 200 µm in diam., roundish, becoming apothecioid, erumpent, solitary, immersed to rarely slightly emergent, then depressed-hemispherical. Disc usually not visible from surface, very rarely becoming partly visible, whitish, epruinose. Pores tiny to small, up to c. 60(100) µm in diam., predominantly irregular, formed by apical margin of proper exciple, pore margin/visible part of proper exciple ±split, fused to indistinctly free, off-white to pale brownish, incurved. Thalline rim moderately thick to moderately thin, becoming slightly layered in older stages, split to slightly lacerate, sometimes eroded, (dark) brownish, sometimes indistinctly contrasted by off-white to pale brownish layers, outer thalline rim concolorous with thallus, incurved to erect. Proper exciple becoming apically to almost entirely free, moderately thick, hyaline to pale yellowish internally, grayish to (dark) brown or slightly carbonized marginally, sometimes with substrate inclusions, often amyloid in lower parts. Hymenium up to c. 100 µm high, non-inspersed, strongly conglutinated, paraphyses straight, parallel to slightly interwoven, unbranched, with unthickened to slightly thickened tips, lateral paraphyses present, usually very inconspicuous, up to c. 15 µm long, columellar structures absent. Epihymenium indistinct to thin, hyaline, rarely with fine grayish to colorless granules. Asci 8-spored, tholus (moderately) thick, thin or not visible at maturity. Ascospores small, transversely septate, cell walls (moderately) thick, in younger stages with thin halo, hyaline, distinctly to strongly amyloid, oblong to fusiform or somewhat claviform, with roundish to subacute ends, loci roundish, subglobose to slightly lentiform, septae moderately thin to thick, regular, 12-20 x 4-6 µm with 4-7(8) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no compounds detectable by TLC.

ECOLOGY AND DISTRIBUTION – *Thelotrema parvizebrinum* was collected in Australia on tree bark in tropical rainforests in altitudes ranging from 100 to 1200 m. It is rare and currently only known from northern Queensland.

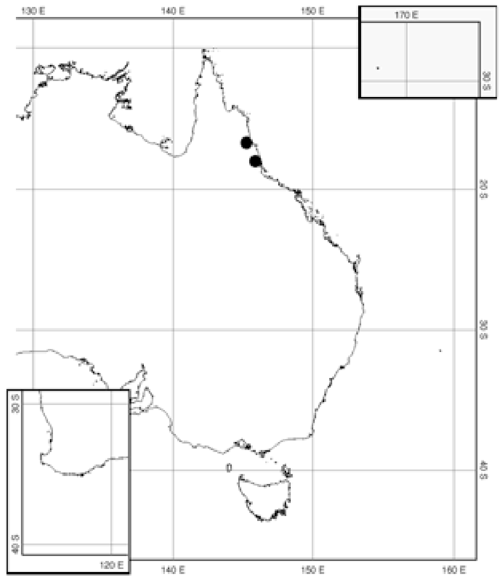

Fig. 206. Australian distribution of *T. parvizebrinum*.

NOTES – The new species is characterized by a verruculose thallus, small, usually immersed ascomata with often slightly layered, brownish to slightly carbonized proper exciple, small, transversely septate, hyaline, amyloid ascospores with thickened cell walls and the absence of secondary compounds. It can be distinguished from *T. zebrinum* by the smaller ascomata with less distinctly layered margins, the smaller ascospores (up to 80 µm long with up to 22 loci in *T. zebrinum*) and the absence of secondary compounds (stictic and/or protocetraric acid chemosyndrome in *T. zebrinum*). *Thelotrema defossum* is another similar species, which differs in having larger ascospores (usually up to 30 µm long with up to 11 loci) with less thickened cell walls, a distinct halo, more angular, flattened loci. *Thelotrema refertum* known from Panama and Brazil[15] is also similar to *T. parvizebrinum*, but differs by a continuous to rimose, corticate thallus and the hypoprotocetraric acid chemosydrome.

SPECIMENS EXAMINED – Australia, Queensland: Thornton Range, 5 km in from Daintree River crossing, NW of Mossman, *Hale 831714* (US). Mt. Windsor logging area, 9 km from rd. to old Forestry Camp and the main rd., NW of Mossman, *Hale 832424* (US). Mt. Lewis Rd. 4 km N of Kennedy Hwy., W of Mossman, *Hale 831235, 832549* (US).

"Leptotrema" schizoloma Müll.Arg.

Nuov. Giorn. Botan. Ital. 21: 49 (1889). Type: Argentina, Tierra del Fuego ['Fuegia'], Ushuaia, Beagle Channel, 1885, *Spegazzini 101* (ex Herb. Jatta) (G!-lectotype, here selected).

Thelotrema hypomelaenum Müll. Arg., Bull. Herb. Boissier 3: 314 (1895). Type: Australia, New South Wales, *Knight 16* pr.p. (G!-lectotype, here selected).

ILLUSTRATION – Fig. 207.

Thallus variable, epi- to hypophloedal, very thin to moderately thick, up to c. 300 µm high, pale gray to pale yellowish-gray or pale grayish-green to yellowish-olive. Surface dull to slightly shiny, smooth to rough, continuous to strongly verrucose or verruculose, often distinctly fissured. Thallus predominantly covered by a ±continuous protocortex, up to

15 Unpublished collection in US, newly reported here: Brazil, Amazonas, Rio Uatuma, *Buck 2943* (US).

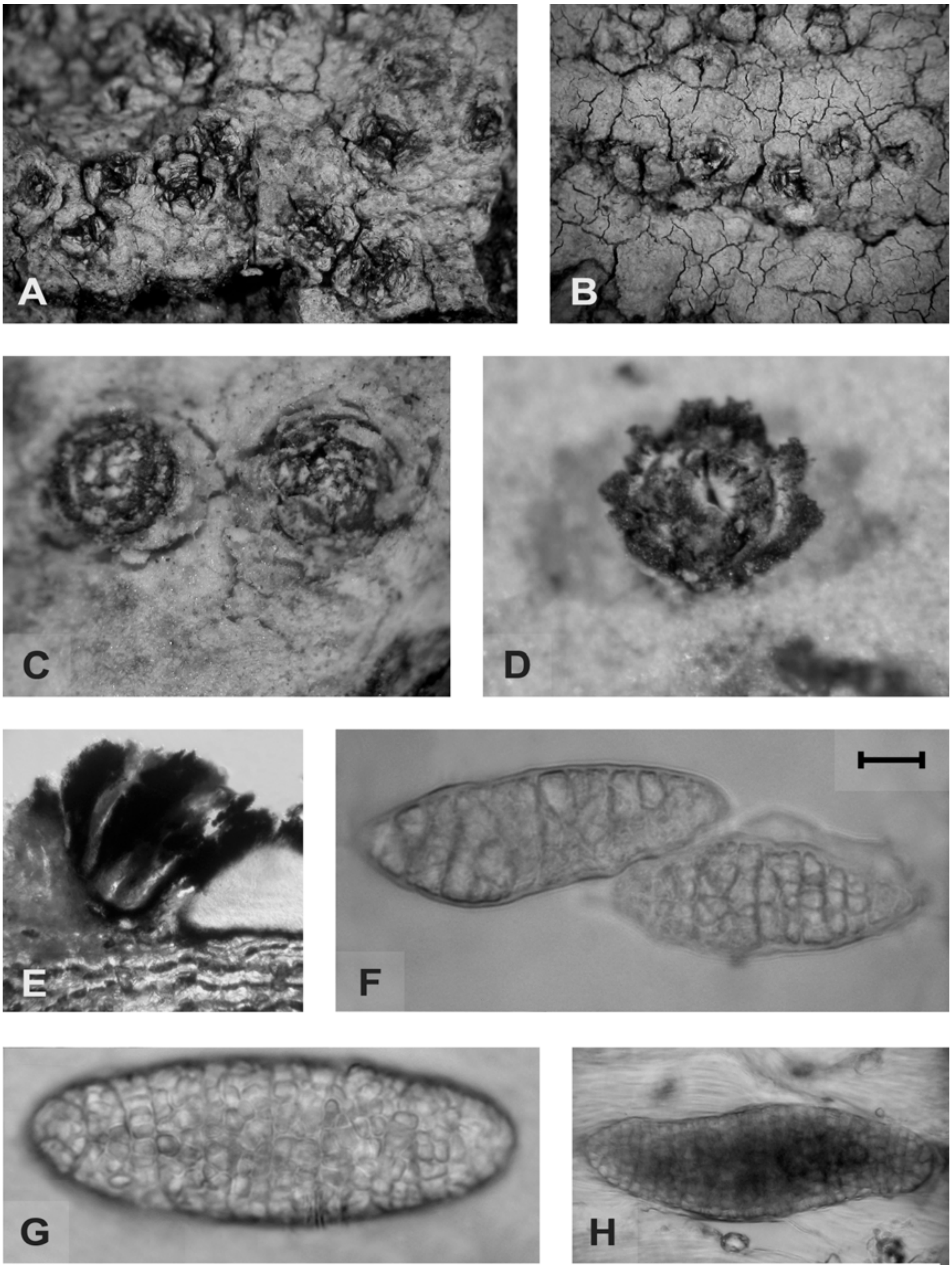

Fig. 207. *Leptotrema schizoloma*: growth habit (**A, B**), ascomata (**C, D**), ascoma margin (**E**), ascospores (**F, G**) and ascospore showing amyloid reaction (**H**). A., F., G.: *A. & K. Kalb 20560*; B.: *Hale 832271*; C.: *Spegazzini* s.n.; D.: *Lumbsch 8678 c*; E.: G-lectotype; H.: *Mangold 22 r*. Bar= A: 1 mm; B: 0.8 mm; C: 0.5 mm; D: 0.35 mm; E: 110 µm; F: 16 µm; G: 15 µm; H: 24 µm.

c. 20 µm thick, rarely becoming distinctly conglutinated forming a true cortex of periclinal hyphae. Algal layer continuous and usually well developed, calcium oxalate crystals abundant, small to large, solitary or in clusters. Vegetative propagules not seen, isidia-like structures sometimes present in strongly verruculose specimen. Ascomata variable, conspicuous, large, up to c. 1.2 mm in diam., roundish, perithecioid in younger stages, becoming indistinctly apothecioid with age, erumpent, regenerating, solitary to more rarely fused, predominantly ±emergent, (irregular-)hemispherical to (irregular-)depressed-urceolate. Disc not visible from surface to very rarely becoming partly visible, pale grayish to whitish, epruinose. Pores tiny to (moderately) small, up to c. 250 µm in diam., roundish to irregular, formed by apical margin of proper exciple, pore margin/visible part of proper exciple ±split, fused to indistinctly free, off-white to pale brownish, incurved. Thalline rim (moderately) thick, becoming distinctly layered with proceeding succession of ascomata generations, coarsely split to predominantly lacerate, more rarely somewhat eroded, (dark) brownish to blackish, ±distinctly contrasted by off-white layers, outer thalline rim concolorous with thallus, in distinctly layered thalline rims exfoliating, incurved to erect in inner layer(s), to erect to slightly recurved in outer layer(s), in un-layered thalline rims predominantly incurved. Proper exciple moderately thick, predominantly apically free, predominantly entirely (dark-)brown to usually distinctly carbonized, sometimes with substrate inclusions, distinctly amyloid at the base. Inner subhymenial layer dark-brown to carbonized, sometimes followed by a hyaline layer of newly developing hymenium. Hymenium up to c. 200 µm high, non-inspersed, strongly conglutinated, paraphyses straight to slightly bent, ±distinctly parallel, unbranched, tips unthickened, lateral paraphyses present, conspicuous, up to c. 30 µm long, true columella absent, columella-like structures sometimes present in newly developing ascomata generations (=raised subhymenial layer) or in fused ascomata. Epihymenium indistinct, hyaline, without granules or crystals. Asci 1-4(6)-spored, tholus and lateral ascus walls (moderately) thick, thin when mature. Ascospores (moderately) large, densely eumuriform, cell walls and endospore slightly thickened in younger stages, becoming thin at maturity, non-halonate, hyaline to yellowish or rarely pale brownish in late maturity or when deceased, non-amyloid to faintly amyloid in older ascospores, predominantly oblong to ellipsoid with roundish to narrowed-roundish ends, loci predominantly ±angular, predominantly irregular, becoming small with age, transverse septae thin, distinct in younger stages, becoming indistinct with age, predominantly ±irregular, (40)60-120(130) x 20-40 µm, with multiple loci. Pycnidia not seen.

CHEMISTRY – Strain I: Thallus K-, C-, PD-; no secondary compounds detectable by TLC. Strain II: Thallus K+ yellow becoming deep red, C-, PD+ orange; containing salazinic acid (major).

ECOLOGY AND DISTRIBUTION – *Leptotrema schizoloma* occurs on bark and wood in cool- to warm-temperate rainforests, more rarely in (sub)tropical highland rainforests, in altitudes ranging from 100 to 1500 m. It is a moderately common and wide-spread species occurring along the east coast from high altitudes in northern Queensland to New South Wales and also Tasmania. It is also known from Argentina and New Zealand (Lumbsch & al., 2008), being an subantarctic element that extends to the subtropics at high elevations.

Fig. 208. Australian distribution of *L. schizoloma*.

NOTES – This taxon is readily distinguished by the regenerating, distinctly layered and carbonized ascomata (at least in older stages), large, densely eumuriform, thin-walled, hyaline to slightly pigmented, non- to faintly amyloid ascospores and either the absence of secondary compounds (strain I) or the presence of salazinic acid (strain II). Similar is *T. guadeloupensis*, for differences see under that species.

SPECIMENS EXAMINED – Strain I: Australia: Queensland: Bellenden Ker NP., below the cable car line near the summit, *Stevens 22033* (GZU). Lamington NP., Main Border Track out of O'Reillys, *Hale 832271* (US). New South Wales: Border Ranges NP., NE of Wiangaree, *Hafellner 16592* (GZU). Mt. Warning NP., track from summit to parking lot, *Mangold 19 c, m, u, zg, zl, ze, zn* (F). Dorrigo NP.: Never Never Picnic Area and Rosewood Creek Track, *Mangold 24 c* (F); Sassafras Creek Track, *Mangold 25 o, s* (F). Nightcap Forest Drive: Gibbergunyah Roadside Reserve, Whian Whian SF., W of Mullumbimby, *Hale 831692* (US); 1 km W of Minyon Falls, N of Lismore, *Hale 832193* (US). Nightcap NP., Mt. Nardi/Mt. Matheson Track, *Mangold 22 r* (F). Barrington Tops, Stewarts Brook SF., *Lumbsch & Filson 8678 c* (CBG, F). Doyles River SF. on Oxley Hwy., 95 km SE Walcha, *Hale 58638, 58566* (US). Mill Creek, 50 km NW of Sydney, *K. & A. Kalb 34268, 34270* (hb. Kalb). Royal NP., Bola Creek, *K. & A. Kalb 20560, 21694* (hb. Kalb). Blue Mts., Below Bridal Veil Falls, nr. Blackheath, *Hale 58539, 58619, 58579, 58547* (US). Tasmania: Mt. Murchison, Anthony Rd., *Kantvilas 202/93* (HOB). Argentina, Isla de los Estados ['Staten Island '], Port Cook, 1888, *Spegazzini* s.n. (G).

Strain II: Australia, Tasmania: Walls of Jerusalem NP., un-named lake, 1.5 km W of Chalice Lake, *Kantvilas 95/99* (HOB). Hartz Mtns. NP., Lake Osborne Track, *Kantvilas & James 496/81* (HOB).

"Thelotrema" subzebrinum Mangold spec. nov. ined.

Type: Australia, New South Wales, Mt. Warning NP., track from summit to parking lot, *Mangold 19 e* (CANB-holotype; NSW-, F-isotypes).

ETYMOLOGY – The epithet refers to the similarities of the new species with *T. zebrinum*.

ILLUSTRATION – Fig. 209.

Thallus moderately thin to moderately thick, epi- to hypophloedal, up to c. 400 µm high, partly bulging and flaking away from the substrate, pale grayish-green. Surface dull, smooth, rugose to verrucose, unfissured. Thallus covered by an incontinuous, thin protocortex up to c. 15 µm thick. Algal layer well developed and continuous, calcium oxalate crystals abundant, predominantly large and scattered. Vegetative propagules not seen. Ascomata inconspicuous, moderately large, up to c. 600 µm in diam., roundish to irregular in fused ascomata, apo- to perithecioid, erumpent, regenerating, solitary to marginally fused, immersed. Disc sometimes becoming partly visible, whitish, epruinose. Pores small to moderately wide, up to c. 350 µm in diam., roundish to angular, formed by apical margin of proper exciple, pore margin/visible part of proper exciple split, off-white to dark-brown or blackish, incurved. Thalline rim moderately thick, becoming ±distinctly layered with proceeding succession of ascomata generations, split to lacerate, dark brownish to blackish, sometimes indistinctly contrasted by off-white to pale brownish layers, outer thalline rim concolorous with thallus, in distinctly layered ascomata thalline rim somewhat exfoliating, incurved in inner layer(s) to erect in outer layer(s), in un-layered ascomata thalline rim predominantly incurved. Exciple free in apical parts, (moderately) thick, yellowish-brown internally, distinctly carbonized marginally, non-amyloid. Hymenium up to c. 120 µm high, non-inspersed, strongly conglutinated, paraphyses straight, parallel, unbranched, with unthickened tips, lateral paraphyses present, short but usually conspicuous, up to c. 15 µm long, columellar structures absent, subhymenium ±distinctly carbonized. Epihymenium indistinct to thin, hyaline, sometimes with fine grayish granules. Asci 8-spored, tholus moderately thick, becoming moderately thin with maturity. Ascospores (moderately) small, transversely septate in younger stages to ±submuriform at maturity, cell walls (moderately) thin, endospore moderately thick, with thin halo, hyaline, non-amyloid, fusiform to claviform with roundish to subacute ends, loci roundish, oblong to lentiform, end cells hemispherical to conical, transverse septae thin, regular, 25-35 x 7-10 µm with 10-14 x 1-2(3) loci. Pycnidia not seen.

CHEMISTRY – Thallus K-, C-, PD-; no compounds detectable by TLC.

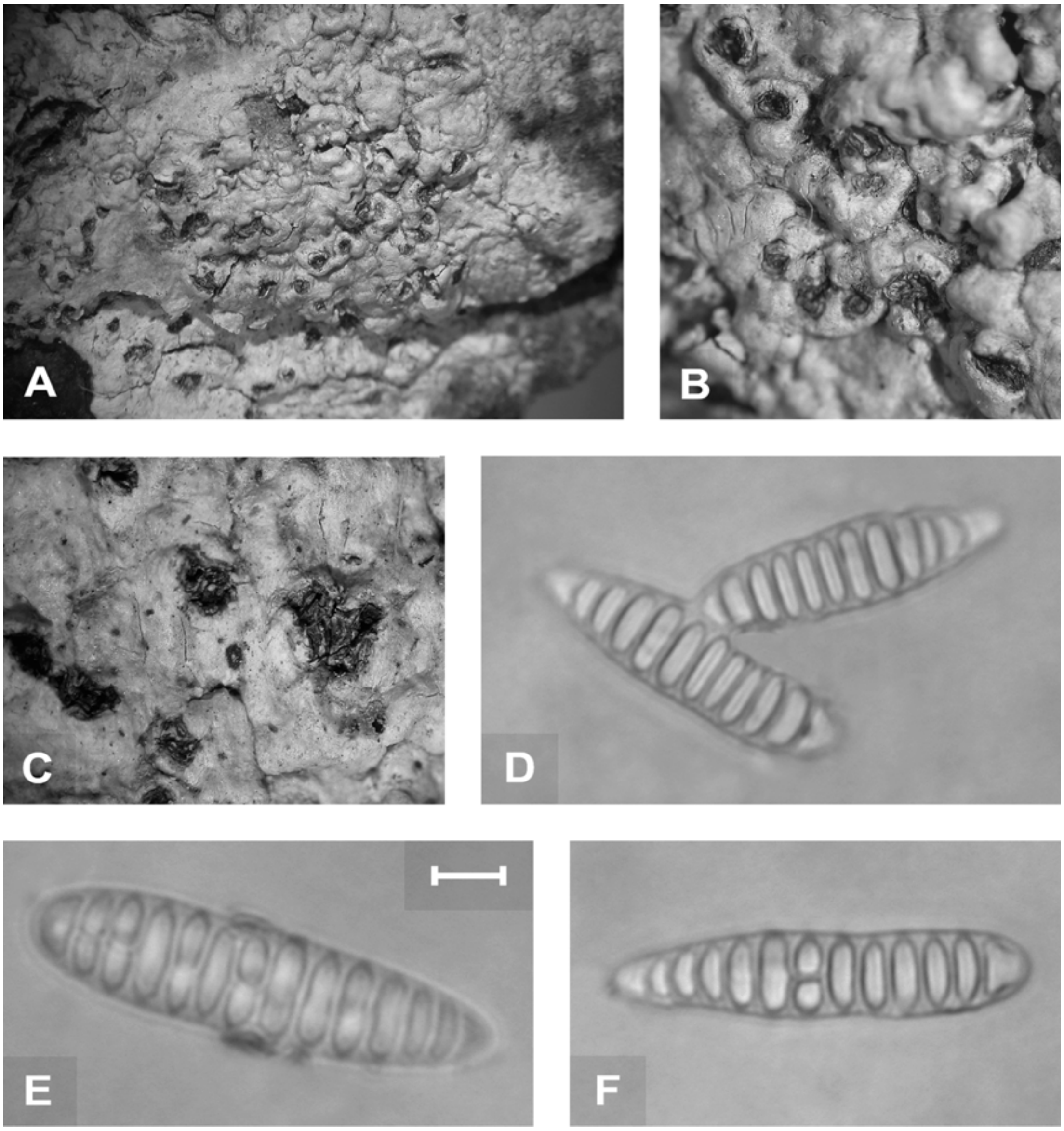

Fig. 209. *Thelotrema subzebrinum*: growth habit (**A**), ascomata (**B, C**) and ascospores (**D-F**). A.-F.: CANB-holotype. Bar= A: 1 mm; B, C: 0.5 mm; D: 7 µm; E: 5 µm; F: 6 µm.

ECOLOGY AND DISTRIBUTION – *Thelotrema subzebrinum* grows on bark in a warm-temperate rainforest at 850 m. It is rare and only known from northern New South Wales.

NOTES – The new species is characterized by a thick, ecorticate thallus, ascomata of the *L. schizoloma*-type, moderately small, transversely septate to submuriform, hyaline, non-amyloid ascospores and the absence of secondary compounds. It is similar to *T. zebrinum*, which differs by larger (up to 80 µm long with up to 22 loci), strictly transversely septate ascospores and the presence of the protocetraric and/or stictic acid chemosyndromes. *Thelotrema parvizebrinum* is readily distinguished by smaller ascospores (up to 20 µm long, with up to 8 loci).

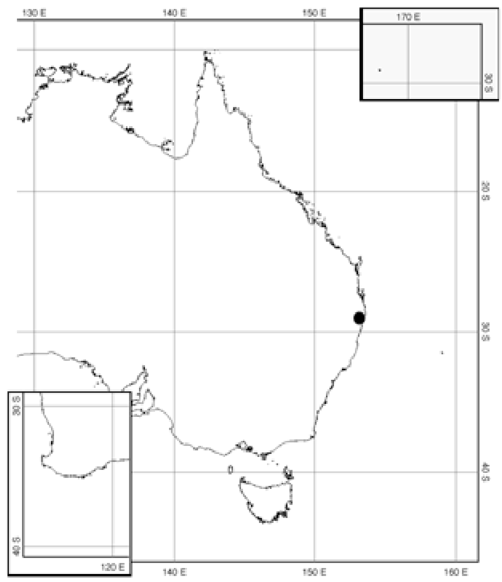

Fig. 210. Australian distribution of *T. subzebrinum*.

SPECIMENS EXAMINED – See type collection.

"Thelotrema" zebrinum Mangold spec. nov. ined.

Type: Australia, New South Wales, Mt. Warning NP., track from summit to parking lot, *Mangold 19 zo* (CANB-holotype; NSW-isotype).

ETYMOLOGY – The epithet refers to the layered ascomata margins (from lat. *zebrinus* =striped).

ILLUSTRATION – Fig. 211.

Thallus variable, thin to very thin to partly entirely hypophloedal, up to c. 100 µm high, rarely pale yellowish-gray or greenish-olive to more often pale gray to grayish-green. Surface dull to shiny, smooth to roughened, continuous to verruculose, sometimes fissured. Thallus predominantly covered by an incontinuous protocortex, up to c. 20 µm thick, rarely becoming distinctly conglutinated forming a true cortex of periclinal hyphae. Algal layer incontinuous and poorly developed, calcium oxalate crystals sparse, ±small, solitary or in clusters. Vegetative propagules not seen. Ascomata variable, usually conspicuous, (moderately) large, up to c. 0.9 mm in diam., roundish, peri- to indistinctly apothecioid in older stages, erumpent, solitary, regenerating, predominantly ±emergent, (irregular-)hemispherical to (irregular-)depressed-urceolate. Disc usually not visible from surface, rarely becoming partly visible, pale grayish to whitish, epruinose. Pores tiny to (moderately) small, up to c. 200 µm in diam., roundish to irregular, formed by apical margin of proper exciple, pore margin/visible part of proper exciple ±split, fused to indistinctly free, off-white to pale brownish, incurved. Thalline rim (moderately) thick, becoming distinctly layered with proceeding succession of ascomata generations, coarsely split to predominantly lacerate, sometimes eroded, (dark) brownish to blackish, ±distinctly contrasted by off-white layers, outer thalline rim concolorous with thallus, in distinctly layered thalline rims exfoliating, incurved to erect in inner layer(s), erect to slightly recurved in outer layer(s), in un-layered thalline rims predominantly incurved. Proper exciple moderately thick, predominantly apically free, rarely with a very thin, indistinct hyaline area internally to ±entirely (dark-)brown or usually distinctly carbonized, sometimes with substrate inclusions, distinctly amyloid at the base. Inner subhymenial layer dark-brown to carbonized, sometimes followed by a hyaline layer of newly developing hymenium. Hymenium up to c. 200 µm high, non-inspersed, strongly conglutinated, paraphyses straight to slightly bent, ±distinctly parallel, unbranched, tips unthickened, lateral paraphyses present, conspicuous, up to c. 30 µm long, true columella absent, columella-like structures sometimes present in newly developing ascomata generations (=raised subhymenial layer). Epihymenium indistinct, hyaline, without granules or crystals. Asci 6-8-spored, tholus and lateral ascus walls (moderately) thick, thin when mature. Ascospores predominantly moderately large, transversely septate, cell walls (moderately) thick, becoming distinctly crenate at maturity, with thin and somewhat irregular halo in younger stages, non-halonate at maturity, hyaline, non-amyloid, oblong to oblong-ellipsoid, often slightly bent, with rounded to narrowed-rounded ends, loci large, roundish to slightly angular (predominantly in younger ascospores), oblong to usually ±lentiform, end cells hemispherical to conical, septae (moderately) thin, predominantly regular, 30-80 x 6-11 µm with 12-22 loci. Pycnidia not seen.

CHEMISTRY – Thallus K+ yellowish to yellow, C-, PD+ reddish to orange; containing constictic, conprotocetraric, stictic, protocetraric, fumarprotocetraric (major to absent), hypoconstictic, hypostictic and virensic (minor to absent) acids.

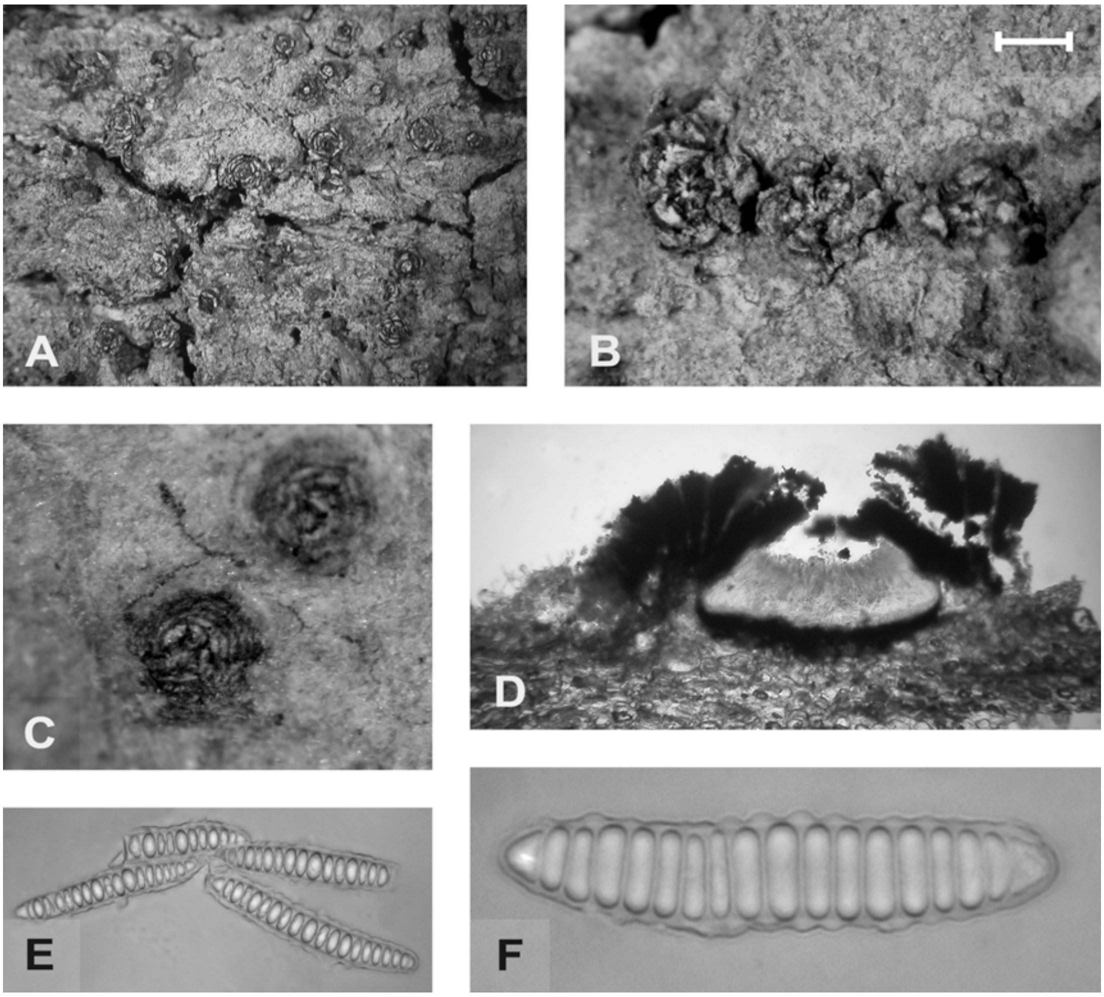

Fig. 211. *Thelotrema zebrinum*: growth habit (**A**), ascomata (**B, C**), ascoma section (**D**) and ascospores (**E, F**). A., B., E., F.: CANB-holotype; C., D.: *Wilson* s.n. (NSW-169660). Bar= A: 1.75 mm; B, C: 0.5 mm; D: 200 µm; E: 22 µm; F: 7 µm.

ECOLOGY AND DISTRIBUTION – *Thelotrema zebrinum* occurs on tree bark in cool- to warm-temperate or subtropical rainforests in altitudes ranging from 250 to 1200 m. It occurs in the Queensland/New South Wales-border-region, Lord Howe Island (NSW), southern Victoria and Tasmania. It is an Australasian species that is also known from New Zealand (Lumbsch & al. 2008).

Fig. 212. Australian distribution of *T. zebrinum*.

NOTES – The new species is readily characterized by the layered and ±distinctly carbonized ascoma margins, the presence of lateral paraphyses and moderately large, trans-versely septate, thick-walled, hyaline, non-amyloid ascospores. The secondary metabolites found are remarkable, several collections have either substances of the stictic or the protocetraric acid chemosyndromes, however, a few specimen produce acids of both chemosyndromes. Consequently, it is refrained from separating two chemical strains for this taxon. *Thelotrema guadeloupensis* and *Leptotrema schizoloma* are similar, but both have eumuriform ascospores and can be therefore easily separated. For differences to *T. parvizebrinum* and *T. subzebrinum* see under these species. Müller (1893) identified Wilson's collection from Victoria (NSW-*Wilson 949*) erroneously as *"Ocellularia" gyrostomoides*, an unidentified *Stictis* species from Queensland. *Ocellularia concentrica* from New Zealand transferred from *Odontotrema* by Sherwood (1987) might be an older name for *T. zebrinum*. The type, however, was not available for study.

SPECIMENS EXAMINED – Australia, Queensland, Gambubal SF., E of Emu Vale, *Hafellner & Stevens 16395* (GZU). New South Wales, Lord Howe Island, Goat House Cave, *Elix 42267 pr.p.* (CANB, [B-dubl. is a different species]). Victoria: Eastern Highlands, Black Spur: Nov. 1900, *Wilson* s.n. (MEL-724545); Feb. 1888, *Wilson* s.n. (NSW-539404); Jan. 1890, *Wilson* s.n. (NSW-539406). Warburton, *Wilson 949* (NSW). Ottway NP., 10 km W of Apollo Bay, *Mangold 1 g* (F). Tasmania: Ulverstone, *Wilson* s.n. (NSW-539324). Mt. Arthur, Feb. 1891, *Wilson* s.n. (BM-761740, NSW-539403). 6 km S of Waratah Hwy. jct. with the Murchison Hwy., *Hale 68737, 68738* (US). Walls of Jerusalem NP., *Kantvilas 65/99* (HOB). Mt. Wellington: *Wilson s.n.* (NSW-169662); Brown Track, *Wilson* s.n. (NSW-153763, -169660); St. Crispin's Well, *Wilson* s.n. (NSW-169661).

3. Molecular phylogeny

3. 1. Introduction

Thus far, molecular studies on Graphidaceae s. lat. are rather limited. One sequence was included in an early study addressing the circumscription of Ostropales (Winka & al., 1998), while Kauff & Lutzoni (2002) included three species in their study on the phylogenetic relationships of Gyalectales and Ostropales. In studies addressing phylogenetic relationships of other families related to Ostropales, several sequences of thelotremataceaen Graphidaceae were included by Grube & al. (2004) and Lücking & al., (2004), a study by Martín & al., (2003) dealt with the molecular phylogeny of the genus *Diploschistes.* A molecular study with special emphasis on the systematic position of *Nadvornikia* was carried out by Lumbsch & al. (2004a). In an analysis addressing the phylogeny of Lecanoromycetes, Miadlikowska & al. (2006) included six species of two genera of thelotrematoid Graphidaceae using five gene regions. As the most recent treatments exclusively focussed on Graphidaceae s. lat., a single-gene phylogenetic analyses was performed on genera of thelotremataceaen Graphidaceae (Frisch & al., 2006), and a two-gene study addressing Graphidaceae s. str. (Staiger & al., 2006).

As already implied above, molecular phylogenetic studies are based on various genes and DNA regions. The most common genes used in fungal systematics are mitochondrial and nuclear ribosomal DNA (mt rDNA/nu rDNA). In previous studies it could be shown (Lumbsch & al. 2000, 2001a, Schmitt & al. 2001) that the most appropriate genetic markers for phylogenetic tests on the family/generic level are the large subunit (28s, LSU) encoding gene of the nu rDNA and the small subunit (18s, SSU) encoding gene of the mt rDNA. A combined dataset of both genes was used for the analysis focusing on the family-level phylogeny (analysis 1), for the molecular revision of the phylogeny of *Thelotrema* and *Topeliopsis*, single gene data sets were employed, using nu LSU rDNA for *Topeliopsis* (analysis 2) and mt SSU rDNA for *Thelotrema* (analysis 3).

3. 2. Material and methods

3. 2. 1. Material

The examined material was predominantly collected on the field trips to Pacific Australia (see chapter 2. 4. 1.). In addition, herbarium specimens from BG, CANB, F, OTA, and PH were used. Several previously published sequences of mt SSU rDNA and nu LSU rDNA, available from GenBank were also included.

For analysis 1, data matrices of 105 ascomycetes were assembled. Nine taxa of Ostropales, which do not belong to Graphidaceae, were included as outgroup. For analysis 2, sequence data of 40 specimens of 38 species were assembled. *Myriotrema desquamans* and *Thelotrema glaucopallens* were used as outgroup, since *Myriotrema* and the *T. glaucopallens*-group clustered basal to the ingroup taxa in analysis 1. For analysis 3, data matrices of 43 sequences of 19 *Thelotrema* species were assembled. As an outgroup, seven sequences of six *Chapsa* species were included since the genus was sister-group to *Thelotrema* s. str. in analysis 2. In the tables 5-7. all used species and specimen are listed with further specifications.

Table 5: Analysis 1. Species and specimens used in the current study with GenBank accession numbers.

Species	Sample	GenBank acc. no. mt SSU	GenBank acc. no. nu LSU
"Graphina" peplophora		DQ431966	DQ431930
"Sarcographina" glyphiza		DQ431972	DQ431934
"Thelotrema" zebrinum	Australia, New South Wales, *Mangold 19 zo* (F)	EU075608	EU075652
Absconditella sp.		AY300873	AY300825
Absconditella sphagnorum		AY300872	AY300824
Acanthothecis aurantiaca		DQ431965	DQ431929
Acanthotrema brasilianum		DQ384916	DQ431928
Acarosporina microspora		AY584612	AY584643
Ampliotrema auratum 1	Australia, Queensland, *Lumbsch 19160 wA & Mangold* (F)	EU075564	EU075612
Ampliotrema auratum 2	Australia, Queensland, *Mangold 33a* (F)	EU075565	EU075613
Chapsa astroidea	Australia, Queensland, *Lumbsch 19166 n & Mangold* (F)	EU075566	EU075614
Chapsa cf. *pulchra]*	Australia, Queensland, *Lumbsch 19082 e & Mangold* (F)	EU075570	EU075618
Chapsa leprocarpa	Australia, Queensland, *Lumbsch 19125 k & Mangold* (F)	EU075568	EU075615
Chapsa niveocarpa	Australia, Queensland, *Lumbsch 19151 p & Mangold* (F)	EU075567	EU075616
Chapsa phlyctidioides	Australia, Queensland, *Lumbsch 19100 f & Mangold* (F)	EU075569	EU075617
Chapsa pulchra	Australia, Queensland, *Lumbsch 19129 t & Mangold* (F)	EU075571	EU075619
Chroodiscus coccineus		DQ384915	AF465441
Cryptodiscus foveolaris		AY661673	AY661683
Cryptolechia sp. .	Kenya, Western Province, *Lumbsch 19562 g, Mangold & Divakar* (F)	EU075572	EU075620
Diorygma circumfusum		DQ431963	AY640019
Diorygma junghuhnii		DQ431962	AY640018
Diorygma pruinosum		DQ431964	AY640014
Diorygma sipmanii		DQ431961	AY640020
Diploschistes cincereocaesius		AY300885	AY300835
Diploschistes muscorum		AY300886	AY300836
Diploschistes rampoddensis		AF431954	AF274094
Diploschistes thunbergianus		AF431955	AF274095
Dyplolabia afzelii		DQ431949	DQ43192
Fibrillithecis halei	Australia, Queensland, *Mangold 31g* (F)	EU075573	EU075621
Fissurina marginata		DQ431951	AY640012
Fissurina triticea		DQ431952	AY640011
Glyphis cicatricosa		DQ431955	AY640025
Glyphis scyphulifera		DQ431956	AY640027
Glyphis substriatula		DQ431982	AY640026
Graphis caesiella		DQ431975	AY640028
Graphis chrysocarpa		DQ431987	AF465448
Graphis cinerea		DQ431988	DQ431947
Graphis cleistoblephara		DQ431974	AY640031
Graphis pavoniana		DQ431986	DQ431946
Graphis ruiziana		DQ431985	DQ431945
Graphis scripta		AY853370	AY853322
Hemithecium implicatum		DQ431978	DQ431939
Leiorreuma hypomelaenum		DQ431971	DQ431933
Leptotrema wightii	Costa Rica, *Lücking 2034A* (F)	EU075574	EU075622
Leucodecton subcompunctum 1	Australia, Queensland, *Lumbsch 19116 o & Mangold* (F)	EU075575	EU075623
Leucodecton subcompunctum 2	Australia, Queensland, *Lumbsch 19153 p & Mangold* (F)	EU075576	EU075624
Myriotrema microporum	Australia, Queensland, *Lumbsch 19092 o & Mangold* (F)	EU075578	EU075626
Myriotrema olivaceum 1		DQ384900	AY640009
Myriotrema olivaceum 2	Australia, Queensland, *Lumbsch 19113f & Mangold* (F)	EU075579	EU075627

Species	**Sample**	**GenBank acc. no.**	
		mt SSU	**nu LSU**
Myriotrema trypaneoides	Australia, Queensland, *Lumbsch 19167 v & Mangold* (F)	EU075580	EU075628
Nadvornikia hawaiensis	Australia, Queensland, *Mangold 36 w* (F)	EU075581	AY605080
Neobelonia sp.		AY300879	AY300830
Ocellularia albocincta	Costa Rica, Lücking 063 (F)	EU075585	EU075632
Ocellularia cavata		DQ384877	DQ431935
Ocellularia chiriquiensis	Australia, Queensland, *Mangold 18 d* (F)	EU075582	EU075629
Ocellularia diacida	Australia, Queensland, *Lumbsch 19120 jb & Mangold* (F)	EU075583	EU075630
Ocellularia inturgescens	Australia, Queensland, *Lumbsch 19132 w & Mangold* (F)	EU075577	EU075625
Ocellularia massalongoi	Australia, Queensland, *Mangold 36 m* (F)	EU075584	EU075631
Ocellularia papillata	Australia, Queensland, *Mangold 43 o* (F)	EU075586	EU075633
Ocellularia perforata 1		DQ384881	AY605081
Ocellularia perforata 2	Australia, Queensland, *Lumbsch 19120 ja & Mangold* (F)	EU075587	EU075634
Ocellularia postposita		DQ384873	AY640008
Ocellularia profunda 1	Australia, Queensland, *Lumbsch 19116c & Mangold* (F)	EU075588	EU075635
Ocellularia profunda 2	Australia, Queensland, *Lumbsch19100p & Mangold* (F)	EU075589	NEW
Ocellularia profunda 3	Australia, Queensland, *Lumbsch 19123 k & Mangold* (F)	EU075590	EU075636
Ocellularia sp.	Australia, Queensland, *Lumbsch 19144d & Mangold* (F)	EU075591	EU075637
Ocellularia thelotremoides	Australia, Queensland, *Lumbsch 19108 I & Mangold* (F)	EU075592	EU075638
Odontotrema sp. 1		AY661674	AY661684
Odontotrema sp. 2		AY661675	AY661685
Phaeographis brasiliensis		DQ431958	AY640022
Phaeographis caesioradians		DQ431968	AY640021
Phaeographis intricans		DQ431960	DQ431927
Phaeographis lecanographa		DQ431983	DQ431943
Phaeographis lobata		DQ431984	DQ431944
Platygramme australiensis		DQ431970	AY640024
Platygramme caesiopruinosa 1		DQ431973	AY640023
Platygramme caesiopruinosa 2	Australia, Queensland, *Mangold 30 eI* (F)	EU075593	EU075639
Ramonia sp.		AY300921	AY300871
Sagiolechia rhexoblephara		AY853341	AY853391
Sarcographa fennicis		DQ431967	DQ431931
Sarcographa ramificans		DQ431981	DQ431942
Stegobolus cf. *subcavatus*	Australia, Queensland, *Lumbsch 19151 u & Mangold* (F)	EU075595	EU075641
Stegobolus fissus	Australia, Queensland, *Lumbsch 19108f & Mangold* (F)	EU075594	EU075640
Stictis populorum		AY300882	AY300833
Stictis radiata		AY300914	AY300864
Thelotrema bicinctulum	Australia, Queensland, *Mangold 34 f* (F)	EU075598	EU075642
Thelotrema cf. *nureliyum*	Australia, Queensland, *Lumbsch 19110 b & Mangold* (F)	EU075603	EU075648
Thelotrema crespoae	Australia, New South Wales, *Mangold 27 v* (F)	EU075606	NEW
Thelotrema diplotrema	Australia, Queensland, *Lumbsch 19127 v & Mangold* (F)	EU075599	EU075643
Thelotrema gallowayanum	Australia, Queensland, *Lumbsch 19151 k & Mangold* (F)	EU075600	EU075653
Thelotrema glaucopallens		DQ384906	AY605069
Thelotrema lepadinum		AY300916	AY300866
Thelotrema monosporum 1	Australia, Queensland, *Lumbsch19161 xb & Mangold* (F)	EU075596	EU075644
Thelotrema monosporum 2	Australia, Queensland, *Lumbsch19158 w & Mangold* (F)	EU075601	EU075646
Thelotrema nureliyum 1	Australia, Queensland, *Lumbsch 19100 ya & Mangold* (F)	EU075597	EU075647
Thelotrema nureliyum 2	Australia, New South Wales, *Mangold 22c* (F)	EU075604	EU075649
Thelotrema pachysporum		DQ384918	DQ431925
Thelotrema rugatulum	Australia, Queensland, *Lumbsch 19082b & Mangold* (F)	EU075605	EU075650
Thelotrema saxatile	USA, Maryland, *Lendemer 6389* (PH)	EU075602	EU075645
Thelotrema subtile 1		DQ871020	DQ871013
Thelotrema subtile 2	Australia, Victoria, *Mangold 3j* (F)	EU075607	EU075651
Thelotrema suecicum		AY300917	AY300867

Species	Sample	GenBank acc. no.	
		mt SSU	nu LSU
Topeliopsis decorticans	Australia, Victoria, *Mangold 5i.I* (F)	EU075609	EU075654
Topeliopsis meridensis	Costa Rica, *Lücking 17770* (F)	EU075610	EU075655
Topeliopsis muscigena	Australia, Vicotria, *Mangold 5d* (F)	EU075611	EU075656

Table 6: Analysis 2. Species and specimens used in the current study with GenBank accession numbers.

Species	Sample	GenBank acc. no. nu LSU
"Thelotrema" zebrinum	Australia, New South Wales, *Mangold 19 zo* (F)	EU075652
Acanthotrema brasilianum		DQ431928
Chapsa astroidea	Australia, Queensland, *Lumbsch 19166 n & Mangold* (F)	EU075614
Chapsa phlyctidioides	Australia, Queensland, *Lumbsch 19100 f & Mangold* (F)	EU075617
Chapsa pulchra	Australia, Queensland, *Lumbsch 19129 t & Mangold* (F)	EU075619
Chroodiscus coccineus		AF465441
Diploschistes cincereocaesius		AY300835
Diploschistes diploschistoides		AY605076
Diploschistes elixii	Australia, Western Australia, *Elix 32450* (F, isotype)	EU126644
Diploschistes muscorum		AY300836
Diploschistes rampoddensis		AF274094
Diploschistes scruposus		AF279389
Diploschistes thunbergianus		AF274095
Melanotopelia toensbergii	USA, Washington, *Tønsberg 32310* (BG)	EU126657
Myriotrema cinereum		AY605074
Myriotrema desquamans		AY605085
Myriotrema laeviusculum		AY605070
Myriotrema olivaceum	Australia, Queensland, *Lumbsch 19092 g & Mangold* (F)	EU126645
Ocellularia bahiana		AY605067
Ocellularia bonplandii	Australia, Queensland, *Lumbsch 19092 f & Mangold* (F)	EU126646
Ocellularia kalbii	Australia, Queensland, *Lumbsch 19085 h & Mangold* (F)	EU126647
Ocellularia microstoma	Australia, Queensland, *Lumbsch 19108 c & Mangold* (F)	EU126648
Ocellularia postposita		AY640008
Ocellularia thelotremoides	Australia, Queensland, *Lumbsch 19081 j & Mangold* (F)	EU126649
Thelotrema diplotrema	Australia, Queensland, *Lumbsch 19127 v & Mangold* (F)	EU075643
Thelotrema glaucopallens		AY605069
Thelotrema lepadinum		AY300866
Thelotrema myriocarpum	Australia, Queensland, *Lumbsch 19120 d & Mangold* (F)	EU126650
Thelotrema pachysporum		DQ431925
Thelotrema porinaceum	Australia, Queensland, *Lumbsch 19108 d & Mangold* (F)	EU126651
Thelotrema porinoides	Australia, Queensland, *Lumbsch 19113 s & Mangold* (F)	EU126652
Thelotrema suecicum		AY300867
Thelotrema weberi		AY605084
Topeliopsis acutispora	Australia, New South Wales, *Mangold 13 f* (F)	EU126653
Topeliopsis decorticans	Australia, Victoria, *Mangold 5i.I* (F)	EU075654
Topeliopsis meridensis	Costa Rica, *Lücking 17770* (F)	EU075655
Topeliopsis muscigena 1	Australia, Victoria, *Mangold 5iII* (F)	EU126654
Topeliopsis muscigena 2	Australia, Vicotria, *Mangold 5d* (F)	EU126655
Topeliopsis muscigena 3		EU075656
Topeliopsis subdenticulata	New Zealand, Otago, 25.4.2006, *Knight* (OTA - 59967)	EU126656

Table 7: Analysis 3: Species and specimens used in the current study with GenBank accession numbers.

Species	Sample	GenBank acc. no. mt SSU
Chapsa astroidea	Australia, Queensland, *Lumbsch 19116 n & Mangold* (F)	AY300917
Chapsa indica		DQ384911
Chapsa leprocarpa	Australia, Queensland, *Lumbsch 19125 k & Mangold* (F)	EU075568
Chapsa niveocarpa	Australia, Queensland, *Lumbsch 19151 p & Mangold* (F)	EU075567
Chapsa phlyctidioides 1	Australia, Queensland, *Lumbsch 19100 f & Mangold* (F)	EU075569
Chapsa phlyctidioides 2	Australia, Queensland, *Mangold 39 ze* (F)	NEW
Chapsa pulchra	Australia, Queensland, *Lumbsch 19129 t & Mangold* (F)	EU075571
Thelotrema capetribulense 1	Australia, Queensland, *Lumbsch 19160 q & Mangold* (F)	NEW
Thelotrema capetribulense 2	Australia, Queensland, *Lumbsch 19161 xA & Mangold* (F)	NEW
Thelotrema capetribulense 3	Australia, Queensland, *Lumbsch 19162 I & Mangold* (F)	NEW
Thelotrema conveniens	Australia, Queensland, *Mangold 29af* (F)	NEW
Thelotrema crespoae	Australia, New South Wales, *Mangold 27 v* (F)	EU075606
Thelotrema defossum	Australia, Queensland, *Lumbsch 19161 v & Mangold* (F)	NEW
Thelotrema diplotrema 1	Australia, Queensland, *Lumbsch 19127 v & Mangold* (F)	EU075599
Thelotrema diplotrema 2	Australia, Queensland, *Lumbsch 19161 r & Mangold* (F)	NEW
Thelotrema diplotrema 3	Australia, Queensland, *Lumbsch 19139 r & Mangold* (F)	NEW
Thelotrema gallowayanum	Australia, Queensland, *Lumbsch 19151 k & Mangold* (F)	EU075600
Thelotrema lepadinum 1		DQ431957
Thelotrema lepadinum 2		DQ384921
Thelotrema lepadinum 3		DQ384922
Thelotrema lepadinum 4		DQ972997
Thelotrema lepadinum 5	Australia, Victoria, *Mangold 1 a* (F)	NEW
Thelotrema lepadinum 6		AY300916
Thelotrema lepadodes	Australia, Queensland, *Lumbsch 19158 k & Mangold* (F)	NEW
Thelotrema monosporum 1	Australia, Queensland, *Lumbsch19158 w & Mangold* (F)	EU075601
Thelotrema monosporum 2	Australia, Queensland, *Lumbsch 19158 v & Mangold* (F)	NEW
Thelotrema monosporum 3	-	EU075596
Thelotrema monosporum 4		DQ384919
Thelotrema nureliyum 1	Australia, Queensland, *Lumbsch19174 x & Mangold* (F)	NEW
Thelotrema nureliyum 2	Australia, New South Wales, *Mangold 22c* (F)	EU075604
Thelotrema nureliyum 3	Australia, Queensland, *Lumbsch 19174 I & Mangold* (F)	NEW
Thelotrema nureliyum 4	Australia, Queensland, *Lumbsch 19100 ya & Mangold* (F)	EU075597
Thelotrema nureliyum 5	Australia, Queensland, *Lumbsch19100 k & Mangold* (F)	NEW
Thelotrema nureliyum 6	Australia, Queensland, *Lumbsch 19110 b & Mangold* (F)	EU075603
Thelotrema oleosum	Australia, New South Wales, *Mangold 25 m* (F)	NEW
Thelotrema pachysporum 1		DQ384918
Thelotrema pachysporum 2	Australia, Queensland, *Lumbsch 19162 j & Mangold* (F)	NEW
Thelotrema porinaceum	Australia, Queensland, *Lumbsch 19156 d & Mangold* (F)	NEW
Thelotrema porinoides 1		DQ384920
Thelotrema porinoides 2	Australia, Queensland, *Lumbsch 19137 i & Mangold* (F)	NEW
Thelotrema pseudosubtile	Australia, Queensland, *Lumbsch 19117 k & Mangold* (F)	NEW
Thelotrema rugatulum	Australia, Queensland, *Lumbsch 19082b & Mangold* (F)	EU075605
Thelotrema saxatile 1	Australia, Queensland, *Lumbsch 19104 a & Mangold* (F)	NEW
Thelotrema saxatile 2	U.S.A., *Lendemer 2149* (PH)	NEW
Thelotrema saxatile 3	Australia, Queensland, *Mangold 32 v* (F)	NEW
Thelotrema subtile 1		DQ871020
Thelotrema subtile 2	Australia, Victoria, *Mangold 3j* (F)	EU075607
Thelotrema subtile 3	Australia, Victoria, *Mangold 3 e* (F)	NEW
Thelotrema suecicum 1		AY300917
Thelotrema suecicum 2	Australia, Victoria, *Mangold 5 f* (F)	NEW

3. 2. 2. DNA extraction

For DNA extraction, small pieces of samples were taken, usually ascomata. As a first step, samples were soaked in acetone for1 h to remove secondary metabolites. The acetone was then discarded and subsequently air-dried samples were crushed using plastic pistils after cooling with liquid nitrogen and then processed using the DNeasy Plant Mini Kit (Qiagen) or E.Z.N.A. Fungal MiniPrep Kit (Omega-Biotech) following the instructions of the manufacturer.

3. 2. 3. PCR amplification and purification of PCR products

PCR amplifications were made using Ready-to-Go-PCR Beads (Amersham-Biosciences) as described in Winka & al., (1998), or performed as described in the following. 25 µL PCR reactions contained: 2.5 µL buffer, 2.5 µL dNTP mix, 1 µL of each primer (10 µM), 5 µL BSA, 2 µL Taq, 2 µL genomic DNA extract and 9 µL distilled water. The genomic DNA extract was prepared of dilutions (10^{-1} up to 10^{-2}) or undiluted DNA. Primers for amplification were: a) for the nu LSU rDNA: nu-LSU-0155-5' (Döring & al., 2000), nu-LSU-0042-5' (=LR0R), nu-LSU-1432-3' (=LR7), and nu-LSU-1125-3' (=LR6) (Vilgalys & Hester, 1990), and AL2R: GCGAGTGAAGCGGCAACAGCTC; b) for the mt SSU rDNA: mr SSU1 (Zoller & al., 1999) and MSU 7 (Zhou & al., 2001).

Thermal cycling parameters were: initial denaturation for 3 min at 94-95ºC, followed by 30 cycles of 1 min at 95ºC, 1 min at 52ºC, 1 min at 73ºC, and a final elongation for 7 min at 73ºC; or when PCR Beads were used, a) for nu LSU: initial denaturation for 5 min at 94ºC, followed by 35 cycles of 30 sec at 94ºC, 30 sec at 52ºC, 1 min at 72ºC, and a final elongation for 10 min at 72ºC, and b) for mt SSU: initial denaturation for 5 min at 94ºC, followed by 35 cycles of 45 sec at 94ºC, 1 min at 50ºC, 1 min 30 sec at 72ºC, and a final elongation for 10 min at 72ºC.

Amplification products were viewed on 1% or 2% agarose gels stained with ethidium bromide and subsequently purified using the QIAquick PCR Purification Kit (Qiagen), Nucleo Spin DNA purification kit (Macherey-Nagel) or EZNA Cycle-Pure kit 200 (Omega Biotech).

3. 2. 4. Sequencing and sequence assembly

For sequencing the same sets of primers were used as for the PCR amplification (see above). Cycle sequencing was executed with the following program: 25 cycles of 95ºC for 30 sec, 48ºC for 15 sec, and 60 º C for 4 min. If direct sequencing failed due to the presence of multiple products, PCR products were cloned using the TOPO TA cloning kit (Invitrogen) or pGEM-T easy vector II cloning kit (Omega Biotech). We picked 3–10 clones of each cloning reaction. Cloned products were sequenced with universal primers specific to the plasmids: M13for and M13rev (TOPO TA) and T7 and SP6 (pGEM-T). Sequenced products were precipitated with 10 µL of sterile dH_2O, 2 µL of 3 M NaOAc, and 50 µL of 95% EtOH before they were loaded on an ABI 3100 or 3730 (Applied Biosystems) automatic sequencer.

Sequence fragments obtained were assembled with SeqMan 4.03 (DNASTAR) and manually adjusted. The identity of the obtained consensus sequences was checked using the BLAST program (Altschul & al., 1990) in the GenBank database.

3. 2. 5. Sequence alignments

Alignments for the single gene data sets were done using Clustal W (Thompson & al., 1994). Insertion and ambiguously aligned regions were delimited manually. Since the mitochondrial data set contains sequence portions that are highly variable, standard multiple alignment programs, such as Clustal (ibid.) become less reliable when sequences show a high degree of divergence. Therefore, for the combined dataset of analysis 1 an alignment procedure that uses a linear Hidden Markov Model (HMM) as implemented in the software SAM (Sequence Alignment and Modelling system) (Karplus & al., 1998) was employed for separate alignments of the two data sets. Regions that were not aligned with statistical confidence were excluded from the phylogenetic analysis.

3. 2. 6. Phylogenetic analysis

The alignments were analysed by maximum parsimony (MP) and a Bayesian approach (B/MCMC) (Huelsenbeck & al., 2001; Larget & Simon, 1999). To test for potential conflict, parsimony bootstrap analyses were performed on each individual data set, and 75% bootstrap consensus trees were examined for conflict (Lutzoni & al., 2004).

Maximum parsimony analyses were performed using the program PAUP* (Swofford, 2003). Heuristic searches with 200 (analysis 1) and 1000 (analyses 2 and 3) random taxon addition replicates were conducted with TBR branch swapping and MulTrees option in effect, equally weighted characters and gaps treated as missing data. Bootstrapping (Felsenstein, 1985) was performed based on 2000 replicates with random sequence additions. To assess homoplasy levels, consistency index (CI) and retention index (RI) were calculated from each parsimony search.

The B/MCMC analyses were conducted using the MrBayes 3.1.1 program (Huelsenbeck & Ronquist, 2001). The analyses were performed assuming the general time reversible model of nucleotide substitution (Rodriguez & al., 1990), including estimation of invariant sites and assuming a discrete gamma distribution with six rate categories (GTR+I+G). In analysis 1, the data set was portioned into the two parts (nu LSU, mt SSU) and each partition was allowed to have own parameters as suggested by Nylander & al., (2004). No molecular clock was assumed. A run with 4,000,000 (analysis 1) and 20,000,000 (analyses 2 and 3) generations starting with a random tree and employing 12 (four in analysis 3) simultaneous chains was executed. Every 100th tree was saved into a file. The first 200,000 (analysis 1), 800,000 (analysis 2) and 1,000,000 (analysis 3) generations (i.e. the first 2000, 8000 or 10,000 trees respectively) were deleted as the "burn in" of the chain. The log-likelihood scores of sample points were plotted against generation time using TRACER 1.0 (http://evolve.zoo.ox.ac.uk/software.html?id=tracer) to ensure that stationarity was achieved after the first 200,000, 800,000 and 1,000,000 generations respectively, by checking whether the log-likelihood values of the sample points reached a stable equilibrium value (Huelsenbeck & Ronquist, 2001). Of the remaining 76,000 (analysis 1), 384,000 (analysis 2) and 380,000 (analysis 3) trees (38,000, 192,000 or 190,000 from each of the parallel runs respectively) a majority rule consensus tree with average branch lengths was calculated using the sumt option of MrBayes. Posterior probabilities were obtained for each clade. Only clades with bootstrap support equal or above 70% (analysis 1) or equal or above 75% (single gene analyses) under MP and posterior probabilities ≥ 0.95 (in all cases) were considered as strongly supported. Phylogenetic trees were visualized using the program Treeview 1.6.6 (Page, 1996).

In the combined analysis as well as in the nu LSU single gene analysis, the results were incongruent with the current classification. It was therefore tested whether the data were sufficient to reject alternative topologies. For the results of the analysis 1 phylogeny the following two topological constraints were tested: 1. monophyly of Graphidaceae and 2. monophyly of Thelotremataceae. Three topological constraints were tested for the phylogeny of analysis 2: 1. monophyly of *Topeliopsis* s. str. + *T. toensbergii*, 2. monophyly of *Topeliopsis* s. str. + *T. meridensis,* and 3. monophyly of *Topeliopsis* s. lat. For the hypothesis testing two different methods were used: a. Shimodaira-Hasegawa (SH) test (2000) and b. expected likelihood weight (ELW) test following Strimmer & Rambaut (2002). The SH and ELW tests were performed using Tree-PUZZLE 5.2 (Schmidt & al., 2002) with the combined data set on a sample of 200 unique trees, the best trees agreeing with the null hypotheses, and the unconstrained ML tree. These trees were inferred in Tree-PUZZLE employing the GTR+I+G nucleotide substitution model.

3. 3. Results

3. 3. 1. Analysis 1

A matrix of 105 sequences was produced with 1164 unambiguously aligned nucleotide position characters.. This included 638 positions of the nu LSU and 526 of the mt SSU data set. 516 characters in the alignment were constant. Insertions present in the nu LSU rDNA of many taxa were removed from the alignment. The MP 75% bootstrap support method for testing data sets for incongruence indicated no strongly supported conflict (data not shown) and hence a combined analysis was performed. The combined alignment will be available in TreeBASE (http://www.treebase.org/treebase). Maximum parsimony analysis yielded in 25 most parsimonious trees 3861 steps long (CI=0.28, RI=0.61). 144 positions in the matrix were parsimony-uninformative, and 504 informative.

In the B/MCMC analysis of the combined data set, the likelihood parameters in the sample had the following mean (Variance): LnL = -20254.95 (0.51), base frequencies $\pi(A)\{mtSSU\}$ = 0.353 (0.0003), $\pi(C)$ {mtSSU} = 0.124 (0.0002), $\pi(G)\{mtSSU\}$ = 0.222 (0.0002), $\pi(T)\{mtSSU\}$ = 0.301 (0.0003), $r\pi(A)\{nuLSU\}$ = 0.252(0.0003), $\pi(C)$ {nuLSU} = 0.204 (0.0002), $\pi(G)\{nuLSU\}$ = 0.308 (0.0003), $\pi(T)\{nuLSU\}$ = 0.235(0.0003), rate matrix r(AC){mtSSU} = 0.073 (0.001), r(AG){mtSSU} = 0.221 (0.0005), r(AT){mtSSU} = 0.102 (0.002), r(CG){mtSSU} = 0.092 (0.0002), r(CT){mtSSU} = 0.442 (0.0006), r(GT){mtSSU} = 0.072 (0.0001), rate matrix r(AC){nuLSU} = 0.07 (0.0001), r(AG){nuLSU} = 0.177 (0.0004), r(AT){nuLSU} = 0.09 (0.002), r(CG){nuLSU} = 0.394 (0.0008), r(CT){nuLSU} = 0.581 (0.005), r(GT){nuLSU} = 0.044 (0.0008), the gamma shape parameter alpha{mtSSU} = 0.56 (0.0009), alpha{nuLSU} = 0.731 (0.0005), and the proportion of invariable site p(invar){mtSSU} = 0.242 (0.0004), and p(invar){nuLSU} = 0.316 (0.0003).

The topologies of the MP and B/MCMC analyses did show one strongly supported conflict. *Thelotrema rugatulum* clustered unsupported in the MP tree at the base of the *T. lepadinum* clade (=*Thelotrema* s. str.), while it is nested within *Topeliopsis* with a long branch in the B/MCMC tree. Since a long branch leads to *T. rugatulum* the placement of this taxon is regarded as uncertain. As no further conflicts were found, only the 50% majority-rule consensus tree of Bayesian tree sampling is shown. Those nodes that received strong support (i.e. PP $\geq$0.95 in B/MCMC analysis and MP bootstrap $\geq$70%) in both the MP and Bayesian analyses are in bold (Fig. 213).

In this phylogeny, it can be seen, that the clade comprising Graphidaceae s. lat. is strongly supported. Taxa hitherto placed in the two distinct families Graphidaceae and Thelotremataceae do not form two separate clades. Although the backbone of the phylogeny within the Graphidaceae/Thelotremataceae clade lacks supports, several, well-supported clades can be distinguished within this clade. A basal clade (*Fissurina*-group A) including

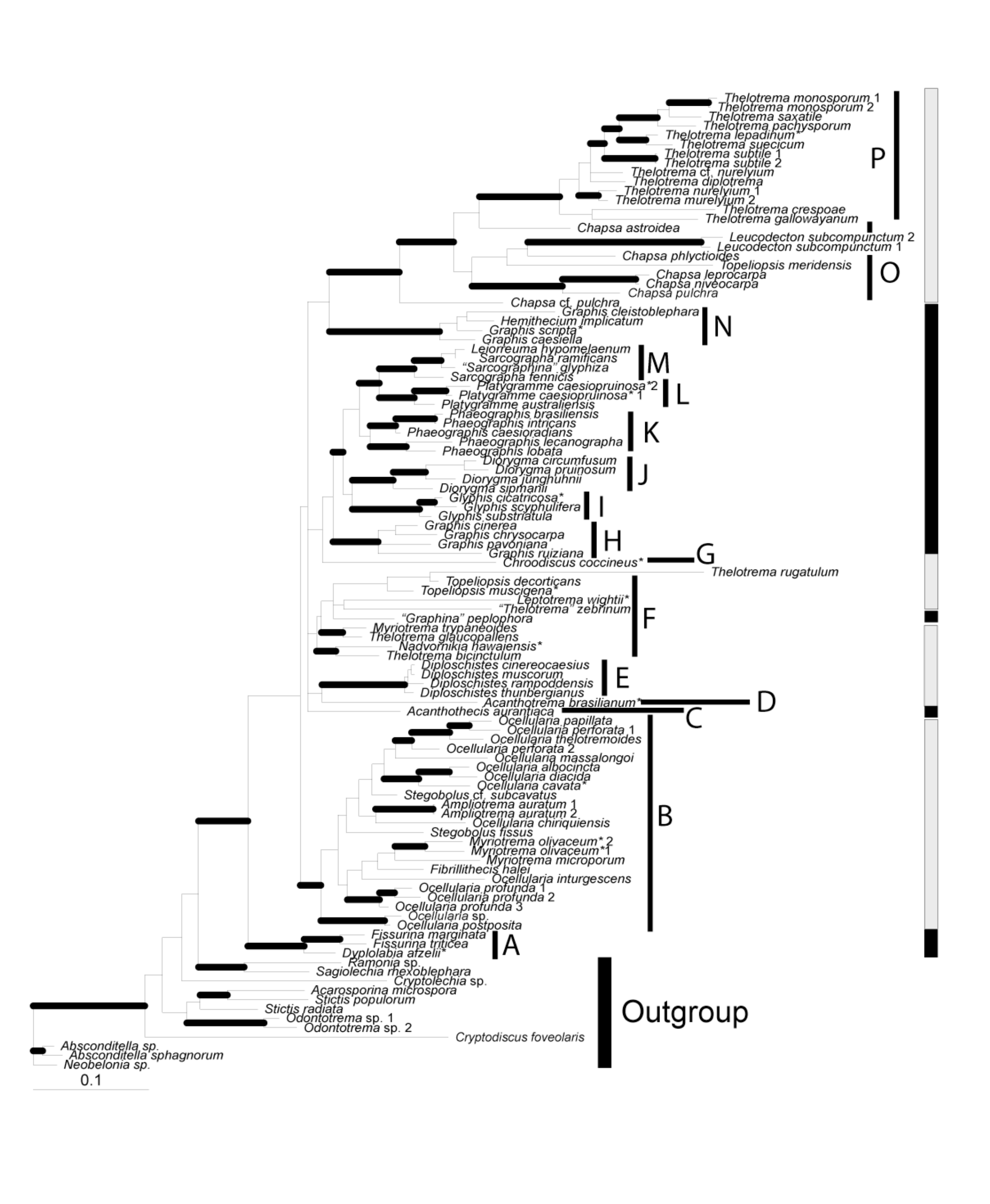

Fig. 213. Phylogeny of Graphidaceae s. lat. as inferred from a two gene-partition analysis. Type species of ingroup genera indicated by an asterisk. Graphidaceae s. str. taxa are indicated by a black bar (right scale), a gray bar represents taxa of thelotrematoid Graphidaceae. Groups mentioned in the text are marked by letters. The bottom scale indicates the genetic distance represented by the branch lengths. (For further explanations see text.)

Dyplolabia and *Fissurina* (both Graphidaceae s. str.) is strongly supported and forms a sister-group to the remaining taxa of Graphidaceae s. str. and thelotrematoid groups. This sister-group relationship, however, lacks support. Another well-supported clade (*Ocellularia*-group B) includes taxa currently classified in *Ampliotrema*, *Fibrillithecis*, *Myriotrema* s. str. (except *M. trypaneoides*), *Ocellularia*, and *Stegobolus*. This clade forms a sister-group to an unsupported clade including all remaining Graphidaceae s. lat. Both *Myriotrema* and *Ocellularia* as currently circumscribed are polyphyletic, but there is no backbone support in the *Ocellularia*-clade. *Fibrillithecis* is clustered within *Myriotrema*, but this lacks support. Both *Ampliotrema* and *Stegobolus* are nested within *Ocellularia*, but also here, support is lacking.

The remaining taxa are scattered in several groups with little backbone support. The relationship of *Acanthothecis* (group C) is not resolved. *Acanthotrema* (group D) appears as sister to *Diploschistes* (group E), which is strongly supported as monophyletic, but the relationships with other genera remain open; three further unsupported clades, all including taxa of both Graphidaceae s. str. and thelotremataceaen Graphidaceae, also have unresolved relationships among each other. The first (*Topeliopsis*-group F) is a weakly supported assemblage of different taxa, including *"Graphina" peplophora* and the thelotrematoid taxa *Leptotrema wightii*, *Nadvornikia hawaiensis*, two species of *Topeliopsis*, *Myriotrema trypaneoides*, and four species of *Thelotrema*. However, support within this clade is mostly lacking. Another clade includes the bulk of graphidaceaen taxa, with the thelotrematoid *Chroodiscus coccineus* (group G) unsupported at the base. The genera *Diorygma* (group I), *Glyphis* (group J), *Phaeographis* (group K), and *Platygramme* (group L), are monophyletic, all except *Phaeographis* strongly supported. *Leiorreuma hypomelaenum* is nested within *Sarcographa*. This group (M) forms a well-supported sister-group relationship to *Platygramme*. Four species of *Graphis* form a well-supported group (H) sister to the remaining Graphidaceae s. str.

In the upper part of the tree an unsupported group includes two strongly supported clades; one comprising of *Graphis* s. str. (*Hemithecium implicatum* nested within; group N), and the other composed of thelotrematoid taxa currently classified in four genera: *Chapsa*, *Leucodecton*, *Thelotrema* s.str., and one *Topeliopsis* species. Within this clade *Chapsa* is paraphyletic (group O) with species of the other three genera nested within. The relationships of *Leucodecton subcompunctum* and *Topeliopsis meridensis*, however, lack support. *Thelotrema* s. str. forms a well-supported monophyletic group (group P).

The two alternative topology tests both significantly rejected monophyly of Graphidaceae and monophyly of Thelotremataceae as currently circumscribed ($p<0.001$ in all four tests).

3. 3. 2. Analysis 2

40 sequences were aligned to produce a matrix of 699 unambiguously aligned nucleotide position characters. 427 characters in the alignment were constant. Maximum parsimony analysis yielded five most parsimonious trees (754 steps long). The strict consensus tree did not contradict the Bayesian tree topology.

In the B/MCMC analysis of the combined data set, the likelihood parameters in the sample had the following mean (Variance): LnL = -4636.836 (0.1), base frequencies $\pi(A)_{\{all\}}$ = 0.265 (0.00008), $\pi(C)_{\{all\}}$ = 0.213 (0.00007), $\pi(G)_{\{all\}}$ = 0.283 (0.00008), $\pi(T)_{\{all\}}$ = 0.239(0.00007), rate matrix $r(AC)_{\{all\}}$ = 0.079 (0.0007), $r(AG)_{\{all\}}$ = 0.199 (0.0002), $r(AT)_{\{all\}}$ = 0.055 $r(CG)_{\{all\}}$ = 0.053 (0.00005), $r(CT)_{\{all\}}$ = 0.563 (0.0003), $r(GT)_{\{all\}}$ = 0.051 (0.00006), the gamma shape parameter alpha = 0.543 (0.0009),and $p(invar)_{\{all\}}$ = 0.292 (0.00006).

Fig. 214. Phylogeny of *Topeliopsis* and allied genera of thelotremataceaen Graphidaceae as inferred from a nu LSU rDNA data set. Groups mentioned in the text are marked by letters. The bottom scale indicates the genetic distance represented by the branch lengths. (For further explanations see text.)

Since the topologies of the MP and B/MCMC analyses did not show any strongly supported conflicts, only the 50% majority-rule consensus tree of Bayesian tree sampling is shown (Fig. 214). Those nodes that received strong support (i.e. PP ≥0.95 in B/MCMC analysis and MP bootstrap ≥75%) in both the MP and Bayesian analyses are in bold.

In the majority-rule consensus tree, *Topeliopsis* is polyphyletic, with a core group, including the type species *T. muscigena,* and *T. acutispora, T. decorticans* and *T. subdenticulata* in a well-supported monophyletic clade (clade A), while *T. meridensis* and the former *T. toensbergii* (=*Melanotopelia toensbergii*) cluster in other groups. *Topeliopsis meridensis*, is basal to a well supported clade including *Chapsa* and *Thelotrema* s. str., however, its basal placement is unsupported. *Melanotopelia toensbergii* has a basal placement to a clade including the well-supported *Chapsa-Thelotrema* s. str.-*T. meridensis* clade and *Chroodiscus coccineus* (clade D). The relationships of these groups are strongly supported, but the exact position of *M. toensbergii* lacks support. The relationships of *Topeliopsis* s. str. are not resolved with confidence. The genus *Diploschistes* is strongly supported as monophyletic (clade B). As also shown in the other phylogenetic analyses (1 and 3), the genera *Chapsa, Myriotrema, Ocellularia,* and *Thelotrema* as currently circumscribed are not monophyletic. Several taxa of *Ocellularia* and two *Myriotrema* species cluster in a well supported clade (clade C) basal to clade D and an unresolved group of three different genera, including *Thelotrema glaucopallens, Acanthotrema brasilianum* and *Myriotrema olivaceum*. *"Thelotrema" zebrinum,* the only member of the *Leptotrema schizoloma*-group examined, is basal to the *Topeliopsis* s. str. clade, but its relationship to this clade as well as to the other taxa is unresolved.

3. 3. 3. Analysis 3

43 sequences were aligned to produce a matrix of 698 unambiguously aligned nucleotide position characters; 484 characters in the alignment were constant. Maximum parsimony analysis yielded 288 most parsimonious trees (438 steps long). The strict consensus tree did not contradict the Bayesian tree topology.

In the B/MCMC analysis of the combined data set, the likelihood parameters in the sample had the following mean (Variance): LnL = -3552.639 (0.32), base frequencies $\pi(A) = 0.334$ (0.00081), $\pi(C) = 0.157$ (0.00076), $\pi(G) = 0.202$ (0.00076), $\pi(T) = 0.308$ (0.0008), the gamma shape parameter alpha = 0.609 (0.0017), and p(invar) = 0.371 (0.00052).

Since the topologies of the MP and B/MCMC analyses did not show any strongly supported conflicts, only the 50% majority-rule consensus tree of Bayesian tree sampling is shown. Those nodes that received strong support (i.e. PP ≥0.95 in B/MCMC analysis and MP bootstrap ≥70%) in both the MP and Bayesian analyses are in bold as shown in Figure 215.

Thelotrema is strongly supported as monophyletic in the majority-rule consensus tree. The backbone of the phylogeny within *Thelotrema* is not resolved with confidence, with the single exception of a placement of a group of five species (*T. conveniens, T. crespoae, T. gallowayanum, T. oleosum, T. porinaceum*) at the base. The relationships among these basal species are not clear, with the exception of a strongly supported sister-group relationship of *T. oleosum* and *T. porinaceum* (clade A). Within the group of remaining *Thelotrema* species, six well supported clades (clades B-G) can be distinguished; the relationships between these clades do not receive strong support and hence are uncertain. The new species *T. capetribulense* forms a well supported sister-group to *T. porinoides* (clade B). Three samples of *T. diplotrema* cluster together (clade C), but the relationships of this species remain unresolved, which is also true for the relationships of *T. nureliyum* (clade D) and *T. subtile* (clade F). Within clade E five species cluster together. *Thelotrema lepadinum* has a well supported sister-group relationship to *T. suecicum* and these two species are strongly supported as sister to *T. rugatulum,* which are sister to an unsupported sister-group, consisting

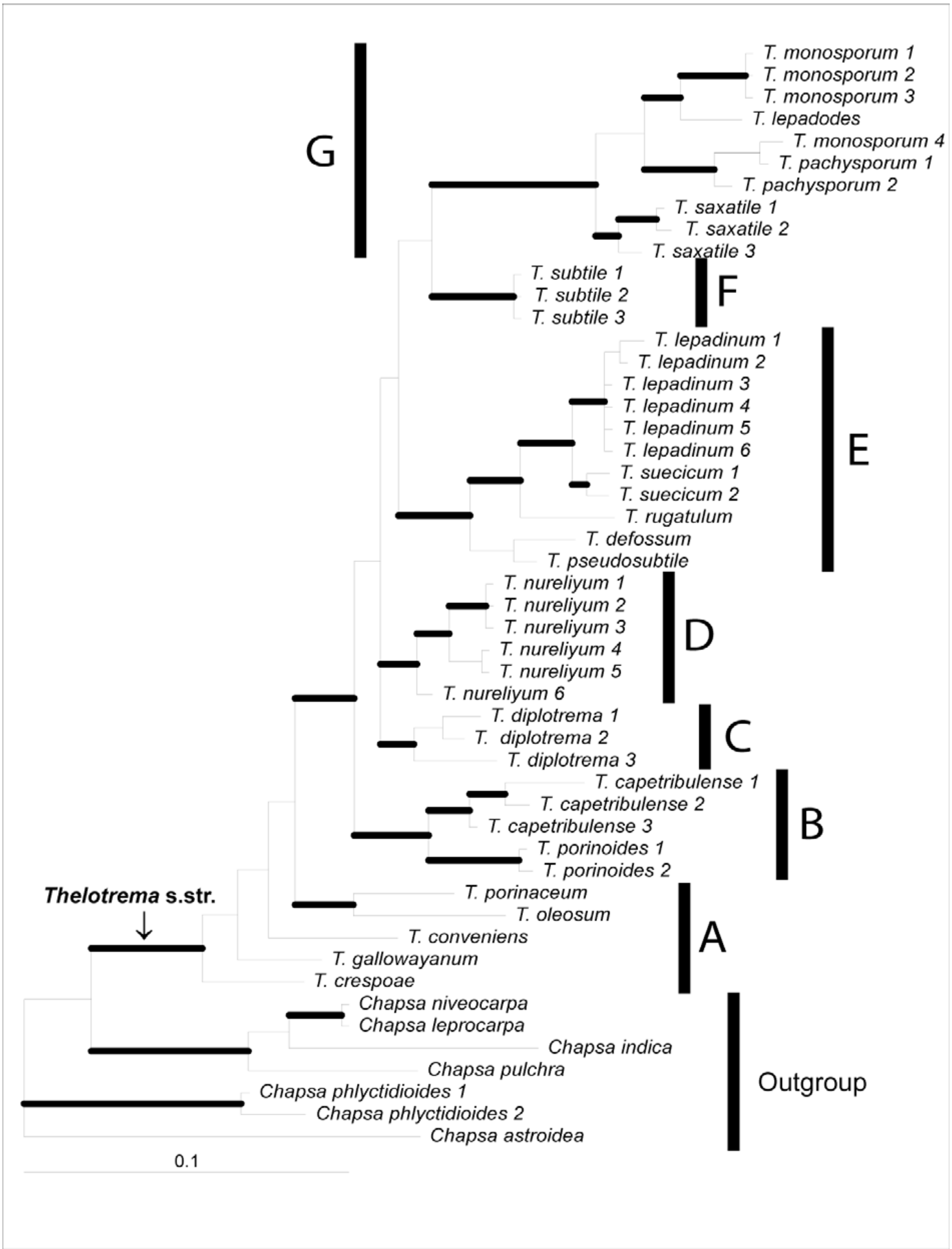

Fig. 215. Phylogeny of *Thelotrema* and *Chapsa* (outgroup) as inferred from a mt SSU rDNA data set. Groups mentioned in the text are marked by letters. The bottom scale indicates the genetic distance represented by the branch lengths. (For further explanations see text.)

of *T. defossum* and *T. pseudosubtile.* Clade G includes four species, *T. saxatile* forms a well supported sister-group with *T. lepadodes,* while *T. monosporum* is nested within *T. pachysporum,* but this position lacks support. The three samples of *T. saxatile* cluster together, but the relationships of this species within clade G remain uncertain.

3. 4. Discussion

3. 4. 1. Phylogenetic relationship of Graphidaceae and Thelotremataceae (analysis 1)

Our understanding of the circumscription of families in lichen-forming fungi is rather limited. This is due to lack of data, especially in crustose, tropical groups, but also due to persistence of traditional concepts based on oversimplifications of observed morphological diversity (Lumbsch, 2000, 2007). Traditionally, the distinction of families in lichenized fungi has been very coarse and based on simple, easy to recognize characters or correlations of few characters. Consequently, molecular data identified many traditionally circumscribed families as poly- or paraphyletic (e.g., Andersen & Ekman, 2004; Buschbom & Mueller, 2004; Ekman, 2001; Ekman & Jørgensen, 2002; Ekman & Wedin, 2000; Helms & al., 2003; Lumbsch & al., 2004; Mattsson & Wedin, 1999; Reeb & al., 2004; Schmitt & al., 2006; Wedin & al., 2000, 2002, 2005). However, it should be noted that some of the families circumscribed using morphological data, such as Parmeliaceae were supported as monophyletic by molecular data (e.g., Crespo & al., 2007).

Although many questions remain open, it could be revealed by the combined analyses of two datasets employing nuclear and mitochondrial rDNA that Graphidaceae and Thelotremataceae in their present circumscription are both non-monophyletic. The distinction of both families was based on an overestimation of the importance of ascoma shape and development. The shape of the ascomata is easily observed and has therefore been used in traditional taxonomy (see also part 2. 1.). While most Graphidaceae have lirelliform ascomata, in some taxa these are rounded to ellipsoid, such as *Acanthothecis hololeucoides*, *Diorygma confluens*, *Glyphis scyphulifera*, *Graphis muscicola*, *Leiorreuma hypomelaenum*, and *Phaeographis lobata* (Staiger, 2002; Kalb & al., 2004). Lobate to almost lirelliform ascomata are known from some species of *Chapsa* (e.g., *C. dilatata*), *Redingeria* (e.g., *R. glyphica*), and *Thelotrema* (Frisch, 2006; Frisch & Kalb, 2006). Hence, the distinction of both families appears difficult in some cases, and the presence of these intermediate forms already made the use of this character set doubtful. Although these similarities are usually interpreted as homologies indicating close phylogenetic relationship, an alternative interpretation, i.e. that these similarities are due to parallelism, was expressed by Henssen (1976) and Henssen and Jahns (1973). These authors classified the two families in different suborders Ostropineae (Thelotremataceae) and Graphidineae (Graphidaceae) based on the differences in ascoma morphology and ascoma development. However, as examples for ascoma development in Graphidaceae they used *Graphina mendax* (=*Diorygma junghuhnii*) and *Gyrostomum scyphuliferum* (=*Glyphis scyphulifera*), two rather atypical examples since both genera produce partially anastomosing paraphyses in contrast to the mostly simple paraphyses of the other genera of Graphidaceae. Henssen & Jahns (ibid.) interpreted those as paraphysoids and compared the development to that of the unrelated Roccellaceae, but as shown by Staiger (2002) and Kalb & al. (2004), the different hamathecium anatomy in these genera is part of the anatomical and ontogenetic variation found in the family, which does not differ significantly from the variation found in Thelotremataceae (Frisch, 2006).

Previous molecular studies already raised uncertainties in the distinction of the families. Grube & al., (2004) and Lumbsch & al., (2004a) found species of Thelotremataceae (the latter including *Nadvornikia*) being monophyletic, but nested within a paraphyletic Graphidaceae.

Frisch & al., (2006) found Graphidaceae and Thelotremataceae being polyphyletic, but the placement of *Graphis* spp. in a Thelotremataceae lineage lacked strong support. In a broad sampling of Graphidaceae including a few sequences of Thelotremataceae Staiger & al. (2006) found taxa of Thelotremataceae in three separate clades within Graphidaceae. However, the relationships of these clades were either unresolved or the relationships lacked significant support. Graphidaceae was not monophyletic with taxa of *Dyplolabia* and the paraphyletic *Fissurina* forming a separate well-supported monophyletic group with an unresolved relationship to the rest of Graphidaceae+Thelotremataceae and the outgroup. In an analysis addressing phylogeny of Lecanoromycetes using five gene regions, Miadlikowska & al. (2006) revealed a monophyletic Thelotremataceae (six species of two genera included) nested in a paraphyletic Graphidaceae.

Here, it could be shown by the analysis of a dataset including over 50 Thelotremataceae and over 30 Graphidaceae species that the rejection of monophyly of the two families is legitimate. As a nomenclatural consequence of this analysis, it is suggested to reduce Thelotremataceae into synonymy with Graphidaceae, which will be formally proposed elsewhere.

3. 4. 2. Phylogenetic relationship of genera within Graphidaceae (analysis 1, 2 and 3)

The difficulties and controversial opinions in the distinction of major clades within thelotremataceaen Graphidaceae into genera were already discussed in part 2.1. As far as the Graphidaceae s. str. are concerned, a very similar discussion has evolved since Müller Argoviensis (1880a, 1882b) erected - prior to his introduction of a generic concept for Thelotremataceae (Müller Argoviensis, 1887) - the same ascospore-based classification for this group. The species were also distinguished in four major genera: brown and transversely septate ascospores: *Phaeographis*, brown and muriform ascospores: *Phaeographina*, hyaline and transversally septate ascospores: *Graphis,* hyaline and muriform ascospores: *Graphina*. However, this classification likewise persisted until recent times, although it was considered artificial by many workers (e. g. Archer, 2000; Santesson, 1952; Wirth & Hale, 1978). Several attempts towards a more natural classification in Graphidaceae, viz. the inclusion of ascomata-based characters and employment of molecular data, were presented in recent years (e. g. Kalb & Staiger, 2000; Kalb & al., 2004; Staiger, 2002; Staiger & al., 2006). As in the thelotrematoid taxa, numerous genera were newly introduced or resurrected, however, the classification is similarly far from being satisfactorily understood.

Thus, in the combined gene analysis (analysis 1 – which is the only here presented analysis that includes this group), no further systematic conclusions can be drawn, except that the results of Staiger & al. (2006) could be confirmed, whereas *Fissurina* and *Dyplolabia* show a basal position within the Graphidaceae/Thelotremataceae clade, but again, this lacks support. The two genera were previously subsumed within *Graphis* s. lat. and *Graphina*, and reinstated by Kalb & Staiger (2001) and Staiger & Kalb (2000). Although the two genera look morphologically different, they have predominantly 3-septate or small muriform, I-negative ascospores as common characters. With the dataset at hand, the issue of generic concepts within Graphidaceae and Thelotremataceae cannot be addressed beyond the fact, that the current, recently introduced concepts (Frisch & al. 2006; Staiger 2002; Kalb & al. 2004) need further revision. One problem of this study is that several genera are not represented (*Anomalographis*, *Anomomorpha*, *Gyrotrema*, *Ingvariella*, *Melanotrema*, *Phaeographopsis*, *Platythecium*, *Pseudoramonia*, *Redingeria*, *Reimnitzia*, *Sarcographina* s. str., *Thecaria*), and of the 24 genera included, twelve are only represented by a single species. Also, type species are only included for 11 genera. Clearly, larger taxon sampling is needed to resolve the delimitation of most genera. Despite the shortcomings in taxon sampling, however, a number of genera were shown to be poly- or paraphyletic as currently circumscribed. This includes the graphidaceous *Graphis* and *Sarcographa* and the thelotremataceous genera *Chapsa*, *Myriotrema*, *Ocellularia*, *Thelotrema* and *Topeliopsis*.

In thelotremataceaen Graphidaceae, the only genus confirmed as monophyletic in two analyses (1 and 2), with more than one species represented, is *Diploschistes*. Although *Thelotrema* is strongly supported as monophyletic in analysis 3, with the extension of taxa beyond the *Thelotrema* s. str. group in the analyses 1 and 2, the genus as currently circumscribed happens to be polyphyletic. In the study of Frisch & al. (2006) *Chapsa* was monophyletic and sister to *Leucodecton*, both genera well supported. The placement of *Leucodecton* nested within *Chapsa* in analysis 1 may be due to poor taxon sampling, since we only included one species of *Leucodecton*, while the single-gene analysis of Frisch & al. (2006) included three taxa. In analysis 3, where six species of *Chapsa* are included as an outgroup, this genus appears well separated from *Thelotrema* but, firstly no other genus than *Chapsa* and *Thelotrema* is included, and, secondly, it does not form a monophyletic group.

Neither *Topeliopsis* sensu Kantvilas and Vezda (2000) nor sensu Frisch & Kalb (2005) are monophyletic. However, *Topeliopsis* sensu Kalb (2001) is monophyletic in analysis 2 (also in analysis 1, but without support). The generic placement of *Topeliopsis meridensis* needs re-evaluation. In both analyses it does not cluster with the type species *T. muscigena* or the strongly supported *Topeliopsis* s. str. group of analysis 2 respectively, but within *Chapsa* (and *Thelotrema* in analysis 2). Morphologically the species resembles other *Chapsa* species, but it differs in anatomical details, such as the sessile, rather urceolate apothecia, and a thick, brown proper exciple. However, the placement within *Chapsa* lacks support in both analyses and the generic placement of *T. meridensis* needs to be addressed with a wider sampling of *Chapsa* species. At the moment it is refrained from drawing any taxonomical conclusions. The former *Topeliopsis* species *Melanotopelia toensbergii* that is included in analysis 2 does also not cluster within the *Topeliopsis* s. str. group. When describing the new genus, Kantvilas and Vezda (2000) already mentioned that it was heterogeneous and that two species, viz. *T. rugosa* Kantvilas & Vezda and *T. toensbergii* Vezda & Kantvilas "may well be better placed in a separate genus altogether" (Kantvilas & Vezda 2000: 348). These two species were said to differ from the type species in having, at least in part, dark pigmented layers in the proper exciple (vs. hyaline proper exciple), a reddish reaction of the ascospores with iodine (vs. amyloid ascospores), and the presence of depsidones (vs. secondary metabolites lacking). Consequently Kalb (2001) restudied the generic circumscription of *Topeliopsis* and found that *Topeliopsis* s. str. differed in ascospores, being thin-walled (and non-amyloid, i.e. not reacting blue in iodine) in *T. rugosa* and *T. toensbergii* and thick-walled and amyloid in *Topeliopsis* s.str. He suggested to exclude the two deviating species from *Topeliopsis* and suggested they "probably belong to another undescribed genus" (Kalb 2001: 325), but did not suggested any nomenclatural consequences. Given the molecular support of analysis 2, the isolated position of these two species and the unique combination of morphological characters within thelotrematoid taxa, the new genus *Melanotopelia* is introduced here (see part 2. 9. 6., the formal description of the genus will be done elsewhere).

Myriotrema in the current circumscription was also polyphyletic in the study by Frisch & al. (2006) and the results of analysis 1 confirm that its circumscription is in need of revision and additional data are necessary to evaluate its distinction from *Ocellularia*. The latter genus is currently poorly understood, our results confirm previous results that found this genus to be polyphyletic (Frisch & al., 2006, Lumbsch & al. 2004). *Stegobolus* has already been shown by Frisch & al. (2006) to be polyphyletic.

In *Thelotrema*, a core group of *Thelotrema* s. str. can be recognized in all of the three analyses. This group largely agrees with the *T. lepadinum* group of Salisbury (1972) and *Thelotrema* subgen. *Thelotrema* of Matsumoto (2000). It is characterized by ascomata of the thelotremoid s. str. type as described in part 2. 5. 2. In analysis 1 it forms a sister group to *T. crespoae* and *T. gallowayanum* (within the clade P), in analysis 2 it is sister to *T. weberi* and

T. porinaceum in the *Thelotrema* sub-group of clade D, in analysis 3 it is resembled by the taxa of the clades B to G. The above mentioned taxa *T. crespoae, T. gallowayanum, T. weberi and T. porinaceum* (all but *T. weberi* included in the basal clade A of analysis 3), differ from the *Thelotrema* s. str. group by a perithecioid-thelotremoid type ascomata morphology (as described in part 2. 5. 2.). In addition, most of this species have large, muriform ascospores and either lack secondary metabolites or contain the norstictic acid chemosyndrome. However, these characters do also apply for *T. saxatile* and – to some extend – to *T. monosporum*, two species that cluster within the *Thelotrema* s. str. clades of analyses 1 and 3.

In the analyses 1 and 2, five *Thelotrema* species cluster elsewhere (*T. bicinctulum T. glaucopallens, T. myriocarpum, T. rugatulum, T. zebrinum*). Some of those have morphological characteristics deviating from *Thelotrema*. The myriotremoid *Thelotrema glaucopallens* was already segregated as *T. glaucopallens*-group by Frisch (2006), without formally describing a separate genus, based on a fused to incompletely free exciple and the lack of lateral paraphyses. *"Thelotrema" zebrinum* is a member of the *Leptotrema schizoloma*-group, which is a rather well defined group of taxa that differ from the other members of *Thelotrema* by regenerating, distinctly layered ascomata and a carbonized exciple (see also part 2. 9. 13.). This group probably forms an independent genus, but further studies are needed to evaluate its systematic position. However, *T. bicinctulum, T. myriocarpum* and *T. rugatulum* fit morphologically into *Thelotrema* and their phylogenetic placement requires additional studies.

In analysis 3, within the six well supported clades (clades B-G) of *Thelotrema* s. str., the two taxa of clade B (*T. capetribulense* and *T. porinoides*) agree in having emergent ascomata with a free proper exciple, transversely septate, hyaline, thick-walled, amyloid ascospores, and both contain the stictic acid chemosyndrome. The species of the clades C, D and F, *T. diplotrema, T. nureliyum* and *T. subtile* belong to a group of morphologically similar species, but also three species of clade E, viz. *T. defossum*, *T. pseudosubtile* and *T. suecicum* belong to this difficult to separate group. They share a similar thallus morphology, lack secondary metabolites and have hyaline, thick-walled, transversally septate ascospores. The other two taxa of clade E, *T. lepadinum* and *T. rugatulum* differ in having muriform ascospores. The distinction of *T. subtile* and *T. suecicum* as discussed by Purvis & al. (1995), which were treated as synonyms (Salisbury, 1972), is supported in our phylogenetic study. Also supported by the molecular results is the distinction of the new species *T. pseudosubtile*, which differs from *T. subtile* merely by subtle morphological differences and a more tropical distribution (see also under these species). It is assumed, that beyond the Australian collections from which it is currently only known, specimens from other tropical locations exist that were identified as *T. subtile*. Further, clade G includes four species that lack secondary metabolites and have brown – at least when mature – ascospores. One species has transversally septate ascospores, while eumuriform species are more common in this clade. This group includes some species, such as *T. monosporum* and *T. saxatile*, which are morphologically similar and due to different concepts of their circumscription, there was considerable confusion about the application of these names (Frisch & al. 2006).

4. References

Acharius, E. (1789) Lichenographia Svecicae Prodromus. *Lincopiae* 24.

Acharius, E. (1803) *Methodus qua omnes detectos lichenes secundum organa carpomorpha ad genera, species et varietates redigere atque observationibus illustrare tentavit*. Stockholm.

Acharius, E. (1804) Beiträge zum Methodus Lichenum. *In*: Weber, F. & Mohr, D.M.H. (eds.): *Archiv für die systematische Naturgeschichte 1*. Leipzig, pp. 83-110.

Acharius, E. (1812a) Anmärkningar vid Laf-Släget Thelotrema, med noga bestämmande åf dess arter. *Nova Acta Reg. Acad. Sci. Holmiae* 33: 79-95.

Altschul, S.F., Gish, W., Miller, W., Myers, E.W. & Lipman, D.J. (1990) Basic local alignment search tool. *J. Mol. Biol.* 215: 403-410.

Andersen, H.L. & Ekman, S. (2004) Phylogeny of the Micareaceae inferred from nrSSU DNA sequences. *Lichenologist* 36: 27–35.

Archer, A. (2000) The lichen genera *Phaeographis* and *Phaeographina* (Graphidaceae) in Australia. 1: Species based on Australian type specimens. *Telopea* 8: 461-475.

Armstrong, R.A. (1988) Substrate colonization, growth, and competition. *In:* Galun, M. (ed.) *CRC Handbook of Lichenology Volume II*. CRC Press, Inc., Boca Raton, pp. 3-16.

Asahina,Y. (1931) Materials for a lichen flora of Japan I. *The Saito Gratitude Foundation, Sendai*: 1-94. 23 pl. pp.

Awasthi, D.D. (1991) A key to the microlichens of India, Nepal and Sri Lanka. *Bibl. Lichenol*. 40: 1-332.

Barlow, B.A. (1981) The Australian flora: its origin and evolution. *In*: Robertson, R., Briggs, B. G., Eichler, H., Pedley, L., Ross, J.H., Symon, D.F. & Wilson, P.G. (eds.) *Flora of Australia*. 1: 25-75.

Beadle, N.C.W. (1981) *The Vegetation of Australia. Vegetationsmonographien der einzelnen Großräume* 4: 1-690.

Brodo, I.M. (1973) Substrate ecology. *In*: Ahmadjian, V. & Hale, M.E. (eds.) *The Lichens*. Academic Press, New York and London, pp. 401-441.

Brodo, I.M. (1978) Changing concepts regarding chemical diversity in lichens. *Lichenologist* 10: 1-11.

Büdel, B. & Scheidegger, C. (1996) Thallus morphology and anatomy. *In*: Nash III, T.H. (ed.) *Lichen Biology*. Cambridge, pp. 37-64.

Buschbom, J. & Mueller, G. (2004) Resolving evolutionary relationships in the lichen-forming genus *Porpidia* and related allies (Porpidiaceae, Ascomycota). *Molec. Phylog. Evol.* 32: 66–82.

Caceres, M.E. (2007) Corticolous crustose and microfoliose lichens of northeastern Brazil. *Libri Botanici Anici 22*. IHW-Verlag, Eching.

Coppins, B.J. & Wolseley, P. (2002) Lichens of tropical forests. *In:* Watling, R., Frankland, J.C., Ainsworth, A.M., Isaac, S. Robinson, C.H. (eds.) *Trop. Mycol. Vol. 2, Micromycetes*. CABI Publishing, Wallingford, pp. 113-131.

Crespo, A., Lumbsch, H.T., Mattsson, J.E., Blanco, O., Divakar, P.K., Articus, K., Wiklund, E., Bawingan, P.A. & Wedin, M. (2007) Testing morphology-based hypotheses of phylogenetic relationships in Parmeliaceae (Ascomycota) using three ribosomal markers and the nuclear *RPB-1* gene. *Molec. Phylog. Evol.* 44: 812-824.

Culberson, C.F. (1986) Biogenetic relationships of the lichen substances in the framework of systematics. *Bryologist* 89: 91-98.

Culberson, W.L. (1969) The use of chemistry in the systematics of the lichens. *Taxon* 18: 152-166.

Culberson, W.L. & Culberson, C.F. (1970) A phylogenetic view of chemical evolution in the lichens. *Bryologist* 73: 1-31.

Culberson, W.L. & Culberson, C.F. (1994) Secondary metabolites as a tool in ascomycete systematics: lichenized fungi. *In*: Hawksworth, D.L. (ed.) Ascomycete Systematics. Problems and Perspectives in the Nineties. *NATO Advanced Science Institutes Series*, Plenum Press, New York, pp. 155-163.

David, J.C. & Hawksworth, D.L. (1995) Lichens of Mauritius I: some new species and records. *Bibl.. Lichenol.* 57: 93-111.

Döring, H., Clerc, P., Grube, M. & Wedin, M. (2000) Mycobiont specific PCR primers for the amplification of nuclear ITS and LSU rDNA from lichenised ascomycetes. *Lichenologist* 32: 200-204.

Ekman, S. (2001) Molecular phylogeny of the Bacidiaceae (Lecanorales, lichenized Ascomycota). *Mycol. Res*. 105: 783–797.

Ekman, S. & Jørgensen, P.M. (2002) Towards a molecular phylogeny for the lichen family Pannariaceae (Lecanorales, Ascomycota). *Canad. J. Bot.* 80: 625–634.

Ekman, S. & Wedin, M. 2000. The phylogeny of the families Lecanoraceae and Bacidiaceae (lichenized Ascomycota) inferred from nuclear SSU rDNA sequences. *Plant Biol.* 2: 350–360.

Elix, J.A. (1993) Progress in the generic delimitation of *Parmelia* sensu lato lichens (Ascomycotina: Parmeliaceae) and a synoptic key to the Parmeliaceae. *Bryologist* 96: 359-383.

Elix, J.A., Johnston, J. & Armstrong, P.M. (1986) A revision of the lichen genus *Xanthoparmelia* in Australasia. *Bull. Brit. Mus. (Nat. Hist.), Bot. Ser* 15: 163-362.

Elix, J.A., Lumbsch, H.T. & Wardlaw, J.H. (1995) Conhypoprotocetraric acid, a new lichen ß-orcinol depsidone. *Aust. J. Chem.* 48: 1479-1483.

Elix, J.A., Wardlaw, J.H. & Kalb, K. (2000c) Subpsoromic acid, a new depsidone from the lichen *Ocellularia praestans*. *Aust. J. Chem*. 53: 813-814.

Eriksson, O.E. (ed.) (2006) Outline of Ascomycota. *Myconet* 12: 1-82.

Eriksson, O.E., Baral, H.-O., Currah, R.S., Hansen, K., Kurtzman, C.P., Rambold, G. & Laessøe, T. (eds.) (2003) Outline of Ascomycota. *Myconet* 9: 1-89.

Esslinger, T.L. 1(977) A chemosystematic revision of the brown Parmeliae. *Jour. Hattori Bot. Lab*. 42: 1-211.

Esslinger, T.L. (1989) Systematics of *Oropogon* (Alectoriaceae) in the New World. *Sys. Bot. Monogr*. 28: 1-111.

Fée, A.L. (1824) *Méthode lichénographique et genera*. Paris.

Fée A.L. (1825) *Essai sur les cryptogames des écorces exotiques officinales.* Paris.

Fée A.L. (1837) *Essai sur les cryptogames des écorces exotiques officinales, Supplément et révision.* Paris, Strasbourg.

Feige, G.B. & Lumbsch, H.T. (1995) Some types of chemical variation in lichens. *Crypt. Bot.* 5: 31-35.

Felsenstein, J. (1985) Confidence limits on phylogenies: an approach using the bootstrap. *Evolution* 39: 783–791.

Frisch, A. (2006) Contributions towards a new systematics of the lichen family Thelotremataceae. I. The lichen family Thelotremataceae in Africa. A revision with special consideration of the taxa from Cameroon and Tanzania. *Bibl. Lichenol.* 92: 3-370.

Frisch, A. & Kalb, K. (2006a) The lichen *Topeliopsis*, additions and corrections. *Lichenologist* 38: 37-45.

Frisch, A. & Kalb, K. (2006b) Contributions towards a new systematics of the lichen family Thelotremataceae. II. A monograph of Thelotremataceae with a complex structure of the columella. *Bibl. Lichenol.* 92: 371-516.

Frisch, A., Kalb, K. & Grube, M. (2006) Contributions towards a new systematics of the lichen family Thelotremataceae. III. Molecular phylogeny of the Thelotremataceae. A study based on Bayesian analysis of mitochondrial 16S rDNA gene data. *Bibl. Lichenol.* 92: 517-539.

Galloway, D.J. (1985) *Flora of New Zealand Lichens.* P. D. Hasselberg, Government Printer, Wellington.

Galloway, D.J. (ed.) (1991) Tropical lichens: Their Systematics, Conservation, and Ecology. *Sys. Ass. Spec. Vol. 43*. Clarendon Press, Oxford.

Galloway, D.J. (2001) *Thelotrema macrocarpum* C.W. Dodge belongs in *Chroodiscus*. *Australasian Lichenology* 49: 16-17.

Gilenstam, G. (1969) Studies in the lichen genus *Conotrema. Ark. Bot.* 2: 149-179.

Grube, M., Baloch, E. & Lumbsch, H.T. (2004) The phylogeny of Porinaceae (Ostropomyetidae) suggests neotenic origin of perithecia in Lecanoromycetes. *Mycol. Res.* 108: 1111-1118.

Guderley, R. & Lumbsch, H.T. (1996) The lichen genus *Diploschistes* in South Africa. *Mycotaxon* 58: 269-292.

Hale, M.E. (1974a) Studies on the lichen family Thelotremataceae part 2. *Phytologia* 27: 490-501.

Hale, M.E. (1974b) Morden-Smithsonian Expedition to Dominica: The lichens (Thelotremataceae). *Smithsonian Contr. Bot.* 16: 1-46.

Hale, M.E. (1975) Studies on the lichen family Thelotremataceae part 3. *Mycotaxon* 3: 173-181.

Hale, M.E. (1978b) A revision of the lichen family thelotremataceae in Panama. *Smithsonian Contributions to Botany* 38: 1-60.

Hale, M.E. (1980) Generic delimitation in the lichen family Thelotremataceae. *Mycotaxon* 11: 130-138.

Hale, M.E. (1981) A revision of the lichen family Thelotremataceae in Sri Lanka. *Bull. Brit. Mus. (Nat. Hist.), Bot. Ser.* 8: 227-332.

Harris, R.C. (1990) *Some Florida lichens*. Publ. by the author. Bronx, N.Y.

Harris, R.C. (1995) *More Florida Lichens. Including the 10ø Tour of the Pyrenolichens*. Publ. by the Author, Bronx, N.Y.

Hawksworth, D.L. (1976) Lichen chemotaxonomy. *In*: Brown, D.H., Hawksworth, D.L. & Bailey, R.H. (eds.) *Lichenology: Progress and Problems*. Academic Press, London, pp. 139-184.

Helms, G., Friedl, T. & Rambold, G. (2003) Phylogenetic relationships of the Physciaceae inferred from rDNA sequence data and selected phenotypic characters. *Mycologia* 95: 1078–1099.

Henssen, A. (1976) Studies in the developmental morphology of lichenized ascomycetes. *In*: Brown, D.H., Hawksworth, D.L. & Bailey, R.H. (eds.), *Lichenology: Progress and Problems*. Academic Press, London, pp. 107-138.

Henssen, A. (1995) Apothecial structure and development in *Protoparmelia badia* (Parmeliaceae s. lat.). *In*: Daniëls, F.J.A., Schulz, M. & Peine, J. (eds.) *Flechten Follmann. Contributions to lichenology in Honour of Gerhard Follmann.* Geobot. & Phytotaxon. Study Grp., Bot. Inst., Univ. of Cologne, Cologne, pp. 55-62.

Henssen, A. & Jahns, H.M. (1973) *Lichenes*. Thieme, Stuttgart.

Homchantara, N. & Coppins, B.J. (2002) New species of the lichen family Thelotremataceae in SE Asia. *Lichenologist* 34: 113-140.

Huelsenbeck, J.P. & Ronquist, F. (2001) MRBAYES: Bayesian inference of phylogenetic trees. *Bioinformatics* 17: 754–755.

Huelsenbeck, J.P., Ronquist, F., Nielsen, R. & Bollback, J.P. (2001) Bayesian inference of phylogeny and its impact on evolutionary biology. *Science* 294: 2310–2314.

Huneck, S. & Yoshimura, I. (1996) *Identification of Lichen Substances*. Springer-Verlag, Berlin, Heidelberg.

Janex-Favre, M.-C. (1964) Sur les ascocarpes, les asques et la position systématiquedes Lichens du genere *Graphis*. *Rev. Bryol. Lichenol.* 33: 242-284.

Jatta, A. (1911) Lichenes lecti in Tasmania a W. Weymouth. *Bull. Soc. bot. Ital.* 1911: 253-260.

Kalb, K. (2001) The lichen genus *Topeliopsis* in Australia and remarks on Australian Thelotremataceae. *Mycotaxon* 79: 319-328.

Kalb, K. (2004) New or otherwise interesting lichens II. *Bibl. Lichenol.* 88: 301-329.

Kalb, K. & Staiger, B. (2000) *Dyplolabia* Massalongo. Monographie einer vergessenen Flechtengattung. *Hoppea* 61: 409-422.

Kalb, K., Staiger, B. & Elix, J.A. (2004) A monograph of the lichen genus *Diorygma* - a first attempt. *Symbolae Bot. Upsal.* 34: 133-181.

Kantvilas, G. (1988) Tasmanian rainforest communities: a preliminary classification. *Phytocoenologia* 16: 391-428.

Kantvilas, G. (1990) Succession in rainforest lichens. *Tasforests* 2: 167-170.

Kantvilas, G. & James, P.W. (1991) Records of crustose lichens from Tasmanian rainforest. *Mycotaxon* 41: 271-286.

Kantvilas, G. & Jarman, S.J. (1988) Lichens of buttongrass (*Gymnoschoenus*) moorland in Tasmania. *Pap. Proc. Roy. Soc. Tasmania* 122: 1-17.

Kantvilas, G. & Jarman, S.J. (1991) Lichens and bryophytes of the Tasmanian World Heritage Area. I. Mount Sprent. *In*: Banks, M.R., Smith, S.J., Orchard, A.E. & Kantvilas, G. (eds.) *Aspects of Tamanian Botany - A Tribute to Winifred Curtis*. Roy. Soc. Tasmania, Hobart, pp. 149-162.

Kantvilas, G. & Minchin, P.R. (1989) An analysis of epiphytic lichen communities in Tasmanian cool temperate rainforest. *Vegetatio* 84: 99-112.

Kantvilas, G. & Vezda, A. (2000) Studies on the lichen family Thelotremataceae in Tasmania. The genus *Chroodiscus* and its relatives. *Lichenologist* 32: 325-357.

Karplus, K., Barrett, C. & Hughey, R. (1998) Hidden Markov Models for Detecting Remote Protein Homologies. *Bioinformatics* 14: 846-856.

Kauff, F. & Lutzoni, F. (2002) Phylogeny of the Gyalectales and Ostropales (Ascomycota, Fungi): among and within order relationships. *Molec. Phylog. Evol.* 25: 138-156.

Kirk, P.M. & Aansell, A.E. (1992) Authors of fungal names. A list of authors of scientific names of fungi, with recommended standard forms of their names including abbreviations. *Index of Fungi, Supplement*. C.A.B. International, Wallingford.

Krempelhuber, A. (1875) Lichenes quos legit O. Beccari in Insulis Borneo et Singapore annis 1866 et 1867. *Nuovo Giorn. Bot. Ital.* 7: 5-66.

Lakatos, M., Rascher, U. & Büdel, B. (2006) Functional characteristics of corticolous lichens in the understory of a tropical lowland rain forest. *New Phytologist* 172: 679-695.

Lamarck, M.M. & De Candolle, A. (1805) *Flore française ou descriptions succinctes de toutes les plantes qui croissent naturellement en France : disposées selon une nouvelle Méthode d'Analyse, et précédées par un Exposé des Principes élémentaires de la Botanique*, ed. 3, 2: I-XII, 1-600.

Larget, B. & Simon, D. L. (1999) Markov chain Monte Carlo algorithms for the Bayesian analysis of phylogenetic trees. *Molec. Biol. Evol.* 16: 750–759.

Lücking, R. (1992a) Foliicolous Lichens - a contribution to the knowledge of the lichen flora of Costa Rica, Central America. *Beih. Nova Hedwigia* 104: 1-179.

Lücking, R. & Grube, M. (2002) Facultative parasitism and reproductive strategies in *Chroodiscus* (Ascomycota, Ostropales). *Stapfia* 80: 267-292.

Lücking, R. & Kalb, K. (2000) Foliikole Flechten aus Brasilien (vornehmlich Amazonien), inklusive einer Checkliste und Bemerkungen zu *Coenogonium* und *Dimerella* (Gyalectaceae). *Bot. Jahrb. Syst.* 122: 1-61.

Lücking, R., Stuart, B.L. & Lumbsch, H.T. (2004) Phylogenetic relationships of Gomphillaceae (Ascomycota): evidence from a combined Bayesian analysis of nuclear and mitochondrial sequences. *Mycologia* 96: 283-294.

Lumbsch, H.T. (1985) The lichen genus *Diploschistes* in the Southern Hemisphere. *DSIR Bot. Div. Newsl., Suppl.* 2: 9-10.

Lumbsch, H.T. (1989) Die holarktischen Vertreter der Flechtengattung *Diploschistes* (Thelotremataceae). *Journ. Hattori Bot. Lab.* 66: 133-196.

Lumbsch, H.T. (1994) Die *Lecanora subfusca*-Gruppe in Australasien. *Journ. Hattori Bot. Lab.* 77: 1-175.

Lumbsch, H.T. (1998a) Taxonomic use of metabolic data in lichen-forming fungi. *In*: Frisvad, J.C., Bridge, P.D. & Arora, D.K.. (eds.): *Chemical Fungal Taxonomy*. Marcel Dekker, Inc., New York, pp. 345-387.

Lumbsch, H.T. (1998b) The use of metabolic data in lichenology at the species and subspecific levels. *Lichenologist* 30: 357-367.

Lumbsch, H.T. (2000) Phylogeny of filamentous ascomycetes. *Naturwissenschaften* 87: 335-342.

Lumbsch, H.T. (2002) Analysis of phenolic products in lichens for identification and taxonomy. *In*: Kranner, I., Beckett, R.P. & Varma, A.K. (eds.): *Protocols in Lichenology. Culturing, Biochemistry, Ecophysiology and Use in Biomonitoring.* Springer-Verlag, Berlin, Heidelberg, pp. 281-295.

Lumbsch, H.T. (2007) Recent Trends in Phylogeny and Classification of Lichen-forming Ascomycetes. *In*: Ganguli, B.N. & Deshmukh, S.K. (eds.): *Fungi: Multifaceted Microbes*. Anamaya, New Delhi, pp. 153-168.

Lumbsch, H.T. & Elix, J.A. (2003) The lichen genus *Diploschistes* (Thelotremataceae) in Australia. *Bibl. Lichenol.* 86: 119-128.

Lumbsch, H.T. & Vezda, A. (1990) Beiträge zur Kenntnis der foliikolen Flechten australischer Regenwälder I. *Nova Hedwigia* 50: 245-254.

Lumbsch, H.T., Guderley, R. & Feige, G.B. (1997) Ascospore septation in *Diploschistes* (Thelotremataceae, lichenized Ascomycota) and the taxonomic significance of macro- and microcephalic ascospore types. *Pl. Syst. Evol.* 205: 179-184.

Lumbsch, H.T., Lindemuth, R. & Schmitt, I. (2000) Evolution of filamentous ascomycetes inferred from LSU rDNA sequence data. *Plant Biology* 2: 525-529

Lumbsch, H.T., Schmitt, I. & Messuti, M.I. (2001a) Utility of nuclear SSU and LSU rDNA data sets to discover the ordinal placement of the Coccotremataceae (Ascomycota). *Org. Divers. Evol*. 1: 99-112.

Lumbsch, H.T., Schmitt, I., Palice, Z., Wiklund, E., Ekman, S. & Wedin, M. (2004) Supraordinal phylogenetic relationships of lichen-forming discomycetes (Lecanoromycetes) based on a combined Bayesian analysis of nuclear and mitochondrial sequences. *Molec. Phylog. Evol.* 31: 822-832.

Lumbsch, H.T., Mangold, A., Lücking, R., Garcia, M.A. & Martin, M.P. (2004a) Phylogenetic position of the genera *Nadvornikia* and *Pyrgillus* (Ascomycota) based on molecular data. *Symbol. Bot. Upsal*. 34,1: 9-17.

Lumbsch, H.T., Mangold, A., Messuti, M.I. & Lücking, R. (2008) A taxonomic revision of Thelotremataceae (Ostropales, Ascomycota) in Subantartic regions excluding Tasmania. *Bot. J. Linn. Soc.* In press.

Lutzoni, F., Kauff, F., Cox, C.J., McLaughlin, D., Celio, G., Dentinger, B., Padamsee, M., Hibbett, D., James, T.Y., Baloch, E., Grube, M., Reeb, V., Hofstetter, V., Schoch, C., Arnold, A.E., Miadlikowska, J., Spatafora, J., Johnson, D., Hambleton, S., Crockett, M., Shoemaker, R., Sung, G.H., Lücking, R., Lumbsch, H.T., O'Donnell, K., Binder, M., Diederich, P., Ertz, D., Gueidan, C., Hall, B., Hansen, K., Harris, R.C., Hosaka, K., Lim, Y.W., Liu, Y., Matheny, B., Nishida, H., Pfister, D., Rogers, J., Rossman, A., Schmitt, I., Sipman, H., Stone, J., Sugiyama, J., Yahr, R. & Vilgalys, R. (2004) Where are we in assembling the fungal tree of life, classifying the fungi, and understanding the evolution of their subcellular traits? *Amer. Journ. Bot.* 91: 1446-1480.

Magnusson, A.H. & Zahlbruckner, A. (1943) Hawaiian Lichens I. The families Verrucariaceae to Peltigeraceae. *Ark. Bot.* 32 A: 1-89.

Makhija, U. & Patwardhan, P.G. (1995) Nomenclatural notes on some species of *Arthothelium* (lichenized Ascomycotina). *Trop. Bryol.* 10: 205-213.

Mangold, A., Elix, J.A. & Lumbsch, H.T. (2006) The *Myriotrema wightii* group in Australia. *Nova Hedwigia* 83: 275-292.

Mangold, A., Elix, J.A. & Lumbsch, H.T. (2007a) The norstictic acid containing *Thelotrema* species in Australia. *Bibl. Lichenol.* 95: 459-470.

Mangold, A., Elix, J.A. & Lumbsch, H.T. (2007b) *Ocellularia* species with a cone-shaped columella in Australia. *Bibl. Lichenol.* In press.

Martín, M.P., LaGreca, S., Schmitt, I. & Lumbsch, H.T. (2003) Molecular phylogeny of *Diploschistes* inferred from ITS sequence data. *Lichenologist* 35: 27-32.

Massalongo, A.B. (1860) Esame comparativo di alcuni generi di Licheni. *Atti Reale Ist. Veneto Sci. Lett. Arti.* ser. 3 (5): 247-276, 313-337.

Matsumoto, T. (2000) Taxonomic studies of the Thelotremataceae (Graphidales, lichenized Ascomycota) in Japan (1) Genus *Thelotrema. J. Hattori Bot. Lab.* 88: 1-50.

Matsumoto, T. & Deguchi, H. (1999) Pycnidial structures and genus concept in the Thelotremataceae. *Bryologist* 102: 86-91.

Mattsson, J.-E. & Wedin, M. (1999) A re-assessment of the family Alectoriaceae. *Lichenologist* 31: 431–440.

McCarthy, P.M. (2007), Checklist of the Lichens of Australia and its Island Territories. ABRS, Canberra. Version 18. December 2007: http://www.anbg.gov.au/abrs/lichenlist/introduction.html.

Meyer, G.F.W. (1825) *Nebenstunden meiner Beschaefftigungen im Gebiete der Pflanzenkunde. Erster Theil*. Göttingen.

Miadlikowska, J., Kauff, F., Hofstetter, V., Fraker, E., Grube, M., Hafellner, J., Reeb, V., Hodkinson, B.P., Kukwa, M., Lücking, R., Hestmark, G., Garcia Otalora, M., Rauhut, A., Büdel, B., Scheidegger, C., Timdal, E., Stenroos, S., Brodo, I.M., Perlmutter, G., Ertz, D., Diederich, P., Lendemer, J.C., Tripp, E., Yahr, R., May, P., Gueidan, C., Arnold, E.A., Robertson, C. & Lutzoni, F. (2006) New insights into classification and evolution of the Lecanoromycetes (Pezizomycotina, Ascomycota) from phylogenetic analyses of three ribosomal RNA- and two protein-coding genes. *Mycologia* 98: 1088-1103.

Montagne, C. (1845) Plantae Cellulares quae in Insulis Philippinensibus a cl. Cumming collectae recensuit. *J. Bot. London* 4(3): 3-11.

Montagne, C. & Van Den Bosch, R. (1855) Lichenes. *In*: Miquel, F.A.W. (ed.) *Plantae Junghuhnianae.* Fasc. IV, Lugduni-Batavorum, pp. 427-494.

Müller Arg., J. (1882) Lichenologische Beiträge 16. *Flora* 65: 483-490, 499-505, 515-519.

Müller Arg., J. (1887a) Lichenologische Beiträge 26. *Flora* 70: 268-273, 283-288, 316-322, 336-338, 396-402, 423-429.

Müller Arg., J. (1887) Graphideae Féeanae. *Mém. Soc. Phys. Hist. Nat. Genève* 29: 1-80.

Müller Arg., J. (1888a) Lichenes Paraguayenses. *Rev. Mycol.* 10: 53-68, 113-120, 177-184.

Müller Arg., J. (1890) *Lichenes epiphylli novi*. Basel.

Müller Arg., J. (1891a) Lichenes Victoryenses. *Nuovo Giorn. Bot. Ital*. 23: 276-279.

Müller Arg., J. (1891b) Lichenes Bellendenici. *Hedwigia* 30: 47-56.

Müller Arg., J. (1892) Lichenes Knightiani. *Bull. Soc. Roy. Bot. Belgique* 31: 22-42.

Müller Arg., J. (1893a) Lichenes Exotici II. *Hedwigia* 32: 120-136.

Müller Arg., J. (1893b) Lichenes Africani in variis territoriis germanicis recenter lecti. *Bot. Jb.* 15: 509-510.

Müller Arg., J. (1894) Conspectus systematicus lichenum Novae Zelandiae, quem elaboravit. *Bull. Herb. Boissier* 2, app. 1: 1-114.

Müller Arg., J. (1895d) Sertum Australienses.species novae Australienses Thelotremearum, Graphidearum et Pyrenocarpearum. *Bull. Herb. Boissier* 3(7):

Nagarkar, M.B. & Hale, M.E. (1989) New species in the lichen family Thelotremataceae from Asia (Ascomycotina). *Mycotaxon* 35: 437-447.

Nagarkar, M.B., Sethy, P.K. & Patwardhan, P.G. (1986) Materials for a lichen flora of the Andaman Islands-I. *Mycotaxon* 27: 71-82.

Nagarkar, M.B., Sethy, P.K. & Patwardhan, P.G. (1987) Materials for a lichen flora of the Andaman Islands-V. *Mycotaxon* 29: 335-343.

Nagarkar, M.B., Sethy, P.K. & Patwardhan, P.G. (1988) Lichen genus *Ocellularia* (Family Thelotremataceae) from India. *Biovigyanam* 14: 24-43.

Nakanishi, M. (1966) Taxonomical studies on the family Graphidaceae of Japan. *Jour. Sci. Hiroshima Univ*., Ser. B, Div. 2 (Bot.) 11: 51-126.

Nylander, J.A.A., Ronquist, F., Huelsenbeck, J.P. & Nieves-Aldrey, J.L. (2004) Bayesian phylogenetic analysis of combined data. *Syst. Biol.* 53: 47-67.

Nylander, W. (1858) Énumération générale des lichens, avec l'indication sommaire de leur distribution géographique. *Mém. Soc. Impér. Sci. Nat. Cherbourg* 5: 85-146.

Nylander, W. (1859) Lichenes in regionibus exoticis quibusdam vigentes. *Ann. Sci. Nat., Bot.*, sér. 4, 11: 203-264.

Nylander, W. (1861a) Lichenes Scandinaviae. *Notiser Sällsk. Fauna Fl. Fennica Förhandl*. 5: 1-313.

Nylander, W. (1862) Conspectus generis Thelotrematis. *Ann. Sci. Nat., Bot.,* sér. 4, 16: 95-96.

Nylander, W. (1864) Circa G. W. Koerberi Reliquias Hochstetterianas. *Flora* 47: 266-270.

Nylander, W. (1867b) Novae explorationes Lichenum Neo-Caledoniae. *Flora* 50: 193-197.

Nylander, W. (1888) *Lichenes Novae Zelandiae.* P. Schmidt, Paris.

Page, R.D.M. (1996) Treeview: an application to display phylogenetic trees on personal computers. *Comp. Appl. Biosci.* 12: 357–358.

Pant, G. & Awasthi, D.D. (1989) Caliciales from India and Nepal. *Biovigyanam* 15: 3-27.

Patwardhan, P.G. & Kulkarni, C.R. (1977a). Some new taxa of the family Thelotremataceae from Western Ghats, SW India. *Norweg. J. Bot*. 24: 127-131.

Patwardhan, P.G. & Kulkarni, C.R. (1977b) A contribution to our knowledge of the lichen flora of India. I. Family Thelotremataceae. *Kawaka* 5: 1-17.

Patwardhan, P.G. & Nagarkar, M.B. (1980) Notes on some lichens from north east India II: family Thelotremataceae. *Biovigyanam* 6: 1-10.

Patwardhan, P.G., Sethy, P.K. & Nagarkar, M.B. (1985) A contribution to our knowledge of the lichen family Thelotremataceae from South India. *Biovigyanam* 11: 133-140.

Poelt , J. (1989) Die Entstehung einer Strauchflechte aus einem Formekreis krustiger Verwandter. *Flora* 183: 65-72.

Poelt, J. & Vezda, A. (1981) Bestimmungsschlüssel europäischer Flechten. Ergänzungsheft II. - *Bibl. Lichenol.* 16: 1–390.

Purvis, O.W., Jørgensen, P-M. & James, P.W. (1995) The lichen genus *Thelotrema* Ach. in Europe. *Bibl. Lichenol*. 58: 335-360.

Räsänen, V. (1949) Lichenes novi. 5. *Arch. Soc. Zool. Bot. Fenn.* 3: 178-188.

Redinger, K. (1936) Thelotremaceae brasilienses. *Ark. Bot.* 28 A: 1-122.

Reeb, V., Lutzoni, F. & Roux, C. (2004) Contribution of RPB2 to multilocus phylogenetic studies of the Pezizomycotina (Euascomycetes, Fungi) with special emphasis on the lichen-forming Acarosporaceae and evolution of polyspory. *Molec. Phylog. Evol.* 32: 1036-1060.

Rodríguez, F., Oliver, J.F., Martín, A. & Medina, J.R. (1990) The general stochastic model of nucleotide substitution. *J. Theor. Biol.* 142: 485–501.

Rogers, R.W. (1989) Chemical variation and the species concept in lichenized ascomycetes. *Bot. Journ. Linn. Soc*. 101: 229-239.

Salisbury, G. (1971) *Thelotrema wightii* (T. Tayl.) Nyl. *Portugaliae Acta Biol. (B)* 11: 35-37.

Salisbury, G. (1972a) *Thelotrema* Ach. sect. *Thelotrema*. 1. The *T. lepadinum* group. *Lichenologist* 5: 262-274.

Salisbury, G. (1972b) *Thelotrema* sect. *Thelotrema* 2. The *T. platycarpum* group. *Rev. Bryol. Lichénol.* 38: 281-290.

Salisbury, G. (1978) *Thelotrema* Achariana et Feeana. *Nova Hedwigia* 29: 405-427.

Santesson, R. (1952) Foliicolous lichens I. A revision of the taxonomy of the obligately foliicolous, lichenized fungi. *Symbolae Bot. Upsal.* 12: 1-590.

Schmidt, H.A., Strimmer, K., Vingron, M. & von Haeseler, A. (2002) TREE-PUZZLE: maximum likelihood phylogenetic analysis using quartets and parallel computing. *Bioinformatics* 18: 502-504.

Schmitt, I. & Lumbsch, H.T. (2001) Identification of the photobionts in *Trapeliopsis* and *Pertusaria* using SSU ribosomal DNA sequences obtained from PCR amplification with a non-green-algal primer. *Mycotaxon* 78: 407-411.

Schmitt, I., Yamamoto, Y. & Lumbsch, H.T. (2006) Phylogeny of Pertusariales (Ascomycotina): resurrection of Ochrolechiaceae and new circumscription of Megasporaceae. *J. Hattori Bot. Lab.* 100: 753-764.

Sethy, P.K., Nagarkar, M.B. & Patwardhan, P.G. (1987) Materials for a lichen flora of the Andaman Islands III. *Mycotaxon* 28: 191-198.

Shimodaira, H. & Hasegawa, M. (2000) Multiple comparisons of log-likelihoods with applications to phylogenetic inference. *Molec. Biol. Evol.* 16: 1114-1116.

Shirley, J. (1889b) The lichen flora of Queensland, part III. - *Proc. Roy. Soc. Queensland* 6: 129-145, 165-218.

Sipman, H.J.M. (1992a) Result of a botanical expedition to Mount Roraima, Guyana II. Lichenes. *Trop. Bryol*. 5: 79-108.

Sipman, H.J.M. (1992b) Results of a lichenological and bryological exploration of Cerro Guaiquinima (Guyana Highland, Venezuela). *Trop. Bryol.* 6: 1-33.

Sipman, H.J.M. (1993) Lichens from Mt. Kinabalu.*Trop. Bryol.* 8: 281-314.

Sipman, H.J.M. (1994) New Graphidales (lichenized Ascomycotina) from the Guianas and nearby areas. Studies on the flora of the Guianas no. 79. *Acta Bot. Fenn*. 150: 165-172.

Sipman, H.J.M. & Harris, R.C. (1989) Lichens. *In:* Lieth, H. & Werger M.J.A. (eds.): *Tropical Rain Forest Ecosystems*. Elsevier Science Publishers B.V., Amsterdam, pp. 303-309.

Specht, R.L. (1970) Vegetation, *In*: Leeper, G.W. (ed.) *The Australian Environment.* Melb. Uni. Press. & CSIRO, pp. 44-67.

Specht, R. L., 1981b. Ecophysical principles determining the biogeography of major vegetation formations in Australia. In: Keast, A., (ed.),Ecological Biogeography of Australia, Dr. W. Junk, Hague. pp301-333.

Specht, R.L. & Specht A. (1999) *Australian Plant Communities. Dynamics of Structure, Growth and Biodiversity.* Oxford University Press.

Staiger, B. (2002) Die Flechtenfamilie Graphidaceae. Studien in Richtung einer natürlicheren Gliederung. *Bibl. Lichenol.* 85: 1-526.

Staiger, B., Kalb, K. & Grube, M. (2006) Phylogeny and phenotypic variation in the lichen family Graphidaceae (Ostropomycetidae, Ascomycota). *Mycol. Res.* 110: 765-772.

Stevens, G.N. (1987) The lichen genus *Ramalina* in Australia. *Bull. Brit. Mus. (Nat. Hist.), Bot. Ser.* 16: 107-223.

Stirton, J. (1881) Additions to the lichen flora of Queensland. *Trans. Roy. Soc. Victoria* 17: 66-78.

Stizenberger, E. (1862) Beitrag zur Flechtensystematik. *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1861/1862: 124-182.

Strimmer, K. & Rambaut, A. (2002) Inferring confidence sets of possibly misspecified gene trees. *Proceed. Royal Soc. London, Ser. Biol. Sci.* 269: 137-142.

Swofford, D.L. (2003) *PAUP*. Phylogenetic Analysis Using Parsimony (*and other methods).* Sinauer Associates, Sunderland, Massachussetts.

Thompson, J.D., Higgins, D.G. & Gibson, T.J. (1994) Clustal W: improving the sensitivity of progressive multiple sequence alignment through sequence weighting, position-specific gap penalties and weight matrix choice. *Nucl. Acids Res.* 22: 4673–4680.

Tibell, L. (1984) A reappraisal of the taxonomy of Caliciales. *Nova Hedwigia*, Beih. 79: 597-713.

Tibell. L. (1996) *Caliciales.* Flora Neotropica, vol. 69, New York.

Trevisan, V. (1853a) Caratteri essenziali di dodici nuovi generi di licheni. *Spighe e Paglie* 1: 5-20.

Tuckerman, E. (1867) Lichenes of the Hawaiian Islands. *Proc. Amer. Acad. Arts and Sci.* 7: 223-234.

Tuckerman, E. (1872) Genera Lichenum: an Arrangement of the North American Lichens. *Amherst*, III-XV, 1-283.

Tuckerman, E. (1882) *A synopsis of the North American lichens: Part I., comprising the Parmeliacei, Cladoniei, and Coenogoniei*. Boston.

Vainio, E.A. (1921) Lichenes insularum Philippinarum III. - *Ann. Acad. Sci. Fenn.* A 15: 1-368.

Vezda, A. (1992) *Lichenes Rariores Exsiccati. Fasciculus tertius* 21-30. Brno.

Vilgalys, R. & Hester, M. (1990) Rapid genetic identification and mapping of enzymatically amplified ribosomal DNA from several *Cryptococcus* species. *Journ. Bacteriol.* 172: 4238-4246.

Walter, H. & Breckle, S.-W. (1991): *Ökologie der Erde. Band 2, Spezielle Ökologie der Tropischen und Subtropischen Zonen.* Fischer, Stuttgart.

Wedin, M., Döring, H., Nordin, A. & Tibell, L. (2000) Small subunit rDNA phylogeny shows the lichen families Caliciaceae and Physciaceae (Lecanorales, Ascomycotina) to form a monophyletic group. *Can. J. Bot*. 78: 246–254.

Wedin, M., Baloch, E. & Grube, M. (2002) Parsimony analyses of mtSSU and nITS rDNA sequences reveal the natural relationships of the lichen families Physciaceae and Caliciaceae. *Taxon* 51: 655–660.

Wedin, M., Wiklund, E., Crewe, A., Döring, H., Ekman, S., Nyberg, Å., Schmitt, I. & Lumbsch, H.T. (2005) Phylogenetic relationships of Lecanoromycetes (Ascomycota) as revealed by analyses of mtSSU and nLSU rDNA sequence data. *Mycol. Res.* 109: 159-172.

Wilson, F.R.M. (1893) The lichens of Victoria, par I. *Proc. Roy. Soc. Victoria* 5: 141-177.

Winka, K., Ahlberg, C. & Eriksson, O.E. (1998) Are there lichenized Ostropales? *Lichenologist* 30: 455-462.

Wirth, M. & Hale, M.E. (1978) Morden-Smithsonian Expedition to Dominica: the lichens (Graphidaceae). *Smith. Contr. Bot*. 40: 1-64.

Zahlbruckner, A. (1905) Thelotremaceae and Diploschistaceae. *Natürliche Pflanzen-familien, 1. Teil, Abt. 1: Lichenes (Flechten).* Leipzig.

Zahlbruckner, A. (1907) Die Flechten der Samoa-Inseln. *Denkschr. Kaiserl. Akad. Wiss. Wien, math.-naturw. Kl.* 81: 26-91.

Zahlbruckner, A. (1924) Die Flechten der Juan-Fernandez-Inseln. *In*: Skottsberg, C. (ed.) *The natural history of Juan Fernandez and Easter Island,* 2 (Botany), 3(11). Uppsala, pp. 315-498.

Zahlbruckner, A. (1927) Additamenta ad Lichenographiam Japoniae. *Bot. Mag. Tokyo* 41: 314-364.

Zhou, S. & Stanosz, G.R. (2001) Primers for amplification of mt SSU rDNA, and a phylogenetic study of *Botryosphaeria* and associated anamorphic fungi. *Mycol. Res.* 105: 1033-1044.

Zoller, S., Scheidegger, C. & Sperisen, C. (1999) PCR primers for the amplification of mitochondrial small subunit ribosomal DNA of lichen-forming ascomycetes. *Lichenologist* 31: 511–516.

5. Appendices

5. 1. Tentatively identified species

Thelotrema* cf. *floridense Harris

Some Florida Lichens: 98 (1990). Type: USA, Florida, Liberty County, *Harris 1480* (US-holotype).

Although it appears to be a characteristic species with a whitish, ecorticate thallus, regenerating ascomata with incurved, free exciple that is conspicuously raised above the hymenium, small, hyaline transversely septate ascospores and the psoromic acid chemosyndrome, the Hale collection from northern Queensland (see below) could not be identified with certainty since the type material was not available for study. So far *T. floridense* has not been reported from outside Florida. The Australian specimen agrees well with the description, however, it differs in ±split thalline rim margins. The identification is therefore tentative.

SPECIMENS EXAMINED – Australia, Queensland: Near end of Black Mnt. Rd., 33 km WNW of Kuranda, *Hale 831909* (US).

5. 2. Excluded or dubious names

Ascidium attenuatum C. Knight

Trans. New Zealand Inst. 15: 354 (1883). Phaeotrema attenuatum (Knight) Müll.Arg., Bull. Herb. Boissier, 2: 74 (1894). Thelotrema attenuatum (Knight) Hellb., Bihang till Kgl. Svensk. Vetensk.-Akad. Handl. vol. 21, 3(13): 78 (1896). Type: New Zealand, sine loco, *C. Knight* s.n. (WELT!-lectotype, selected by Galloway [1985: 575] – without specimen, only drawing present).

This name was considered synonymous to *T. monosporum* (Galloway, 1985). However, the type does not include a specimen but only a drawing of a single ascospore (selected as the type by Galloway) is available. Hence, *A. attenuatum* is here regarded as a *nomen dubium*.

Chroodiscus mirificus (Kremp.) R.Sant.

The report of this taxon from Australia (Lumbsch & Vezda, 1990) was based on erroneously identified collections of *C. parvisporus*. *Chroodiscus mirificus* is thus far not known from Australia.

Conotremopsis weberiana Vezda

Folia Geobot. Phytotax. 12: 314 (1977).

This genus, which was listed as Thelotremataceae in McCarthy (2007) is currently placed in Stictidaceae (Eriksson, 2006).

Leptotrema lepadodes* var. *endochrysoides (Jatta) Zahlbr.

Cat. Lich. Univ. 2: 636 (1923). Thelotrema lepadodes var. endochrysoides Jatta, Boll. Soc. Bot. Ital. 1910: 256 (1911). Type: Australia, Tasmania, "Ad trunctum Pomaderris in monte Wellington, alt. 500 p." (?NAP).

The type of this variation was not available for study, although the herbarium in NAP was contacted.

Leptotrema nitidulum Müll.Arg.

Bull. Herb. Boissier 3: 315 (1895). Type: Australia, Queensland, 1887, *Knight 22* (G!-holotype).

This is a hitherto unpublished synonym of *Stegobolus confluens* (Kremp.) Mangold comb. nov. ined.

Myriotrema microphthalmum (Müll.Arg.) Nagarkar & Hale

Mycotaxon 35: 440 (1989). Bas.: Thelotrema microphthalmum Müll.Arg., Bull. Herb. Boissier 3: 314 (1895). Type: Australia, Queensland, "Brisbane Shrubs", *Bailey 773* (G!-holotype; BRI-'Shirley Book', [p. 22, n. 18]!-isotype).

This is a hitherto unpublished synonym of *Ocellularia thelotremoides* (Leight.) Zahlbr.

Myriotrema minutulum (Hale) Hale

Mycotaxon 11: 134 (1980). Bas.: Ocellularia minutula Hale, Smithson. Contr. Bot. 38: 24 (1978). Type: Panama, Canal Zone, Hale 43341 (US!-holotype).

This taxon is not accepted as *Myriotrema* (=*Ocellularia minutula* Hale, acc. to Mangold & al. ined.).

Thelotrema australiense Müll.Arg.

Flora 70: 61 (1887). Type: Australia, New South Wales, Richmond River, *Hodgkinson* s.n. (M!-lectotype, selected by Hale [1970 in herb.]).

This is a hitherto unpublished synonym of *Ocellularia thelotremoides* (Leight.) Zahlbr.

Myriotrema microporellum (Nyl.) Hale

The report of this taxon (McCarthy, 2007, as 'Australian records'), was based on erroneously identified collections of *Ocellularia thelotremoides*. *Myriotrema microporellum* is thus far not known from Australia.

Thelotrema depressum Mont. {=***Ocelularia depressa*** (Mont.) Hale, [non *O. depressa* Müll.Arg. =*O. cavata* (Ach.) Müll.Arg., (syn. nov.)]}

The collection, on which the report of this taxon (Shirley, 1889b) is based on (Australia, Queensland, "On bark, 3-mile Shrub"), was not available. According to Shirley's description (ibid.), however, the collection differs from the type of this species.

Thelotrema expansum C.Knight [***Phaeotrema expansum*** (C.Knight) Shirley]

This is a hitherto unpublished synonym of *Phaeographis lobata* (Eschw.) Müll.Arg.

Thelotrema inturgescens Müll.Arg. [in McCarthy (2007) as "*T. intergescens*"]

This taxon is transferred to *Ocellularia* [=*Ocellularia inturgescens* (Müll.Arg.) Mangold comb. nov. ined.].

Thelotrema puniceum (Müll.Arg.) Makhija & Patw. [***Chapsa punicea*** (Müll.Arg.) Caceres & Lücking]

This taxon is transferred to *Ocellularia* [=*Ocellularia punicea* (Müll.Arg.) Mangold comb. nov. ined.].

Thelotrema rimulosum Müll.Arg.

This taxon is transferred to *Hemithecium* [=*Hemithecium* rimulosa (Müll. Arg.) Mangold, Lumbsch & Kalb comb. nov. ined.].

Thelotrema subgranulosum Jatta

Boll. Soc. Bot. Ital. 1910: 256 (1911). Type: Australia, Tasmania, Mt. Wellington, *s. col.* [NAP- no reply from herbarium].

The type of this taxon was not available for study.

Thelotrema trypethelioides C.Knight ex F.M.Bailey [***Phaeotrema trypethelioides*** (C.Knight ex F.M.Bailey) Shirley].

This is a hitherto unpublished synonym of *Stegobolus fissus* (Nyl.) A.Frisch.

Tremotylium australiense Müll.Arg. / ***Tremotylium nitidulum*** Müll.Arg.

Material of these species was not examined. The genus *Tremotylium* was transferred to *Minksia* (Roccellaceae) by Makhija & Patwardhan (1995) based on the type species *Tremotylium angolense* (=*Minksia angolensis*).

5. 3. List of synonyms

The following is a list of all accepted synonyms of the present treatment, alphabetically arranged after the genus name of the basionym:

Anthracothecium oligosporum Müll.Arg.	=*Leucodecton compunctellum*
Ascidium manosporum Knight	=*Thelotrema saxatile*
A. octolocularis Knight	=*Thelotrema bicinctulum*
Endocarpon baileyi Stirt.	=*Leptotrema wightii*
Graphis phlyctidea Vain.	=*Chapsa leprieurii*
G. subnivescens Nyl.	=*Chapsa leprieurii*
Leptotrema aemulum Müll. Arg.	=*Thelotrema lepadodes*
L. albocoronata Knight	=*Thelotrema leucophthalmum*
L. bisporum Szatala	=*Thelotrema lepadodes*
L. compunctum var. *purpuratum* Müll. Arg.	=*Leucodecton occultum*
L. deceptum Hale	=*Leucodecton compunctellum*
L. diffractum Müll. Arg.	=*Leucodecton subcompunctum*
L. inclusum Zahlbr.	=*Leucodecton subcompunctum*
L. mastoideum Müll.Arg.	=*Reimnitzia santensis*
L. nitidulum Müll.Arg.	=*Stegobolus confluens*
L. polycarpum Müll.Arg.	=*Leucodecton subcompunctum*
L. polyporum Riddle	=*Myriotrema phaeosporum*
Leucodecton biokense A. Frisch	=*Leucodecton compunctellum*
Myriotrema decorticatum Hale	=*Leucodecton subcompunctum*
M. multicavum Hale	=*Myriotrema rugiferum*
M. nuwarense Hale	=*Leucodecton compunctellum*
M. subcostaricense Sipman	=*Myriotrema glaucophaenum*
Ocellularia alba var. caesiascens Räs.	=*Chapsa astroidea*
O. annulosa Müll.Arg.	=*Thelotrema lacteum*
O. bonplandiae var. *obliterata* Müll. Arg.	=*Thelotrema suecicum*
O. costaricensis Müll. Arg.	=*Myriotrema glaucophaenum*
O. cricota F.Wilson	=*Thelotrema lacteum*
O. demersa Müll.Arg. [nom. nov. pro *Pyrenula clandestina* Fée]	=*Thelotrema bicinctulum*
O. galactina Zahlbr.	=*Myriotrema microporum*
O. jugalis Müll.Arg.	=*Thelotrema subtile*
O. platychlamys Müll. Arg.	=*Thelotrema porinoides*
O. turgidula Müll. Arg.	=*Thelotrema diplotrema*
O. zeorina Müll.Arg.	=*Thelotrema lacteum*
Phaeotrema apertum C. W. Dodge	=*Chapsa platycarpa*
P. consimile Müll.Arg.	=*Thelotrema lacteum*
Thelotrema aemulans Kremp.	=*Thelotrema lepadinum*

T. albescens Vain.	=*Chapsa indica*
T. albidiforme Leight.	=*Thelotrema porinoides*
T. argenteum Müll.Arg.	=*Fibrillithecis halei*
T. australiense Müll.Arg.	=*Ocellularia thelotremoides*
T. clandestinum f. *remanens* Nyl.	=*Myriotrema clandestinum*
T. colobicum Nyl.	=*Chapsa leprocarpa*
T. compunctum f. *portoricensis* Vain.	=*Leucodecton occultum*
T. compunctum var. *antillarum* Vain.	=*Leucodecton occultum*
T. compunctum var. *praiense* Vain.	=*Leucodecton occultum*
T. confluens Vain.	=*Chapsa leprieurii*
T. crassulum Nyl.	=*Myriotrema microporum*
T. diminitum Hale	=*Fibrillithecis halei*
T. disciforme Leight.	=*Thelotrema lepadodes*
T. dissultum Hale	=*Thelotrema cupulare*
T. elachistoteron Leight.	=*Leucodecton compunctellum*
T. emergens Vain.	=*Myriotrema glaucophaenum*
T. exalbidum Stirt.	=*Thelotrema pachysporum*
T. exanthismocarpum Leight.	=*Thelotrema porinoides*
T. expansum C. Knight	=*Phaeographis lobata*
T. flavescens Darb.	=*Thelotrema lepadinum*
T. galactinum Vain.	=*Thelotrema pachysporum*
T. gibbosum H. Magn.	=*Fibrillithecis halei*
T. heterosporum C. Knight	=?*Reimnitzia santensis* (see under this species for details)
T. homothecium Vain.	=*Thelotrema porinoides*
T. hypomelaenum Müll. Arg.	=*"Leptotrema" schizoloma*
T. indicum Hale	=*Topeliopsis muscigena*
T. irosinum Vain.	=*Myriotrema desquamans*
T. laevius Vain.	=*Myriotrema trypaneoides*
T. leucastrum Tuck.	=*Chapsa leprieurii*
T. leucastrum var. *difforme* Tuck.	=*Chapsa leprieurii*
T. leucohymenium Zahlbr.	=*Myriotrema viridialbum*
T. leucophthalmum var. *lacerata* Räs.	=*Chapsa megalophthalma*
T. limae Vain.	=*Thelotrema pachysporum*
T. microglaenoides Vain.	=*Leucodecton compunctellum*
T. microphthalmum Müll.Arg.	=*Ocellularia thelotremoides*
T. monospermum Harris	=*Thelotrema saxatile*
T. monosporoides Nyl.	=*Thelotrema saxatile*
T. monosporum var. *patulum* Nyl.	=*Thelotrema lepadodes*
T. monosporum var. *subgemium* Nyl.	=*Leucodecton compunctellum*
T. myrioporoides Müll. Arg.	=*Myriotrema viridialbum*
T. obconicum Raes.	=*Thelotrema lepadinum*
T. obovatum Stirt.	=*Thelotrema porinoides*
T. pachystomum ssp. *piluliferum* Tuck.	=*Fibrillithecis halei*
T. palmense Vain.	=*Thelotrema pachysporum*
T. platycarpellum Vain.	=*Chapsa astroidea*
T. platycarpoides Tuck.	=*Chapsa platycarpa*
T. platysporum Harm.	=*Fibrillithecis halei*
T. pycnophragmium Nyl.	=*Chapsa indica*
T. ravenelii Tuck.	=*Leptotrema wightii*
T. reclusum Kremp.	=*Leucodecton compunctellum*

T. rimulosum Müll.Arg.	=*Hemithecium* rimulosa
T. sitianum Vain.	=*Thelotrema lacteum*
T. steyermarkii Hale	=*Myriotrema viridialbum*
T. subcaesium Nyl.	=*Myriotrema rugiferum*
T. subconcretum Leight.	=*Leptotrema wightii*
T. subcrassulum Vain.	=*Myriotrema olivaceum*
T. subterebrans Nyl.	=*Myriotrema trypaneoides*
T. terebrans Nyl.	=*Thelotrema bicinctulum*
T. terebratulum Nyl.	=*Myriotrema clandestinum*
T. trypethelioides C.Knight	=*Stegobolus fissus*
T. vernicosum Zahlbr.	=*Fibrillithecis halei*
Topeliopsis corticola Kalb	=*Topeliopsis decorticans*
T. muscicola Kantv. & Vezda	=*Topeliopsis muscigena*
T. vezdae Kalb	=*Topeliopsis subdenticulata*
Tylophoron diplotylium Nyl.	=*Nadvornikia hawaiensis*
Urceolaria compuncta Ach.	=*Leucodecton occultum*

LEBENSLAUF

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Berlin, 26.01.2008

Erklärung:

Hiermit erkläre ich, gem. § 6 Abs. 2, Nr. 6 der Promotionsordnung der Math.-Nat.-Fachbereiche zur Erlangung des Dr. rer. nat., dass ich die vorliegende Dissertation selbständig verfasst und mich keiner anderen als der angegebenen Hilfsmittel bedient habe.

Essen, den ________________ ______________________________

Erklärung:

Hiermit erkläre ich, gem. § 6 Abs. 2, Nr. 7 der Promotionsordnung der Math.-Nat.-Fachbereiche zur Erlangung des Dr. rer. nat., dass ich das Arbeitsgebiet, dem das Thema *“Taxonomic studies on members of thelotrematoid Ostropales (lichenized Ascomycota) in Australia”* zuzuordnen ist, in Forschung und Lehre vertrete und den Antrag von *Armin Mangold* befürworte.

Essen, den ________________ ____________________________________

Erklärung:

Hiermit erkläre ich, gem. § 6 Abs. 2, Nr. 8 der Promotionsordnung der Math.-Nat.-Fachbereiche zur Erlangung des Dr. rer. nat., dass ich keine anderen Promotionen bzw. Promotionsversuche in der Vergangenheit durchgeführt habe und dass diese Arbeit von keiner andern Fakultät abgelehnt worden ist.

Essen, den ________________ _________________________