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a signature of undiscovered global diversity

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One hundred new species of lichenized fungi: a signature of undiscovered global diversity

H. THORSTEN LUMBSCH[1*], TEUVO AHTI[2], SUSANNE ALTERMANN[3], GUILLERMO AMO DE PAZ[4], ANDRÉ APTROOT[5], ULF ARUP[6], ALEJANDRINA BÁRCENAS PEÑA[7], PAULINA A. BAWINGAN[8], MICHEL N. BENATTI[9], LUISA BETANCOURT[10], CURTIS R. BJÖRK[11], KANSRI BOONPRAGOB[12], MAARTEN BRAND[13], FRANK BUNGARTZ[14], MARCELA E. S. CÁCERES[15], MEHTMET CANDAN[16], JOSÉ LUIS CHAVES[17], PHILIPPE CLERC[18], RALPH COMMON[19], BRIAN J. COPPINS[20], ANA CRESPO[4], MANUELA DAL-FORNO[21], PRADEEP K. DIVAKAR[4], MELIZAR V. DUYA[22], JOHN A. ELIX[23], ARVE ELVEBAKK[24], JOHNATHON D. FANKHAUSER[25], EDIT FARKAS[26], LIDIA ITATÍ FERRARO[27], EBERHARD FISCHER[28], DAVID J. GALLOWAY[29], ESTER GAYA[30], MIREIA GIRALT[31], TREVOR GOWARD[32], MARTIN GRUBE[33], JOSEF HAFELLNER[33], JESÚS E. HERNÁNDEZ M.[34], MARÍA DE LOS ANGELES HERRERA CAMPOS[7], KLAUS KALB[35], INGVAR KÄRNEFELT[6], GINTARAS KANTVILAS[36], DOROTHEE KILLMANN[28], PAUL KIRIKA[37], KERRY KNUDSEN[38], HARALD KOMPOSCH[39], SERGEY KONDRATYUK[40], JAMES D. LAWREY[21], ARMIN MANGOLD[41], MARCELO P. MARCELLI[9], BRUCE MCCUNE[42], MARIA INES MESSUTI[43], ANDREA MICHLIG[27], RICARDO MIRANDA GONZÁLEZ[7], BIBIANA MONCADA[10], ALIFERETI NAIKATINI[44], MATTHEW P. NELSEN[1, 45], DAG O. ØVSTEDAL[46], ZDENEK PALICE[47], KHWANRUAN PAPONG[48], SITTIPORN PARNMEN[12], SERGIO PÉREZ-ORTEGA[4], CHRISTIAN PRINTZEN[49], VÍCTOR J. RICO[4], EIMY RIVAS PLATA[1, 50], JAVIER ROBAYO[51], DANIA ROSABAL[52], ULRIKE RUPRECHT[53], NORIS SALAZAR ALLEN[54], LEOPOLDO SANCHO[4], LUCIANA SANTOS DE JESUS[15], TAMIRES SANTOS VIEIRA[15], MATTHIAS SCHULTZ[55], MARK R. D. SEAWARD[56], EMMANUËL SÉRUSIAUX[57], IMKE SCHMITT[58], HARRIE J. M. SIPMAN[59], MOHAMMAD SOHRABI[2, 60], ULRIK SØCHTING[61], MAJBRIT ZEUTHEN SØGAARD[61], LAURENS B. SPARRIUS[62], ADRIANO SPIELMANN[63], TOBY SPRIBILLE[33], JUTARAT SUTJARITTURAKAN[64], ACHRA THAMMATHAWORN[65], ARNE THELL[6], GÖRAN THOR[66], HOLGER THÜS[67], EINAR TIMDAL[68], CAMILLE TRUONG[18], ROMAN TÜRK[69], LOENGRIN UMAÑA TENORIO[17], DALIP K. UPRETI[70], PIETER VAN DEN BOOM[71], MERCEDES VIVAS REBUELTA[4], MATS WEDIN[72], SUSAN WILL-WOLF[73], VOLKMAR WIRTH[74], NORA WIRTZ[75], REBECCA YAHR[20], KUMELACHEW YESHITELA[28], FRAUKE ZIEMMECK[14], TIM WHEELER[76], ROBERT LÜCKING[1]

(full contract addresses of 103 authors on pages 3–5)

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Full contact addresses and emails of 103 authors

[1]*Department of Botany, The Field Museum, 1400 South Lake Shore Drive, Chicago, Illinois 60605-2496, U.S.A. Corresponding author, e-mail: tlumbsch@fieldmuseum.org. *Other e-mail addresses see footnote.*
[2]*Botanical Museum, P. O. Box 7, FI-00014, Helsinki University, Finland.*
[3]*Department of Ecology and Evolutionary Biology, University of California, Santa Cruz, California 95064, U.S.A.*
[4]*Universidad Complutense de Madrid, Departamento de Biología Vegetal II, Plaza de Ramón y Cajal s/n, 28040 Madrid, Spain.*
[5]*ABL Herbarium, G. v. d. Veenstraat 107, NL-3762 XK Soest, The Netherlands.*
[6]*Botanical Museum, Lund University, Östra Vallgatan 18, SE-223 61 Lund, Sweden.*
[7]*Universidad Nacional Autónoma de México (UNAM), Instituto de Biología, Departamento de Botánica, Apdo. Postal 70-233, Coyoacán 04360, México D.F., Mexico.*
[8]*College of Natural Sciences, Saint Louis University, Baguio City, The Philippines.*
[9]*Instituto de Botânica, Núcleo de Pesquisa em Micologia, Caixa Postal 3005, 01031-970, São Paulo, Brazil.*
[10]*Licenciatura en Biología, Universidad Distrital Francisco José de Caldas, Cra. 4 No. 26B-54, Torre de Laboratorios, Herbario, Bogotá, Colombia.*
[11]*Stillinger Herbarium, University of Idaho, Moscow, Idaho 83843, U.S.A.*
[12]*Biology Department, Faculty of Science, Ramkhamhaeng University, Hua Mak, Bangkok 10240, Thailand.*
[13]*Klipperwerf 5, NL-2317 DX Leiden, The Netherlands.*
[14]*Fundación Charles Darwin, Puerto Ayora, Santa Cruz, Galápagos, Ecuador; mailing address: Charles Darwin Foundation for the Galápagos Islands, Av. 6 de Diciembre N 36-109 y Pasaje California, Post Box 17-01-3891, Quito, Ecuador.*
[15]*Departamento de Biociências, Universidade Federal de Sergipe, CEP: 49.500-00, Itabaiana, Sergipe, Brazil.*
[16]*Department of Biology, Faculty of Science, Anadolu University, 26470 Eskişehir, Turkey.*
[17]*Laboratorio de Hongos, Instituto Nacional de Biodiversidad (INBio), Apdo. 22-3100, Santo Domingo de Heredia, Costa Rica.*
[18]*Conservatoire et Jardin botaniques, Case postale 60, CH-1292 Chambésy/Genève, Switzerland.*
[19]*534 Fenton St., Lansing, Michigan 48910, U.S.A.*
[20]*Royal Botanic Garden, Edinburgh, EH3 5LR, Scotland, U.K.*
[21]*Department of Environmental Science and Policy, George Mason University, Fairfax, Virginia 22030-4444, U.S.A.*
[22]*Conservation International Philippines, Number 6 Maalalahangin Street, Teachers Village, Diliman 1101, Quezon City, The Philippines.*
[23]*Research School of Chemistry, Building 33, Australian National University, Canberra, ACT 0200, Australia.*
[24]*Tromsø University Museum, University of Tromsø, N-9037 Tromsø, Norway.*
[25]*Department of Plant Biology, University of Minnesota, St. Paul, MN 55108, U.S.A.*
[26]*Institute of Ecology and Botany, Hungarian Academy of Sciences, H-2163 Vácrátót, Hungary.*
[27]*Instituto de Botánica del Nordeste (IBONE), Casilla del Correo 209, 3400 Corrientes, Argentina.*
[28]*Institute for Integrated Natural Sciences, Department of Biology, University of Koblenz-Landau, Universitätstraße 1, D-56070 Koblenz, Germany.*
[29]*Landcare Research, Private Bag 1930, Dunedin 9054, New Zealand.*
[30]*Department of Plant Biology (Botany Unit), Facultat de Biologia, Universitat de Barcelona, Av. 7 Diagonal 645, 08028 Barcelona, Spain.*
[31]*Departament de Bioquímica i Biotecnologia (Àrea de Botànica), Facultat d'Enologia de Tarragona, Universitat Rovira i Virgili, Marcellí Domingo s/n, 43007, Tarragona, Spain.*
[32]*Herbarium, Department of Botany, University of British Columbia, Vancouver, British Columbia V6G 2B1, Canada; mailing address: Edgewood Blue, Box 131, Clearwater, British Columbia V0E 1N0, Canada.*
[33]*Institut für Pflanzensystematik, Universität Graz, Holteigasse 6, A-8010 Graz, Austria.*
[34]*Fundación Instituto Botánico de Venezuela, División de Plantas no Vasculares, Sección Hongos y Líquenes, Ave. Salvador Allende, Jardín Botánico de Caracas, Universidad Central de Venezuela, Apartado # 2156, Caracas 1010-A, Venezuela.*
[35]*Lichenologisches Institut Neumarkt, Im Tal 12, D-92318 Neumarkt, Germany.*
[36]*Tasmanian Herbarium, GPO Box 252-04, Hobart, Tasmania 7001, Australia.*
[37]*Botany Department, East Africa Herbarium, National Museums of Kenya, Nairobi, Kenya.*
[38]*The Herbarium, Deptartment of Botany & Plant Sciences, University of California, Riverside, California 92521, U.S.A.*
[39]*OIKOS – Institute for Applied Ecology and Basic Research, Hartbergerstr. 40, 8200 Gleisdorf, Austria.*
[40]*M. G. Kholodny Institute of Botany, Tereschenkivs'ka 2, 252601 Kiev-4, Ukraine.*
[41]*Ossastrasse 6, D-12045 Berlin, Germany.*
[42]*Department of Botany and Plant Pathology, Oregon State University, 2082 Cordley Hall, Corvallis, Oregon 97331-2902, U.S.A.*

[43]*Instituto de Investigaciones en Biodiversidad y Medioambiente (INIBIOMA) – CONICET, Universidad del Comahue, Quintral 1250, 8400 Sán Carlos de Bariloche, Río Negro, Argentina.*
[44]*Institute of Applied Science, Faculty of Science and Technology, University of the South Pacific, Private Bag, Laucala Campus, Suva, Fiji.*
[45]*Committee on Evolutionary Biology, University of Chicago, 1025 E. 57th Street, Chicago, Illinois 60637, U.S.A.*
[46]*Bergen Museum, DNS, P.O.Box 7803, 5020 Bergen, Norway.*
[47]*Institute of Botany, Czech Academy of Science, CZ-252 43 Pruhonice & Department of Botany, Faculty of Natural Sciences, Charles University, Benátská 2, CZ-128 01 Prague, Czech Republic.*
[48]*Department of Biology and Natural Medicinal Mushroom Museum, Faculty of Science, Mahasarakham University Khamrieng, Kantarawichai Maha Sarakham Province, 44150 Thailand.*
[49]*Department of Botany and Molecular Evolution, Forschungsinstitut Senckenberg, Senckenberganlage 25, D-60325 Frankfurt am Main, Germany.*
[50]*Department of Biological Sciences, University of Illinois-Chicago, 845 West Taylor Street (MC 066), Chicago, Illinois 60607, U.S.A.*
[51]*Coordinador del Bosque Protector Río Guajalito, Mariana de Jesús E6-09 y Hungría, Quito, Ecuador.*
[52]*Departamento de Biología. Universidad de Oriente. Patricio Lumumba s/n, CP. 90500 Cuba.*
[53]*Fachbereich Organismische Biologie, Universität Salzburg, Hellbrunnerstrasse 34, 5020 Salzburg, Austria.*
[54]*Smithsonian Tropical Research Institute, Box 0843-03092, Balboa, Ancon, Panama.*
[55]*Biocenter Klein Flottbek and Botanical Garden, University of Hamburg, Ohnhorststrasse 18, D-22609 Hamburg, Germany.*
[56]*Department of Environmental Science, The University, Bradford, Yorkshire, BD7 1DP, England, U.K.*
[57]*Plant Taxonomy & Conservation Biology Unit, University of Liège, Sart Tilman B22, B-4000 Liège, Belgium*
[58]*Biodiversity and Climate Research Centre (BiK-F), Goethe University and Senckenberg, Senckenberganlage 25, D-60325 Frankfurt, Germany.*
[59]*Botanischer Garten & Botanisches Museum Berlin Dahlem, Königin-Luise-Strasse 6–8, D-14195 Berlin, Germany;*
[60]*Department of Plant Science, University of Tabriz, 51666, Tabriz, Iran.*
[61]*Department of Biology, University of Copenhagen, Universitetsparken 15, DK-2100 Copenhagen Ø, Denmark.*
[62]*Vrijheidslaan 27, NL-2806 KE Gouda, The Netherlands.*
[63]*Laboratório de Botânica, Departamento de Biologia, Centro de Ciências Biológicas e da Saúde, Universidade Federal de Mato Grosso do Sul, Cidade Universitária, Caixa Postal 549, CEP 79070-900, Campo Grande, Minas Gerais, Brazil.*
[64]*King Mongkut' Institute Of Technology Ladkrabang, Chumphon Campus, 17/1 Moo 6, Chumcho, Patiew, Chumphon, 86160, Thailand.*
[65]*Department of Biology, Faculty of Science, Khon Kaen University, Khon Kaen Province, 40002, Thailand.*
[66]*Department of Ecology, Swedish University of Agricultural Sciences, P.O. Box 7044, SE-750 07 Uppsala, Sweden.*
[67]*Botany Department, Natural History Museum, Cromwell Road, London, SW7 5BD, England, U.K.*
[68]*Natural History Museum, University of Oslo, PO Box 1172 Blindern, N-0318 Oslo, Norway.*
[69]*Fachbereich Organismische Biologie, Universität Salzburg, Hellbrunnerstrasse 34, 5020 Salzburg, Austria.*
[70]*Lichenology Laboratory, National Botanical Research Institute, Rana Pratap Marg, P. B. No. 436, Lucknow-226001, India.*
[71]*Arafura 16, NL-5691 JA Son, The Netherlands.*
[72]*Department of Cryptogamic Botany, Swedish Museum of Natural History, P.O. Box 50007, SE-104 05 Stockholm, Sweden.*
[73]*University of Wisconsin-Madison, Department of Botany, 430 Lincoln Dr., Madison, Wisconsin 53706, U.S.A.*
[74]*Staatliches Museum für Naturkunde, Erbprinzenstr. 13, D-76133 Karlsruhe, Germany.*
[75]*48 Wood Lane, Leeds LS6 2BA, England, U.K.*
[76]*6606 Jocko Canyon Road, Arlee, MT 59821 USA*

**E-mail addresses of authors (resp.): tlumbsch@fieldmuseum.org, teuvo.ahti@helsinki.fi, salter@biology.ucsc.edu, g_amo@farm.ucm.es, andreaptroot@gmail.com, ulf.arup@botmus.lu.se, abarcenas@ibunam2.ibiologia.unam.mx, pbawingan@slu.edu.ph, michel_benatti@yahoo.com.br, macualu@gmail.com, crbjork@gmail.com, kansri@ru.ac.th, fbungartz@fcdarwin.org.ec, mscaceres@hotmail.com, mecandan@anadolu.edu.tr, jchaves@inbio.ac.crm, philippe.clerc@ville-ge.ch, common@msu.edu, lichensEL@btopenworld.com, acrespo@farm.ucm.es, manudalforno@hotmail.com, pdivakar@farm.ucm.es, mvduya@conservation.org, john.elix@anu.edu.au, arve.elvebakk@uit.no, fank0006@umn.edu, efarkas@botanika.hu, itati_liq@yahoo.com.ar, efischer@uni-koblenz.de, gallowayd@xtra.co.nz, eb62@duke.edu, mireia.giralt@urv.cat, tgoward@interchange.ubc.ca, martin.grube@uni-graz.at, josef.hafellner@uni-graz.at, jesus.hernandez@ucv.ve, mahc@ibiologia.unam.mx, klaus.kalb@arcor.de, ingvar.karnefelt@botmus.lu.se, gintaras.kantvilas@tmag.tas.gov.au, killmann@uni-koblenz.de, paulkirika@yahoo.com, knudsen@ucr.edu, harald.komposch@utanet.at, ksya_net@ukr.net, jlawrey@gmu.edu, arminmangold@gmail.com, mpmarcelli@msn.com, bruce.mccune@science.oregonstate.edu, mmessuti@crub.uncoma.edu.ar, andreamichlig@hotmail.com, mirandar_g@yahoo.com.mx, lbmoncada@udistrital.edu.co, naikatini_a@usp.ac.fj, mpnelsen@gmail.com, dag.ovstedal@bm.uib.no, zpalice@yahoo.com, khwanruan.p@msu.ac.th, sparnmen@gmail.com, sperezortega@farm.ucm.es, christian.printzen@senckenberg.de, rico@farm.ucm.es, erivasplata@fieldmuseum.org,*

javierobayo@gmail.com, drl@cnt.uo.edu.cu, ulrike.carl@sbg.ac.at, salazarn@si.edu, sancholg@farm.ucm.es, lucianaufsbio@hotmail.com, tamy_phn@hotmail.com, schultzm@botanik.uni-hamburg.de, m.r.d.seaward@bradford.ac.uk, e.serusiaux@ulg.ac.be, imke.schmitt@senckenberg.de, h.sipman@bgbm.org, mohammad.sohrabi@helsinki.fi, ulriks@bio.ku.dk, mzsogaard@snm.ku.dk, sparrius@biodiv.nl, adrianospielmann@yahoo.com.br, toby.spribille@uni-graz.at, sea_flora@hotmail.com, achara@kku.ac.th, arne.thell@botmus.lu.se, goran.thor@ekol.slu.se, h.thues@nhm.ac.uk, einar.timdal@nhm.uio.no, camille.truong@ville-ge.ch, roman.tuerk@sbg.ac.at, lumana@inbio.ac.cr, upretidk@rediffmail.com, pvdboom@kpnmail.nl, mpvivas@farm.ucm.es, mats.wedin@nrm.se, swwolf@wisc.edu, volkmar.wirth@online.de, norawirtz@googlemail.com, r.yahr@rbge.org.uk, kumeyesh@yahoo.com, frauke.ziemmeck@fcdarwin.org.ec, timothybwheeler@gmail.com, rlucking@fieldmuseum.org.

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Abstract

The number of undescribed species of lichenized fungi has been estimated at roughly 10,000. Describing and cataloging these would take the existing number of taxonomists several decades; however, the support for taxonomy is in decline worldwide. In this paper we emphasize the dire need for taxonomic expertise in lichenology. We bring together 103 colleagues from institutions worldwide to describe a total of 100 new species of lichenized fungi, representing a wide taxonomic and geographic range. The newly described species are: *Acarospora flavisparsa*, *A. janae*, *Aderkomyces thailandicus*, *Amandinea maritima*, *Ampliotrema cocosense*, *Anomomorpha lecanorina*, *A. tuberculata*, *Aspicilia mansourii*, *Bacidina sorediata*, *Badimia multiseptata*, *B. vezdana*, *Biatora epirotica*, *Buellia sulphurica*, *Bunodophoron pinnatum*, *Byssoloma spinulosum*, *Calopadia cinereopruinosa*, *C. editae*, *Caloplaca brownlieae*, *C. decipioides*, *C. digitaurea*, *C. magnussoniana*, *C. mereschkowskiana*, *C. yorkensis*, *Calvitimela uniseptata*, *Chapsa microspora*, *C. psoromica*, *C. rubropulveracea*, *C. thallotrema*, *Chiodecton pustuliferum*, *Cladonia mongkolsukii*, *Clypeopyrenis porinoides*, *Coccocarpia delicatula*, *Coenogonium flammeum*, *Cresponea ancistrosporelloides*, *Crocynia microphyllina*, *Dictyonema hernandezii*, *D. hirsutum*, *Diorygma microsporum*, *D. sticticum*, *Echinoplaca pernambucensis*, *E. schizidiifera*, *Eremithallus marusae*, *Everniastrum constictovexans*, *Fellhanera borbonica*, *Fibrillithecis sprucei*, *Fissurina astroisidiata*, *F. nigrolabiata*, *F. subcomparimuralis*, *Graphis caribica*, *G. cerradensis*, *G. itatiaiensis*, *G. marusa*, *Gyalideopsis chicaque*, *Gyrotrema papillatum*, *Harpidium gavilaniae*, *Hypogymnia amplexa*, *Hypotrachyna guatemalensis*, *H. indica*, *H. lueckingii*, *H. paracitrella*, *H. paraphyscioides*, *H. parasinuosa*, *Icmadophila eucalypti*, *Krogia microphylla*, *Lecanora mugambii*, *L. printzenii*, *L. xanthoplumosella*, *Lecidea lygommella*, *Lecidella greenii*, *Lempholemma corticola*, *Lepraria sekikaica*, *Lobariella sipmanii*, *Megalospora austropacifica*, *M. galapagoensis*, *Menegazzia endocrocea*, *Myriotrema endoflavescens*, *Ocellularia albobullata*, *O. vizcayensis*, *Ochrolechia insularis*, *Opegrapha viridipruinosa*, *Pannaria phyllidiata*, *Parmelia asiatica*, *Pertusaria conspersa*, *Phlyctis psoromica*, *Placopsis imshaugii*, *Platismatia wheeleri*, *Porina huainamdungensis*, *Ramalina hyrcana*, *R. stoffersii*, *Relicina colombiana*, *Rhizocarpon diploschistidina*, *Sticta venosa*, *Sagenidiopsis isidiata*, *Tapellaria albomarginata*, *Thelotrema fijiense*, *Tricharia nigriuncinata*, *Usnea galapagona*, *U. pallidocarpa*, *Verrucaria rhizicola*, and *Xanthomendoza rosmarieae*. In addition, three new combinations are proposed: *Fibrillithecis dehiscens*, *Lobariella botryoides*, and *Lobariella pallida*.

Key words: Darwin declaration, Encyclopedia of Life, Global Taxonomy Initiative, lichens, taxonomy, taxonomic impediment

Introduction

The number of species inhabiting our planet is estimated to be between 2–10 and 30–100 million (May 1988, Curtis *et al.* 2002, Rosenzweig *et al.* 2003). About 2.2 million are recorded, including 400,000 plants, 100,000 fungi (including 17,500 lichens), 1.5 million animals, 200,000 protists, and 10,000 bacteria (Prance *et al.* 2000, Govaerts 2001, Pitman & Jørgensen 2002, Scotland & Wortley 2003, Schloss *et al.* 2004, Williamson & Day 2007, Feuerer & Hawksworth 2007, Kirk *et al.* 2008). The total number of fungi is estimated at 700,000 to 1.5 million species (Hawksworth 1991, 2001, Mueller & Schmit 2007). The majority of the undescribed fungal species are expected in poorly studied areas, such as tropical forests or in under-explored habitats, for example living on or in insects, plants or lichens (Hawksworth & Rossman 1997, Frohlich & Hyde 1999, Taylor *et al.* 2000a, Sipman & Aptroot 2001, Lawrey & Diederich 2003, Arnold & Lutzoni 2007). There is also a growing body of evidence suggesting that the approach to current species recognition, which is based largely on morphology and chemistry, significantly underestimates the number of species. Phylogenetic studies indicate that numerous distinct lineages may be hidden under a single species name (Roy *et al*. 1998, Grube & Kroken 2000, Kroken & Taylor 2001, Koufopanou *et al*. 2001, Peterson *et al.* 2001, Cruse *et al.* 2002, Molina *et al*. 2004, Douhan & Rizzo 2005, Pringle *et al*. 2005, Geml *et al.* 2006, Kauserud *et al.* 2006, Matute *et al.* 2006, Arguello *et al.* 2007b, Giraud *et al.* 2008, Wirtz *et al.* 2008, Baloch & Grube 2009).

Even with a conservative estimate of ten million existing species, including perhaps around one million fungi, the number of eight million remaining undiscovered species, including 900,000 fungi, is mind-boggling. Assuming that modern taxonomic revisions were produced mainly in the past 50 years, it would

take the same number of taxonomists another 200 years to describe the remaining undiscovered species (Hebert *et al.* 2003, Lücking 2009b). This appears an almost impossible task, especially given the rapid and dramatic decline in numbers of employed taxonomists in the past 20 years (Butler *et al.* 1998, Suarez & Tsutsui 2004, Graham 2005). In light of these huge gaps in our knowledge, the shortage of trained taxonomists and museum curators, the *taxonomic impediment* (http://flyaqis.mov.vic.gov.au/chaec/taximp.html) now has a significant negative impact on our ability to manage and utilize our biological diversity. In addition, the advent of molecular phylogeny has created a misleading impression that taxonomy is an outdated discipline. The Barcode of Life initiative (http://www.barcoding.si.edu) is sometimes seen as a way to replace taxonomists by handheld DNA scanners (Hebert *et al.* 2003, Stoeckle 2003). Identification of species using DNA signature sequences is indeed a fascinating concept, but for this to become reality, a huge reference database is required that contains the signature sequences of all species (Lücking 2009b). This is an enormous task that encompasses not only sequencing itself, but also requires targeted collecting, taxonomic revision and assembly of reference voucher collections and with it a large number of well-trained taxonomists who are not only specialists in their respective groups but proficient in a variety of methods, including nomenclature, morphology, and molecular phylogeny, and are capable of attracting and training students.

The task of cataloging our planet's diversity is even more imperative considering estimates that 15–50% of the species will go extinct in the next fifty years due to increasing pressure from a growing world population (Hughes *et al.* 1997, Woodruff 2001, Thomas *et al.* 2004, Pimm *et al.* 2005, Ehrlich & Pringle 2008). We will not only lose biodiversity of unknown ecological and economic importance, we will also alter the dynamic equilibrium of our global ecosystems, something that has happened repeatedly during the long history of our planet, but never within a timeframe of a few hundred years (Ehrlich & Pringle 2008). Global initiatives such as the United Nations Convention on Biological Diversity CBD (http://www.cbd.int), the Darwin Declaration (http://www.environment.gov.au/biodiversity/abrs/publications/other/darwin/index.html), and the Global Taxonomy Initiative GTI (http://www.cbd.int/gti) are attempting to reverse this trend by publicizing the need for increased efforts in cataloging biodiversity before it vanishes, and the need for shifts in human behavior to protect our ecosystems. However, in reality not much is happening to support a sustainable level of well-trained taxonomists; in fact we are in a paradoxical situation where politics has acknowledged a problem that science refuses to deal with appropriately: without proper taxonomic expertise, the sound management of biodiversity is not possible (House Of Lords Report 1991, Aylward *et al.* 1993, Janzen 1993, Systematics Agenda 2000 1994, Graham 2005). Taxonomists therefore must actively make a strategic change to work effectively on the huge task at hand (Janzen 1993, Lücking 2009b). The degree to which collaborative research can be effective in accumulating a huge amount of knowledge in a short time is demonstrated by the National Center for Biotechnology Information, commonly known as GenBank (http://www.ncbi.nlm.nih.gov/guide). Within two decades, it has become the most important resource in biosciences (McEntyre & Lipman 2001). Further, the NSF-funded Tree of Life projects, including AFTOL (*Assembling the Fungal Tree of Life*; http://aftol.org), which began in 2002 and is currently in its second phase until 2011, have been extremely effective in enhancing global collaboration to elucidate the phylogeny of the fungal kingdom (Lutzoni *et al.* 2004, James *et al.* 2006, Matheny *et al.* 2006, Miadlikowska *et al.* 2006, Spatafora *et al.* 2006, Schoch *et al.* 2006, 2009, Hibbett *et al.* 2007).

Traditionally, systematic papers and monographic revisions have just one or a few authors, but the aforementioned collaborative initiatives have initiated a mind-shift with a multi-authored, community-wide classification for the fungal kingdom (Hibbett *et al.* 2007). In addition, the mycological community has several, regularly updated fundamental resources for species and higher level classification and nomenclature available, such as Myconet (http://www.fieldmuseum.org/myconet), Index Fungorum (http://www.indexfungorum.org) and other CABI Bioscience databases, and the *Dictionary of the Fungi* (Kirk *et al.* 2008). The organizing authors of the present paper, H. T. Lumbsch and R. Lücking, extended this successful collaborative concept to promote and organize a community-wide monographic revision of the lichenized fungal family Graphidaceae (http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1025861). This concept has been labelled ATM – Assembling a Taxonomic Monograph. In the present paper, we

elucidate this idea by bringing together 102 colleagues from 35 countries to describe 100 new species of lichenized fungi, representing a wide taxonomic and geographic range covering 33 families of Ascomycota and Basidiomycota and 37 countries around the globe (Fig. 1).

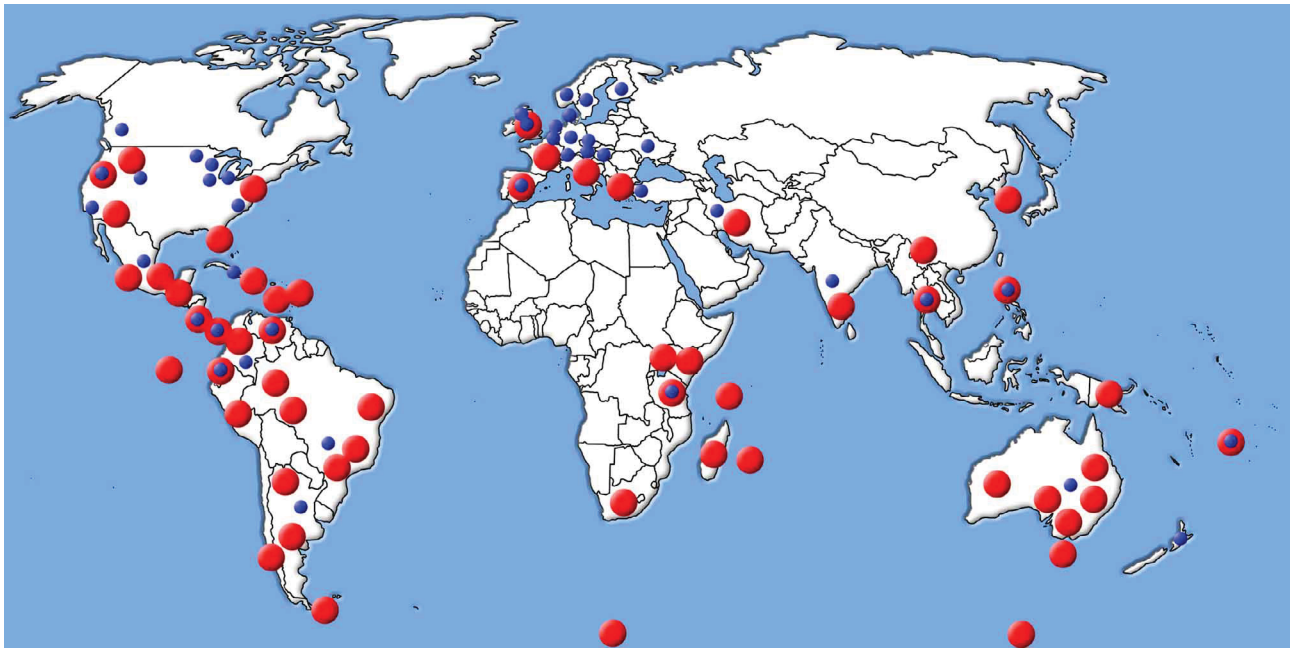

FIGURE 1. Map showing origin of new species (red dots) and geographic affiliation of contributing authors (blue dots).

The 100 New Species

The new species are described below in alphabetical order. They represent a total of 70 genera in 33 families, 15 orders, five classes in the *Ascomycota* and one genus, family, and order in the *Basidiomycota*. The individual taxon entries are standardized as far as possible but reflect in style and content the diversity of participating authors.

Acarospora flavisparsa **V.J.Rico & Candan, *sp. nov.*** (Fig. 2A–B) Mycobank MB 518279

Sicut Acarospora microcarpa sed cum Protoparmelia montagnei consociata, squamulis et ascomatibus majoribus, squamulis latere carbonato nigro, paraphysibus crassibus, ascosporis elongate-cylindraceis et epanorinam continente differt.—http://www.eol.org/pages/Acarospora flavisparsa

Type:—SPAIN. Madrid: Sán Lorenzo de El Escorial, near Silla de Felipe II, 40º 35'N, 04º 09'W, 1080 m, associated with *Protoparmelia montagnei* on granite, July 1986, *Florido & Rico 1133/1* (holotype MAF-Lich. 16463).

Thallus areolate to squamulose (subsquamulose), forming dispersed patches of one to few areoles associated with thalli of, among areoles or overgrowing it, *Protoparmelia montagnei* (Fr.) Poelt & Nimis and occasionally with nearby *Dimelaena oreina* (Ach.) Norman. Areoles irregular, rounded to angular by pressure, sometimes lobulate, 0.5–3.5 mm in diameter, up to 2.25 mm thick, commonly forming a short stipe and becoming squamulose; upper surface yellow to pale yellow or greenish yellow, usually dull, convex to concave, smooth to rough, sometimes fissured; lateral/lower surface ± smooth, yellow-brown to dark brown or carbonized black. Upper cortex paraplectenchymatous, (35–)40–125 µm thick depending on development of areoles, cells usually indistinct, ± globular, in several layers, upper layers brown-yellow pigmented, lower

layers hyaline; layers containing granules of various sizes; syncortex lacking or up to 25 µm; lateral/lower cortex continuous with upper cortex, but with brown or dark brown to commonly carbonized black pigmented upper layers. Algal layer continuous, up to 200 µm thick, photobiont chlorococcoid, cells 6–15 µm in diameter. Medulla hyaline to dirty white, continuous with broad to forming stipe attaching tissue. Apothecia immersed, aspicilioid, up to 0.7 mm in diameter, 1–8 per areole, sometimes confluent, punctiform to round or irregular; disk brown to red, concave to ± plane, rough. Proper excipulum cupular, surrounded by algae, ± prosoplechtenchymatous, 12–30 µm wide, hyaline to yellowish. Hymenium hyaline to yellowish, 125–250(–300) µm tall; paraphyses 1.5–3 µm wide at the base, up to 4.5 µm at slightly pigmented apices; epihymenium brownish-yellow, coherent, with yellowish granules, up to 20 µm tall. Hypothecium, including subhymenium, hyaline to slightly yellowish, up to 150 µm thick. Asci clavate, 70–130 × 18–30 µm, more than 100-spored, outer wall K/I + blue, tholus K/I–. Ascospores hyaline, simple, elongate to cylindrical, 4–*6.01*–7.5 × 1.5–*2.78*–3.5 µm, length/width ratio 1.66–3, l/w mean value 2.21 (n = 150). Pycnidia immersed, punctiform, ± spherical, up to 210 µm in diameter, ostiole inconspicuous or yellow to red-brown, wall hyaline to yellowish, surrounded by algae. Conidia hyaline, bacilliform, 2.5–5 × 1–2 µm. Spot tests in cortex and medulla: K–, C–, KC–, P–, I–; thallus: UV ± orange. Secondary chemistry: epanorin (major) with or without rhizocarpic acid (traces) (8 TLC, 3 HPLC).

Distribution and habitat:—Currently, *Acarospora flavisparsa* is known from continental mediterranean areas in Portugal (Tras os Montes) and Spain (Madrid, València and Zamora provinces). The species occurs on acid rocks in inland areas, at 550–1480 m, on exposed ± vertical rock walls from continental dry to sub-humid places, associated with *Protoparmelia montagnei* and sometimes with *Dimelaena oreina*.

Etymology:—The epithet refers to the scattered yellow squamules growing among other lichens.

Additional specimens examined (paratypes):—PORTUGAL. Tras os Montes e Alto Douro: Bragança, IP4 road to the south, Sabor river valley, 3 km to Lagoa, *Rico 3649/*2 (MAF). SPAIN. Zamora: Pereruela, Las Enillas, September 1998, *Crespo & Blanco s.n.* (MAF). Madrid: between El Berrueco and Berzosa del Lozoya, El Villar dam, *Barreno & Rico 275/1, 276/3* (MAF). La Cabrera, Sierra de La Cabrera, El Mojón summit, *Rico & Florido 380/2, 385/1, 434/2, 451/2, 452/1* (MAF). Manzanares el Real, La Pedriza, Collado de Valdealcones, *Rico & Barreno 589/4, 590/1, 621/3, 632/1* (MAF); ibid., El Chivato stream, *Rico & Barreno 477/3, 489/2* (MAF). Lozoya, El Chaparral, *Rico & Manrique 770/1* (MAF). Collado-Mediano, Cerro del Castillo, *Rico 863/2, 901/6, 903/3* (MAF). Robledillo de la Jara, Collado de Fragüela, *Rico & Manrique 1093/1* (MAF). Robledo de Chavela, El Almojón summit, *Rico 805/1, 807/3* (MAF). Zarzalejo, December 1988, *Valladares s.n.* (MAF). València: Serra, Font del Berro, December 1990, *Calatayud s.n.* (VAB). Castelló: Alfondeguilla, Nevera summit, June 1989, *Calatayud s.n.* (VAB).

The new taxon falls into the group of mediterranean *Acarospora* species (Clauzade & Roux, 1981) with yellow, non-effigurate margin, silicolous thalli, associated with other lichens, brown to red apothecia and K–, C–, white medulla. *Acarospora flavisparsa* is probably closest to *A. microcarpa* (Nyl.) Wedd. (Magnusson 1929, 1936, Poelt & Vězda 1977, Clauzade & Roux 1981, Egea & Llimona 1981), apparently a juvenile or specific parasite on silicolous *Diploschistes actinostomus* (Ach.) Zahlbr. also growing on nearby lichens (Poelt 1958, Clauzade & Roux 1981, 1985, Sipman & Rausch 1999, Roux *et al.* 2006). Furthermore, *A. microcarpa* differs in having: areoles never lobulate, squamulose or shortly stalked and with yellowish to pale lateral surface, smaller areoles and apothecia (up to 2 and 0.4 mm respectively), thinner cortex, algal layer, hymenium and hypothecium (up to 70, 100, 140 and 35 µm respectively), narrow paraphyses at the base (up to 2 µm), ellipsoidal ascospores [3–6 × 2.5–4 µm, length/width ratio 1.28–1.85, l/w mean value 1.6 (n = 80)], rhizocarpic acid as major secondary substance (5 TLC, 8 HPLC; Leuckert & Buschardt 1978) and occurring below 700 m elevation in France, Greece, Italy, Morocco and Spain, with optimum in the Thermo-Mediterranean belt (Egea & Rowe 1987, Nimis & Poelt 1987). Although *A. flavisparsa* grows primarily dispersed within the areoles of *P. montagnei* and *D. oreina*, it does not appear to be an obligatory or host-specific juvenile parasite, but a close association with those lichens is assumed. On the contrary, in some specimens of *A. microcarpa* the thallus was observed growing endokapylically at first, becoming successively epikapylic and independent and forming little thalli up to 2 cm diameter on *D. actinostomus* [Follmann, *Lich.*

Exs. Sel. Cass. 182 (MAF)]. *Acarospora heufleriana* Körb., frequently invades other lichens but differs in its ellipsoid to subglobose ascospores, rhizocarpic with or without norstictic acid as major substances, and ± continuous thalli often with pruina (Clauzade & Roux 1981, Knudsen 2007). *Acarospora charidema* (Clemente *ex* Colmeiro) Llimona is a thermophilic pioneer, not a parasitic lichen, with robust convex squamules up to 4 mm wide, apothecia up to 1.5 mm wide and with a hymenium up to 140 µm tall (Clauzade & Roux 1981, Egea & Rowe 1987). *Acarospora epithallina* H.Magn. is also similar to *A. flavisparsa*, but grows as a juvenile parasite on *Acarospora hilaris* (Dufour) Arnold, forming up to 5 mm wide convex squamules, ± globose ascospores and producing rhizocarpic and gyrophoric acids (Leuckert & Buschardt 1978, Clauzade & Roux 1981).

Acarospora janae **K.Knudsen, *sp. nov.*** (Fig. 2C) Mycobank MB 516796

Sicut Acarospora obpallens sed differt thallo striato.—http://www.eol.org/pages/Acarospora janae

Type:—U.S.A. New Mexico: Sán Miguel County, Las Vegas, 'aux fous', on sandstone, January 1927, *Bro. Arsène Brouard 19568* (holotype FH).

Thallus of dispersed epruinose areoles, dark brown to light brown, with a single immersed apothecium, at first punctiform, becoming dilated and the areole rarely lobulate. Lacking faveoles but upper surface often with fine striations. Lacking a stipe, broadly attached, lower surface white and ecorticate. Disc epruinose, same colour or darker than the thallus, rough, sometimes with umbos and ridges, these disappearing as disc fully dilates. Algal layer continuous. Exciple and hypothecium indistinct. Subhymenium 30–40 µm high. Hymenium ca. 100 µm high, paraphyses 2 µm in diameter. Asci clavate, ca. 60 × 20 µm. Ascospores about 100 per ascus, 3–4 × 2 µm. Secondary chemistry: gyrophoric acid.

Distribution and habitat:—On siliceous rock. Currently known from historical collections from Las Vegas, New Mexico and a modern collection by Gary B. Perlmutter from North Carolina.

Etymology:—The species is named in honor of my colleague, frequent co-author and fiancé, Jana Kocourková.

Additional specimens examined (paratypes):—U.S.A. New Mexico: Sán Miguel County, Las Vegas, *Bro. Arsène Brouard 19936* (FH). North Carolina: Wake County, Marks Creek county conservation area, *Perlmutter 2216* (NCU).

Acarospora is a large, cosmopolitan genus with at least 45 species known in southwestern North America (Knudsen 2007, 2008, Knudsen & Morse 2009). The genus is characterized by polyspory (50–200 ascospores per ascus), simple hyaline ascospores, aspicilioid or pseudo-lecanorine apothecia, and bitunicate but non-fissitunicate asci with a non-amyloid tholus. The new species is distinguished by its epruinose and finely striated areoles, each with a single immersed and eventually dilated apothecium, and containing gyrophoric acid. Though the author was aware of the taxon for some time, it was not found during research on the genus in the greater Sonoran desert region (Knudsen 2007). It is expected to be at least infrequent at middle elevations on sandstone, possibly from Utah and the Colorado Plateau south into non-Sonoran Mexico and east to North Carolina. *Acarospora fuscescens* H.Magn. (Knudsen 2008) is similar, but has larger, verruciform areoles with punctiform apothecia. When its apothecia are fully dilated, *A. janae* resembles *A. obpallens* (Nyl. *ex* Hasse) Zahlbr. (Knudsen 2007), but that species is persistently faveolate with small pits, especially on the thalline rim around the disc.

Aderkomyces thailandicus **Papong, Boonpragob & Lücking, *sp. nov.*** (Fig. 2D) Mycobank MB 517730

Sicut Aderkomyces gomezii sed thallo verrucoso et ascosporis minoribus differt.—http://www.eol.org/pages/Aderkomyces thailandicus

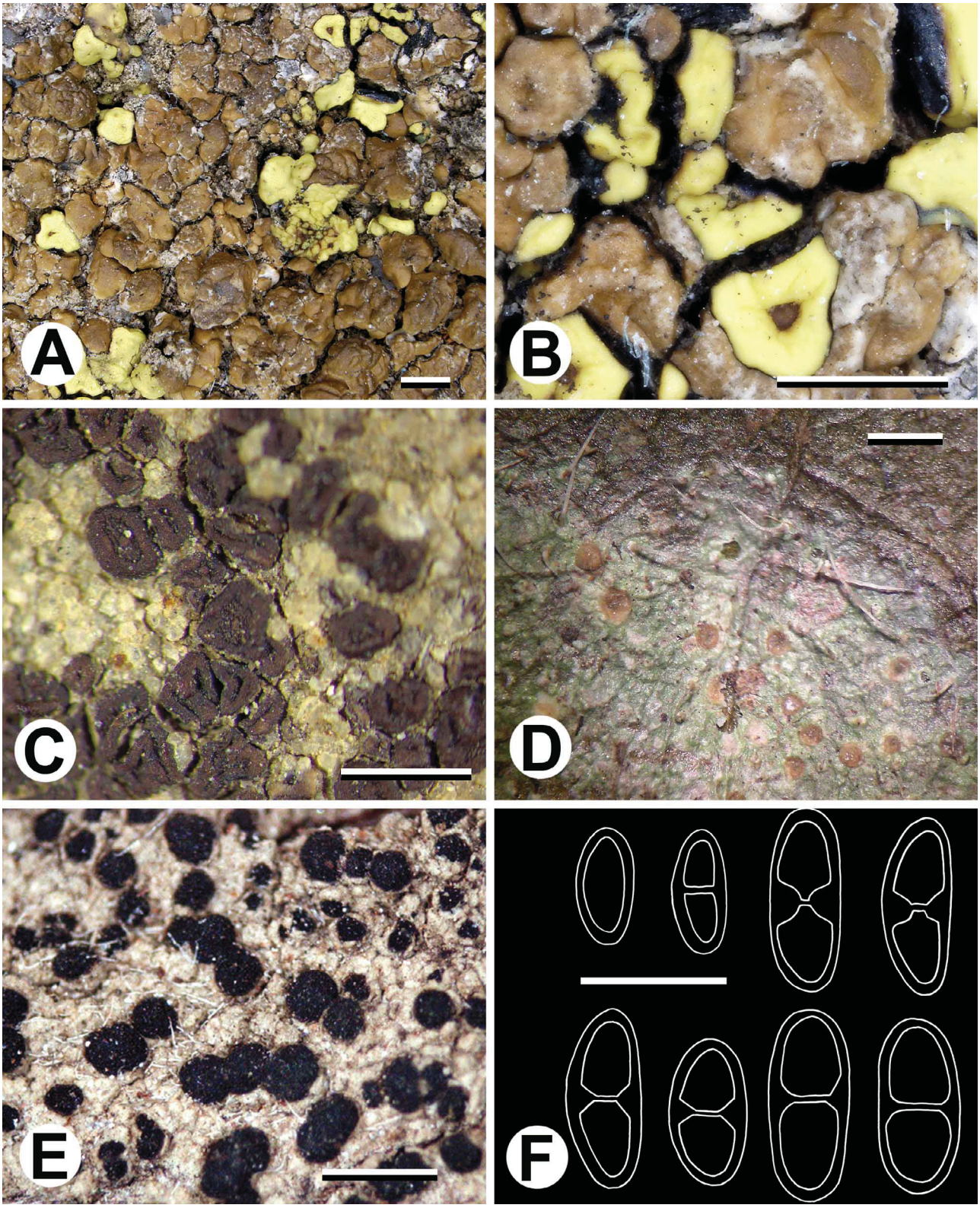

FIGURE 2. A–B. *Acarospora flavisparsa* (holotype). A. Habit growing among areoles of *Protoparmelia montagnei* (photograph V. J. Rico). B. Detail of squamules with apothecia, showing dark lateral surface (photograph V. J. Rico). C. *Acarospora janae* (holotype), habit (photograph M. Schmull). D. *Aderkomyces thailandicus* (holotype), habit (photograph K. Papong). E. *Amandinea maritima* (*van den Boom 19164*), general habit showing the crustose, creamy thallus; the young apothecia, erumpent or lecideine with pseudothalline margins; and the mature apothecia, typically lecideine. F. *Amandinea maritima* (holotype), ascospore ontogeny and ascospore variability. Scale in A, C, D = 1 mm, in B, E = 0.5 mm, in F = 10 µm.

Type:—THAILAND. Chiang Mai Province: Huai Nam Dung National Park, 19°18'N, 98°36'E, 1368 m, lower montane rainforest, forest margin, February 2006, *Papong 2654* (holotype KKU).

Thallus epiphyllous, crustose, verrucose, greenish grey, 10–15 µm thick, with white, long sterile setae 2–2.5 mm long. Apothecia at first immersed-erumpent with thin marginal lobules but finally broadly sessile to adnate, with slightly prominent margin, light grey-brown, sometimes with orange tinge, 0.2–0.5 mm diameter. Excipulum composed of radiating hyphae embedded in a gelatinous matrix, colourless, 25–30 µm broad. Hymenium colourless, 35–50 µm high. Paraphyses anastomosing. Asci annelasceous, clavate, colourless, 35–40 × 18–20 µm, tholus I–. Ascospores 2–4 per ascus, colourless, ellipsoid, muriform, 17–22 × 12–14 µm. Secondary chemistry: no substances detected by TLC.

Distribution and habitat:—Known from several collections in Thai lower montane rainforest; found in the understory in more illuminated situations.

Etymology:—Referring to the country in which the species was discovered.

Additional specimens examined (paratypes):—THAILAND. Chiang Mai Province: Huai Nam Dung National Park, *Papong 2686* (F), *2692* (KKU), *2694* (KKU); ibid., 1410 m, *Papong 2812* (KKU), *2824* (KKU), *2830* (F), *2845* (KKU), *2916* (KKU), *2995* (KKU).

Aderkomyces thailandicus is recognized by its initially immersed-erumpent apothecia (similar to those of several *Gyalideopsis* species) and its submuriform ascospores, 2–4 per ascus, in combination with the verrucose thallus. No other species of *Aderkomyces* has a similar combination of characters or comes close to this new taxon. The neotropical *A. gomezii* Lücking is most similar but has a smooth thallus and much larger ascospores. *Aderkomyces thailandicus* agrees with several species of *Gyalideopsis* in the verrucose thallus (Lücking 2008), but *Gyalideopsis* always lacks sterile setae.

Amandinea maritima* Giralt, van den Boom & Elix, *sp. nov. (Fig. 2E–F) Mycobank MB 517731

Sicut Amandinea fouquieriensis, sed differt thallo crustaceo, albido vel cremeo, hypothecio et parte interni excipuli semper incoloribus, ascosporis typo Physconia.—http://www.eol.org/pages/Amandinea maritima

Type:—ITALY. Sardinia: Sassari, Capo Punta Falcone, Felsabbrüche, Dornpolster-Heiden, *Juniperus phoenicea*-Bestände, July 1985, *Nimis & Poelt* (holotype GZU).

Thallus corticolous, episubstratal, crustose, continuous, thin and smooth to moderately thickened, rugose to verrucose, whitish to creamy, covering large areas. Prothallus absent. Medulla not amyloid (I–), lacking calcium oxalate (H_2SO_4–). Photobiont chlorococcoid, 10–15 µm diameter. Apothecia initially immersed-erumpent and apparently lecanorine, surrounded by a pseudothalline margin concolorous with the thallus, entire or cracked and discontinuous, becoming lecideine and sessile but remaining broadly attached, often contiguous, up to 0.6 mm diameter. Disc black, epruinose, concave at first, then plane, rarely subconvex. Proper margin thick in young apothecia, becoming thinner, always prominent, persistent. Proper excipulum ± *aethalea*-type (Bungartz *et al.*, 2007), 35–50 µm wide, prosoplectenchymatous, inner cells elongate, hyaline, outermost cells short, swollen and brown. Hymenium colourless, 50–70(–80) µm high, not inspersed with oil droplets. Hypothecium colourless, 75–100(–120) µm high. Apical cells of the paraphyses 3–5(–6) µm diameter, with dark brown cap. Asci 8-spored, *Bacidia*-type (Rambold *et al.*, 1994). Ascospores *Physconia*-type, (9–)10.7–13.3(–15) × (4–)5.2–6.5(–7) µm (M = 12; 5.8; SD = 1.3; 0.6; n = 100), ellipsoid, straight or slightly curved, not constricted at septum, faintly microrugulate at 1000×; ontogeny of type A (Giralt 2001). Pycnidia subimmersed, abundant, conidiophores type III (Vobis 1980). Conidia filiform, curved, 12–20 × 0.5–1 µm. Secondary chemistry: nil or lichesterinic acid by HPLC (Elix *et al.* 2003).

Distribution and habitat:—*Amandinea maritima* is known only from coastal areas, including the western Mediterranean coastal areas, from where it extends to the Atlantic coast of southern Portugal and the Canary Islands. It grows in coastal-dune areas, mainly on *Juniperus* spp., accompanied by other typically maritime Mediterranean-Atlantic-Macaronesian species such as *Caloplaca aegatica* Giralt, Nimis & Poelt,

Diploicia canescens (Dicks.) A.Massal., *Endohyalina kalbii* (Giralt & Matzer) Giralt, van den Boom & Elix, *Rinodina anomala* (Zahlbr.) H.Mayrhofer & Giralt and *R. nimisii* Giralt & H.Mayrhofer. Further associated species on *Juniperus* in the Canary Islands locality include *Bactrospora patellarioides* (Nyl.) Almq., *Lecanora sabinae* Hern.-Padr. & Vänskä, *Labrocarpon canariensis* (D.Hawksw.) Etayo & Pérez-Ortega (on *Pertusaria*) and *Thelopsis isiaca* Stizenb.

Etymology:—The name reflects the typical habitat of this species.

Additional specimens examined (paratypes):—SPAIN. Canary Islands: El Hierro, W of Sabinosa, E-side along road H1-500, SW of Montaña del Escobar, *van den Boom 43015* (hb. van den Boom). Andalucía: Málaga, Costa del Sol, Playas de Manilva, *Egea s.n.* (BCN). PORTUGAL. Alentejo: Porto Covo, 1 km S of village, *van den Boom 19164* (hb. van den Boom). Algarve: NW of Lagos, N of Carrapateira, *van den Boom 32560* (hb. van den Boom).

The genus *Amandinea* was segregated from the genus *Buellia* on the basis of its filiform, curved conidia (Choisy 1950, Scheidegger 1993). Additional diagnostic characters have been proposed for the genus (Rambold *et al.* 1994, Sheard & May 1997, Marbach 2000, Mayrhofer & Sheard 2002). It is a mid-sized, cosmopolitan genus of ca. 50 species which is particularly well-represented in tropical and subtropical areas, where it commonly occurs on bark and lignum rather than on rocks. *Amandinea* shows considerable variation in apothecium-type, hypothecium pigmentation and chemistry. *Amandinea maritima* is mainly distinguished by the initially erumpent apothecia with a pseudothalline margin, the colourless hypothecium and inner part of the proper excipulum and the small *Physconia*-type ascospores, with a fine microrugulate ornamentation. Related species include *A. dakotensis* (H.Magn.) P.May & Sheard and *Buellia fouquieriensis* Bungartz, corticolous species from North America. Like *A. maritima*, both have apothecia with an initial pseudothalline margin. However, the former is distinguished by the significantly wider (Bungartz *et al.* 2007), *Buellia*-type ascospores and the brown hypothecium (Sheard & May 1997, Bungartz *et al.* 2007). *Buellia fouquieriensis* is mainly separated by the brown, subsquamulose to distinctly squamulose thallus and the brown hypothecium (Bungartz *et al.* 2007; see *B. fouquieriensis*).

Ampliotrema cocosense* Lücking & Chaves, *sp. nov. (Fig. 3A) Mycobank MB 517732

Sicut Ampliotrema lepadinoides sed ascosporis muriformibusque differt.—http://www.eol.org/pages/Ampliotrema cocosense

Type:—COSTA RICA. Puntarenas: Cocos Island National Park, Wafer Bay, 500 km SW of Costa Rica, trail above ranger station, 87°04'W, 5°31'N, 100 m, lowland rainforest zone, closed primary forest, on bark (branch), partially shaded, April 1992, *Lücking s.n.* (holotype CR, isotypes F, INB, USJ).

Thallus grey-olive-yellow, verrucose, with dense, paraplectenchymatous cortex; photobiont layer and/or medulla with clusters of calcium oxalate crystals. Apothecia sessile, rounded, 1–2 mm diameter; disc partially covered by 0.3–0.6 mm wide pore, brown-black, yellow- to orange-pruinose; margin entire, fused, yellowish white, covered by thalline layer. Columella absent. Excipulum paraplectenchymatous, carbonized; periphysoids absent. Hymenium 150–200 µm high, inspersed; paraphyses apically branched. Ascospores 4–8/ascus, richly muriform, 80–100 17–22 µm, oblong, with thick septa and rounded lumina, colourless, I+ violet-blue (amyloid). Secondary chemistry: protocetraric and virensic acid and satellites; thallus (medulla) C–, K–, P+ orange-red.

Distribution and habitat:—Known from a rich collection from lower montane rainforest on Cocos Island.

Etymology:—The epithet refers to the type locality.

Ampliotrema cocosense is known from one well-developed collection made on Cocos Island. The lichens of this island are not well-known except for foliicolous species (Lücking & Lücking 1995), and the fact that the only two thelotremoid *Graphidaceae* collected there are new to science (Sipman *et al.* unpubl. data)

indicates that for certain groups, Cocos Island harbors a unique lichen biota. *Ampliotrema cocosense* is the only species in the genus with large, muriform ascospores, and hence easy to recognize. It is most closely related to *A. lepadinoides* (Leight.) Kalb, which has ascospores of similar length but which are much narrower and with transverse septa only. From species of *Ocellularia s.lat.* with large muriform ascospores, the new species is set apart by the combination of a wide pore, absence of a columella, paraplectenchymatous excipulum, inspersed hymenium, and protocetraric acid as main secondary substance.

Anomomorpha lecanorina* Sipman, *sp. nov. (Fig. 3B–C) Mycobank MB 517733

Anomomorpha ascomatibus rotundis margine lecanorino provisis, ad basin constrictis; hymenio insperso, ascosporis submuriformibus 10–15 × 7 µm, 4 × 1–2 loculis.—http://www.eol.org./pages/Anomomorpha lecanorina

Type:—ECUADOR. Zamora-Chinchipe: Estacion Cientifico Sán Francisco Nature Reserve, S of road Loja-Zamora, ca. 40 km from Loja, 79°04'W, 3°58'S, 2025 m, primary montane forest on steep slope, tree near 5/I-27, *Elaeagia obovata*, ca. 40 cm dbh, on canopy branches, June 2004, *Sipman 52804* (holotype B, isotype LOJA).

Thallus crustose, corticolous, forming large patches over 5–10 cm wide, pale grey, irregularly fissured, delimited by a dark-brown prothallus line; upper surface flat to depressed-verrucose, smooth; cortex strong, 15–25 µm thick, of densely conglutinated, periclinal hyphae; medulla ca. 200 µm thick, of loose hyphae, filled with many small crystals showing white in polarised light, sometimes including old, overgrown cortical layers. Photobiont trentepohlioid, cells ca. 10 µm in diameter. Ascomata frequent, rounded with prominent thalloid margin, 1–3 mm wide, sessile with constricted, wide base, with pale to dark grey-brown, pruinose, flat disc surrounded by a thin, ca. 0.05 mm wide, white proper margin, which is often separated by a split from the thallus-coloured, ca. 0.2 mm wide thalline margin. Hymenium 75–100 µm tall, inspersed with ca. 1–2 µm wide, irregular droplets disappearing in K, I–. Paraphyses ca. 1.2 µm thick, septate, unbranched except near the tip; terminal locules subglobose and to 3 µm thick, not spinulose. Hypothecium yellow-brown, I–. Asci cylindrical with attenuated base, ca. 90 × 10 µm. Ascospores hyaline, 8/ascus, uniseriate, submuriform, with rounded lumina, I+ dark blue-violet, 10–15 7 µm, with 4 × 1–2 locules, halonate. Pycnidia not seen. Secondary chemistry: thallus K+ orange, C–, KC–, UV–. Secondary metabolites: constictic acid (TLC).

Distribution and habitat:—Known so far only from three specimens from the Reserva Biológica Sán Francisco, prov. Zamora-Chinchipe, southern Ecuador, where it was found in montane primary forest at 2000–2500 m. Two specimens were collected in the canopy of *Elaeagia obovata* trees, which have a rather acid bark.

Etymology:—The epithet reflects the similarity of the ascocarps with the genus *Lecanora*, quite unusual in *Graphidaceae*.

Additional specimens examined (paratypes):—ECUADOR. Zamora-Chinchipe: Cordillera Numbala, Sán Francisco Biological Reserve, S of road Loja-Zamora, transecto 1, near Refugio, *Sipman & Mandl 51464* (B, LOJA). Estación Científica Sán Francisco Nature Reserve, S of road Loja-Zamora, ca. 40 km from Loja, *Sipman 53142* (B, LOJA).

The family *Graphidaceae* is long known as very diverse in the tropics, but for a long time the large number of species described on limited and often unconvincing characters was in most cases prohibitive for a careful identification. Recent studies by Staiger (2002) and Lücking *et al.* (2008) have greatly improved the situation and currently many additional species are being recognized, e.g. Dal-Forno & Eliasaro (2010). *Anomomorpha lecanorina* is a very unusual species, because its ascomata look much like species of *Lecanora*. However, the I-negative hymenium and I+ dark-violet, muriform spores are a certain indication for *Graphidaceae*, and the species matches well the genera *Anomomorpha* and *Platythecium* (Staiger 2002). Ascocarps in these genera are usually lirelloid, but may be rather variable in shape. Apart from the rounded apothecia, *A. lecanorina* differs from other species of *Anomomorpha*, which mostly have norstictic acid, in the

unusual chemistry. The region where the species was found appears to be particularly rich in locally endemic lichens. For instance, Sipman *et al.* (2009) report three endemic *Hypotrachyna* species from the area.

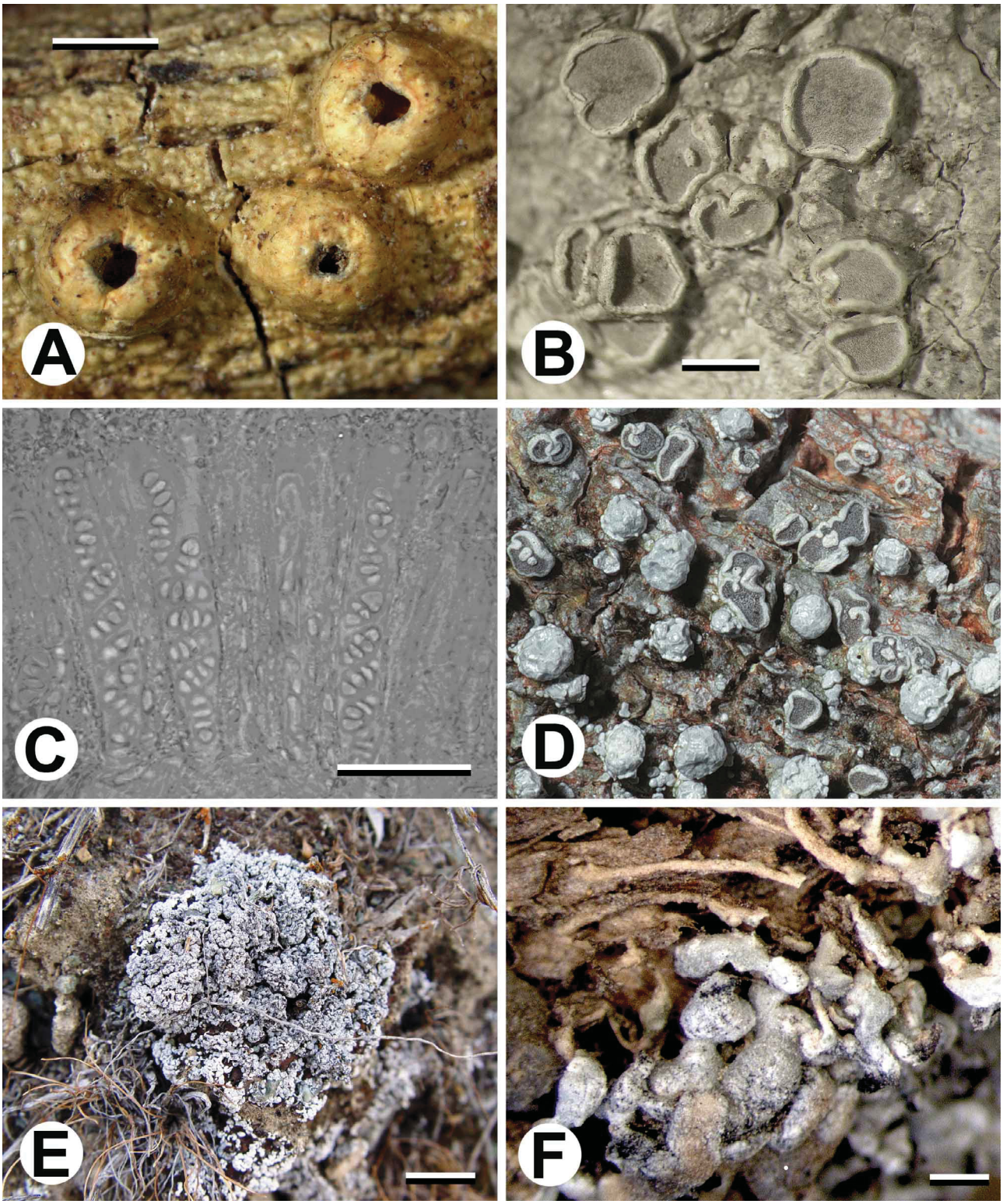

FIGURE 3. A. *Ampliotrema cocosense* (holotype), apothecia. B–C. *Anomomorpha lecanorina* (holotype). B. Thallus with apothecia. C. Hymenium with asci and ascospores. D. *Anomomorpha tuberculata* (holotype), thallus with lirellae and tubercles. E–F. *Aspicilia mansourii*. E. General thallus morphology *in situ*. F. Rounded thallus lobes and tiny rhizomorph-like extensions. Scale in A, D = 1 mm, in B, F = 2 mm, in C = 10 µm, in E = 20 mm.

Anomomorpha tuberculata* Lücking, Umaña & Will-Wolf, *sp. nov. (Fig. 3D) Mycobank MB 517734

Anomomorpha speciei apotheciis sessilibus et thallo tuberculato differt.—http://www.eol.org/pages/Anomomorpha tuberculata

Type:—COSTA RICA: Puntarenas: La Amistad International Park, Cerro Biolley Section, Sabanas Esperanza (La Amistad Pacífico Conservation Area), Terraba Valley, 83°03'W, 9°04'N, 1300–1400 m, lowland to lower montane moist forest savanna zone, disturbed savanna vegetation with abundant shrubs and trees, on bark (lower trunk), July 2002, *Lücking 15309c* (holotype INB, isotype F).

Thallus corticolous, up to 10 cm diameter, 50–100 µm thick, continuous; surface uneven, grey to pale brownish or yellowish grey, with numerous large tubercles; prothallus absent. Tubercles 0.8–1.5 mm diameter and up to 1.5 mm high, orbicular with the base constricted, white, consisting of a wall of numerous corticate, angular plates (resembling a soccer ball) which eventually break off as angular-rounded schizidia (especially at the apex) to expose a soredia-like surface composed of an irregular mass of hyphae intermingled with photobiont cells. Thallus in section with cartilaginous upper cortex, irregular algal layer and large clusters of crystals. Apothecia angular-rounded to elongate and then flexuose, unbranched, sessile with the base strongly constricted, with thick, prominent thalline margin, 1–3 mm long, 0.5–0.1 mm wide, 0.4–0.5 mm high; disc exposed, grey-brown with white pruina and therefore appearing grey-pruinose; proper margin indistinct, labia entire; thalline margin conspicuous, thick, prominent. Excipulum uncarbonized, orange-brown, 100–150 µm wide; hypothecium prosoplectenchymatous, 30–50 µm high, colourless to pale yellow; hymenium 120–150 µm high, colourless, strongly inspersed, inspersion partly disappearing in K; epithecium granulose, 5–10 µm high, grey-brown. Paraphyses unbranched; asci fusiform to clavate, 100–130 × 10–15 µm. Ascospores 8 per ascus, ellipsoid, 3-septate, 7–10 × 5–6 µm, 1.5 times as long as wide, colourless. Secondary chemistry: no substances detected by TLC.

Distribution and habitat:—The new species was found in a rare cerrado vegetation in the southern part of Costa Rica.

Etymology:—The epithet refers to the conspicuous tubercles of the thallus.

Additional specimens examined (paratypes):—COSTA RICA. Alajuela: Volcán Tenorio National Park, Pilón Biological Station (Arenal-Tempisque Conservation Area), *Will-Wolf 12772* (INB, WIS), *Sipman 51789* (B-600173357, INB). Puntarenas: Parque Internacional La Amistad (AC Amistad Pacifico), Cerro Biolley, 30 km NNW of Sán Vito near Biolley, July 2002, *Sipman 48109c* (B-600173358, INB). VENEZUELA: Bolivar: Cerro Guaiquinima, in central part of upper plateau (near camp 4); February 1990, *Sipman 26569* (B-600083625, VEN); ibid., near NE edge of upper plateau (near camp 2), February 1990, *Sipman 26782* (B-600083627, VEN). GUYANA: Upper Mazaruni District: N-slope of mount Roraima (campsite 5), February 1985, *Sipman & Aptroot 18760* (B-600113247), *18808* (B-60 0113248).

Anomomorpha is a small genus in *Graphidaceae* characterized by usually uncarbonized lirellae with strongly inspersed hymenium and minute ascospores (Staiger 2002). The new species is placed in this genus as it agrees in the non-carbonized lirellae with strongly inspersed hymenium and minute ascospores. However, it deviates from other species of the genus in the strongly sessile lirellae and the lack of secondary substances. In addition, the large tubercles formed on the thallus are unique within the family. *Anomomorpha tuberculata* is probably closely related to the preceding species, since the apothecia are partly rounded and resemble those of a *Lecanora* species. However, distinctly elongate lirellae are also present, the thallus features large tubercles, the ascospores are 3-septate, and no secondary substances appear to be present.

Aspicilia mansourii* Sohrabi, *sp. nov. (Fig. 3E–F) Mycobank MB 518502

Thallus terricola, squamulosus vel subfruticulosus, subtus rhizomorphis obtectus. Similis Aspiciliae filiformis sed thallo plus squamuloso, lobis mas irregularibus, ultimis simplicioribus, apice non nigrescentibus. Aspicilinam continens.—http://www.eol.org/pages/Aspicilia mansourii

Type:—IRAN: Golestan National Park, Mirzabaylou towards Almeh valley, 37°21'N, 56°12'E, 1300 m, May 2008, *Sohrabi 15077* & *Ghobad-Nejhad* (holotype IRAN-MS015088, isotypes H-MS016188, GZU-MS016189, hb. Sohrabi-MS016192).

Thallus terricolous, on soil or plant debris, subsquamulose to appressed sub-fruticose, attached by tiny rhizomorph-like extensions, forming small patches up to 3–5(–8) cm wide, lobes discrete, more or less stringy, continuous, warty, rimose, to areolate-verruculose to irregularly developed on the substrate, central part subgranular to subsquamulose, mostly irregular, sometimes angular to rounded lobes, 0.3–0.9(–1.3) mm in diameter, prothallus absent. Surface with small cracks or depressions, smooth to roughened, white-pruinose, sometimes diffusely granulose, when dry, dull, light grey, when wet, whitish grey to dark grey, ashy grey. Cortex paraplectenchymatous, (10–)20–30(–35) µm thick, filled with granules and irregular globose to round cells 5–8(–10) µm wide, uppermost part brown; cortex usually covered with a thick epinecral layer, (10–)12–17(–22) µm thick, with crystals. Photobiont green, chlorococcoid, unicellular, cells 5–16(–22) µm wide, distributed in regular to irregular layer, occasionally fragmented in small patches 30–70 µm wide. Medulla ± loose to paraplectenchymatous, variable in thickness, lower parts somewhat interrupted by prosoplectenchymatous tissue, originated from the small rhizomorph-like extensions. Lower surface white to pale yellow, sometimes dark grey to ochraceous, without cortex, basally with 1–3 ± isodiametric cells, some partly belonging to rhizomorph-like extensions. Rhizomorph-like extensions from the lower surface short, up to 0.5–1 mm long, hypha 5–8(–10) µm thick, delicate, lacking algal cells, pale, white to yellowish, sometimes light brown, usually attached to plant debris, occasionally visible under the margins. Apothecia and pycnidia not known. Secondary chemistry: aspicilin and unknown fatty acid detected in some thalli by TLC; thallus (medulla) K–, C–, P–, KC–, CK–, I–.

Distribution and habitat:—*Aspicilia mansourii* has been found on soil and dead plant debris, often on dead tufts of *Poa bulbosa* L. and other perennial grass. It grows on calcareous soil in open situation in the mountain areas with steppe-like habitat. It is so far known from Iran.

Etymology: The species is named in honor of Reza Mansouri, Iranian physicist who made significant contributions to the development of science in Iran.

Additional specimens examined (paratypes):—IRAN: Golestan Prov., Golestan National Park, Mirzabaylou towards Almeh valley, *Sohrabi 15078* & *Ghobad-Nejhad* (hb. Sohrabi). East Azerbaijan Prov., Jolfa district 1 km S of Daran village, E of Hadishahr, *Sohrabi et al. 10119*, *10123* (hb. Sohrabi).

Aspicilia is a relatively large genus, comprising ca. 200 species. The majority of the species are saxicolous, but several taxa are known to be terricolous, and a few lignicolous or corticolous species have also been described. Recently, non-vagrant-terricolous species were revised (Sohrabi *et al.* 2010). *Aspicilia mansourii* is distinguished from the terricolous North American species, *A. californica* Rosentreter, by its subsquamulose to appressed subfruticose thallus, small and short lobes and tiny rhizomorph-like extensions, lacking black lobe tips, as well as in negative reactions to K, C, and P in both medulla and cortex. It differs from *A. filiformis* Rosentreter, another North American terricolous species, in lacking black tips on the lobes and a different thallus morphology (Rosentreter 1998). There is another poorly known species, *A. reptans* (Looman) Wetmore, which has a crustose, subsquamulose to appressed sub-fruticose thallus and its type is fertile, with brown-black discs, growing directly on soil. However, rhizomorph-like extensions and chemistry are lacking in *A. reptans*. *Aspicilia crespina* V.J.Rico is a Mediterranean species, known from Spain. It is also fertile, squamulose and attached with large rhizomorph-like extensions to the substrate and usually grows among mosses, on siliceous rocks and on soil, and lacks chemistry. *Aspicilia tibetica* Sohrabi & Owe-Larss. was recently described from Tibet in China (Sohrabi *et al.* 2010). It has a well-developed fertile thallus and commonly grows on soil and plant debris in the very high mountains of the Tibetan Plateau. *Aspicilia tibetica* differs in certain morphological characters (e.g. apothecia very common), lacking secondary chemistry, and whitish colour thallus, and its ecological requirements. Additional information can be found at the Myco-Lich website http://www.myco-lich.com (Sohrabi & Ghobad-Nejhad 2010).

Bacidina sorediata **Seaward & Lücking, *sp. nov.*** (Fig. 4A) Mycobank MB 517735

Sicut Bacidina apiahica sed thallo sorediato differt.—http://www.eol.org/pages/Bacidina sorediata

Type:—SEYCHELLES. Mahé: Path to Le Niol Road, 70 m, January 1974, *Norkett 18668B* (holotype BM, isotypes F, hb. Seaward 115567).

Thallus foliicolous, 5–10 mm across and 15–20 µm thick, dispersed into minute, corticate, granulose to microsquamulose patches 0.05–0.1 × 0.05 mm, giving the entire thallus a granulose appearance, pale olive-green, sorediate; soredia at first discrete, maculiform, becoming in part confluent, farinose, 0.2–0.3(–0.5) mm diameter, yellowish white. Photobiont chlorococcoid, cells 5–10 µm diameter. Apothecia rounded, 0.25–0.5 mm diameter and 130–180 µm high; disc plane to slightly convex, pale yellow to orange-yellow; margin thin, evanescent, same colour as disc or somewhat paler. Excipulum paraplectenchymatous, 30–50 µm broad. Hypothecium 20–30 µm high, colourless to very pale yellow. Hymenium 40–50 µm high, colourless. Asci clavate, 35–45 × 6–7 µm. Ascospores arranged in bundle, bacillar to very narrowly clavate, tapering towards the proximal end, 25–35 × 1.2–1.7 µm, 17–22 times as long as broad, 3-septate. Pycnidia not observed. Secondary chemistry: no substances detected by TLC.

Distribution and habitat:—Known from a rich collection from the Seychelles.

Etymology:—The epithet refers to the sorediate thallus, an unusual feature in the genus.

Bacidina is a small genus of crustose lichens with usually granulose to microsquamulose thallus and pale yellow to orange apothecia (Ekman 1996, Lücking 2008). In several species, including *Bacidina varia* S.Ekman, the farinose to granulose thallus can become diffusely sorediate. However, the combination of a distinctly microsquamulose thallus consisting of corticate squamules with discrete, maculiform soralia of a different colour is not yet known from the genus. *Bacidina sorediata* otherwise combines features of three other common, foliicolous species: *B. apiahica* (Müll.Arg.) Vězda has the same type of ascospores but a farinose to granulose thallus lacking distinct soralia, whereas *B. defecta* Vězda and *B. scutellifera* (Vězda) Vězda have the same thallus squamules as in the new species and also share the apothecium and ascospore type, but instead of soralia produce scutelliform isidia (Lücking 2008).

Badimia multiseptata **Papong & Lücking, *sp. nov.*** (Fig. 4B) Mycobank MB 517736

Sicut Badimia pallidula sed ascosporis maioribus multiseptatis differt.—http://www.eol.org/pages/Badimia multiseptata

Type:—THAILAND. Nakhorn Ratchasima Province: Khao Yai National Park, 14°11’N, 101°37’E, 650 m, lower montane rainforest, shady understory, on leaves, December 2005, *Papong 5888* (holotype KKU).

Thallus foliicolous, continuous or irregularly dispersed, 20–25 µm thick, densely verrucose, pale greenish grey; verrucae wart-shaped, white. Photobiont chlorococcoid. Apothecia rounded, 0.4–0.8 mm diameter; disc pale yellow to orange; margin slightly prominent, paler than the disc. Excipulum paraplectenchymatous, lacking crystals, 30–40 µm broad. Hypothecium prosoplectenchymatous, 20–30 µm high, colourless to pale yellow, K–. Epithecium indistinct. Hymenium 45–55 µm high, colourless, I+ blue. Paraphyses unbranched, 1–1.5 µm thick. Asci clavate, 40–50 × 8–10 µm, I+ blue. Ascospores 8 per ascus, oblong to fusiform, (3–)5–7(–9)-septate, without or with slight constrictions at septa, 25–32 × 4–5 µm, 6–7 times as long as broad, colourless. Campylidia sessile, halfmoon-shaped, chamois-coloured to white. Conidia filiform, 5–7-septate, 50–60 × 1–1.5 µm, with short lateral appendages at most segments, colourless. Chemistry: usnic acid and zeorin.

Distribution and habitat:—Known from several collections from lowland rain forest in Thailand.

Etymology:—The epithet refers to the multiseptate ascospores as compared to other species of the genus.

Additional specimens examined (paratypes):—THAILAND. Chanthaburi Province: Namtok Phlio National Park, *Papong 882*, *884-1*, *887-1* (KKU). Loei Province: Phu Kradueng National Park, *Papong 3269*

(KKU). Nakhon Si Thammarat Province: Khao Lung National Park, *Papong 3526* (F), *3543* (KKU). Nakhorn Ratchasima Province: Khao Yai National Park, *Papong 5905-2* (F).

Badimia is a small genus of foliicolous lichens characterized by comparatively large, vividly coloured apothecia and unique, campylidioid conidiomata (Vězda 1986, Lücking 2008). The genus is pantropical and restricted to lowland rain forest and appears to be an excellent indicator of undisturbed rain forest (Lücking & Kalb 2001). Two groups are distinguished which differ in apothecial colour and excipulum structure: the core group of the genus with crystalline excipulum and opaque apothecia, and the *pallidula*-group with non-crystalline excipulum and slightly translucent, gyalectoid apothecia (Lücking 2008). *Badimia multiseptata* belongs in the latter group and is characterized by its multiseptate, comparatively large ascospores. It is morphologically similar to *B. pallidula* (Kremp.) Vězda and relatives, but differs in its ascospores: *B. pallidula* and *B. polillensis* (Vain.) Vězda have 3-septate ascospores, whereas those of *B. verrucosa* (Vězda) Lücking & Vězda are submuriform.

Badimia vezdana **Lücking, Farkas & Wirth, *sp. nov.*** (Fig. 4C–D) Mycobank MB 517737

Sicut Badimia galbinea sed thallo continuo regulariter verrucoso differt.—http://www.eol.org/pages/Badimia vezdana

Type:—COSTA RICA. Limón: Tortuguero National Park, 10°32'N, 83°30'W, sea level, lowland rainforest zone, primary rainforest close to village, June 1988, *Lücking 88-56* (holotype F).

Thallus foliicolous, continuous, 10–40 mm across and 15–25 µm thick, strongly verrucose, pale bluish grey; verrucae hemispherical, 0.1–0.15(–0.2) mm diameter, pale bluish grey to white, filled with yellow crystals. Apothecia rounded, 0.3–0.8 mm diameter and 150–220 µm high; disc plane to slightly concave, bright yellow to orange-yellow; margin distinct, slightly prominent, yellow to orange. Excipulum with indistinct structure due to strong incrustation with yellow crystals, 20–40 µm broad, grey, in K under pressure dissolving into free, moniliform hyphae with globose cells and constricted septa. Hypothecium 20–30 µm high, colourless to pale yellow, K–. Epithecium 5–10 µm high, yellow granular. Hymenium 40–60 µm high, colourless. Asci 35–50 × 8–12 µm. Ascospores ellipsoid to fusiform, 3-septate, with slight constrictions at septa, 10–16 × 3.5–5 µm, 3–3.5 times as long as broad, colourless. Campylidia 0.7–1.6 mm broad, ferrugineous brown, wall incrusted with yellow crystals. Conidia filiform, 3–9-septate, 50–70 × 1.2–1.6 µm, with lateral appendages up to 10 µm long and 0.7 µm thick, colourless. Chemistry: usnic acid, zeorin.

Distribution and habitat:—Neotropical and restricted to the shady understory of undisturbed lowland rainforests.

Etymology:—The epithet honors the late Antonín Vězda, one of the prominent lichen taxonomists of the 20th century (Wirth 2009, Farkas 2010, Farkas *et al.* 2010a, b).

Additional specimens examined (paratypes):—COSTA RICA. Limón: Barra del Colorado National Wildlife Refuge, *Lücking 92-2386* (B, CR, GZU, LG, M, NY, STU, UPS), *92-2414* (B, CR, GZU, LG, M, STU, UPS). PANAMA. Colón: Barro Colorado Island, *Lücking 92-581* (hb. Lücking). COLOMBIA. Nariño: La Espriella Forest Station, *Sipman et al. 29591*, *29665* (B). GUYANA. Potaro/Siparuni: Paramakatoi, *Lücking 96-3779* (BRG), *96-3781* (US). Upper Takutu: 50 km S of Aishalton, trail to Kassikaityu river, *Sipman 37086* (B). BRAZIL. Pará: Caxiuanã, 300 km W of Belém, *Lücking 95-74* (F, Lücking, Lich. Fol. Exs. 57).

This species was believed to be conspecific with the paleotropical *B. galbinea* (Kremp.) Vězda (Lücking 2008). However, restudy of the available material confirmed the differences previously observed between the neotropical and paleotropical populations: the neotropical populations have a continuous, strongly and regularly verrucose thallus with white verrucae and yellow to yellow-orange apothecia, whereas in the paleotropical material, the irregularly laciniate thallus produces scattered and irregular, pale yellow verrucae and the apothecia are ferrugineous-orange. We therefore describe the neotropical populations under a separate name.

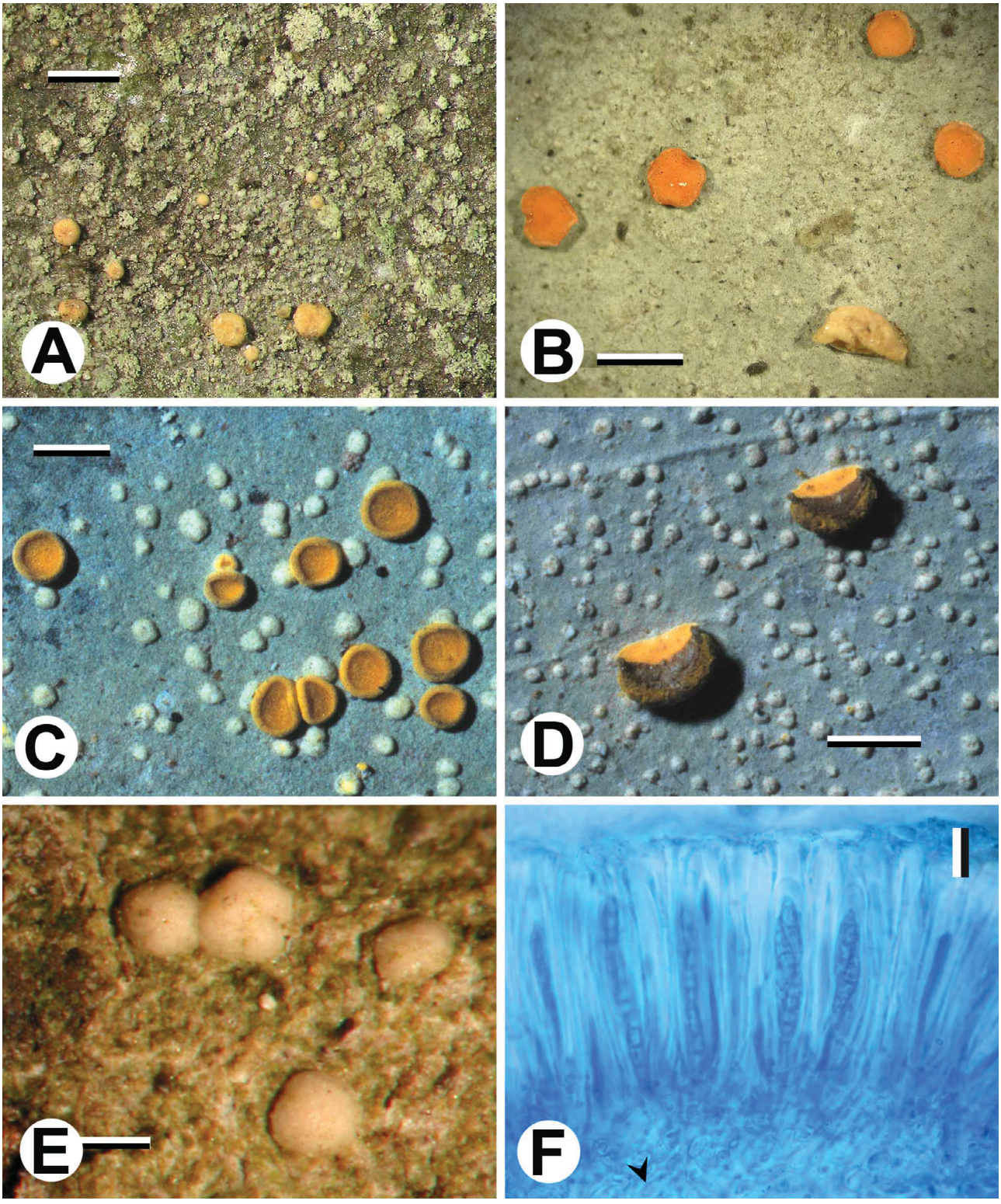

FIGURE 4. A. *Bacidina sorediata* (isotype), microsquamulose thallus with apothecia. B. *Badimia multiseptata* (holotype), thallus with apothecia and one campylidium. C–D. *Badimia vezdai* (holotype). C. Thallus with apothecia. D. Thallus with campylidia. E–F. *Biatora epirotica* (holotype). E. Habit. F. Cross section through apothecium stained with lactic blue, note gelatinized hypothecium with "lacunae" (arrow). Scale in A–D = 1 mm, in E = 0.5 mm, in F = 10 µm.

Biatora epirotica* Printzen & T.Sprib., *sp. nov. (Fig. 4E–F) Mycobank MB 519464

Biatorae pallentis similis sed ascosporis majoribus et hymenio altiore differt.—http://www.eol.org/pages/Biatora epirotica

Type:—GREECE. Epirus, Nomos Ioanninon, Tzoumerka, near Palaiochorion, 39°30'N, 21°05'E, 776 m, corticolous on twigs of *Abies borisii-regis,* April 2006, *Spribille 19735* (holotype FR, isotypes ATHU, GZU, further isotypes to be distributed as exsiccatae).

Thallus ecorticate, smooth to rimose, surface beige to gray, often with a greenish tinge, matt, esorediate, up to 10 mm in diameter. Photobiont trebouxioid. Apothecia sessile with a broad base or slightly constricted basally, 0.3–0.6 mm diameter; margin usually not visible, rarely as a lighter rim around the disc; disc weakly to moderately convex, white to pale ochre, matt, epruinose. Excipulum hyaline, 30–40 µm laterally, 20–45(–90) µm wide basally, of strongly gelatinized, diverging hyphae with 1–2.5 µm wide lumina, lumina of apical cells 1.5–3.5 µm wide, partly free and with thick gelatinous outer walls. Hymenium hyaline, 50–60 µm high. Paraphyses colourless, weakly to moderately branched and anastomosing, mostly in basal parts of the hymenium and the subhymenium, lumina 0.8–1.2(–1.5) µm wide, apical cells with lumina of 1–3(–4) µm. Subhymenium hyaline, 20–40(–55) µm high. Hypothecium 20–40(–80) µm high, of densely entangled, narrow hyphae with lumina 0.8–1.2 µm wide, strongly gelatinised, but with characteristic "lacunae" 3–10 µm wide. Asci *Biatora*-type, 8-spored. Ascospores (0–)3-septate, (11–)12.4–16.5(–19.5) × (3.3–)4.2–4.8(–5.5) µm, hyaline, narrowly ellipsoid, sometimes slightly bent. Pycnidia not found. Secondary chemistry: no substances detected by TLC.

Distribution and habitat:—Biatora epirotica has been found on twigs of *Abies borisii-regis, A. nordmanniana, Laurus nobilis, Ostrya carpinifolia, Quercus coccifera*, and trunks and dead twigs of young *Picea orientalis* on the southwest Balkans and along the Turkish Black Sea coast. It mostly occurs in mountain areas with high humidity and extensive cyanolichen communities at elevations of 450 to 1500 m.

Etymology:—The epithet is derived from Epirus, the geographical region on the Balkans where most of the material was collected.

Additional specimens examined (paratypes):—GREECE. Epirus, Nomos Ioanninon, Dimos Tzoumerka, near Kataraktis, shrine to Profitis Ilias, *Spribille s.n.* (hb. Spribille); ibid., near Palaiochorion, *Spribille 16283* (GZU); ibid., above Pramantha, *Spribille 19818* (GZU); ibid., W of Arachthos River above Politsa, *Spribille 19861* (GZU). Epirus, Nomos Ioanninon, Dimos Koinotita Vovousas, Zagori region, Pindos Mts., above Aoos River, S of Vovousa, *Spribille 16001* (GZU). TURKEY. Bolu vilayet, S of Karacasu, *Spribille 23136* (GZU). Kars vilayet, lake Karagöl NE of Savşat, *Printzen 6468, 6495* (BG).

Biatora epirotica most closely resembles *B. pallens* (Kullh.) Printzen in having 3-septate ascospores and excipular hyphae with broad lumina. *Biatora pallens* is easily distinguished by its narrower ascospores (10.5–17.0 × 2.5–4.0 µm), a more shallow hymenium (30–40 µm tall) and the presence of usnic acid. Three more species of *Biatora* with predominantly 4-celled spores are known: *B. aegrefaciens* Printzen, *B. nobilis* Printzen & Tønsberg and *B. rufidula* (Graewe) S.Ekman & Printzen. All three species have excipular hyphae with narrowly elongate lumina and orange-brown apothecia. In *B. aegrefaciens* and *B. rufidula*, the exciple reacts I+ violaceous. *Biatora nobilis* and *B. aegrefaciens* also have broader ascospores (5.0–8.5 µm wide). The known distributional range of *Biatora epirotica* is centred around the Black Sea region, a well known Tertiary and Pleistocene refugial area. Other species of *Biatora* with a similar distributional range include *B. bacidioides* Printzen & Tønsberg, *B. pontica* Printzen & Tønsberg and *B. longispora* (Degel.) Lendemer & Printzen. The latter two are also known from eastern North America and East Asia, and *B. epirotica* should be looked for in those regions.

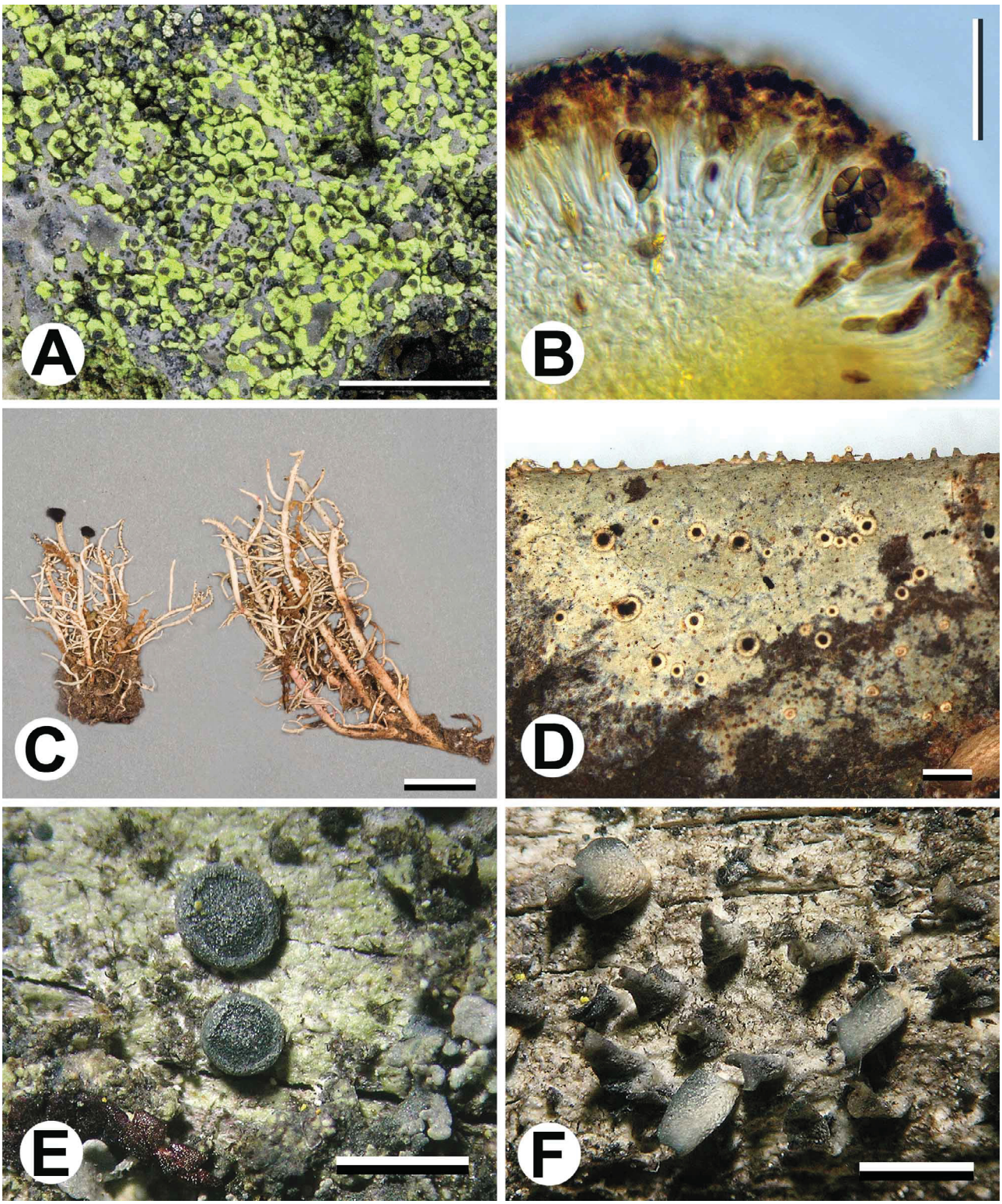

FIGURE 5. A–B. *Buellia sulphurica* (holotype). A. Thallus with apothecia. B. Section through apothecium. C. *Bunodophoron pinnatum* (holotype), fertile branches to the left; note black mazaediate terminal apothecia. Sterile branches with distinct pinnate branching to the right (photograph R. Ubral-Hedenberg). D. *Byssoloma spinosum* (holotype), apothecia on the leaf surface and pycnidia on the leaf margin. E–F. *Calopadia cinereopruinosa* (E holotype, F *Bungartz 5480*). E. Apothecia. F. Thallus with campylidia. Scale in A, D = 2 mm, in B = 50 µm, in C = 10 mm, in E, F = 1 mm.

Buellia sulphurica* Bungartz & Aptroot, *sp. nov. (Fig. 5A–B) Mycobank MB 517738

Sicut Buellia saxicola sed thallo sulphureo, apotheciis minutis et hypothecio hyalino—http://www.eol.org/pages/Buellia sulphurica

Type:—ECUADOR. Galápagos: Isabela Island, Volcán Alcedo, upper NNW-exposed slope inside the crater, 0°27'S, 91°7'W, 1055 m, open vegetation with *Adianthus concinnum* and scattered shrubs of *Tournefortia rufosericea* among basalt blocks in the vicinity of the sulfur vents, on basalt, March 2006, *Aptroot 64881* (holotype CDS-31458, isotype ABL).

Thallus crustose, thin, of dispersed groups of areoles, marginal ones ± subsquamulose, epilithic; prothallus absent; thallus surface matt, bright neon yellow, finely whitish pruinose, phenocorticate; thallus densely filled with fine crystals (ca. 5 µm in diameter, dissolving in 10% KOH), and few large mineral crystals (irregular in diameter, ca 30–50 µm, not dissolving). Apothecia lecideine, initially inconspicuously lecanorine; (0.10–)0.15–0.25(–0.30) mm in diameter; soon adnate to sessile; proper margin black, soon excluded, when emerging typically covered by coarse, thick thalline fragments; disc black, epruinose, initially plane, but soon strongly convex; thalline exciple, if present, poorly developed and reduced to very few adglutinated hyaline hyphae densely packed with photobiont cells, ± merging with the surrounding thallus; proper exciple similar to the aethalea-type sensu Scheidegger (1993), but strongly reduced to few, parallel hyphae, almost indistinct from the paraphyses, apically moderately swollen (textura oblita) and reddish brown (cf. elachista-brown, HNO_3–), pigmentation continuous with the epihymenium; excipular hyphae downward soon losing pigmentation and not clearly differentiated from either hymenium or hypothecium, hymenium hyaline, not inspersed with oil droplets; paraphyses simple to moderately branched, apically swollen, with a brown pigment cap (cf. elachista-brown). Asci 8-spored, clavate, *Bacidia*-type. Ascospores oblong, not constricted with age, with obtuse ends, not curved, (9.8–)10.7–[12.1]–12.7(–13.7) × (5.9–)6.0–[6.6]–6.7(–6.8) µm (n = 25), 1-septate, proper septum briefly thickened during spore ontogeny (*Physconia*-type); ornamentation absent (not visible in DIC). Pycnidia not found. Secondary chemistry: rhizocarpic acid; thallus P–, K–, C–, KC–, CK–; thallus surface and medulla not amyloid (always test with concentrated Lugol's iodine or in the compound microscope; thallus reactions can be very weak!), the hymenium reacts amyloid in Lugol's.

Distribution:—Known only from Galápagos, on Isabela Island (Volcán Alcedo: north-northwest exposed inner caldera rim; Volcán Chico: along northern outer slope of Sierra Negra); on basalt (HCl–), close to volcanic sulphur vents.

Etymology:—The epithet refers both to the thallus colour and the close approximation to sulphur vents.

Additional specimens examined (paratypes):—ECUADOR. Galápagos: Isabela Island, Volcán Alcedo, upper NNW-exposed slope inside the crater, *Aptroot 64815, 64798, 64800, 64797* (CDS). Volcán Chico, on the N outer slope of the caldera of Sierra Negra, *Bungartz 8732* (CDS-44070).

Despite its minute size, it is a very conspicuous species, unlikely to be overlooked in the field because of its bright neon colour. Found only near sulphur vents. Both the conspicuous colour and its unusual habitat suggest that the species could be truly endemic to the archipelago. The species is very unusual not only because of its habitat and presumed high tolerance to sulphur. It contains rhizocarpic acid, a substance very rarely encountered in *Buellia* and known only from few species of uncertain taxonomic placement, e.g. *Buellia centralis* H.Magn. (Lamb 1968, Obermayer *et al.* 2004). The apothecia have a hyaline hypothecium that is typically regarded as diagnostic for *Rinodina* rather than *Buellia*; as very few species of *Buellia* are known to possess a weakly or completely unpigmented hypothecium. The ascospores show *Physconia*-type ontogeny, i.e., they initially have a thickened septum, becoming reduced with age. This spore type is seen both in *Buellia* and *Rinodina*. The apothecia are unusually small, have a strongly reduced proper exciple, and, when emerging from the thallus, large chunks of thalline material initially remain attached. Nevertheless they never develop a distinctly lecanorine margin. The main reason why the species is described here in *Buellia s.lat.* is the typical *Bacidia*-type ascus, which in Lugol has the characteristic deep blue flanks merging at the tip and a thin, unstained inner tholus axis.

Bunodophoron pinnatum* Wedin, *sp. nov. (Fig. 5C) Mycobank MB 517739

Species insignis thallo elongato, subtereti, pinnato et sporis parvis, brunneis diagnoscenda. Sphaerophorinam et acidum protocetraricum continens.—http://www.eol.org/pages/Bunodophoron pinnatum

Type:—PAPUA NEW GUINEA. Northern Province: English Peaks, 147°29'E, 8°45'S, 3600 m, 1988, *Lambley 1643* (holotype BM, isotype UPNG 17591, not seen).

Thallus elongated, narrow, up to 7 cm long. Fertile branches narrowly flattened to almost terete, 30–50 mm long and 1–2 mm wide; major branch sparingly branched but typically with abundant, perpendicular, terete branchlets along the sides. Upper surface pale grey to white, smooth or rugose to slightly wrinkled above the apothecia. Lower surface white. Ascomata sparse, terminal, 2–4 mm wide. Mazaedia subapically exposed; thalline receptacle ruptured early but remaining and slightly widening at maturity. Ascospores ± globose, 6.5–7.5 µm in diameter, greyish brown, with an irregular ornamentation of mazaedial material. Pycnidia common, along the sides and in the apices of terminal branchlets. Conidia oblong to obovoid, (3.0–)3.5–4.5 × 1.5 µm. Secondary chemistry: sphaerophorin and protocetraric acid (no ascomata were tested due to the scarce material).

Distribution and habitat:—*Bunodophoron pinnatum* is known from three localities in the Northern Province of Papua New Guinea only. According to the label data, on Mt. Kenevi, *B. pinnatum* grows on trunks of *Dacrycarpus* in stunted *Dacrycarpus*-dominated forests. The type does not carry any further information on substrate or forest type.

Etymology:—The epithet refers to the pinnate branching of the thallus.

Additional specimens examined (paratypes):—PAPUA NEW GUINEA. Northern Province: S of Mt Kenevi, *Lambley 1349* (BM, UPNG 17167, not seen); ibid., Mt Kenevi, Myola, *Lambley 1625* (BM, UPNG 17573, not seen).

Wedin (1993) reinstated the genus *Bunodophoron* A.Massal. (about 30 species) following a hypothesis on the phylogeny of the mazaedia-producing family *Sphaerophoraceae* (Lecanorales). *Bunodophoron* includes the majority of the species formerly classified in *Sphaerophorus* Pers. and differs in the spore shape and spore ontogeny: the globose spores in *Bunodophoron* have an irregular ornamentation consisting of an amorphous material adhering to the spore wall after the spores have been released from the asci (Tibell 1981). *Bunodophoron* is further characterised by having a β-orcinol depsidone-based chemistry (compared to β-orcinol depsides in *Sphaerophorus*) and rod-shaped conidia (compared to ellipsoidal in *Sphaerophorus*). A detailed discussion of taxonomic concepts, relevant characters, and terminology is found in Wedin (1993, 1995). *Bunodophoron pinnatum* is a very characteristic species with no apparent close relatives. There are few protocetraric acid-containing species in the tropics, and among these *B. pinnatum* is easily recognised by its almost terete main branches, with a unique pinnate branching pattern, and the comparatively small, brown ascospores.

Byssoloma spinulosum* Sérus., *sp. nov. (Fig. 5D) Mycobank MB 517740

A Byssolomate humboldtiano differt pycnidiis evolutis ad marginem foliis, apotheciis magnis et hypothecio reagenti K+ purpureo.—http://www.eol.org/pages/Byssoloma spinulosum

Type:—PAPUA NEW GUINEA. Northern Province: Owen Stanley Range, Myola, right bank of Iora river, 9°09'S, 147°46'E, 2100–2400 m, primary montane forest on slope, October 1995, *Sérusiaux s.n.* (holotype LG, isotype F).

Thallus mostly developed along margins and scars of living leaves, over 1–1.5 cm in diameter, usually continuous near the margins (not developing on the under surface of the leaves, not even in a non-lichenized stade) but typically patchy, patches irregular in shape and size, whitish to very pale bluish, seemingly cottony

at high magnification, withish prothallus sometimes seen between the patches (hyphae distinct at high magnification). Apothecia present or not, rounded, (0.3–)0.4–0.5(–0.6) mm in diameter (incl. the margin), with a pale yellowish to whitish margin, typically byssoid, especially in young apothecia, getting thinner when old but never excluded, disc first slightly concave and eventually flat, bluish black. Excipulum made of densely interwoven, almost cylindrical hyphae, without constrictions, inspersed with minute, pale orange brown crystals (not disappearing in K). Hypothecium and apothecia basal center brown to dark brown, K+ dark brown or usually purple brown to bluish black. Asci clavate, 40–45 5–10 µm, of the *Byssoloma*-type. Paraphyses simple or slightly branched, not broadened at apices. Ascospores 8/ascus, ellipsoid, 3-septate, with rounded ends and without constrictions at the septa, 12–15 × 3.5–4 µm, with a thin halo around them. Pycnidia mostly but not exclusively developed at the leaves margins (natural margins or along scars), typically in a single row at the margins, conical or almost so, with a short but nevertheless distinct beak, 0.15–0.2(–0.25) mm high, ca. 0.2 mm in diameter, basis covered by the thallus (sometimes up to the ostiole margin) which can be slightly byssoid, upper part bluish grey to dark bluish, sometimes very pale, K+ pale bluish to aeruginose, a pale yellow orange glut of conidia sometimes present. Conidia numerous, rarely ellipsoid, usually enlarged at one end or typically pyriform, simple, colourless, 5×6 × 2–2.5 µm.

Distribution and habitat:—*Byssoloma spinulosum* is typically a foliicolous species in the understory of montane rainforest. So far, it has been found in two localities in the mountains of Papua New Guinea.

Etymology:—The epithet refers to the characteristic pycnidia frequently located at the leaves margins and that look like tiny spinules.

Additional specimen examined (paratype):—PAPUA NEW GUINEA. Madang: S side of Ramu river, Bundi village, on slope towards Mt Pizetara, November 1995, *Sérusiaux s.n.* (LG).

Several species of foliicolous lichens in *Lecanorales* have beaked pycnidia. They belong to two families (*Ramalinaceae* for the first genus mentioned and *Pilocarpaceae* for all others) and different genera (Lücking, 2008): *Bacidina pseudohyphophorifera* (Lücking & Sérus.) Lücking (probably pantropical), *Byssoloma humboldtianum* Lücking & Kalb (Neotropics), *B. kalbii* Sérus. (Macaronesia), *Fellhanera africana* (Vězda) Lücking (Paleotropics), *F. pilomarginata* Lücking (Central America), *F. trichariodes* Lücking & R.Sant. (Neotropics), *F. vandenberghenii* (Sérus.) Vězda (Neotropics and Africa), *Eugeniella corallifera* (Lücking) Lücking, Sérus. & Kalb (Neotropics), and *Szczawinskia tsugae* Fink (Central and North America). Two different types of pycnidia are involved: (type 1): the conidiogenous chamber is located at the tip of a pedicel (*Bacidina* and *Szczawinskia*) or (type 2): the conidiogenous chamber is sessile (thus forming a typical pycnidium) but its ostiole is extended into a distinct beak or pedicel and thus opens at its tip (other genera mentioned above). A further case (type 3): is provided by the rare *Bacidia clauzadei* Sérus. & Lambinon, so far known only from Central Africa, where the upper surface of cilia is covered with proliferating conidiogenous cells (Sérusiaux & Lambinon 1994). We here report the discovery of a further foliicolous species with beaked pycnidia, found in montane forests of Papua New Guinea. It is easily characterized by the position of the pycnidia, which are most developed at the margins of the leaves, either the natural margins or along scars. The ellipsoid, small and 3-septate ascospores and a byssoid margin (densely interwoven hyphae with cylindrical cells without constrictions, incrusted with minute brownish granules) point to the speciose and diverse genus *Byssoloma* in the *Pilocarpaceae*. Phylogenetic studies with statistical treatment of several loci sequences are very much needed to circumscribe the genera within that family; meanwhile, the generic delimitation of Lücking (2008) is the most appropriate. Within the genus, *Byssoloma spinosum* is close to the Amazonian endemic *B. humboldtianum* (Lücking & Kalb 2000) and, besides the main development of its pycnidia at leaves margins and scars, differs in the following characters: apothecia (0.3–)0.4–0.5(–0.6) mm in diameter (vs 0.15–0.25 mm in *B. humboldtianum*) with a thick byssoid margin inspersed with minute orange granules (vs thin and without granules in *B. humboldtianum*), and hypothecium and apothecia basal center brown to dark brown, K+ purple brown to bluish black (vs hypothecium sordid aeruginous and apothecial base dark brown, both being K– in *B. humboldtianum*). Apart from the conspicuous, beaked pycnidia, the new species is morphologically close to *B. confusum* Farkas & Vězda and *B. discordans* var. *flavescens* G.Thor, Lücking & Tat.Matsumoto, which agree in the pale thallus with a bluish tinge and compact, crystalline

apothecial margins, but *B. confusum* has colourless and *B. discordans* var. *flavescens* has yellow crystals in the margin.

Calopadia cinereopruinosa* Bungartz & Lücking, *sp. nov. (Fig. 5E–F) Mycobank MB 517741

Sicut Calopadia subcoerulescens sed apotheciis cinereopruinosis differt.—http://www.eol.org/pages/Calopadia cinereopruinosa

Type:—ECUADOR. Galápagos: Isla Sán Cristóbal, area W of Cerro Pelado on the way to El Ripioso, 0°52'S, 89°28'W, 400 m, transition zone, open *Psidium guajava* shrubland with *Macraea laricifolia* and dominant annual herb *Malachra capitata*, on bark and wood, dead twigs of *Psidium guajava*, sunny, wind- and rain-exposed, August 2008, *Bungartz 8489* (holotype CDS-41135).

Thallus corticolous or between bryophytes, continuous or marginally dispersed into rounded, confluent patches, up to 30 mm across and 20–40 µm thick, ecorticate or with an indistinct cortical layer, smooth, pale grey to greenish grey. Apothecia rounded, 0.4–1 mm diameter and 250–350 µm high; disc plane, grey-black and with distinct, white pruina; margin distinct, rather thick and prominent when young, grey-black and white-pruinose. Excipulum 50–70 µm broad. Hypothecium 50–100 µm high, aeruginous. Apothecial base aeruginous. Epithecium 5–10 µm high, granular, grey-brown. Hymenium 120–190 µm high, colourless. Asci 100–170 × 20–30 µm. Ascospores single, oblong-ellipsoid, muriform, 45–80 × 15–25 µm, 3–3.5 times as long as broad, colourless. Campylidia sessile, 0.4–0.7 mm broad; lobe well-developed, hood-shaped, grey but white-pruinose; socle not apparent. Conidia filiform with clavate apex, 3–7-septate, 40–55 × 1–1.5 µm.

Distribution and habitat:—The new species was found fertile only on Isla Sán Cristóbal in the transition zone towards the humid upper parts of the island. Collections with campylidia were also found on other islands mostly in the humid zone. The species usually grows on bark of stems and twigs.

Etymology:—The epithet refers to the grey-black, white-pruinose apothecia.

Additional specimens examined (paratypes):—ECUADOR. Galápagos: Isla Santa Cruz, N of El Puntudo, *Bungartz 7295* (CDS). Isla Santa Cruz, near Los Gemelos craters, *Bungartz 5480* (CDS).

Calopadia cinereopruinosa closely resembles *C. subcoerulescens* (Zahlbr.) Vězda in the grey-black apothecia and aeruginous hypothecium. However, the apothecia are thickly and persistently pruinose, a feature not observed in *C. subcoerulescens*. The new species is similar to *C. editae*, in forming pruinose apothecia and ascospores shorter than 100 µm, but *C. editae* has brownish apothecia often with a yellowish tinge and the hypothecium is light brown. The two paratype specimens bear campylidia only and their identification is not absolutely certain, however, the pruinose lobes indicate that they belong to the new species, as other species in the genus with non-pruinose apothecia also have non-pruinose campylidia.

Calopadia editae* Vězda *ex* Chaves & Lücking, *sp. nov. (Fig. 6A) Mycobank MB 517742

Sicut Calopadia perpallida sed ascosporis brevioribus differt.—http://www.eol.org/pages/Calopadia editae

Type:—TANZANIA. Morogoro Region: Submontane rainforest on the SE slope of Mt. Kanga, along Mkange stream, 850–1200 m, foliicolous, March 1989, *Farkas 89110* (holotype PRA).

Thallus foliicolous or corticolous, continuous or marginally dispersed into rounded, confluent patches, up to 50 mm across and 20–40 µm thick, ecorticate, smooth, pale grey to brownish grey. Apothecia rounded, 0.5–1 mm diameter and 250–350 µm high; disc initially plane but becoming convex in old apothecia, light brown and with thick, pale yellowish to creme-coloured pruina; margin distinct, rather thick and prominent when young, creme-coloured. Excipulum 40–70 µm broad. Hypothecium 50–100 µm high, light brown. Apothecial base sordid brown to aeruginous. Epithecium thin, 5–10 µm high, granular, pale yellowish brown. Hymenium

100–130 µm high, colourless. Asci 90–110 × 30–35 µm. Ascospores single, oblong-ellipsoid, muriform, 50–80 × (15–)20–30 µm, 2.5–4 times as long as broad, colourless. Campylidia sessile, 0.4–0.6 mm broad; lobe well-developed, hood-shaped, grey but white to pale yellow pruinose; socle not apparent. Conidia filiform with clavate apex, 3–7-septate, 40–60 × 1–1.5 µm.

Distribution and habitat:—The new species appears to have a wide tropical distribution, as it has also been found in collections from Costa Rica and the Galápagos Islands (Bungartz *et al.* unpubl. data). The available collections are either foliicolous or corticolous and found in more or less exposed microsites at low to mid elevations.

Etymology:— Antonín Vězda wished to dedicate this beautiful species to the Hungarian lichenologist Edit Farkas, but due to illness did not have the opportunity to formally publish it before he died in 2008. Since we have, meanwhile, found the species in several localities across the tropics, we take up Vězda's original name for this taxon and validate it here.

Additional specimen examined (paratype):—COSTA RICA. Limón: Gandoca-Manzanillo Wildlife Refuge, Manzanillo Section (La Amistad Caribe Conservation Area), Manzanillo, *Lücking 17098a* (F, INB).

Calopadia editae is externally similar to *C. perpallida* (Nyl.) Vězda, another pantropical species. However, the ascospores in the latter are longer and mostly exceed 100 µm in length. The ascospores of *C. editae* are similar in size to those of *C. fusca* (Müll.Arg.) Vězda and relatives, but these species lack pruina on the apothecia (Lücking 2008).

Caloplaca brownlieae* S.Y.Kondr., Elix & Kärnefelt, *sp. nov. (Fig. 6B) Mycobank MB 517743

Caloplacae cinnabarinae similis, sed thallo obscure roseo vel obscure rubello, interdum inconspicue albo-pruinato, ascosporis latioribus (6–7 µm latis) et latius septatis (3–5 µm), praesentia acido gyrophorici multo, etiam acido ovoico et acido lecanorico differt.—http://www.eol.org/pages/Caloplaca brownlieae

TYPE:—AUSTRALIA. New South Wales: Above Lake Eucumbene, on granite boulder; April 1969, *Brownlie* (holotype MEL 1023635).

Thallus 3–5 cm wide or aggregated in larger colonies, crustose, distinctly areolate, dull pink, dirty whitish pink to pinkish orange or dull brownish orange; areoles 0.3–0.8 mm wide, somewhat smaller in the centre, but 1.0–1.5 mm wide in the peripheral zone, angular or more or less rounded with somewhat raised and slightly darker coloured edges, upper surface dull pink. Apothecia (0.2–)0.3–0.6 mm diameter, immersed at first then slightly raised above the level of the areole, usually 1–3(–5) per areole, rounded to distorted by mutual pressure, rarely aggregating in irregular, compound apothecia, often with a very thin, obscure, paler pinkish thalline rim ca. 40–50 µm wide; disc plane to subconvex, dark reddish brown to dark brick orange, sometimes with a sparse whitish pruina; hymenium ca. 50 µm high; uppermost cells of paraphyses swollen, to 4 µm diameter; asci (7–)8–spored, very small, 27–30(–40) × 12–15 µm, various sized ascospores sometimes present in the same ascus; ascospores broadly ellipsoid, slightly widened at the septum, (8–)9–11(–14) × (5.5–)6–7 µm in water and (9–)10–13(–14) × 7–9 µm in K, septum 3–5 µm wide in water and 3–5(–6) µm wide in K. Secondary chemistry: parietin (major), gyrophoric acid (major), ovoic acid (minor/trace), lecanoric acid (minor), xanthorin (minor), erythroglaucin (minor).

Distribution and habitat:—Scattered on siliceous rocks in Western Australia, Northern Territory, Queensland, Australian Capital Territory, New South Wales, and South Australia.

Etymology:—The species is named in honour of the Australian botanist Sue Brownlie, who kindly provided us with the type collection.

Additional specimens examined (paratypes):—AUSTRALIA. Western Australia: Wokatharra Hill, W Moresby Range, August 1983, *Cranfield s.n.* (PERTH). Lake Argyle Road, 31 km south-east of Kununurra, *Elix 27797, Lumbsch & Streimann 39419* (CANB). Northern Territory: Newcastle Range, 12 km SSW of Timber Creek, *Streimann 42016* (CANB); escarpment, Newcastle Range, 8 km SSW of Timber Creek,

Streimann 42016 (CANB). Queensland: Mt. Walker, 15 km S of Hughenden, *Elix & Streimann 20697* (CANB). East Leichhardt River Reservoir, presumably near Mt Isa, September 1969, *Brownlie s.n.* (MEL). First Turkey, Mt Archer Environmental Park, 7 km NE of Rockhampton, *Elix 34518* (CANB). Australian Capital Territory: 11 km S of Tharwa, Booroomba rocks, *Filson 19336* (MEL). Brindabella Ranges, 9 km SW of Tharwa, Booroomba Rocks, *Filson 16736* (MEL). New South Wales: 'Bush Bottoms', 32 km NE of Goulburn, *Streimann 38875* (B, CANB). Armidale Hills, *Elix 2694* (CANB). South Australia: Kangaroo Island, just S of Wisanger Hills H. S., 7 km WSW of Emu Bay, *Elix & Elix 19644* (CANB).

Caloplaca brownlieae is similar to *C. cinnabarina* (Ach.) Zahlbr. in having dark reddish brown to dark brick orange discs but differs in its dull pink to dull brownish orange thallus, wider paraphysis tips, wider ascospores and septa. *Caloplaca australiensis* S.Y.Kondr. & Kärnefelt is also similar. The latter differs in its distinctly areolate, crustose thallus, while *C. montisfracti* S.Y.Kondr. & Kärnefelt has a thicker, somewhat subconvex thallus with slightly raised edges (Kondratyuk *et al.* 2007). A fourth similar species is *C. eos* S.Y.Kondr. & Kärnefelt, from which *C. brownlieae* is distinguished by having more immersed, somewhat biatorine apothecia. Finally, *Caloplaca brownliae* differs from all four species in the high concentration of gyrophoric acid and presence of ovoic and lecanoric acids (Kondratyuk *et al.* 2007).

Caloplaca decipioides* Arup, *sp. nov. (Fig. 6C) Mycobank MB 517744

Caloplacae decipienti similis, sed lobi magis plani, soralia ex isidiis demum fractis formata, nec in calce crescit.—http://www.eol.org/pages/Caloplaca decipioides

Type:—SOUTH KOREA. Gangwon Province: Inje-gun, Buk-myun, Yongdae-ri, Sorak-san National Park, inner part of the massif Sorak Mts, along the road in Backdam Valley from Backdam (Paekdam) temple towards the village Yongdae-ri, where the road crosses the river ca. 1.5 km NW Backdam (Paekdam) temple, 38°10'N, 128°22'E, 410–420 m, on almost vertical rock, shaded from running water, probably at least partly with a higher pH than true siliceous rocks, exposed to S at the river, October 2006, *Thor 20768* (holotype UPS, isotypes NIBR, UPS).

Thallus to 1.5 cm, single or coalescing with other thalli, lobate, growing radiately in rosettes with marginal lobes and the centre covered by smaller, irregularly arranged, often imbricate lobes; lobes 0.5–2.3 × 0.2–0.6 mm, slightly convex to rather flat, slightly wider toward tips, irregularly branched one to three times, divided by narrow but distinct furrows, 0.1–0.2 mm wide, surface ± smooth to finely granular near lobe tips, yellow (in shade) to dark orange or red-orange, slightly paler at margin and partly with very thin white pruina; soralia ± punctiform or irregular in outline, laminal or terminal on central lobes, initiating as globose to elongate isidia that soon dissolve into soredia; isidia 75–125 µm when globose and up to 200 µm long when elongate, in dense clusters, of the same colour as the thallus; soredia 35–60 µm, rather compact with rather smooth surface, yellow to orange-yellow, contrasting against the darker thallus; cortex 20–40 µm thick, paraplectenchymatous with thin-walled cells 4–8 µm in diameter, without epinecral layer; algal layer ± continuous with trebouxioid algal cells 7–12 µm in diameter; prothallus not seen; pycnidia not seen. Apothecia not seen. Secondary chemistry (HPLC): Parietin (major), fallacinal (major), vicanicin (major, isofulgidin (major), teloschistin (major) and traces of emodin, parietinic acid and caloploicin. This chemosyndrome corresponds rather well with A+3 according to Søchting & Frödén (2002).

Distribution and habitat:—The new species was collected under an overhang of a tall rock with a river running below. The rock face was exposed to the south and there were no trees giving any shade. The lichen flora is very rich at the locality and *C. decipioides* was very abundant in suitable places away from both rain and running water. The rock was very hard and probably of some kind of greenstone, but did not contain any lime. The new species is so far known only from the type locality. The locailty is situated in the Sorak-san National Park and many habitats included mainly oldgrowth forests on steep mountain slopes dominated by deciduous trees. The climate is somewhat continental with warm summers (up to 36°C) and cold winters

(down to –17°C). The annual precipitation is 1300 mm and the mountains are snow-covered from November to April. The species was collected at just above 400 m elevation. The distribution range is not yet known for this species but it is probaly rare since the collector has not seen it elsewhere in Korea or Japan on his exursions in the region.

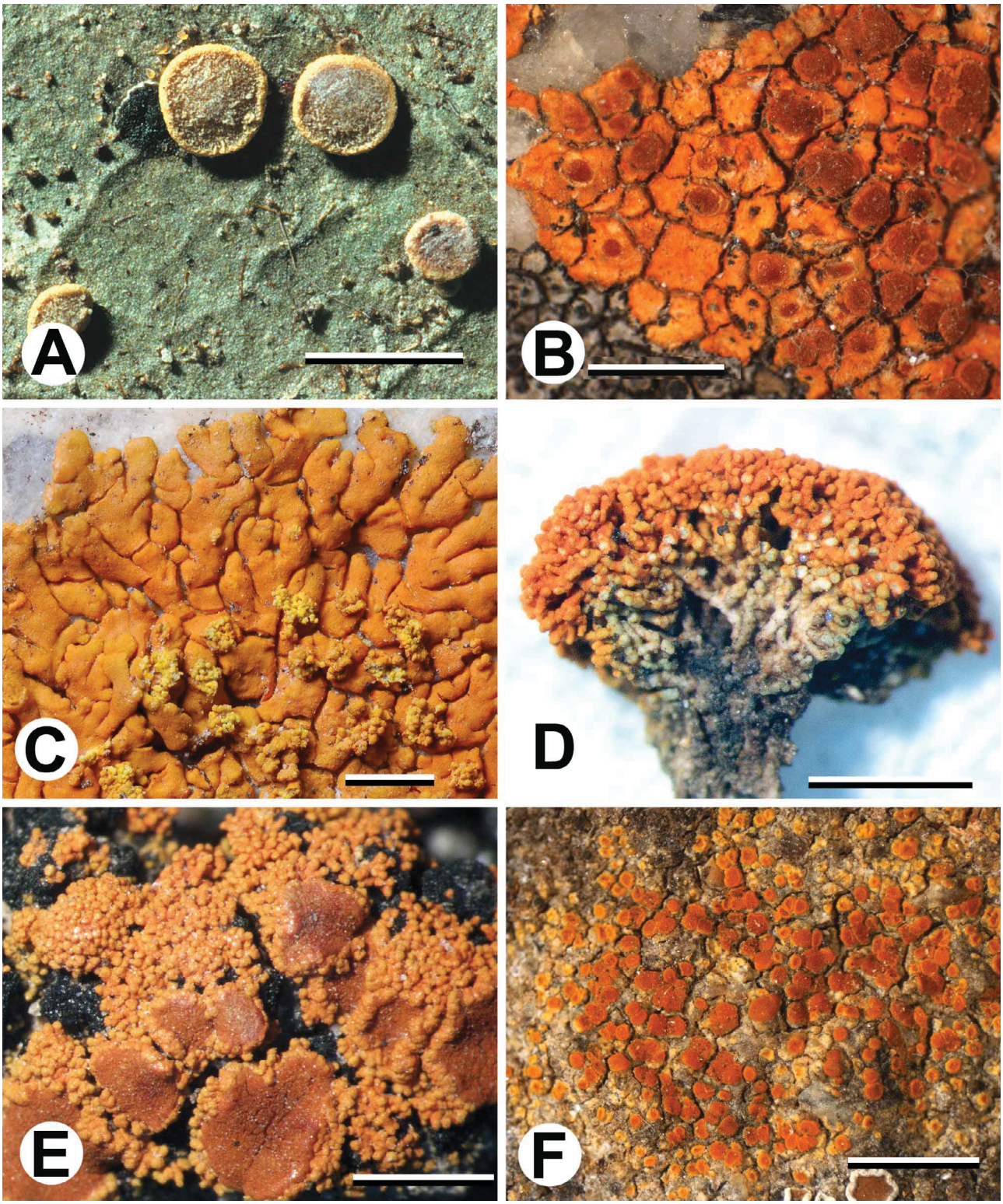

FIGURE 6. A. *Calopadia editae* (holotype), apothecia. B. *Caloplaca brownlieae* (holotype), general habit. C. *Caloplaca decipioides* (holotype), habitus. D–E. *Caloplaca digitaurea* (D, holotype; E, *Elvebakk 97-468*). D. Vertical view of thallus. E. Thallus with apothecia. F. *Caloplaca magnussoniana* (holotype), general habit. Scale in A–E = 1 mm, in F = 2 mm.

Etymology:—The epithet refers to the similarity with *C. decipiens*.

This new species of *Caloplaca* was collected in South Korea by G. Thor who kindly put the material at the author's disposal. The lobate species turned out to be difficult to determine using appropriate keys and works. Neither Gaya's recent work on the *C. saxicola* group (Gaya 2009) nor those from North America (Arup 1995, Wetmore & Kärnefelt 1998, Wetmore 2007), nor Kondratyuk's papers on Australian species (Kondratyuk *et al.* 2007a, 2007b, 2009a, 2009b), nor Poelt & Hinteregger's (1993) book on Himalayan *Caloplaca* helped in determining the species. None of the older papers from Asia were useful either (Nylander 1890, Magnusson 1940, 1944). Finally, the new species failed to match any of the many genetically investigated species of *Caloplaca* in the possesion of the author and U. Søchting or in Genbank. The new species is characterized by the orange lobate thallus with clusters of isidia that dissolve into soredia. It is similar to *C. decipiens* (Arnold) Blomb. & Forssell, a rather common lichen on anthropogenic calcareous substrates in Europe, but differs in the flatter lobes and in the soredia that develop from breakdown of globose isidia. In addition, the isidia and soralia are laminal or terminal on horizontal lobes rather than borne on ascending lobe tips as in *C. decipiens*. Finally, *C. decipioides* differs in its ecology, as it grows on hard, non-calcareous rocks and not on limestone, concrete or mortar. *C. decipens* sometimes produces apothecia, but the new species has not yet been found fertile. Molecular data also show that these two species are not closely related, as *C. decipiens* belongs to the *C. saxicola* group (Gaya *et al.* 2008) and *C. decipioides* belongs to quite another clade within the family (unpublished data). The new species could also be confused with *C. cirrochora* (Ach.) Th.Fr., but differs from that species in the same way as it differs from *C. decipiens*.

Caloplaca digitaurea* Søgaard, Søchting & Sancho, *sp. nov. (Fig. 6D–E) Mycobank MB 517745

*Sicut Caloplaca wetmorei sed apothecia majores et thallus non parasitcus.—*http://www.eol.org/pages/Caloplaca digitaurea

Type:—CHILE. XII Región de Magellanes y de la Antártica Chilena: 15 km N of Puerto Natales, Cueva del Milodón, 51°34'S, 72°37'W, 145 m, January 2005, *Søchting 10.401* (holotype C).

Thallus fruticulose, composed of mostly vertical, terete to rarely flattened, moderately branched, isidia-like lobules dispersed among mosses or cyanobacteria and sometimes forming up to 2 mm high, compact cushions; vertical lobules 60–100 µm thick and up to 1500 µm high, slightly moniliform, at the thallus edge slightly flattened and more horizontal, colour vivid orange yellow to vivid orange with uneven, matt surface. Photobiont trebouxioid. Apothecia sparse, embedded between the lobes, 0.8–1.5 mm with regular to flexuouse margin, initially zeorine with a proper margin concolorous with disc and an isidiate thalline margin concolorous with thallus, later lecanorine with an elevated margin, which is often obscured by isidia; disc deep orange, darker than thallus, flat; episamma medium coarse. Exciple fan shaped, laterally ca. 80 µm, centrally ca. 20 µm. Hymenium 60–100 µm; paraphyses branched with slightly thickened end cells, up to 4 µm. Asci clavate with 8 spores. Spores ellipsoid, polarbilocular, (12.5–)13–16(–18) × (5–)6–7.5(–8) µm; septum narrow, (1–)1.5–2.5(–3.5) µm. Pycnidia not observed. Secondary chemistry (HPLC): parietin (major), teloschistin (minor), fallacinal (minor), parietinic acid (minor), emodin (minor); conforms to chemosyndrome A according to Søchting (1997).

Distribution and habitat:—Chile, Province Última Esperanza and Province Antárctica Chilena, Isla Navarino. On rock, detritus and over other lichens on exposed outcrops in shrub vegetation, and grassland by coast, but not maritime, 5–170 m elevation.

Etymology:—The epithet *digitaurea* refers to the golden, finger-like isidia with a slight reference to the James Bond blockbuster movie *Goldfinger* from 1964. Its English vernacular name would be "Goldfinger Fire Dot Lichen".

Additional specimens examined (paratypes):—CHILE. XII Región de Magellanes y de la Antártica Chilena. Última Esperanza Province, Parque Nacional Torres del Paine, *Søgaard 38* (C). Parque Nacional

Torres del Paine. Walk from Lago Grey, *Søgaard 43, 48* (C), Parque Nacional Torres del Paine, Lago Pehoe, Río Paine, 2 km NE of Laguna Linda, *Elvebakk 97:468* (C). Antártica Chilena Province, Isla Navarino, 37 km W of Pto. Williams, Caleta Honde, *Søchting 10.175* (C).

The genus *Caloplaca* is one of the largest lichen genera, with probably close to 1000 species, particularly in cool regions, favoring especially calcareous or nutrient rich substrata or maritime rocks. The cool parts of the Southern Hemisphere are still poorly studied. *Caloplaca digitaurea* is one of a number of undescribed species discovered during recent field work in Southern Patagonia as part of the Spanish ANTRAX project. It is characterized by the vivid orange, thick and terete isidia-like lobules, often in microfruticose clusters. The lobules are mostly distinct, always growing ± vertically upwards. The species can resemble *C. isidioclada* Zahlbr., but *C. digitaurea* has thicker lobules (up to 100 µm) than *C. isidioclada* (30–60 µm). Based on available ITS sequences and morphology, *Caloplaca wetmorei* Nimis, Poelt & Tretiach from the Sonoran Desert seems to be the closest relative. It has, however, smaller apothecia (0.3–0.4 mm) and a parasitic life habit (Nimis *et al.* 1994). Also, even though *C. wetmorei* may be a relative, there is only a 93 % similarity between the ITS region of the nuclear rDNA of the two species (*C. digitaurea* Genbank number HQ 317922, *C. wetmorei*, isotype Genbank number HQ 317923). Therefore it is unlikely that they belong to the same taxon.

Caloplaca magnussoniana **S.Y.Kondr., Kärnefelt & A.Thell,** ***sp. nov.*** (Fig. 6F) Mycobank MB 517746

*Caloplacae lithophilae similis, sed apotheciis in thallo centrali aggregatioribus, paraphysibus cum cellulis oleosis, et septo ascosporae angustiore (3–4 µm lato) differt.—*http://www.eol.org/pages/Caloplaca magnussoniana

Type: AUSTRALIA. Tasmania: Mt Barrow Chalet; 41°23'S, 147°25'E, 600 m, on dolerite, sheltered and rare, January 1966, *Bratt & Bratt 3226* (holotype HO 38775).

Thallus 1–2 cm wide, usually aggregated into larger colonies, appearing dull yellowish or dull brownish orange due to numerous apothecia, thallus areoles absent or rare, minute, to 0.1 mm wide, whitish grey greenish-yellow or whitish-yellowish, in the peripheral zone or among the apothecia in the centre of thallus, rarely seen as undulating fragments of a continuous yellowish film, ca. 0.3 mm wide. Apothecia 0.2–0.4(–0.55) mm diameter, 0.2 mm thick, usually numerous and densely aggregated, biatorine, dull yellowish, proper margin margin 0.03–0.05 mm wide, becoming excluded, disc plane to subconvex, dull orange to dull brownish orange; in section biatorine; true exciple to 70 µm thick in the uppermost lateral portion, 10–15 µm thick in the basal portion; hymenium 70–75 µm high; paraphyses swollen towards the tips, to 4–5 µm diameter, with numerous oil cells, 4–5 µm diameter (better seen in K!); ascospores broadly ellipsoid, (8–)9–12 × (5.5–)6–7 µm in water and 10–13(–15) × 7–10 µm in K, septum 3–4 µm wide in water and (3–)4–5(–6) µm wide in K. Secondary chemistry: epihymenium K+ dark purple, becoming pale, in K brownish.

Distribution and habitat:—Known from scattered localities in Victoria and Tasmania, but probably overlooked. Australian records of *C. lithophila* or epilithic collections of *C. pyracea* or *C. holocarpa* may represent this new species. It grows on siliceous or calcareous rocks.

Etymology:—It is named for the well known Swedish lichenologist A. H. Magnusson, who made significant contributions to our knowledge of *Caloplaca* and described *C. lithophila,* which is closely related to this new species.

Additional specimens examined (paratypes):—AUSTRALIA. Victoria: Gippsland Plain, Highett (suburb of Melbourne), CSIRO, March 1985, *Martin s.n.* (MEL). 5 km E of Tragalgon, Flynn's Creek Road, heavily grazed paddock, *Filson 15219* (MEL). 26 km E of Murrayville on the Mallee Highway, 20 km S of Walpeup, *Kärnefelt 992601, 992602* (LD). Tasmania: Clarkes Island, ca. 5.1 km at 2 degrees NW of Black Point, *Whinray 1442* (MEL).

The key characters indicate that *C. magnussoniana* is closely related to *C. lithophila* H.Magn. and *C. approximata* (Lynge) H.Magn. It differs from *C. approximata* in having wider ascospores and septa and from

C. lithophila by its narrower ascospores and by the presence of oil cells, not only oil droplets, in the paraphyses. It differs from both these species in lacking distinct thalline areoles and in having apothecia more aggregated towards the centre (Kondratyuk *et al.* 2004).

Caloplaca mereschkowskiana* S.Y.Kondr. & Kärnefelt, *sp. nov. (Fig. 7A) Mycobank MB 517747

Caloplacae brachysporae similis, sed apotheciis aggregatis, paraphysibus supra cum cellulis et guttulis oleosis, ascis saepe 1–2–4–6-sporis, ascosporis latius septatis (3–4(–6) µm), et hypothallo obscure cinereo deficiente differt.—http://www.eol.org/pages/Caloplaca mereschkowskiana

Type: AUSTRALIA. Western Australia: North of Northampton, road to Horrocks, Bower River Road, on calcareous rocks, 28°24'S, 114°27'E, January 2004, *Kärnefelt et al. 20041503* (holotype PERTH, isotypes CANB, LD, KW).

Thallus 0.5–2 cm wide, usually aggregated into larger colonies, appearing dull orange or brownish orange due to the numerous apothecia, thallus areoles yellowish white to greenish yellow-white or brownish, very thin, immersed and indistinct in the peripheral zone to rather thick and areolate in the centre, areoles immersed and almost indiscernible at the periphery to distinct in the centre, (0.2–)0.3–0.8(–1.3) mm wide, 0.3–0.4 mm thick. Apothecia 0.2–0.5(–0.7) mm diameter, 0.15–0.22 mm thick, numerous, immersed at first, becoming sessile, 1–2 per areole, aggregated but regularly rounded, rarely crowded; disc plane to subconvex, dull orange, brownish yellow to brownish orange or somewhat orange-pink, ± with sparse whitish pruina; biatorine in section with a slightly paler proper margin, 0.03–0.05 mm wide, becoming excluded or very rarely zeorine; thalline exciple developed only at the base, 70–80 µm thick, cortical layer 10–15 µm thick; hymenium 50–60 µm high, hyaline, epihymenium brownish orange; subhymenium 80–100 µm thick; paraphyses swollen towards the tips to 4-6(–7) µm diameter, usually with oil droplets 1–2(–4) µm diameter, very rarely with oil cells 5–6(–7) µm diameter present; asci (1–2–4–6–)8-spored, bipolar and simple spores seen in the same ascus; ascospores distinctly widened at the septum, with rounded ends, varying from elongate-ellipsoid to almost spherical, (9–)10–12(–15) × 6–7 µm in water and 10–13(–14) × (5–)6–7(–8) µm in K (often with wrinkled surface in K), and rather narrow septa, 3–4(–6) µm wide in water and (4–)5–7 in K. Secondary chemistry: thallus K+ purple, epihymenium K+ purple or blackish purple in places, then dark cherry blossom pink to dark cherry blossom red; containing parietin (major), parietinic acid (minor), fallacinal (trace), teloschistin (trace).

Distribution and habitat:—Common on limestone outcrops in Western Australia, South Australia, Victoria and Tasmania.

Etymology:—This species is named after the Russian biologist, Konstantin Sergejewicz Mereschkowsky (1855–1921), known for his hypothesis on symbioses, who described *C. brachyspora* belonging to this species group.

Additional specimens examined (paratypes):—AUSTRALIA. Western Australia: E. Wallabi, N end of airstrip WA, April 1980, *Green s.n.* (PERTH). Nullarbor Plain, Eyre Highway, near Eucla Pass, 1 km W of Eucla, *Curnow 4753* (CANB). N of Northampton, road to Horrocks, Bower River Road, *Kärnefelt 20041502* (LD). 0.25 km E of mouth of Bower River, S of Horrocks Beach, *Kondratyuk et al. 20421* (KW). South Australia: Salt Creek, *Bratt 67/138* (HO 64728). 15 km W of Peake along Highway 12, *Elix 8727* (MEL). Eyre Peninsula, 28.3 km E of Cowell on the Lincoln Highway, *Filson 11795* (MEL). Nullarbor Homestead, January 1952, *Kempsey s.n.* (MEL). Victoria: Buchan-Gelantipy road, 6 km NNE of Buchan, *Streimann 39787* (CANB). Tasmania: Bass Strait, Hogan Group, Hogan Island, 4 m, December 1973, *Whinray s.n.* (MEL).

Caloplaca mereschkowskiana belongs to the *Caloplaca lactea* group, characterized by a whitish thallus and yellow apothecia with small ascospores. It is similar to *C. lactea* (A.Massal.) Zahlbr. from which it differs by wider ascospore septa and absence of a well-developed thalline margin of the apothecia (Kondratyuk *et al.*

2004). The whitish thallus of *C. mereschkowskiana* resembles *C. brachyspora* Mereschk., a species that differs in having less aggregated apothecia, in lacking oil droplets and oil cells in the upper portion of paraphyses and in having narrower ascospore septa and the presence of a dark grey hypothallus (Kondratyuk *et al.* 2004). Further, *C. mereshkowskiana* differs from *C marmorata* (Bagl.) Jatta and *C. lacteoides* Nav.-Ros. & Hladun, two species growing on limestone outcrops with reddish apothecia, by its smaller ascospores (Kondratyuk *et al.* 2004). *Caloplaca yorkensis* often grows together with *C. mereschkowskiana* but differs in having narrower ascospores and a more immersed thallus and apothecia without the pink orange-pink tinge observed in *C. mereschkowskiana*.

Caloplaca yorkensis* S.Y.Kondr. & Kärnefelt, *sp. nov. (Fig. 7B) Mycobank MB 517748

Caloplacae lacteae similis, sed thallo tenuissimo–crassiusculo, albido-cinereo, apotheciis biatorinis, obscure luteis, subhymenio minus evoluto et ascosporis angustissimis ((3.5–5(–5.5[–6]) µm latis) differt.—http://www.eol.org/pages/Caloplaca yorkensis

Type: AUSTRALIA. South Australia: Yorke Peninsula, Coodowie, 5 km E of Editburgh along the coast, 35°03'S, 137°44'E, on calcareous rocks, growing together with *Caloplaca johnwhinrayi*, January 1999, *Kärnefelt 995207* (holotype CANB).

Thallus (0.3–)1–2 cm wide or aggregated into larger colonies forming grey to greyish brown, somewhat indistinct areas of different thickness, from indistinct, almost endolithic or very thin and immersed in the substrate, cracked together with the substrate forming areoles, 0.4–0.7 mm wide, to rather thick and well-developed, (to 0.3 mm thick), plane or subconvex, immersed to ± exfoliating; areoles grey or greyish white to brownish grey with sparse, often minute, biatorine, dull yellow orange apothecia. Apothecia to 0.3–0.6(–0.7) mm diameter, 0.2–0.25 mm thick in section, biatorine, usually scattered and regularly rounded, rarely irregular due to mutual pressure; proper margin pale yellowish or concolorous with disc, becoming excluded; disc plane to subconvex, dull yellow orange to brownish yellow-orange, in section biatorine, true exciple 30–50 µm thick in uppermost lateral part and to 40 µm thick in lower lateral part, 30–70 µm thick at the base, pseudoprosoplectenchymatous to somewhat mesodermatous paraplectenchymatous with a well-developed matrix in the centre; hymenium 50–60 µm high; subhymenium 20–25(–70) µm thick; epihymenium bright yellow; paraphyses 1.5–2 µm diameter, distinctly swollen to 4–5 µm diameter towards the tips; asci 2–4–6–8-spored, often mature bipolar and simple undeveloped or abortive ascospores present; ascospores small and very narrow, slightly swollen at the septa, 9–11(–12) × 3.5–5(–6) µm in water and (8–)9–12 × (4–)4.5–6(–7) µm in K, with rather thin septum, (1.5–)2–3.5 µm wide in water and 2.5–3.5(–4) µm wide in K. Secondary chemistry: epihymenium K+ purple to crimson purple, becoming brownish crimson on standing.

Distribution and habitat:—*Caloplaca yorkensis* is known from scattered localities in Western Australia, South Australia, Victoria and Tasmania, where it occurs on limestone outcrops.

Etymology:—This new species is named after the type locality, Yorke Peninsula in South Australia.

Additional specimens examined (paratypes):—AUSTRALIA. Western Australia: Point Peron, ca. 80 km S of Perth, *Marchant 5578* (MEL 234720). 5 km S of Dongara, *Kärnefelt et al. 20041103* (LD). 0.25 km E of mouth of Bow River, S of Horrocks Beach, *Kondratyuk et al. 20421* (CANB, LD, KW, PERTH). Victoria: Portland region, Cape Bridgewater, *Kärnefelt 996101* (LD). Tasmania: Bass Strait, Hogan Group, Hogan Island, 4 m, December 1973, *Whinray s.n.* (MEL). Bass Strait, Furneaux Group, Kangaroo Island, ca. 90 m SSW of the summit, February 1972, *Whinray s.n.* (MEL).

Caloplaca yorkensis, with its grey to greyish brown thallus and yellow to orange apothecia with small ascospores resembles species in the *Caloplaca lactea* group. This new species is similar to *C. lactea* (A. Massal.) Zahlbr., but differs in having a thinner and more immersed thallus. The subhymenium is thinner in *C. yorkensis,* the ascospores considerably narrower (3.5–5.5 µm vs, 6–7 µm wide), and the apothecia lack a well-developed thalline margin. *Caloplaca brachyspora* Mereschk. has a similar morphology, and also grows on

limestone However, the thallus is better developed and greenish-brown in *C. brachyspora* and the ascospores are broader (6–8 µm; Kondratyuk *et al.* 2004). *Caloplaca yorkensis* differs from *Caloplaca lithophila* by its grey, mainly immersed thallus and smaller, narrower ascospores. *Caloplaca oxfordensis* Fink and *C. mereschkowskiana,* described above, differ in having orange apothecia and larger or broader ascospores.

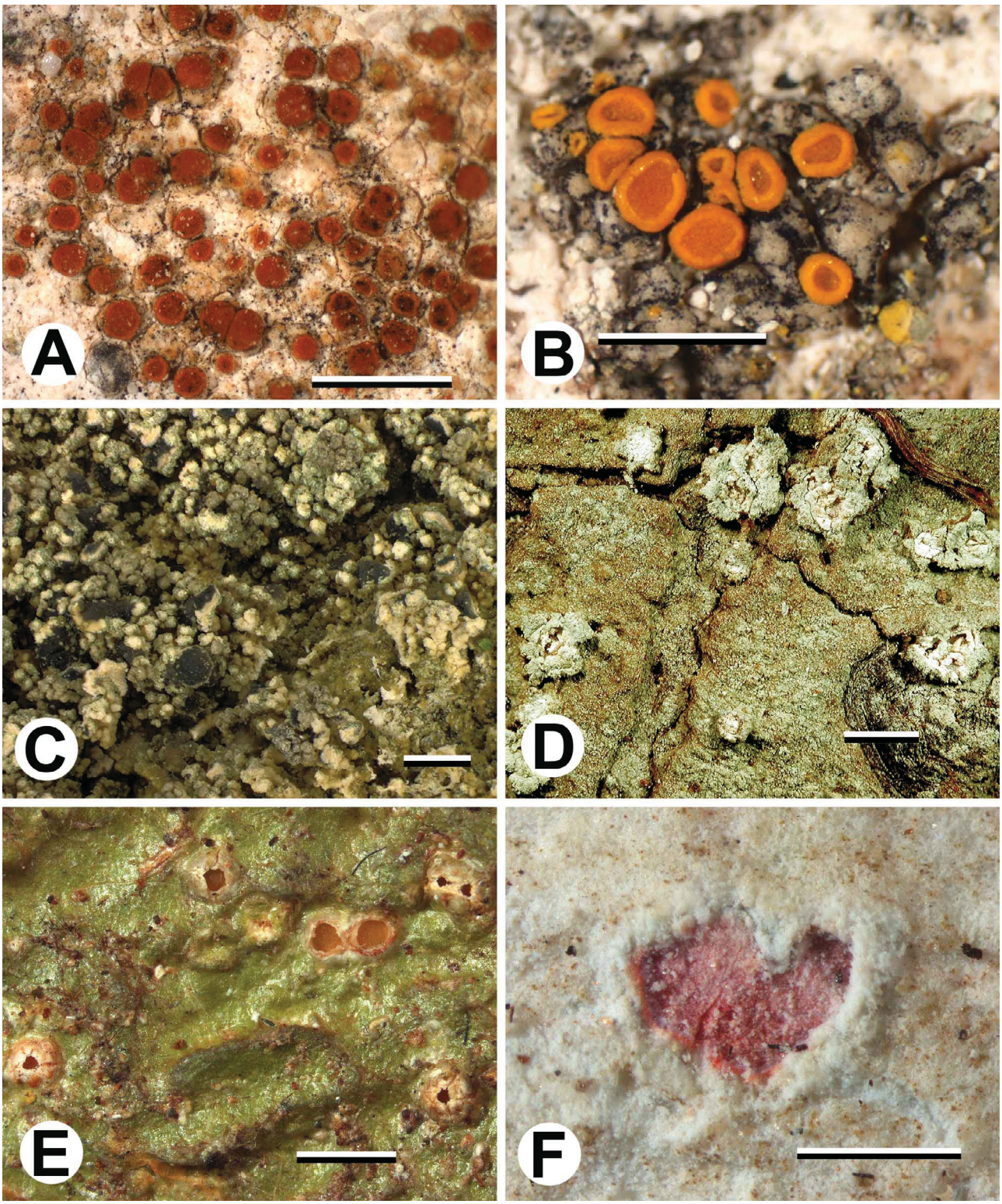

FIGURE 7. A. *Caloplaca mereschkowskiana* (holotype), general habit. B. *Caloplaca yorkensis* (MEL 234720), general habit. C. *Calvitimela uniseptata* (holotype), thallus with apothecia. (photograph by Vítězslav Maňák). D. *Chapsa microspora* (holotype), thallus with apothecia. E. *Chapsa psoromica* (isotype), thallus with apothecia. F. *Chapsa rubropulveracea* (holotype), apothecium. Scale in A–E = 1 mm, in F = 0.5 mm.

Calvitimela uniseptata* G.Thor, *sp. nov. (Fig. 7C) Mycobank MB 517749

Thallus squamulosus, squamulis adscendentibus, verrucoso-coralloideis, cinereis vel cinereo-viridibus. Ascosporae hyalinae, subcurvatae usque ad ellipsoideae, 1-septatae vel raro non septatae, 9–16 µm longae et 4–5 µm latae.—http://www.eol.org/pages/Calvitimela uniseptata

Type:—ANTARCTICA. Dronning Maud Land: Vestfjella, the nunatak Basen, 1000 m NW of the Swedish station Wasa, 73°02'S, 13°25'W, 505 m, steep SW facing slope 50 m E of the precipice, at old *Pagodroma nivea* nest, February 1992, *Thor 10792* (holotype S, isotype UPS).

Thallus of erect, wart-like to coralloid squamules, grey to greenish grey, not pruinose; prothallus diffuse to clearly visible, whitish; medulla whitish to greyish, with calcium oxalate crystals, C–, K–, PD–, UV–, I–, K/I–; hyphae 2–4 µm wide; soralia not seen. Photobiont chlorococcoid, cells 5–12 µm in diameter. Apothecia frequent, clearly constricted at base, up to 1.1 mm in diameter; margin thin to thick, often partly lacking, of the same colour as the thallus; disc flat to convex, black to brown to colourless with pink tinge (in deep shade), not pruinose; hypothecium colourless; hymenium colourless, without oil-drops, 40–70 µm tall, I+ blue, K/I+ blue, K–; epithecium colourless to dark olive-green, N+ reddish violet; paraphyses sparsely branched, thin-walled, without distinct gallertic sheaths, 2 µm wide; paraphyses apices colourless to dark olive-green, 3–5 µm wide. Asci of the *Lecanora*-type, 50–55 × 15–20 µm. Ascospores 8/ascus, colourless, slightly curved to ellipsoid, without perispore, 1-septate or rarely simple, (9–)10–13(–16) × (4–)4–5(–5) µm (Length: X = 11.7 µm, SD = 1.4 µm, n = 120; Width: X = 4.8 µm, SD = 0.5 µm, n = 120). Pycnidia few, immersed; wall colourless; conidia thread-like, curved (14–)17–21(–22) × (1–)1(–1) µm (Length: X = 18.6 µm, SD = 2.0 µm, n = 120; Width: X = 1.0 µm, SD = 0.0 µm, n = 120). Secondary chemistry (TLC): no substances.

Distribution and habitat:—*Calvitimela uniseptata* is only known from the type locality, where it was abundant. It was searched for on numerous other localities in Heimefrontfjella and Vestfjella without success. The species grows on basalt rocks and on adjacent old snow petrel *Pagodroma nivea* feathers at an old snow petrel nest under a boulder. Thus, the locality was probably rich in nitrogen and phosphorous.

Etymology:—The new species is named after the 1-septate ascospores.

The genus *Calvitimela* is separated from *Tephromela* on the bases of, e.g., the greenish epithecium, which reacts N+ red, and asci of the *Lecanora*-type (Hafellner & Türk 2001). *Tephromela s. str.* is distinguished by a reddish brown hymenium, reacting K+ violet and by having asci of the *Bacidia*-type (Hafellner & Türk 2001). *Calvitimela uniseptata* is recognized by the wart-like to coralloid thallus squamules and the 1-septate spores. The immersed and colourless pycnidia are easily overlooked. The species is not included in Hertel (1984, 1987) or Øvstedal & Lewis Smith (2001).

Chapsa microspora* Kalb, *sp. nov. (Fig. 7D) Mycobank MB 517750

Similis Chapsae aggregatae sed differt thallo non corticato, ascosporis minoribus, hyalinis et materia chemica.—http://www.eol.org/pages/Chapsa microspora

Type:—BRAZIL. Amazonas: Rainforest along Rio Negro, 150 km upstream Manaus, 02°30'S, 61°10'W, 40 m, October 1980, *Kalb s.n.* (holotype hb. Kalb 26934).

Thallus corticolous, light grey to whitish, smooth, continuous, ca. 20–50 µm thick, dull, ecorticate to endoperidermal. Photobiont layer indistinct, 10–15 µm thick, with numerous photobiont cells and the inclusion of decomposed periderm cells and of a few small calcium oxalate crystals. Medulla endophloeodal. Apothecia erumpent to prominent, roundish, 0.6–1.2 mm in diameter, usually 1–3 aggregate. Margin strongly raised, deeply fissured to lobed, upright to usually strongly recurved, with a thin, pale-grey to white-felty and sometimes slightly crystalline inner surface; proper exciple free. Disc pale brown, covered by a thin to rather thick white pruina. Periphysoids distinct, ca. 20 µm long. Hymenium 50–60 µm high, clear. Epihymenium

unpigmented or partially greyish, ca. 5–8 µm high. Paraphyses simple, straight, 2–2.5 µm wide; tips indistinctly moniliform to occasionally branched, adspersed with fine greyish granules. Ascospores 6–8/ascus, 2–3 seriate, hyaline, with (2–)3 transverse septae, 7–9 × 4 µm, thick-walled, with rounded ends, I–. Pycnidia not seen. Secondary chemistry (TLC): stictic acid (major), constictic acid (major), hypostictic acid (trace) and hypoconstictic acid (trace).

Distribution and habitat:—*Chapsa microspora* is known from a single but ample collection from a more or less virgin tropical rainforest in the Amazon basin. It was collected from the smooth and slightly decaying bark of an old deciduous tree in a rather shady situation.

Etymology:—The epithet refers to the relatively small ascospores.

Chapsa microspora is a conspicuous species being characterised by rather large roundish and aggregate apothecia with a clear hymenium, a free proper exciple, paraphyses with indistinctly moniliform or slightly branched tips and hyaline, transversely septate, small, non-amyloid ascospores with a well-developed endospore. The thallus is pale grey to whitish and contains substances of the stictic acid aggregate. *C. aggregata* (Hale) Sipman & Lücking from Dominica looks similar, but that species is distinctly corticate, without secondary lichen products, and has brown ascospores, ca. 16 × 8 µm. *Chapsa albomaculata* (Sipman) Sipman & Lücking also has aggregate apothecia, but the thallus is corticate and the ascospores are more septate with (4–)5–7(–8) septa, and the chemistry is slightly different [constictic acid (major), stictic acid (trace)]. *Chapsa platycarpa* (Tuck.) A.Frisch, another species with stictic acid aggr., has an epiperidermal, olive-green thallus with a prosoplectenchymatous cortex and brown ascospores. The same chemistry and a similar habitus as *C. microspora*, together with a free exciple, is found in *Thelotrema porinoides* Mont. & Bosch, but that species differs by large, multiseptate, I+ violet ascospores. Another species of *Chapsa* with very small (4.5 × 2.5 µm) and I– ascospores, namely *C. bicellularis* Sipman & Lücking, has a clear hymenium too, but differs in the absence of secondary lichen products and the hardly discernable thallus.

Chapsa psoromica **M.Cáceres, Santos de Jesus & Santos Vieira, *sp. nov.*** (Fig. 7E) Mycobank MB 517751

Sicut Chapsa elabens sed thallo olivaceo corticato, acidum psoromicum continente et ascosporis I+ violaceis differt.—http://www.eol.org/pages/Chapsa psoromica

Type:—BRAZIL. Rondônia: Porto Velho, Estação Ecológica de Cuniã, 8º 04'S, 63º 31'W, 100 m, July 2009, *Cáceres 7595* (holotype ASE, isotype F).

Thallus corticolous, up to 5 cm diameter, 70–100 µm thick, continuous; surface smooth to uneven, olive-green. Thallus in section with well-developed, prosoplectenchymatous upper cortex with internal splitting and irregular algal layer; clusters of calcium oxalate crystals absent. Apothecia erumpent, angular-rounded, 0.4–0.6 mm diameter; disc more or less covered by a narrow pore, flesh-coloured and slightly translucent, non-pruinose; proper margin indistinct; thalline margin fissured to lobulate with 3–6 inclined to erect lobules. Columella absent. Excipulum paraplectenchymatous, 30–60 µm thick, yellow; periphysoids present but indistinct. Hymenium 150–200 µm high, strongly inspersed and appearing nubilous grey; inspersion of two types: primary inspersion quickly dissolving in KOH and then hymenium appearing translucent, but secondary inspersion persistent; paraphyses unbranched. Ascospores 8 per ascus, 9–11-septate, 35–45 × 9–12 µm, oblong, with thickened septa and lenticular lumina, colourless, I+ dark violet-blue. Secondary chemistry: psoromic acid.

Distribution and habitat:—This species is thus far only known from the type collection from the state of Rondônia in the western part of the Amazon forest. It appears to be a forest understory species on the bark of large trees.

Etymology:—The epithet refers to the, for this genus, unusual chemistry.

Chapsa psoromica at first glance resembles a species of *Fissurina* because of its olive-green, corticate thallus with a split-cortex and fissured apothecia. However, the apothecia are rounded with a well-developed

disc and therefore the species is here placed in *Chapsa*. Inspersion is very rare in *Chapsa* and only three species with hyaline, transversely septate ascospores show this feature: *C. elabens* (Müll.Arg.) Rivas Plata & Mangold, *C. lueckingii* Kalb, and *C. pseudoschizostoma* (Hale) Sipman (Kalb 2009, Rivas Plata *et al.* 2010). The latter has an ecorticate, whitish thallus and much smaller ascospores; also, the apothecia are pseudocolumellate. *Chapsa lueckingii* produces stictic acid and has much larger apothecia with thick white pruina and smaller ascospores. *Chapsa elabens* differs from *C. psoromica* in the ecorticate, endoperidermal thallus and the non-amyloid, narrower ascospores with more numerous septa. Both species also lack psoromic acid. *Chapsa psoromica* resembles other fissurinoid species in the genus, namely *C. dissuta* (Hale) Mangold, *C. lassae* Mangold, and *C. zahlbruckneri* (Redinger) A.Frisch. The first two are externally almost indistinguishable but have a non-inspersed hymenium and much smaller, 3-septate ascospores, and lack psoromic acid. The latter agrees with *C. psoromica* especially in the indistinct periphysoids, but its hymenium is also non-inspersed and the ascospores are muriform; in addition, the apothecia are much larger and more distinctly chroodiscoid; also here, psoromic acid is lacking. The unusual psoromic acid chemistry may suggests that *C. psoromica* is not a genuine *Chapsa*; however, in the related genus *Thelotrema*, there is also a single species with psoromic acid, *T. saxicola* (Vain.) Salis. (Rivas Plata *et al.* 2010).

Chapsa rubropulveracea* Hale *ex* Mangold, Lücking & Lumbsch, *sp. nov. (Fig. 7F) Mycobank MB 517753

Sicut Chapsa farinosa sed apotheciis rubris ascosporis minoribus differt.—http://www.eol.org/pages/Chapsa rubropulveracea

Type:—DOMINICA. Barbers Block, May 1972, *Hale 46121* (holotype US).

Thallus corticolous, up to 5 cm diameter, 50–100 µm thick, continuous; surface distinctly farinose, white-grey. Thallus in section lacking upper cortex, with irregular algal layer and abundant clusters of calcium oxalate crystals. Apothecia erumpent, angular-rounded, 0.5–1 mm diameter; disc exposed, red-pruinose; margin lobulate, fused, white-pruinose. Columella absent. Excipulum paraplectenchymatous, 10–20 µm thick, colourless; periphysoids present. Hymenium 50–70 µm high, with a layer of crystalline red pigment above which dissolves in KOH; paraphyses unbranched. Ascospores 8 per ascus, 5–7-septate, 15–20 × 5–6 µm, oblong, with thin to slightly thickened septa and rectangular lumina, colourless, I–. Secondary chemistry: no substances detected with TLC except red pigment on apothecial disc (K+ purple).

Distribution and habitat:—This species is thus far only known from the type collection from Barber's Block, a 400 m high hill about 8 km N of Grand Savanna on Dominica.

Etymology:—The epithet refers to the red-pruinose apothecial disc.

Chapsa is a large genus of chiefly tropical, crustose lichens in *Graphidaceae*, usually with large apothecia bordered by a lobulate margin (Rivas Plata *et al*. 2010). The genus is quite variable morphologically, chemically, and ecologically, although most species are found in lowland to lower montane rain forests. *Chapsa rubropulveracea* was intended to be described as a new *Thelotrema* by the late Mason Hale, but apparently never published, and is validated here in the genus *Chapsa*. There are only few other species of *Chapsa* with transversely septate, hyaline ascospores and pigmented apothecial discs. *Chapsa waasii* (Hale) Sipman & Lücking from southeast Asia agrees in most aspects, but has apothecia with a purple-violet disc and distinct, recurved, felty-pruinose lobules, as well as an endoperidermal thallus (Rivas Plata *et al.* 2010). *Chapsa rubropruinosa* Messuti & Codesal from Argentina (Messuti *et al.* 2010) differs in the red-brown apothecial disc and the loosely corticate thallus, as well as in the presence of stictic acid. *Chapsa rivas-platae* Kalb & Lücking from Brazil (Kalb 2009) is another similar species; it also lacks a cortex but the apothecia are ochraceous to orange-pruinose, the ascospores are much larger (45–80 µm) and I+ violet-blue, and stictic acid is present. Finally, there is *C. magnifica* (Berk. & Broome) Rivas Plata & Mangold, with a dense thallus cortex, inclined to erect apothecial lobules, and large, multiseptate ascospores (70–100 µm). Another species of *Chapsa* with pigmented apothecial disc, *C. neei* (Hale) Mangold & Lücking, differs in having brown

ascospores and lepadinoid apothecia with a double margin. Except for the apothecial pigment, *C. rubropulveracea* is most similar to *C. farinosa* Lücking & Sipman from Costa Rica (Sipman *et al.* 2010), which agrees in the farinose thallus and general apothecial morphology, but lacks a pigment and has larger ascospores (20–30 µm).

Chapsa thallotrema **Lücking & N.Salazar, *sp. nov.*** (Fig. 8A–B) Mycobank MB 517753

Sicut Chapsa sublilacina sed thallo sorediis instructo differt.—http://www.eol.org/pages/Chapsa thallotrema

Type:—PANAMA. Panamá: Altos de Campana National Park, 50 km W of Panama City near the town of Capira, 8º 42'N, 79º 57'W, 500–600 m, submontane rainforest, on bark of large trees in the shaded understory, *Lücking 27305* (holotype F, isotype PMA).

Thallus grey-olive, smooth to uneven, with dense, prosoplectenchymatous cortex with internal splitting, sorediate; soralia usually numerous but discrete, capitate, finely granular, 1–2 mm diameter, white to bluish or yellowish white, strongly contrasting with the surrounding thallus; photobiont layer and/or medulla with clusters of calcium oxalate crystals. Apothecia erumpent, angular-rounded, 1–3(–5) mm diameter; disc exposed, flesh-coloured to pink-purple; margin lobulate to recurved, often layered, flesh-coloured to beige. Columella absent. Excipulum paraplectenchymatous, colourless; periphysoids present. Hymenium 150–200 µm high; paraphyses unbranched. Ascospores 2–4/ascus, 15–19-septate, 60–120 × 10–15 µm, cylindrical, with thick septa and lens-shaped lumina, colourless, I+ violet-blue (amyloid). Secondary chemistry: stictic acid and satellites (K+ yellow).

Distribution and habitat:—Apparently a widely distributed neotropical species restricted to the shady understory of lowland to lower montane rainforests.

Etymology:—This common and widespread taxon was long ago recognized by Henry Imshaug and his students from collections in the Caribbean and provisionally named '*Thallotrema antillarum*' but was never validly published. The chosen epithet honours this earlier name.

Additional specimens examined (paratypes):—COSTA RICA. Alajuela: Volcán Tenorio National Park, Pilón Biological Station (Arenal-Tempisque Conservation Area), Tilarán Ridge, 140 km NW of Sán José, 25 km NNW of Tilarán, near Bijagua, *Nelsen 3745* (INB, WIS), *Lücking 17219* (F); ibid., main trail through forest to crater, *Will-Wolf 12745b* (CR, INB, WIS). Puntarenas: Corcovado National Park, Sirena Section, Sirena Biological Station (Osa Conservation Area), Osa Pensinsula, 160 km SSE of Sán José and 50 km WSW of Golfito, *Lücking 16204* (F, USJ); *16228* (F, INB). PANAMA. Panamá: Altos de Campana National Park, 50 km W of Panama City near the town of Capira, *Lücking 27303*, *27304* (F, PMA).

This new species is part of a complex of species centered around *Chapsa sublilacina* (Ellis & Everh.) Sipman & Lücking, all sharing the same thallus morphology and ascospore type. Four forms are distinguished: with or without stictic acid and satellite substances, and with either large, compact, finely granular soralia or with small, irregular, coarse soralia. The form with large soralia, described here as *C. thallotrema*, contains stictic acid, whereas the form with small soralia lacks secondary substances. Thus, *C. thallotrema* is considered the sorediate counterpart of *C. sublilacina*.

Chiodecton pustuliferum **Aptroot, *sp. nov.*** (Fig. 8C–D) Mycobank MB 517754

Chiodecton thallo sterili pustulato, pustulis sorediatis albidis, hypothallo extenso brunneo, acidum roccellicum continens.—http://www.eol.org/pages/Chiodecton pustuliferum

Type:—MADAGASCAR. Tamatave: Périnet, Andasibe, 18º 56'S, 48º 16'E, May 1984, *Aptroot & Hensen 13406* (holotype ABL).

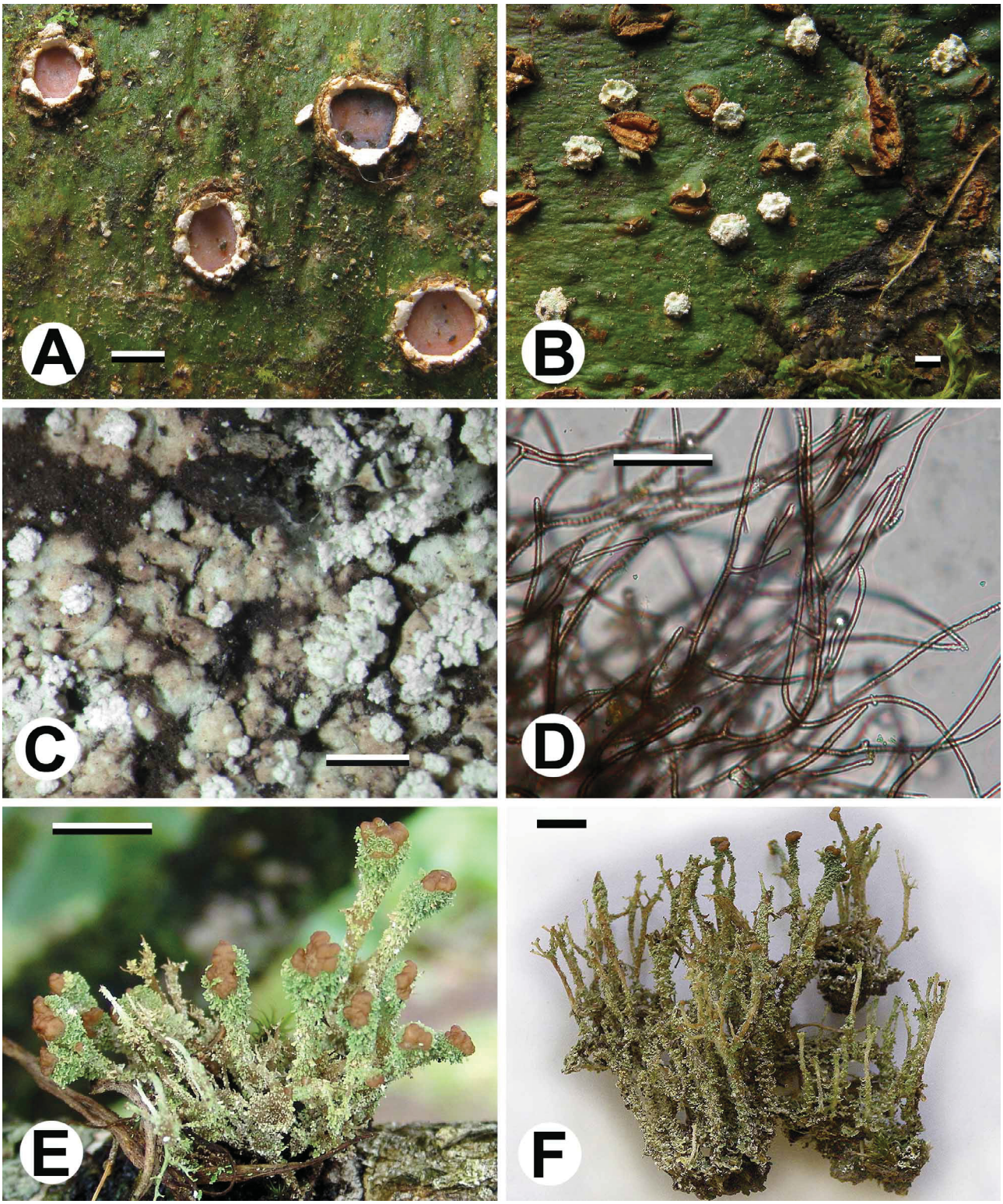

FIGURE 8. A–B. *Chapsa thallotrema* (holotype). A. Thallus with apothecia. B. Thallus with soralia. C–D. *Chiodecton pustuliferum* (holotype). C. Thallus with soralia. D. Hyphae of hypothallus. E–F. *Cladonia mongkolsukii* (holotype). E. Thallus with podetia. F. Thallus with podetia. Scale in A–C = 1 mm, in D = 50 µm, in E, F = 10 mm.

Thallus corticolous, crustose, pale brownish along the margins, whiter at the centre of the areoles, dull, consisting of ca. 0.4–4 mm diameter crenate thallus areoles of irregular surface and outline on a continuous layer of brown arachnoid hypothallus that is underlying the whole thallus, covering areas of up to 7 cm

diameter, margins delimited by a continuous hypothallus, forming a line of up to 1 mm. Hypothallus filaments 2–3 µm wide, surface partly rough from crystals. Pustules numerous, erumpent, starting round, up to 3.0 mm diameter and generally ca. 1.0 mm high, scarcely confluent, white (contrasting with the thallus), globular to irregular. Soredia formed inside the pustules, granular, ca. 100–200 µm diameter, partly clustering into aggregates, internally formed of branched and gnarled hyphae with copious crystals. Algae trentepohlioid, cells ellipsoid, ca. 10 × 15 µm, identical in thallus and soredia. Apothecia and pycnidia unknown. Secondary chemistry: roccellic acid.

Distribution and habitat:—The new species is only known from the type from primary tropical mountain forest at 950 m elevation in Madagascar.

Etymology:—The epithet refers to the pustules.

Chiodecton is a small genus in the family *Roccellaceae* characterized by stromatic ascomata with punctiform discs, superficially resembling the perithecial stromata of *Trypethelium* or other pyrenocarpous taxa (Thor 1990). This species is the first *Chiodecton* to be described with pustules (Thor 1990), and even in the order *Arthoniales* pustules were previously unknown. Although the material is sterile, the dull, yet not byssoid thallus on the arachnoid hypothallus and the presence of roccellic acid, make a classification in *Chiodecton* possible.

Cladonia mongkolsukii* Parnmen & Ahti, *sp. nov. (Fig. 8E–F) Mycobank MB 517755

Cladoniae awasthianae similis sed podetiis esorediatis et microsquamulosis differt.—http://www.eol.org/pages/Cladonia mongkolsukii

Type:—THAILAND. Pitsanulok Province: State Authority Agency areas, Phu Hin Rong Kla National Park, 16°59'N, 100°60'E, 1110 m, on rocks in lower montane scrub forest, May 2005, *Parnmen SP271RAMK* (holotype RAMK, isotype H).

Primary thallus persistent, irregularly lobed to deeply laciniate, 0.7–1.8 mm long, 0.2–0.8 mm wide, lower surface white, ecorticate, upper surface greenish, corticate; podetia 10–65 mm tall, 0.3–3 mm thick, clavate, whitish grey to brownish, unbranched or slightly branched at apex, blunt, at first ascyphose but soon becoming tipped with very narrow scyphi, 1–3 mm in diameter, 6–7 tiers of scyphi produced per podetium; podetial wall 87.5–150 µm: medulla 12.5–50 µm, stereome 70–100 µm; surface rough, ecorticate to discontinuously corticate with microsquamules, especially densely squamulate near tips; podetial squamules 0.6–2 mm long, 0.2–0.5 mm wide, upper part green, corticate, lower part whitish, ecorticate; apothecia pale brown to orange or brownish, terminal on podetia; ascospores simple, hyaline, oblong to ellipsoid, (6.4–)9–9.5–10(–14) × (1.6–)2.7–2.9–3.1(–4.2) µm, 8/ ascus; conidiomata not seen. Secondary chemistry: podetia: P+ orange turning red, K± yellow, C–, KC–, containing fumarprotocetraric acid (major) and homosekikaic acid (major).

Distribution and habitat:—*Cladonia mongkolsukii* is known from lower montane scrub forests in northeast Thailand.

Etymology:—The specific epithet honors the Thai lichenologist Pachara Mongolsuk (Bangkok).

Additional specimens examined (paratypes):—THAILAND. Pitsanulok Province: Phu Hin Rong Kla National Park, Lan Hin Pum, July 2002, *Dangphui s.n.* (RAMK); ibid., the office of the National Park and guesthouse, 400 m, February 2003, *Dangphui s.n.* (RAMK); ibid., the sideway to Ban CP house and the State Authority Agency, February 2003, *Buarueng s.n.* (RAMK); ibid., natural trail 100 m from car park, February 2003, *Chaiyabutr s.n.* (RAMK); ibid., Lan Hin Pum, February 2003, *Homchantara & Diangsa s.n.* (RAMK); ibid., the State Authority Agency areas, June 2003, *Homchantara s.n.* (RAMK); ibid., natural trail 100 m from car park, June 2003, *Chaiyabutr s.n.* (RAMK); ibid., Pha Chu Thong, June 2003, *Homchantara & Diangsa s.n.* (RAMK); ibid., the sideway to Lan Hin Pum, June 2003, *Dangphui s.n.* (RAMK); ibid., natural trail about 10 m from the State Authority Agency, June 2003, *Chaiyabutr s.n.* (RAMK); ibid., areas between the air raid

shelter of the State Authority Agency, June 2003, *Homchantara & Diangsa s.n.* (RAMK); ibid., along the sideway to Lan Hin Teak, June 2003, *Mongkolsuk s.n.* (RAMK); ibid., along the sideway to Hmun Daeng waterfall, March 2004, *Parnmen s.n.* (RAMK); ibid., kilometer post 28, April 2004, *Parnmen s.n.* (RAMK); ibid., the State Authority Agency areas, May 2005, *Parnmen s.n.* (RAMK); ibid., Phu Luang Wildlife Sanctuary, August 2005, *Parnmen s.n.* (RAMK); ibid., the sideway to TV station, August 2005, *Parnmen s.n.* (RAMK).

Morphologically this new species resembles the Himalayan *Cladonia awasthiana* Ahti & Upreti (2004), but that species differs in having sorediate podetia and microsquamules that are distributed over the entire length of the podetia and not densely squmulose near the tips. In our phylogenetic analysis (Parnmen *et al.* 2008) based on ITS sequence data, *C. mongkolsukii* [as cf. *awasthiana*; specimens SP271RAMK (EU113290) and SP283RAMK (EU113289)] was placed near *Cladonia singhii* Ahti & Dixit in the same clade with *Cladonia fimbriata* (L.) Fr., *Cladonia gracilis* (L.) Willd. subsp. *gracilis* and *Cladonia ochrochlora* Flörke. Stenroos *et al.* (2002) placed the last three species in their "supergroup" *Cladonia*.

Clypeopyrenis porinoides* Komposch, J.E.Hern. & Rosabal, *sp. nov. (Fig. 9A) Mycobank MB 517756

*Sicut Clypeopyrenis microsperma sed peritheciis thallo obtectis differt.—*http://www.eol.org/pages/Clypeopyrenis porinoides

Type:—COSTA RICA. Puntarenas: Sán Vito de Coto Brus, Las Cruces Biological Station, 82°58'W, 8°47'N, 1200 m, on ridge beyond Río Java, on trunks and undergrowth of primary forest, September 2007, *Komposch et al. A6J2T3* (holotype INB, isotype F)

Thallus corticolous, up to 10 cm diameter, continuous; surface smooth to uneven, light greyish green. Thallus in section with thick, paraplectenchymatous upper cortex and thick algal layer. Perithecia solitary or 2–3 aggregate, erumpent to prominent, wart-shaped, 0.4–0.6 mm diameter, 0.3–0.4 mm high, completely covered by thalline layer up to the ostiole, light greyish green to yellowish green, ostiolar area with red-brown to dark brown spot. Involucrellum and excipulum not well separated, basally up to 25 µm thick and laterally and apically 50–100 µm thick, fully carbonized; covered by corticate algiferous thallus up to the ostiole; hypothecium prosoplectenchymatous, 5–10 µm high, colourless; hamathecium colourless, clear, I–, KI–. Paraphyses unbranched, glabrous; periphyses not observed. Asci clavate, 40–50 × 6–8 µm. Ascospores 8 per ascus, irregularly arranged, ellipsoid with rounded ends, 1-septate, with slight constriction at septum, 5–6 × 2.5–3 µm, 2 times as long as wide, with slightly thickened septum and angular lumina, dark brown, I–. Secondary chemistry: no substances detected by TLC.

Distribution and habitat:—The new species was found abundantly in the understory of a primary rain forest at mid elevation but is not known outside that area.

Etymology:—The species closely resembles a species of *Porina*.

Additional specimens examined (paratypes):—COSTA RICA. Puntarenas: Sán Vito de Coto Brus, Las Cruces Biological Station, *Komposch et al. A4AT1*, *A6HT1*, *A7J2T1* (F).

Clypeopyrenis was proposed as a monospecific genus in *Pyrenulaceae* by Aptroot (1991), to accommodate a species with very small, dark brown ascospores without distinct endospore, *C. microsperma* (Müll.Arg.) Aptroot. The type material originates from Costa Rica, very close to the locality of the new species, but *C. microsperma* is also known from the Caribbean and South America. While *C. microsperma* is characterized by completely exposed, black perithecia with rather massive involucrellum (clypeus), resting on a dark green to olive thallus, the new species, *C. porinoides*, has more delicate perithecia completely covered by a thalline layer up to the ostiole. It therefore closely resembles a *Porina*, and only microscopical examination will reveal the fundamental anatomical differences. Besides the morphological differences, *Clypeopyrenis porinoides* also has smaller asci and ascospores than *C. microsperma* (the smallest known to date in the family), although at this size, it is difficult to ascertain whether these differences are significant.

The excipulum and involucrellum are also more delicate (up to 300 µm thick in *C. microsperma*). At the type locality, both species grew together, although *C. porinoides* was much more abundant, and the morphological differences were easily observed. The new species was collected during the first OTS (Organization for Tropical Studies) course on tropical lichenology held at Las Cruces Biological Station in 2007.

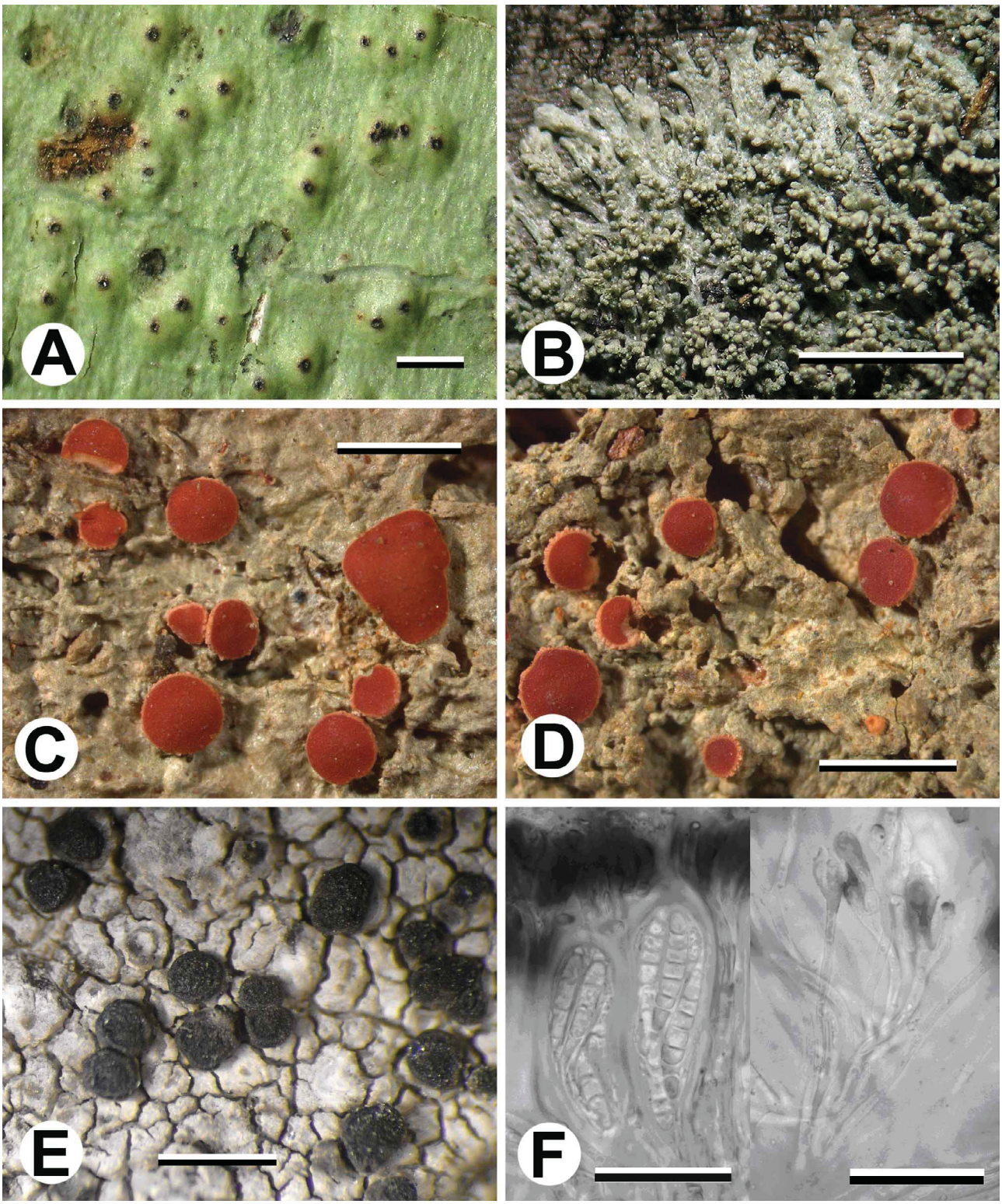

FIGURE 9. A. *Clypeopyrenis porinoides* (holotype), thallus with perithecia. B. *Coccocarpia delicatula* (holotype), part of thallus with isidia. C–D. *Coenogonium flammeum* (holotype), thallus with apothecia. E–F. *Cresponea ancistrosporelloides* (holotype). E. Detail of type specimen showing apothecioid ascomata and areolate thallus. F. Ascus with non-tailed spores next to one with tailed spores and paraphysoid tips. Scale in A–E = 1 mm, in F = 25 µm.

Coccocarpia delicatula **Bungartz, Ziemmeck & Lücking, *sp. nov.*** (Fig. 9B) Mycobank MB 517757

*Sicut Coccocarpia domingensis sed isidiis cylindricis laminalibus differt.—*http://www.eol.org/pages/Coccocarpia delicatula

Type:—ECUADOR. Galápagos: Isla Sán Cristóbal, area W of Cerro Pelado on the way to El Ripioso, 0°52'S, 89°28'W, 400 m, transition zone, open *Psidium guajava* shrubland with *Macraea laricifolia* and dominant annual herb *Malachra capitata*, on bark and wood, dead twigs of *Psidium guajava*, sunny, wind- and rain-exposed, August 2008, *Bungartz 8496* (holotype CDS-41142).

Thallus foliicolous, foliose, rounded, up to 10 mm diameter. Lobes thin, flat, 0.1–0.2 mm wide, linear but slightly widened towards the apex, isotomically branched and dissected, rather close. Upper surface blue-green when moist, plumbeous to bluish grey when dry, with thin, longitudinal, white striae. Lower surface pale, with pale, unbranched, tapering, 0.2–0.4 mm long rhizines partly protruding from under the lobe margins and visible from above. Lobes isidiate; isidia laminal, dense, uniformly cylindrical, mostly unbranched to bifurcate, 0.1–0.3 mm long and 0.05–0.1 mm thick, in mature thalli covering most of the thallus interior. Apothecia not observed. Pycnidia not observed. Secondary chemistry: no substances detected by TLC.

Distribution and habitat:—Thus far only known from the Galápagos Islands, in the transition zone on Sán Cristóbal Island.

Etymology:—The epithet refers to the delicate thallus compared to the common *Coccocarpia palmicola* (Spreng.) Arv. & D.J.Galloway, which has the same type of isidia.

This new species is close to *Coccocarpia domingensis* Vain. and the recently described *C. neglecta* Aptroot & Lücking (Lücking *et al.* 2007). All three species have very narrow, linear thallus lobes with fine, white longitudinal striae on the surface, and differ principally in the shape and arrangement of their isidia. In *C. neglecta*, the isidia are mostly marginal and rounded-squamiform, whereas *C. domingensis* has marginal, cylindrical to often slightly flattened isidia. *C. delicatula* produces laminal, always cylindrical isidia, identical to the type of isidia found in *C. palmicola*. The latter, however, has much broader, rounded thallus lobes.

Coenogonium flammeum **L.I.Ferraro, Michlig & Lücking, *sp. nov.*** (Fig. 9C–D) Mycobank MB 517758

*Sicut Coenogonium luteum sed apotheciis fusco-rubris differt.—*http://www.eol.org/pages/Coenogonium flammeum

Type:—ARGENTINA. Salta: El Rey National Park, March 2007, *Ferraro 7977* (holotype CTES, isotype F).

Thallus crustose, corticolous, continuous, thin, smooth, pale olive-grey, 2–5 cm diameter, with cartilaginous corticiform layer, shiny; white prothallus present. Photobiont *Trentepohlia*, cells angular-rounded, in irregular plates or short threads, 6–10 µm diameter. Apothecia sessile, rounded, 0.6–1.2 mm diameter and 150–200 µm high; disc at first plane but becoming slightly convex, deep orange-brown to red-brown; margin thin, not prominent, minutely denticulate (especially when young), creme-coloured. Excipulum paraplectenchymatous with radiating cell rows in outer parts, 70–150 µm broad, colourless to pale orange peripherally, I+ sordid yellow-brown; outermost cells elongated and thin-walled. Hypothecium 15–25 µm high, colourless to pale yellowish. Hymenium 90–100 µm high, colourless, I+ (pale) blue then quickly sordid green, then reddish brown. Asci 70–80 × 5–6 µm. Ascospores uniseriate, ellipsoid, 1-septate, 8–11 × 2.5–3.5 µm, 3–3.5 times as long as broad. Pycnidia not observed. Chemistry: no substances detected by TLC.

Distribution and habitat:—The new species was found in northwestern Argentina, in montane rainforest of the "yungas", at localities in the provinces of Salta and Jujuy. The forest is dominated by Myrtaceae, Lauraceae, and *Podocarpus*, with a mean annual temperature of 20 ºC and annual precipitation of up to 2000 mm.

Etymology:—The epithet refers to the deep orange-brown to red-brown apothecia.

Additional specimens examined (paratypes):—ARGENTINA. Salta: El Rey National Park, *Ferraro 8018* (CTES). Santa Victoria, Los Toldos, Quebrada El Nogalar, *Palací 433* (CTES). Jujuy: Ledesma, Parque Nacional Calilegua, *Ferraro 7519* (CTES).

Coenogonium flammeum is characterized by the unusually dark, deep red-brown apothecia. Anatomically, including the ascospore size and length to width relation, it comes closest to *C. luteum* (Dicks.) Kalb & Lücking, but that species has a pale-orange disc and a thicker apothecial margin, and the apothecia are larger on average. Another similar taxon is *C. siquirrense* f. *denticulatum* Rivas Plata & Lücking (Rivas Plata *et al.* 2006), which agrees in the size of the apothecia and the minutely denticulate margin, but the disc is vividly orange with a darker margin and the ascospores are smaller on average.

Cresponea ancistrosporelloides* Sparrius & Sipman, *sp. nov. (Fig. 9E–F) Mycobank MB 517759

Cresponea saxicola apotheciis parvis 0.3-0.6 mm diametro, ascosporis (6-)8-locularibus basaliter frequenter uncinatis et torsivis, 35–50 x 5 µm.—http://www.eol.org/pages/Cresponea ancistrosporelloides

Type:—AUSTRALIA. Western Australia: Trail to Toolbrunup Peak, Stirling Ranges, Stirling Range National Park, 40 km SW of Borden, 118°3'E, 34°23'S, 740 m, dry sclerophyll forest with pockets of denser shrub vegetation, on volcanic rocks, September 1994, *Elix 41495* (holotype B, isotype CANB).

Thallus crustose, saxicolous, over 10 cm wide, flat, pale grey, finely areolate, up to 150 µm thick; areoles irregular in size and outline, 0.1–0.6 mm wide, separated by thin and irregularly winding fissures; cortical layer up to 30 µm, of dense, winding hyphae; medulla ca. 100 µm, white, with loose hyphae and ca. 8 µm diameter, thick-walled trentepohlioid photobiont cells. Apothecia frequent, black, slightly glossy, 0.3–0.6 mm in diameter, with flat disc and thin margin not extending above the disc. Excipulum dark-brown, strongly conglutinated and without individual hyphae visible. Hypothecium pale. Hymenium 60–65 µm tall, clear, I+ reddish throughout; paraphysoids 2 µm thick, septate, hardly branched between the asci, apically swollen to ca. 4 µm and furcate; terminal cell or two uppermost cells clavate, 3–4 × 6–10 µm, covered by a brown layer with tiny granules. Epithecium dark-brown, ca. 20 µm, composed of densely agglutinated paraphyses tips. Asci pyriform, ca. 50–60 × 20–22 µm. Ascospores 8/ascus, (6–)8-loculate, fusiform, with thin walls and septa without thickened edges, at base usually attenuated into a ca. 20 µm long tail which is spiralled in the ascus, (30–)45–50 × 5 µm. Pycnidia not seen. Secondary chemistry: thallus K–, C–, KC–, UV–; no substances found.

Distribution and habitat:—Known so far only from the type collection, from volcanic rock at 740 m in sclerophyll scrub in West Australia.

Etymology:—The epithet reflects the tailed spores which resemble those of the genus *Ancistrosporella*.

The genus *Cresponea* was monographed by Egea & Torrente (1993). Since then only few additional species were recognized, *C. apiculata* Egea *et al.* (1996) and *C. litoralis* Elix (2007). *Cresponea ancistrosporelloides* differs markedly from all known species by the long basal tails of the spores. Only in *C. apiculata* are basally attenuated spores reported, but the attenuated part is short and the spores are 11–14-loculate. The attenuated spores may be an overlooked feature because they were recently described from several taxa: *Ancistrosporella australiensis* (G.Thor) G.Thor (1990, as *Ancistrospora*), *Opegrapha curvata* Aptroot [Aptroot *et al.* (1997) = *Ancistrosporella curvata* (Aptroot) Komposch] and *Ancistrosporella psoromica* Komposch, Aptroot & Hafellner (Komposch *et al.* 2002). These species differ in their lirelloid ascomata and partly byssoid thallus. Also in these species, the asci are much longer than the spores, so that the spore tails are probably not spiralled below the main body of the spores in the asci, as in *C. ancistrosporelloides*. Therefore the new species is provisionally placed in *Cresponea* rather than in *Ancistrosporella*. However, the genus *Cresponea* seems to be not completely fitting since the ascospores lack the thick walls and thickened septum edges illustrated by Egea & Torrente (1993).

Crocynia microphyllina* Aptroot, *sp. nov. (Fig. 10A–B) Mycobank MB 517760

Crocynia thallo sterili microphyllino albido, hypothallo extenso nigro, acidum protocetraricum continens.—http://www.eol.org/pages/Crocynia microphyllina

Type:—PAPUA NEW GUINEA. Central Province: Owen Stanley Range, Kagi village, along Kokoda Trail towards Gap, 9º 08'S, 147º 40'E, October 1995, *Aptroot 39483a* (holotype ABL).

Thallus corticolous, crustose, pale greenish white, byssoid, dull, consisting of ca. 0.4–2.0 mm diameter crenate thallus areoles of irregular surface and outline on a continuous layer of black arachnoid hypothallus that is underlying the whole thallus, covering areas of up to 10 cm diameter, margins delimited by a continuous hypothallus, forming a line of up to 1 mm. Hypothallus filaments 2–3 µm wide, branching mostly perpendicular, surface partly rough from crystals. Phyllidia numerous, ascending, starting at the margins of the areoles, up to 0.3 mm diameter and generally ca. 0.2 mm high, scarcely confluent, pale greenish white (not contrasting with the thallus), flattened to globular to irregular, internally formed of branched and gnarled hyphae with copious crystals. Algae chlorococcoid, cells ellipsoid, ca. 5 × 7 µm. Apothecia and pycnidia unknown. Secondary chemistry: protocetraric acid.

Distribution and habitat:—The new species is only known from the type from primary tropical mountain forest dominated by *Lithocarpus* on a ridge at 1700 m elevation in Papua New Guinea.

Etymology:—The epithet refers to the phyllidiate thallus.

Crocynia is a small genus with only two widely accepted species (Cáceres 2007), which are both often fertile and differ in chemistry, lobe configuration, hypothallus colour, and apothecium characters. This species is the first *Crocynia* to be described with phyllidia. Although the material is sterile, the byssoid thallus on the arachnoid hypothallus and the presence of chlorococoid algae make a classification in *Crocynia* possible. The chance that it represents an aberrant morph of one of the known species of *Crocynia* is low, because the only other species with a dark hypothallus, *C. pyxinoides*, is restricted to the Neotropics.

Dictyonema hernandezii* Lücking, Lawrey & Dal-Forno, *sp. nov. (Fig. 10C) Mycobank MB 517761

Sicut Dictyonema phyllophilum sed thallo et prothallo cartilagineo differt.—http://www.eol.org/pages/Dictyonema hernandezii

Type:—COSTA RICA. Puntarenas: Las Cruces Biological Station and Wilson Botanical Garden (La Amistad Pacífico Conservation Area), 8°47'N, 82°57'W, 1200 m, montane rainforest zone, disturbed rainforest patches, on branches, July 2007, *Hernández s.n.* (holotype F).

Thallus starting out as small, circular crust but soon covering large areas of the substrate, appressed-filamentous, composed of a strongly compressed mat of densely interwoven, blue-green cyanobacterial filaments embedded in a yellowish white thallus matrix which forms an often zonate, yellowish white to brown prothallus free of cyanobacteria; the entire structure appearing gelatinous when wet. Thallus in section 300–500 µm thick, composed of a dominant medullary layer with numerous, interwoven hyphae, above which is a strongly compacted photobiont layer with more or less periclinally arranged cyanobacterial filaments; upper part strongly compacted and forming a thin, pale yellow, cortex-like layer. Cyanobacterial filaments blue-green to yellow-green with cells 10–12 µm wide and 3–5 µm high; surrounded by a thin fungal sheath forming jigsaw puzzle-shaped cells, the same cells extending above the photobiont layer to form the thin cortex. Clamps not observed on the medullary hyphae. Basidiocarps not observed.

Distribution and habitat:—The new species is known from two collections in the montane rainforest of southern Costa Rica. It was found growing in the same habitat as *Dictyonema glabratum* (Spreng.) D.Hawksw. and *D. sericeum* (Sw.) Berk.

Etymology:—We dedicate this new species to our colleague and friend, Venezuelan lichenologist Jesús Hernández, who also collected the type material.

Additional specimen examined (paratype):—COSTA RICA. Puntarenas: Las Cruces Biological Station and Wilson Botanical Garden (La Amistad Pacífico Conservation Area), *Lücking s.n.* (F).

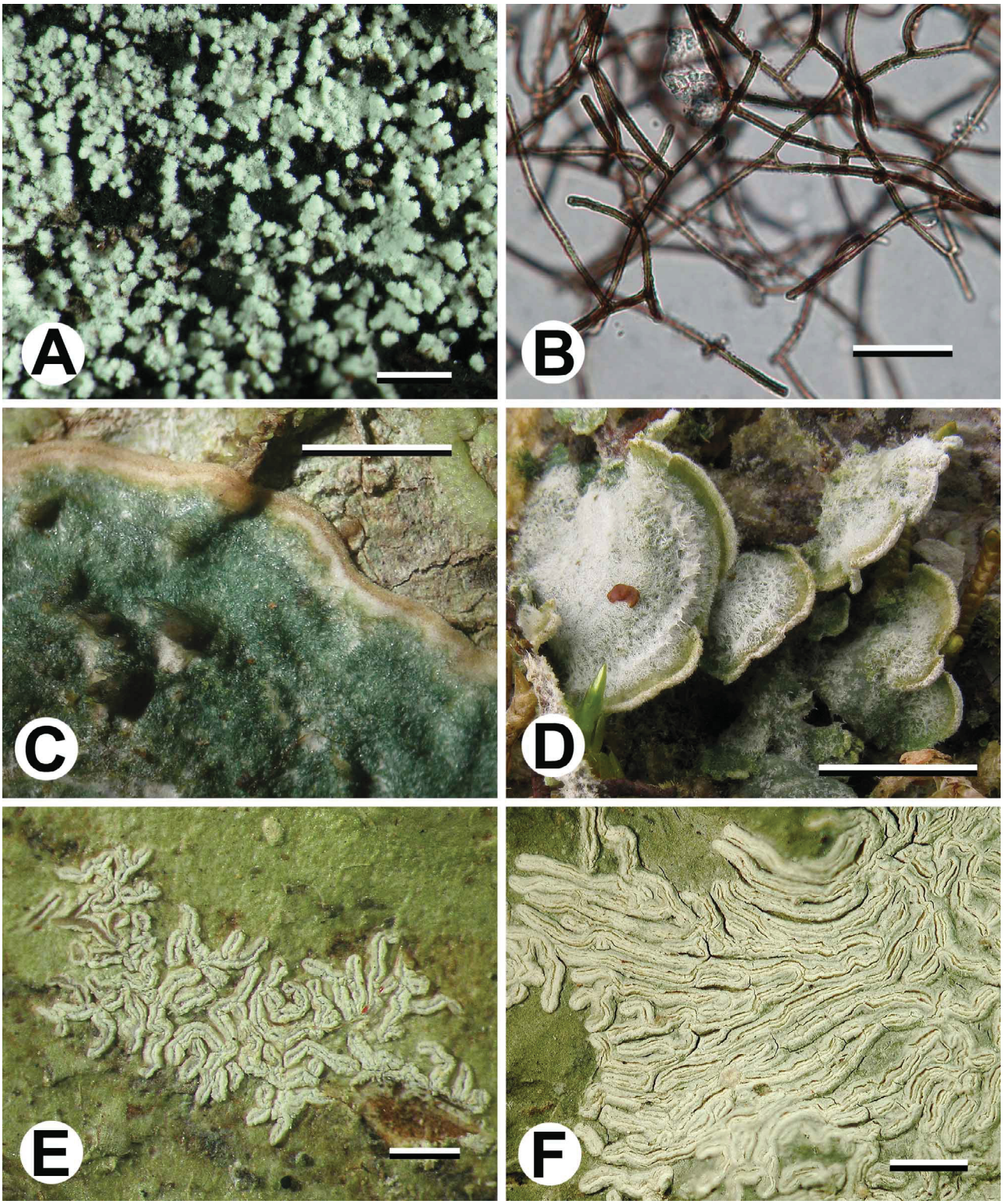

FIGURE 10. A–B. *Crocynia microphyllina* (holotype). A. Thallus. B. Hyphae of hypothallus. C. *Dictyonema hernandezii* (paratype), thallus with zonate prothallus. D. *Dictyonema hirsutum* (holotype), thallus lobes with surface hairs. E. *Diorygma microsporum* (holotype), thallus with lirellae. F. *Diorygma sticticum* (holotype), clustered lirellae. Scale in A, E, F = 1 mm, in B = 50 µm, in C, D = 5 mm.

This remarkable new species belongs in the group formed by *Dictyonema sericeum* and relatives, characterized by a more or less filamentous thallus having a characteristic fungal sheath around the cyanobacterial filaments composed of jigsaw puzzle-shaped cells (Chaves *et al.* 2004, Lawrey *et al.* 2009). It is distinguished from all other species in this group by its peculiar thallus morphology and anatomy: the thallus is strongly compacted and gelatinous when wet, with a smooth and nitidous surface when dry, and in section the photobiont layer is strongly compacted in the upper part of the thallus and resting on a thick medulla. This heteromerous structure is otherwise known only from *D. glabratum* and relatives, which differ from species of the *D. sericeum* group in the foliose thallus with the photobiont formed by individual cells rather than filaments. Yet, phylogenetically, *D. hernandezii* is closely related to species in the *D. sericeum* group.

Dictyonema hirsutum **Moncada & Lücking, *sp. nov.*** (Fig. 10D) Mycobank MB 517762

*Sicut Dictyonema glabratum sed thallo hirsuto differt.—*http://www.eol.org/pages/Dictyonema hirsutum

Type:—COLOMBIA. Cundinamarca: Municipio de Choachí, Vereda el Verjón, Reserva Natural Matarredonda, vía Laguna El Verjón, 3220 m, paramo vegetation, August 2008, *Lücking s.n.* (holotype UDBC, isotype F).

Thallus terricolous or between bryophytes, foliose, composed of semicircular to flabellate lobes 0.5–1 cm diameter wide and 200–300 µm thick, with thickened, involute margins; upper surface densely hirstute and covered with obliquely oriented, white trichomes 0.3–0.5 mm long and 20–30 µm thick at the base, composed of densely packed parallel hyphae; zone close to the lobe margin usually glabrous and olive-green, surface otherwise white; lower surface ecorticate, finely felty-byssoid, mottled pale brownish to bluish grey. Thallus in section with upper corticiform layer composed of loosely packed, intricate, 3–4 µm thick, colourless hyphae, irregular photobiont layer with groups of cyanobacterial cells wrapped in a dense, partially paraplectenchymatous, hyphal sheath, and thin medulla of loosely woven hyphae also forming the lower thallus surface; clamps not observed. Photobiont a chroococcoid morph of *Rhizonema* (Lücking *et al.* 2009), cells in groups of 4–8, groups 20–40 µm diameter, individual cells ovoid-ellipsoid, 10–13 × 6–10 µm, olive green. Basidiocarps on lower side, forming pieces of flat crust, each 1–3 mm in diameter; hymenophore attached by basal layer to lower side of thallus lobes, beige; margin slightly involute when dry, pale beige to white. Basal layer byssoid, composed of loosely woven, 4–5 µm thick hyphae, 200–300 µm high, colourless; subhymenial layer composed of densely woven, short-celled hyphae, 50–90 µm high, colourless; hymenium composed of densely arranged, palisade-like, 30–40 × 4–5 µm, slightly clavate basidioles, colourless, non-amyloid. Basidiospores not observed.

Distribution and habitat:—The new species is known from the paramo region near Bogotá at over 3000 m elevation.

Etymology:—The epithet refers to the conspicuously hirsute upper surface of the thallus lobes.

The foliose forms of the genus *Dictyonema* are the most commonly collected basidiolichens; they usually grow at higher elevations on soil or between bryophytes but also occur as epiphytes on trees (Chaves *et al.* 2004). A recent phylogenetic study suggested that the single foliose species distinguished by Parmasto (1978) as *D. glabratum* (Spreng.) D.Hawksw., actually comprises several different species that are distinct morphologically and genetically (Chaves *et al.* 2004, Lawrey *et al.* 2009). *Dictyonema hirstutum* differs from *D. glabratum s.str.* in the dense layer of trichomes produced on the upper surface, together with the overall smaller lobes. *Cora pavonia* f. *villosa* Tomas. might represent the same taxon, but that epithet has not been used at the species level. Because of its small thalli and its growth over soil and between bryophytes, *D. hirsutum* is easily overlooked between vegetation but very conspicuous up close for its peculiar morphology.

Diorygma microsporum **M.Cáceres & Lücking, *sp. nov.*** (Fig. 10E) Mycobank MB 517763

Sicut Diorygma poitaei sed ascosporis minoribus et thallo acidum norsticticum continente differt.—http://www.eol.org/pages/Diorygma microsporum

Type:—BRAZIL. Pernambuco: Igarassu, Charles Darwin Ecological Refuge, 34°54'W, 7°50'S, 20 m, undisturbed, closed lowland rain forest (Mata Atlântica), on bark, 2000, *Cáceres & Lücking 00-531* (holotype ASE, isotype F).

Thallus corticolous, up to 5 cm diameter, 50–120 µm thick, continuous; surface smooth to uneven, light greyish green; white prothallus sometimes present. Thallus in section with 5–10 µm thick loose upper cortex, irregular algal layer and clusters of calcium oxalate crystals. Lirellae in dense clusters, stellately branched, erumpent, with thick complete thalline margin, 1–5 mm long, 0.15–0.25 mm wide, 0.1 mm high; disc partly exposed, flesh-coloured to light red-brown but thickly white-pruinose; labia conspicuous, white, the proper excipulum white-pruinose and crumbling and usually separated from the thalline margin by a split; thalline margin white. Excipulum entire, orange-brown, 15–25 µm thick; laterally covered by corticate algiferous thallus including clusters of crystals; hypothecium prosoplectenchymatous, 10–15 µm high, yellowish; hymenium 60–70 µm high, colourless, clear; epithecium granulose, 5–10 µm high, yellow-brown. Paraphyses unbranched; asci clavate, 60–70 × 12–15 µm. Ascospores 8 per ascus, ellipsoid, submuriform with 3 transverse and 0–1 longitudinal septa per segment, 12–15 6–7 µm, 2 times as long as wide, with thickened septa and rounded lumina, colourless, strongly I+ violet-blue. Secondary chemistry: norstictic acid.

Distribution and habitat:—*Diorygma microsporum* appears to have a rather wide neotropical distribution, as indicated by the disjunct collections from northeastern Brazil, Colombia, and Florida.

Etymology:—The epithet refers to the unusually small ascospores, thus far the smallest known in the genus.

Additional specimens examined (paratypes):—U.S.A. Florida: Collier Co., Fakahatchee Strand Preserve State Park, *Lücking & Rivas Plata 26504* (F). COLOMBIA: Tolima: Purificacion, Vereda El Tambo, Finca El Santuario, *Cruz & Sandoval s.n.* (UDBC).

The genus *Diorygma* is a mid-sized genus in *Graphidaceae* (Kalb *et al.* 2004). The genus is essentially tropical and restricted to lowland and lower montane rain forest. Species typically grow on tree trunks in the shady understory of undisturbed forest and hence are good indicators of forest health. The new species presented here was first collected in Brazil and identified as *Anomomorpha aggregans* (Nyl.) Staiger (Cáceres 2007), because of the very small ascospores and norstictic acid chemistry. A second collection was recently made in Florida, and restudy of the material revealed that hymenial inspersion, an important character in *Anomomorpha* (Staiger 2002) is lacking; also, the morphology differs from typical species in *Anomomorpha* being more reminescent of *Diorygma*. DNA sequencing of the Florida collection confirmed placement in *Diorygma* (Rivas Plata *et al.* unpubl. data), where the species is quite unusual due to its very small ascospores and compact thallus (Kalb *et al.* 2004). Superficially, the new species is similar to *D. poitaei* (Nyl.) Kalb, Staiger & Elix.

Diorygma sticticum **Sutjaritturakan, Kalb & Lücking, *sp. nov.*** (Fig. 10F) Mycobank MB 517764

Sicut Diorygma poitaei sed ascosporis minoribus differt.—http://www.eol.org/pages/Diorygma sticticum

Type:—THAILAND. Nakhon Ratchasima Province: Khao Yai National Park, in front of Ban To Or, on unidentified tree, 1999, *Sutjaritturakan 12683* (holotype RAMK).

Thallus corticolous, up to 5 cm diameter, 70–150 µm thick, continuous; surface smooth to uneven, light green; white prothallus sometimes present. Thallus in section with 10–15 µm thick loose upper cortex, irregular algal layer and clusters of calcium oxalate crystals. Lirellae in dense clusters, stellately branched,

erumpent, with thick, complete thalline margin, 1–3 mm long, 0.15–0.3 mm wide, 0.1 mm high; disc concealed to partly exposed, pale brown but thickly white-pruinose; labia conspicuous, white, the proper excipulum white-pruinose; thalline margin white. Excipulum entire, orange-brown, 15–30 µm thick; laterally covered by corticate algiferous thallus including clusters of crystals; hypothecium prosoplectenchymatous, 10–15 µm high, yellowish; hymenium 60–80 µm high, colourless, clear; epithecium granulose, 5–10 µm high, yellow-brown. Paraphyses unbranched; asci clavate, 60–70 × 10–12 µm. Ascospores 8 per ascus, ellipsoid, submuriform with 3 transverse and 0–1 longitudinal septa per segment, 10–13 × 6–8 µm, 1.5–2 times as long as wide, with thickened septa and rounded lumina, colourless, strongly I+ violet-blue. Secondary chemistry: stictic, hypostictic, and cryptostictic acids.

Distribution and habitat:—*Diorygma sticticum* is so far known from several collections from lowland rain forest in Thailand.

Etymology:—The epithet refers to the secondary chemistry.

Additional specimens examined (paratypes):—THAILAND. Nakhon Ratchasima Province: Khao Yai National Park, *Sutjaritturakan 13556* (RAMK). Saraburi Province: *Sutjaritturakan 20215* (RAMK). Loei: Phuluang Wildlife Sanctuary, Phuluang Animal Research Station, *Poensungnoen RU-VP00413* (RAMK).

This is a second new species in the genus *Diorygma*, similar to the preceding one in having extremely small ascospores, but differing in the secondary chemistry and the geographic distribution.

Echinoplaca pernambucensis* Øvstedal & Elix, *sp. nov. (Fig. 11A) Mycobank MB 517765

Speciei Echinoplacae verruciferae similis, sed sine setis, et acidum gyrophoricum, acidum lecanoricum et acidum subgyrophoricum continens. Apothecia non vidi.—http://www.eol.org/pages/Echinoplaca pernambucensis

Type:—BRAZIL. Pernambuco: Recife, Dois Irmãos, January 2010, *Silva s.n.* (holotype BG).

Thallus crustose, the basal crust whitish with a green hue, 2–3 cm wide, 100–115 µm thick, corticate but some places cracked and granular. Photobiont a species of Chlorococcaceae, cells 4–6 µm wide (similar to that in *E. similis*). Calcium oxalate crystals abundant. Numerous conical areolae present on the upper surface, up to 0.2 mm high and 0.2 mm wide, pinkish white, without algae, with a more compact texture than the basal crust, with a central hyphophore. Hyphophores whitish, up to 0.4 mm long, mostly curved, 30–40 µm wide, slightly broader at the apices. No diahyphae, setae or apothecia seen. Secondary chemistry: gyrophoric acid (major), lecanoric acid (minor) and subgyrophoric acid (minor).

Distribution and habitat:—On bark of undetermined tree in remnant Mata Atlantica, ca 1.5 m above ground.

Etymology:—The specific epithet derives from the locality of the type specimen.

The genus *Echinoplaca* (*Gomphillaceae*) is usually epiphyllous, but a few species are corticolous (Cáceres 2007, Kalb & Vězda 1988, Lücking 2008). It is characterized by apothecia which are flush with the thallus and frequently the presence of hyphophores and setae. A more detailed description of the genus and family is found in Lücking (2008). The combination of hyphophores, the presence of calcium oxalate crystals and the type of photobiont is clearly consistent with Gomphillaceae. In the absence of apothecia, the generic placement of this species is tentative. At least three genera seem likely possibilities: *Echinoplaca*, *Gyalideopsis* and *Calenia*. Cáceres (2007) found no species of *Gyalideopsis* on bark in Pernambuco. Although there are some epiphyllous species of *Gyalideopsis* with white hyphophores present in the Neotropics (Lücking 2008), all have some characteristics which distinguish them from the present species.There are no similar corticolous species reported in a recent review of the genus (Lücking *et al.* 2006). In contrast, Cáceres (2007) found three species of *Echinoplaca* on bark in Pernambuco, *E. bispora* Kalb & Vězda, *E. caruaruensis* Cáceres & Lücking, and *E. leucotrichoides* (Vain.) R.Sant. However, *E. caruaruensis* lacks hyphophores, *E. leucotrichoides* has tapered hyphophores with a darkened apex, and *E. bispora* has a thin and shiny thallus, small, white, tapered setae and hyphophores with a pale base and dark brown apices. A

further corticolous Brazilian species, *E. similis* Kalb & Vězda, has a thick white thallus, white tapered setae and white hyphophores which are dark on the dorsal side. It contains no lichen compounds (TLC, type studied). At present only one corticolous species of *Calenia*, viz. *C. corticola* (Henssen) Ferraro, Lücking & Séru. is known, but that species lacks hyphophores. As to the epiphyllous species of *Calenia*, several have hyphophores (e.g. *C. lueckingii* Hartmann, *C. monospora* Vězda) like those present in *E. pernambucensis* but their thalli differ and they lack lichen substances (Lücking 2008). There are parasitic members of *Gomphillaceae* (Lücking 2008) and one could envisage that the hyphophore-bearing areolae belong to a parasite on another species, but as the areolae bearing hyphophores react C+ red, there appears to be only one species present. No mention of lichen products in *Gomphillaceae* is found in Vězda & Poelt (1987), Kalb & Vězda (1988), Lücking (1997, 2008), and Lücking *et al*. (2005, 2007).

Echinoplaca schizidiifera **J.E.Hern. & Lücking, *sp. nov.*** (Fig. 11B–C) Mycobank MB 517766

Echinoplaca species thallo schizidiis disintegrantibus differt.—http://www.eol.org/pages/Echinoplaca schizidiifera

Type:—VENEZUELA. Distrito Federal: Parque Nacional El Ávila, zonas aledañas a Lagunazo, 10º 33'N, 66º 52'E, 2000 m, bosques nublados costeros de la Cordillera de la Costa, bosque siempreverde de media altura (20–25 m) con árboles emergentes que pueden alcanzar hasta 40 m, foliicolous, August 2008, *Lücking 26084* (holotype VEN, isotype F).

Thallus foliicolous, up to 50 mm across and 20–30 µm thick, with cartilaginous, corticiform layer, uneven to coarsely verrucose due to incrustation with clusters of calcium oxalate crystals, with very scattered sterile setae, pale greenish grey to white; verrucae rather flat, irregular, 0.1–0.3 mm diameter, white; setae 0.2–0.3 mm long, white or apically darkened. Thallus especially in inner parts dissolving into angular schizidia by disintegration; schizidia with the same anatomy as the thallus, 0.3–0.5(–1) mm diameter, at first visible by irregular splits but eventually becoming involute and falling off, leaving behind small, rounded structured marking the attachment points. Apothecia not observed. Hyphophores not observed (but sterile setae might represent postmature hyphophores lacking diaphyphae). Secondary chemistry: no substances detected by TLC.

Distribution and habitat:—*Echinoplaca schizidiifera* was found inhabiting the leathery leaves of *Clusia* trees in upper montane cloud forest in Venezuela near the capital Caracas.

Etymology:—The epithet refers to the thallus dissolving into schizidia.

This new species is distinguished from all other species of *Echinoplaca* by the unusual vegetative reproduction via schizidia. Schizidia are otherwise unknown in the family *Gomphillaceae* but very similar schizidia have been described from species of *Coenogonium* in the related family *Coenogoniaceae* (Lücking 2008). The schizidia of *E. schizidiifera* should not be confused with the disc-shaped propagules found in a species of the related genus *Actinoplaca*, *A. gemmifera* (Lücking) Lücking. In the latter, the discs produced on the thallus surface are homologous to hyphophores, whereas in the new species, the schizidia represent parts of the original vegetative thallus.

Eremithallus marusae **R.Miranda, Gaya & Lücking, *sp. nov.*** (Fig. 11D) Mycobank MB 517767

Sicut Eremithallus costaricensis sed ascosporis minoribus differt.—http://www.eol.org/pages/Eremithallus marusae

Type:—MEXICO. Jalisco: Estación de Biología Chamela, tropical deciduous dry forest, on bark of *Heliocarpus pallidus*, 19° 29'N, 105°02W, 60 m, June 2009, *Miranda 766* (holotype MEXU).

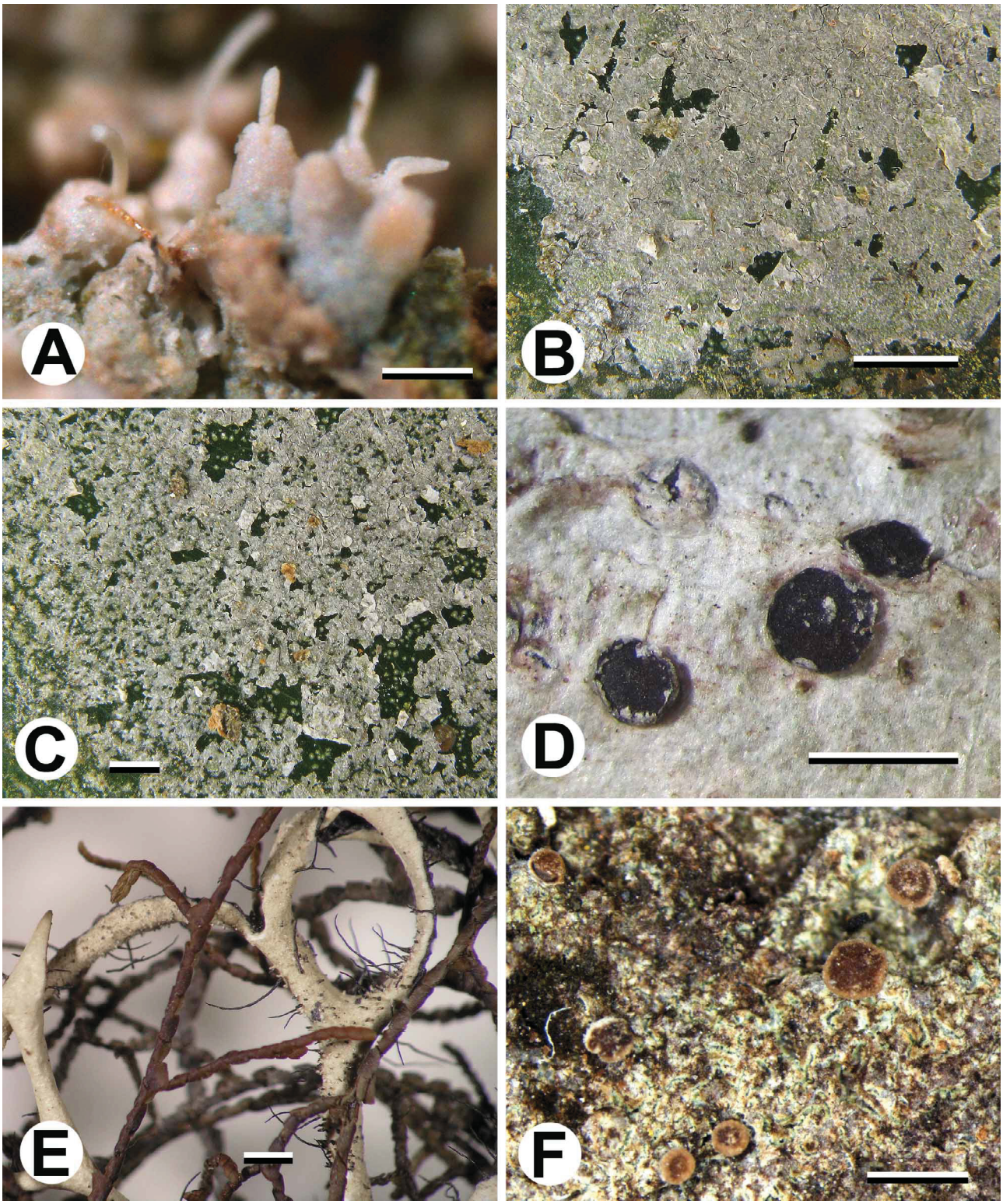

FIGURE 11. A. *Echinoplaca pernambucensis* (holotype), hyphophores. B–C. *Echinoplaca schizidiifera* (isotype), thallus dissolving into schizidia that leave behind circular traces where the stipe originally attached to the leaf surface. D. *Eremithallus marusae* (holotype), apothecia in different stages of development. E. *Everniastrum constictovexans* (holotype), detail of thallus. F. *Fellhanera borbonica* (holotype), thallus with apothecia. Scale in A = 0.3 mm, in B–D, F = 1 mm, in E = 3 mm.

Thallus superficially delimited by yellowish-grey colour and partially a thin, brown-black prothallus, but proper thallus structures (cortex, algal layer, medulla) absent; photobiont a species of *Trentepohlia*, cells 7–12

× 7–9 µm, located within the periderm cells of the tree bark and connected to the base of the apothecia by hyaline fungal hyphae. Apothecia erumpent from periderm and finally almost appearing sessile, rounded, up to 1 mm diameter, with brown-black disc and irregular marginal, grey-white lobules (remnants of the initially covering periderm). Proper excipulum 20–40 µm broad, red-brown, lateral towards the hymenium with anastomosing periphysoids and paraphysoids. Hymenium 55–70 µm high, non-amyloid, composed of unbranched to rarely anastomosing paraphyses; asci ellipsoid to clavate, 55–65 × 15–18 µm, non-amyloid, with thick tholus and distinct ocular chamber when young (probably fissitunicate). Ascospores 8 per ascus, ellipsoid, 1-septate, 15–20 × 6–8 µm, hyaline, non-amyloid, constricted at septum when mature. Secondary chemistry: no substances detected by TLC.

Distribution and habitat:—*Eremithallus marusae* is known from Chamela-Cuixmala Biosphere Reserve in Jalisco, Mexico, which is one of the last protected areas of tropical deciduous dry forest remaining in the Neotropics. The reserve bears a unique and highly diverse lichen biota with dominance of crustose taxa (Miranda *et al.* 2009). Both known species of *Eremithallus* seem to prefer (semi-)deciduous dry forest vegetation.

Etymology:—We honour our mentor and colleague, María de los Angeles Herrera-Campos, for her contributions to lichenology in Mexico.

Additional specimen examined (paratype):—MEXICO. Jalisco: Estación de Biología Chamela, *Miranda 767, 1328, 1331* (MEXU).

Eremithallus is a recently described genus that appears to represent a distinctive lineage within the higher *Ascomycota* (Lücking *et al.* 2008b). Morphologically and anatomically it resembles *Ostropales* (*Lecanoromycetes*), but genetically clusters outside that class. Unique features of the genus are the absence of a lichen thallus, the photobiont cells instead clustered in distinct, discrete groups within dead periderm cells of the tree bark, the laterally strongly anastomosing periphysoids, and the ascospores containing folds or crystals, at least in the type species. The genus superficially resembles non-lichenized fungi such as *Dothidea* and *Melaspilea*, but these differ anatomically in the structure of the hymenia and/or stromata. The new species differs from the type species mainly in the smaller ascospores (20–30 µm long in *E. costaricensis*) which lack folds. Also, the hymenium is lower and the asci are smaller on average. Otherwise, the apothecial anatomy, especially the thin brown excipulum bordering a layer of strongly anastomosing periphysoids (or lateral paraphyses), as well as the peculiar position of the photobiont, agree in both taxa. While in the type species, only mature asci were observed, the new species also showed young asci with a typical fissitunicate anatomy. It is not unlikely that an older name is available for this genus, but thus far we have not been able to detect anything similar described in the literature or among revised herbarium collections.

Everniastrum constictovexans **Sipman, *sp. nov.*** (Fig. 11E) Mycobank MB 517768

Everniastrum corticola lobis linearibus, isidiis ciliatis provisum, acida constictum et protolichesterinicum in medulla continens.—http://www.eol.org/pages/Everniastrum constictovexans

Type:—PERU. Cuzco: Along the Cuzco-Pilcopata-Paucartambo Rd. at a point ca 135 km from the intersection of the Cuzco-Puno Rd., on soil in road cut, July 1976, *Dumont et al. 1653* (holotype NY).

Thallus foliose to subfruticose, corticolous, over 5 cm wide, not coriaceous, dichotomously lobate. Lobes long-linear, separate, 0.6–1.5 mm wide, over most of their length strongly convex and subtubular. Upper surface pale grey, slightly shiny, epruinose, weakly maculate, isidiate, lacking soredia, pustules, dactyls or lobules. Isidia cylindrical, scattered over the surface, concolorous with the thallus, when young often brown-capped, when old often with an erect, apical, black cilium. Medulla white. Lower surface black, towards the lobe tips brown. Cilia black, slender, 1–4 mm long, simple or occasionally once dichotomously branched. Apothecia and Pycnidia not seen. Chemistry: upper cortex K+ yellow, C–, KC–, P–, UV–, medulla K+ orange, C–, KC–, P+ orange-red, UV–. Secondary metabolites: Upper cortex with atranorin, medulla with constictic and protolichesterinic acids (TLC).

Distribution and habitat:—Known so far only from one specimen from the highlands of Peru.

Etymology:—The epithet reflects the morphological similarity to *Everniastrum vexans* (Zahlbr. *ex* W.Culb. & C.Culb.) Hale *ex* Sipman and the presence of constictic acid.

A key to all known species of *Everniastrum* was given in Sipman (1986a). Since then only few additional species were published, from East and Southeast Asia (Chen *et al.* 1989, Jiang & Wei 1989, 1993, Pooprang *et al.* 1999). The genus was included in *Cetrariastrum* by, e.g. Culberson & Culberson (1981), considered different by Sipman (1986b) and of undecided status following DNA analyses (Divakar *et al.* 2006, 2010). Here the traditional classification based on morphology is followed provisionally, awaiting further taxonomic rearrangements resulting from DNA analyses. *Everniastrum constictovexans* is morphologically very similar to *E. vexans*, at least the common morph of the Neotropics, with which it shares the often very elongate and ciliate superficial isidia. It differs only in the presence of constictic acid instead of salazinic acid as main medullary substance. Thus it might be considered as a chemical strain. However, in recent taxonomic treatments (Sipman *et al.* 2009) such chemical differences are given species rank. The chemical difference is not easily demonstrated with spot tests. *E. constictovexans* has a non-isidiate relative in *E. peruvianum* Hale *ex* W.Culb. & C.Culb.

Fellhanera borbonica* Sérus., van den Boom & Brand, *sp. nov. (Fig. 11F) Mycobank MB 517769

Ab omnibus speciebus generis Fellhanerae differt ascosporis submuriformibus et muriformibus et conidiis biclavatis.—*http://www.eol.org/pages/Fellhanera borbonica*

Type:—LA RÉUNION (French Mascarenes). Forêt de Bélouve, near entrance of Sentier de Mazerin; 21°04'S, 55°33'E, 1500 m; subvertical shaded basaltic outcrop; *van den Boom et al. 39866* (holotype LG, isotype hb. van den Boom).

Thallus saxicolous, crustose, greyish green to pale grey, somewhat rimose and cracked (and then medulla seen at high magnification); prothallus indistinct. Photobiont chlorococcoid with cells green and globose, 5–8 µm diameter. Apothecia rare, round, 0.5–0.7 mm in diameter and ca. 0.2 mm high, sessile and strongly constricted at the base, disc flat and eventually slightly convex, dark brown, with a violet hue (especially when fresh), margin thin but distinct, first slightly prominent and eventually flexuose and almost excluded, pale orange brown to brown; outer parts usually downy or with short whitish hairs, in young apothecia some connecting the apothecia to the thallus. Excipulum thin (c. 20–30 µm), inner parts typically paraplectenchymatous, becoming less typical towards the margin, and then made of densely interwoven hyphae with short hyphae protruding. Hypothecium 50–70 µm thick, dark brown to blackish, K–. Paraphyses strongly gelatinized, branched and not inflated at apices. Asci clavate, 50–60 × 10 µm, of the *Byssoloma*-type. Ascospores 8/ascus, ellipsoid, submurifom to muriform, 3(–4) transverse septa and (1–)2(–3) longitudinal or oblique ones, 18–20 × 5–7 µm, with a distinct halo (best seen in K). Pycnidia half-immersed in the thallus, ca. 0.1 mm in diameter, wall pale orange, K–, C–, with a distinct gaping ostiole but no glut of conidia. Conidia numerous, typically biclavate (almost all conidia with both ends typically inflated and almost spherical), colourless, simple, 4–5 × 1.5–2 µm (width measured at extremities).

Distribution and habitat:—*Fellhanera borbonica* is a saxicolous species, only known from the type collection in the montane forest of La Réunion ("forêt de Bois de Couleur des Hauts"). It was found on a shaded basaltic outcrop within a disturbed forest.

Etymology:—The epithet has been choosen after the historical name of La Réunion: Île Bourbon (Borbonia).

Lücking (1997) provided a comprehensive survey of the variation in *Fellhanera* (*Pilocarpaceae*), mostly represented by foliicolous species, including two species with muriform ascospores. The genus is characterized by: biatorine apothecia with paraplectenchymatous exciple, *Byssoloma*-type asci, *Bilimbia*- type ascospores and bacillar to pyriform conidia. This concept still prevails (Lücking 2008), awaiting eventual

support from molecular phylogenetic studies. In their survey of the *Fellhanera silicis* group in eastern North America, Harris & Lendemer (2009) recorded variation in conidia shape and size and used these characters to support delimitation of several new species. Although known only from a single collection, *Fellhanera borbonica* further demonstrates the variation encountered in that group as it combines a paraplectenchaymatous excipulum (becoming less organized and almost byssoid at the margins) with submuriform to muriform ascospores and biclavate conidia, this shape not earlier reported in the genus. Otherwise, the new species is most similar to *F. elliottii* (Vain.) Vězda and *F. paradoxa* (Vězda) Vězda, both of which have a similar morphology and also (sub-)muriform ascospores, but the ascospores are distinctly longer and the conidia are bacillar to narrowly pyriform (Lücking 2008).

Fibrillithecis sprucei **Mangold, Lücking & Lumbsch, sp. nov.** (Fig. 12A) Mycobank MB 517770

Sicut Fibrillithecis dehiscens sed ascosporis muriformibus majoribusque differt.—http://www.eol.org/pages/Fibrillithecis sprucei

Type:—BRAZIL: Amazonas: Rio Negro Sán Carlos, *Spruce 395* (holotype BM, two larger pieces on left side).

Thallus corticolous, up to 10 cm diameter, 200–500 µm thick, continuous; surface uneven to bumpy, light greyish green to olive-green. Thallus in section with 20–30 µm thick prosoplectenchymatous upper cortex, thick, irregular algal layer, and white medulla; calcium oxalate crystals not apparent. Apothecia erumpent, rounded to angular-rounded, 0.7–1.2 mm diameter; disc hidden by a narrow, 0.05–0.1 mm wide pore; proper margin invisible; thalline margin thick, coarsely crenulate to almost lobulate, exposing the white medulla. Excipulum pale yellow, 30–50 µm thick; laterally covered by a thick layer of algiferous, apically with radially elongate, partially free fibrils; hypothecium prosoplectenchymatous, 10–20 µm high, colourless to pale yellowish; hymenium 180–250 µm high, colourless, strongly inspersed; epithecium indistinct. Paraphyses unbranched, glabrous; periphysoids absent; asci fusiform to clavate, 150–200 × 30–40 µm. Ascospores single, oblong, richly muriform, 120–180 × 25–35 µm, 4–5 times as long as wide, with comparatively thin septa and angular lumina, colourless, I+ violet-blue. Secondary chemistry: psoromic acid and satellite substances (P+ yellow).

Distribution and habitat:—This species is so far only known from a single historic collection from the Amazon rainforest.

Etymology:—The epithet honours Richard Spruce (1817–1893), collector of the type material and many other interesting Amazonia lichens.

This new species was completely overlooked previously. It is part of the type collection of another species of the same genus, ***Fibrillithecis dehiscens*** **(Leight.) Mangold, Lücking & Lumbsch,** ***comb. nov.*** [Basionym: *Thelotrema dehiscens* Leight., *Trans. Linn. Soc. London* 25: 448 (1866); lectotype (here selected): BRAZIL: Amazonas: Rio Negro Sán Carlos, *Spruce 395* (lectotype BM, two smaller pieces on upper right side)]. Both species look very similar externally and share the same apothecial morphology and anatomy, the inspersed hymenium, and the psoromic acid chemistry. However, of the four pieces of bark in the collection, two differ in having much larger apothecia. These are mostly sterile, but a few contain ascospores that are large, muriform, and single in each ascus. The other two specimens have smaller apothecia with ascospores being 11–15-septate and 40–60 × 8–12 µm. This material corresponds to the description of *Thelotrema dehiscens*, whereas the material with large apothecia and muriform ascospores is here described as new. *Fibrillithecis sprucei* is the first species in the genus with large, muriform ascospores; all other species have transversely septate or submuriform ascospores that are very small to medium-sized, not exceeding 60 × 12 µm (Rivas Plata *et al.* 2010).

Fissurina astroisidiata **Herrera-Campos & Lücking, *sp. nov.*** (Fig. 12B–C) Mycobank MB 517771

Sicut Fissurina incrustans sed thallo isidiato, lirellis stellatis et ascosporis minoribus differt.—http://www.eol.org/pages/Fissurina astroisidiata

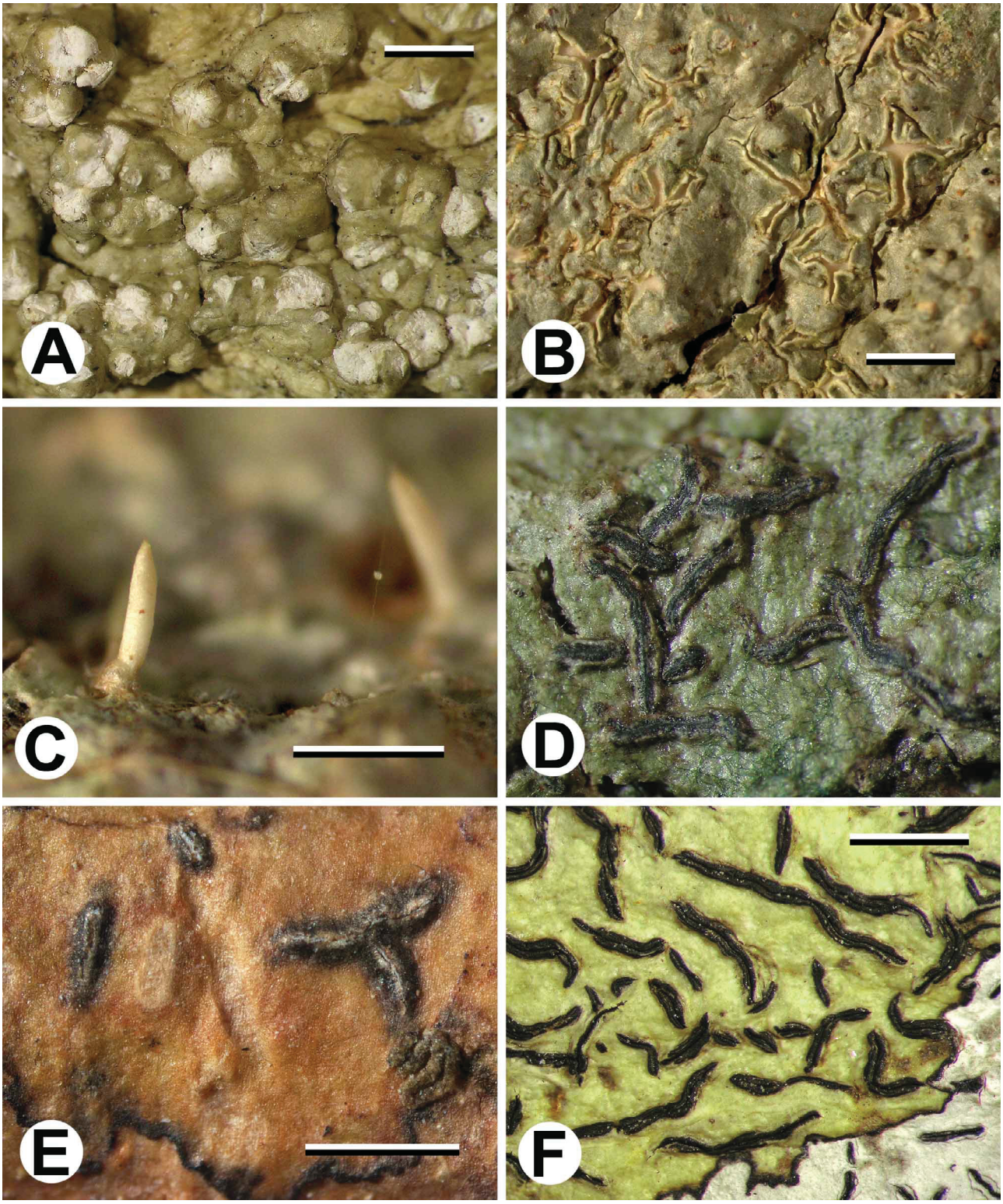

FIGURE 12. A. *Fibrillithecis sprucei* (holotype), thallus with apothecia. B–C. *Fissurina astroisidiata* (B, isotype; C, paratype). B. Thallus with lirellae. C. Isidia. D. *Fissurina nigrolabiata* (holotype), thallus with lirellae. E. *Fissurina subcomparimuralis* (holotype), thallus with lirellae. F. *Graphis caribica* (holotype), thallus with lirellae. Scale = 1 mm.

Type:—MEXICO: Veracruz: Los Tuxtlas Biosphere Reserve, Volcán Sán Martín Tuxtla, 95°13'N, 18°34', 1000–1100 m, selva alta perennifolia perturbada, February 2003, *Herrera Campos et al. RLD051* (holotype MEXU, isotype F).

Thallus corticolous, up to 10 cm diameter, 100–150(–300) µm thick, continuous but typically cracked, isidiate; surface uneven to bumpy (large bumps up to 300 µm thick), light greyish green to olive-green; isidia coarse, cylindrical, basally constricted and tapering towards the apex, 1–2 mm long and 0.1–0.15 mm thick, yellowish white but often darkened at the tip. Thallus in section with 10–15 µm thick prosoplectenchymatous upper cortex, irregular algal layer and clusters of calcium oxalate crystals. Lirellae stellately branched, the stellate clusters concentrated on the elevated thallus bumps, erumpent, fissurine, with thick complete thalline margin, 1–3 mm long, 0.2–0.3 mm wide, 0.1–0.15 mm high; disc partly exposed; labia thin but conspicuous, yellowish white; thalline margin light yellowish green to olive-green. Excipulum entire, colourless to orange-brown, 15–25 µm thick; laterally covered by corticate algiferous thallus including clusters of crystals; hypothecium prosoplectenchymatous, 5–10 µm high, colourless to pale yellowish; hymenium 90–100 µm high, colourless, clear; epithecium granulose, 5–10 µm high, grey-brown. Paraphyses unbranched, glabrous; periphysoids not observed; asci fusiform to clavate, 80–90 × 12–15 µm. Ascospores 8 per ascus, ellipsoid, submuriform with 3 transverse and 0–1 longitudinal septa per segment, 12–15 × 6–8 µm (including 1–1.5 µm thick wall), 2 times as long as wide, with angular-rounded septa and lumina, colourless, I–. Secondary chemistry: no substances detected by TLC.

Distribution and habitat:—*Fissurina astroisidiata* is only known from Los Tuxtlas Biosphere Reserve in Veracruz, Mexico, which represents the northernmost extension of neotropical rain forest. The new species grows on trunks of larger trees in the rain forest understory and hence belongs to the group of species of *Graphidaceae* which can be used as bioindicators of ecological continuity or forest health (Rivas Plata *et al.* 2008).

Etymology:—The epithet refers to the stellately branched lirellae and the isidiate thallus.

Additional specimen examined (paratype):—MEXICO: Veracruz: Los Tuxtlas Biosphere Reserve, Volcán Sán Martín Tuxtla, *Herrera Campos et al. RLD057* (F).

The genus *Fissurina* belongs in *Graphidaceae*, the largest family of tropical crustose lichens, and includes species with more or less inconspicuous lirellae that usually appear as fissures in the thallus (Staiger 2002). Species of *Fissurina* are typically found in undisturbed tropical to subtropical rain forests and grow on tree trunks in the shady understory, less frequently on branches. Currently, c. 65 species are known (Lücking unpubl. data), being distinguished on ascospore septation, chemistry, and lirellae and thallus morphology. *Fissurina astroisidiata* is the first species in the genus known to produce isidia; similar isidia are known from unrelated species in the family, such as *Myriotrema hartii* (Müll.Arg.) Hale and *Reimnitzia santensis* (Tuck.) Kalb. (Rivas Plata *et al.* 2010, Sipman *et al.* 2010). Apart from the isidia, *F. astroisidiata* is morphologically most similar to *F. dumastii* Fée, *F. incrustans* Fée, and *F. karnatakensis* Makhija & Adaw. (Staiger 2002, Makhija & Adawadkar 2007); all three species share the gaping lirellae with the disc partially exposed and thin but distinct labia, similar to species of the genus *Platythecium* (Staiger 2002). However, all lack isidia, and *F. dumastii* differs in its 3-septate ascospores and irregularly branched lirellae, whereas *F. incrustans* has larger, muriform ascospores and irregularly branched lirellae. The lirellae of *F. karnatakensis* look very similar to those of *F. astroisidiata*, but that species has 3-septate ascospores and produces protocetraric and fumarprotocetraric acid. The two available collections of the new species were sequenced (mtSSU and nuLSU) and cluster at the base of *Fissurina* s.str., including also *F. crassilabra* Mont. & Bosch, *F. dumastii*, *F. elaiocarpa* (A.W.Archer) A.W.Archer, and *F. triticea* (Nyl.) Staiger (Rivas Plata *et al.* unpubl. data).

Fissurina nigrolabiata* Rivas Plata, Bawingan & Lücking, *sp. nov. (Fig. 12D) MycobankMB 517772

Sicut Fissurina comparimuralis sed labiis ventricosis et ascosporis I– differt.—http://www.eol.org/pages/Fissurina nigrolabiata

Type:—PHILIPPINES. Luzon Island, Nueva Vizcaya: Mount Palali, 1400 m, March 2007, *Rivas Plata 1198B* (holotype F, isotype CAHUP).

Thallus corticolous, 3–5 cm diameter, 30–50 µm thick, continuous; surface smooth to uneven, green, shiny. Thallus in section with prosoplectenchymatous upper cortex, irregular algal layer and large clusters of crystals. Lirellae straight to curved, unbranched to sparsely branched, erumpent to prominent, with well-developed labia, with lateral thalline margin, 1–3 mm long, 0.3–0.4 mm wide, 0.3–0.4 mm high; disc concealed; labia conspicuous, thickened, greyish black to brown-black, apically covered by translucent cortical layer; thalline margin cream-coloured, sometimes with slight redding tinge. Excipulum entire, completely and massively carbonized including below the hypothecion, black, 80–120 µm wide laterally and up to 200 µm thick below; laterally covered by corticate algiferous thallus including large clusters of crystals at the base; hypothecium prosoplectenchymatous, 5–10 µm high, colourless to pale yellowish; hymenium 120–180 µm high, colourless, clear; epithecium indistinct. Paraphyses unbranched, glabrous; periphysoids not observed; asci fusiform, 80–100 × 15–20 µm. Ascospores 8 per ascus, ellipsoid, muriform with 3–5 × 1–2 septa, 12–17 × 5–8 µm, with comparatively thin outer wall, 2–2.5 times as long as wide, I–. Secondary chemistry: no substances detected by TLC.

Distribution and habitat:—This new species is thus far only known from pristine lower montane rainforest in northern Luzon.

Etymology:—The epithet refers to the thick, carbonized labia.

Fissurina nigrolabiata was first believed to belong in *Carbacanthographis*, because of its massively carbonized labia and I– ascospores. However, molecular data (Rivas Plata *et al.* unpubl. data) place this taxon in the *Fissurina* clade, quite distant from *Carbacanthographis*. The new species is therefore provisionally placed in *Fissurina*, with which it agrees in the distinctly corticate, shiny thallus and the lirellate ascomata. However, *Fissurina* is possibly a collective genus and more data are required to divide this genus into natural groups. Within *Fissurina* s.lat., several species are known to form lirellae with thick labia and well-developed excipulum (*subcontexta*-type according to Staiger 2002). However, a completely and massively carbonized excipulum was not formerly reported from this genus. The shape and anatomy of the lirellae are reminiscent of *Graphis*, but species in that genus have I+ violet-blue ascospores and the thallus is mostly white-grey.

Fissurina subcomparimuralis* Common & Lücking, *sp. nov. (Fig. 12E) Mycobank MB 517773

Sicut Fissurina comparimuralis sed ascosporis I– et periphysoidis spinulosis differt. Thallus corticatus. Lirellae fissurinae, 1–3 mm longae, 0.25 mm latae. Ascosporae muriformes, 15–25 × 6–8 µm, I–. Acidi lichenici desunt.— http://www.eol.org/pages/Fissurina subcomparimuralis

Type:—U.S.A. Florida. Collier County, Fakahatchee Strand Preserve State Park, *Common 7323A* (holotype MSC, isotype hb. Common).

Thallus corticolous, 1–2 cm diameter, 30–50 µm thick, continuous; surface smooth, yellowish-brown to olive-brown. Thallus in section with prosoplectenchymatous upper cortex, irregular algal layer and scattered clusters of crystals. Lirellae straight to curved, unbranched to sparsely branched, erumpent, fissurine, with complete thalline margin, 1–3 mm long, 0.2–0.25 mm wide, 0.12–0.15 mm high; disc concealed; labia conspicuous but not thickened, greyish black to brown-black below corticate thalline margin; thalline margin olive-brown. Excipulum entire, brown-black, 20–40 µm wide; covered by corticate algiferous thallus including clusters of crystals; hypothecium prosoplectenchymatous, 5–10 µm high, colourless to pale yellowish; hymenium 70–90 µm high, colourless, clear; epithecium granulose, 5–10 µm high, grey-brown. Paraphyses unbranched, glabrous; periphysoids present, apically spinulose; asci fusiform, 70–80 × 15–20 µm. Ascospores 8 per ascus, ellipsoid, muriform with 5–7 × 1–3 septa, 15–25 × 6–8 µm (including 1–1.5 µm thick wall), 2.5–3 times as long as wide, with ± trypethelioid septa and lumina, colourless, I–. Secondary chemistry: no substances detected by TLC.

Distribution and habitat:—*Fissurina subcomparimuralis* is known from several rich collections from Fakahatchee Strand Preserve State Park in Florida.

Etymology:—The epithet refers to the close similarity with *F. comparimuralis*.

Additional specimens examined (paratypes):—U.S.A. Florida. Collier County, Fakahatchee Strand Preserve State Park, *Common 7276A*, *7276J* (hb. Common).

This new species was at first identified with *F. comparimuralis* Staiger, until we discovered two significant differences: *F. comparimuralis* has I+ distinctly violet-blue ascospores and lacks spinulose periphysoids. Since we consider these characters taxonomically important, we describe the Florida material as a separate species.

Graphis caribica* Lücking, *sp. nov. (Fig. 12F) Mycobank MB 517774

Sicut Graphis fournieri sed excipulo carbonisato in parte apicali et ascosporis transversaliter septatis differt.—http://www.eol.org/pages/Graphis caribica

Type:—DOMINICA. Bois Serpé (trail from South Chiltern to Soufrière Bay) Parishes of St Luke and St. Marks, 300 m, November 1963, *Imshaug & Imshaug 32777-A2* (holotype MSC).

Thallus corticolous, up to 5 cm diameter, 30–70 µm thick, continuous; surface uneven, yellowish green; prothallus absent. Thallus in section with cartilaginous upper cortex, irregular algal layer and large clusters of crystals below the algal layer. Apothecia lirelliform, flexuose, sparsely to irregularly branched, prominent, lacking thalline margin, 1–5 mm long, 0.3–0.4 mm wide, 0.2–0.3 mm high; disc concealed; proper margin thick, labia striate; thalline margin absent. Excipulum apically crenulate, apically to peripherally carbonized, 50–100 µm wide, apically black but laterally and basally pale yellow to orange-brown; hypothecium prosoplectenchymatous, 10–15 µm high, colourless to pale yellowish; hymenium 120–150 µm high, colourless, clear; epithecium granulose, 10–15 µm high, olive brown. Paraphyses unbranched; asci fusiform to clavate, 120–150 × 20–30 µm. Ascospores 8 per ascus, oblong, transversely 9–15-septate, 50–65 × 9–12 µm, 5–6 times as long as wide, colourless. Secondary chemistry: no substances detected by TLC.

Distribution and habitat:—The new species is known from several collections throughout the Neotropics, centered around the Caribbean, being typically found in drier and subtropical forests.

Etymology:—The epithet refers to the apparently Caribbean distribution of this species.

Additional specimens examined (paratypes):—USA. Florida: Manatee, s.dat., *Reasoner s.n.* (F-1204901). COSTA RICA. Alajuela: La Palma de Sán Ramón, *Brenes 84* (FH). Volcán Tenorio National Park, Pilón Biological Station (Arenal-Tempisque Conservation Area), Tilarán Ridge, *Lücking 17265ab* (F). Guanacaste: Barra Honda National Park, Barra Honda Biological Station (Tempisque Conservation Area), Barra Honda Mountains, *Lücking 17550e, 17557a* (F). Monte Alto Forest Reserve, Monte Alto Biological Station (Tempisque Conservation Area), Nicoya Peninsula, *Lücking 17511e* (F, INB).

This new species, collected first by the late Henry Imshaug, was already discussed in detail in a monographic revision of *Graphis* from Costa Rica but not yet described formally (Lücking *et al.* 2008). *Graphis caribica* differs from most other species of the genus in its yellowish green, uneven thallus. It is morphologically very similar to *G. fournieri* Lizano & Lücking, but the latter has a more or less completely carbonized excipulum and muriform ascospores.

Graphis cerradensis* Marcelli, Benatti & Lücking, *sp. nov. (Fig. 13A–B) Mycobank MB 517775

Sicut Graphis inspersostictica sed ascosporis muriformibus differt.—http://www.eol.org/pages/Graphis cerradensis

Type:—BRAZIL. São Paulo: Municipality of Mogi-Guaçu, Martinho Prado Jr. District, Mogi-Guaçu

Biological Reserve, 22°15'S, 47°11'W, dense, humid Cerrado vegetation, on bark, November 2007, *Lücking 23027* (holotype SP, isotype F).

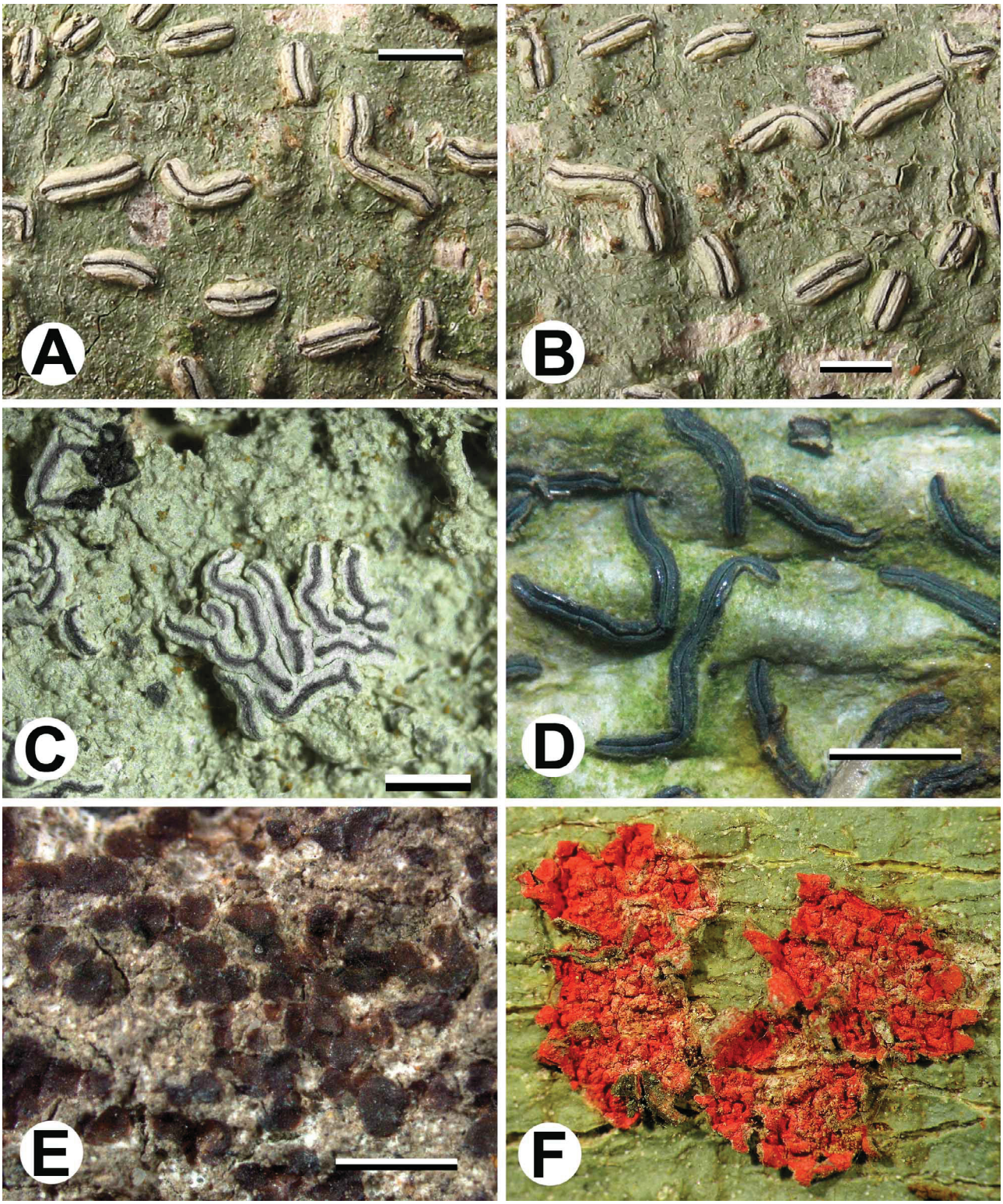

FIGURE 13. A–B. *Graphis cerradensis* (isotype). Thallus with lirellae. C. *Graphis itatiaiensis* (isotype), thallus with lirellae. D. Thallus with lirellae. E. *Gyalideopsis chicaque* (isotype), thallus with apothecia. F. *Gyrotrema papillatum* (holotype), thallus with apothecia. Scale = 1 mm.

Thallus corticolous, up to 5 cm diameter, 30–70 µm thick, continuous; surface smooth to uneven, matte, pale greenish grey; prothallus absent. Thallus in section with cartilaginous upper cortex, irregular algal layer and large clusters of crystals. Apothecia lirelliform, flexuose, unbranched to sparsely branched, prominent, with thick complete thalline margin, 1–3 mm long, 0.5–0.6 mm wide, 0.25–0.35 mm high; disc concealed; proper margin thick, labia striate; thalline margin thick, completely covering the labia, white. Excipulum apically crenulate, completely carbonized, 70–150 µm wide, black; laterally covered by corticate algiferous thallus including large clusters of crystals; hypothecium prosoplectenchymatous, 10–15 µm high, colourless to pale yellowish; hymenium 150–200 µm high, colourless, strongly inspersed with small granules along the paraphyses (paraphyses and asci hardly discernible), inspersion rapidly disappearing in KOH (type B); epithecium granulose, 10–15 µm high, olive brown. Paraphyses unbranched; asci fusiform to clavate, 130–180 × 30–40 µm. Ascospores 4–8 per ascus, oblong, muriform with 15–25 transverse and 1–3 longitudinal septa per segment, 80–100 × 15–20 µm, 6–7 times as long as wide, colourless. Secondary chemistry: stictic acid.

Distribution and habitat:—The new species is known from a single collection in a dense, humid Cerrado vegetation in southern Brazil.

Etymology:—The epithet refers to the type of vegetation in which the species grows.

Graphis cerradensis belongs to the *G. cinerea* group, characterized by robust, prominent lirellae with often striate labia, massively carbonized excipulum, and strongly inspersed hymenium (Lücking 2009, Lücking *et al.* 2008, 2009). Thus far, no stictic-acid containing species with muriform ascospores was known in this group. Most similar is *G. argentata* Lücking & Umaña, which lacks secondary substances and has slightly broader ascospores. *Graphis inspersostictica* Sipman & Lücking also appears to be closely related; it agrees with *G. cerradensis* in morphology and chemistry, but the lirellae are narrower with entire labia and the ascospores are transversely septate or very rarely provided with a longitudinal septum in one of the segments.

Graphis itatiaiensis **Nelsen, Lücking & Spielmann, *sp. nov.*** (Fig. 13C) Mycobank MB 517776

Sicut Graphis rhizocola sed thallo isidioso et lirellis astroideis aggregatis differt.—http://www.eol.org/pages/Graphis itatiaiensis

Type:—BRAZIL. Minas Gerais: Municipality of Itamonte, Parque Nacional do Itatiaia, Estrada das Prateleiras, 22°22'S, 44°44'W, July 2009, *Nelsen 4185* (holotype SP, isotype F).

Thallus corticolous, up to 7 cm diameter, 30–70 µm thick, continuous; surface smooth to uneven-verrucose, greenish grey, with scattered isidioid outgrowths; isidoid outgrowths globose to irregular, 0.05–0.1 mm diameter. Thallus in section with cartilaginous upper cortex, irregular algal layer and large clusters of crystals; photobiont trentepohlioid. Apothecia lirelliform, flexuose, stellately branched and aggregate into pseudostromatic clusters, prominent to sessile, with thick, almost complete thalline margin leaving only the uppermost part of the labia exposed, 1–3 mm long, 0.3–0.5 mm wide, 0.25–0.35 mm high; disc concealed; proper margin thick, labia entire, grey-black; thalline margin thick, covering the labia except for the uppermost part, white-grey and contrasting with the darker surrounding thallus. Excipulum completely carbonized, 50–100 µm wide, black; laterally covered by algiferous thallus lacking crystals; hypothecium prosoplectenchymatous, 10–15 µm high, colourless to pale yellowish; hymenium 150–200 µm high, colourless, clear; epithecium granulose, 10–15 µm high, olive brown. Paraphyses unbranched; asci fusiform to clavate, 130–180 × 30–40 µm. Ascospores 2–4 per ascus, oblong to cylindrical, 15–25-septate, 100–150 × 14–17 µm, 7–9 times as long as wide, colourless, with thin gelatinous caps at both ends. Secondary chemistry: no substances detected by TLC.

Distribution and habitat:—The new species is known from a few collections in lower montane Atlantic rainforest in southeastern Brazil.

Etymology:—The epithet refers to the type locality.

Additional specimens examined (paratypes):—BRAZIL. Minas Gerais: Municipality of Itamonte, Parque Nacional do Itatiaia, Estrada das Prateleiras, *Nelsen 4186* (F).

Graphis is a large genus with over 300 species found primarily on tree bark in semi-open to open conditions in midelevation sites, such as lower montane rainforests (Lücking *et al.* 2008, Lücking 2009, Lücking *et al.* 2009). The genus is typically characterized by a white-grey, corticate thallus, with erumpent-prominent lirellae, a partly to fully carbonized excipulum, a hymenium mostly lacking inspersion and transversely septate to muriform ascospores reacting I+ violet-blue (Staiger 2002, Lücking *et al.* 2008, Lücking 2009). *G. itatiaiaensis* is distinguished from *G. rhizocola* (Fée) Lücking & Chaves by its coarsely isidiate thallus and stellately branched lirellae. *G. itatiaiaensis* differs from *G. isidiata* (Hale) Lücking in that the new species has elongate, stellately branched lirellae and septate rather than muriform ascospores. *G. itatiaiaensis* differs from *G. patwardhanii* C.R.Kulk, another isidiate species with stellately branched lirellae, in having prominent-sessile lirellae covered with thallus, slightly larger ascospores with a greater number of septa per ascospore, a completely carbonized excipulum, and labia lacking striations.

Graphis marusae* B.Peña & Lücking, *sp. nov. (Fig. 13D) Mycobank MB 517777

Sicut Graphis longula sed lirellis nudis differt.—http://www.eol.org/pages/Graphis marusae

Type:—MEXICO. Veracruz: Municipio Catemaco, Los Tuxtlas Biosphere Reserve, Ejido Adolfo López Mateos Ecological Reserve, 18º 26'N, 94º 28'W, 345 m, lowland rainforest, on bark of *Astrocaryum mexicanum*, April 2009, *Bárcenas Peña 1077* (holotype MEXU).

Thallus corticolous, up to 5 cm diameter, 50–100 µm thick, continuous; surface smooth, pale greenish grey, shiny; prothallus absent. Thallus in section with cartilaginous upper cortex, irregular algal layer and clusters of crystals. Apothecia lirelliform, flexuose, usually unbranched, prominent, lacking or with indistinct basal to lateral thalline margin, 1–5 mm long, 0.2–0.3 mm wide, 0.2–0.25 mm high; disc concealed; proper margin thick, labia for a long time entire but eventually becoming striate; thalline margin indistinct, thin, basal to almost lateral, greenish grey, the grey-black labia almost fully exposed. Excipulum entire to apically crenulate, completely carbonized, 80–120 µm wide, black; basally covered by thin thallus layer; hypothecium prosoplectenchymatous, 10–20 µm high, colourless; hymenium 100–150 µm high, colourless, clear; epithecium indistinct. Paraphyses unbranched; asci fusiform, 90–120 × 25–35 µm. Ascospores 8 per ascus, oblong, 9–13-septate, 50–70 × 10–15 µm, 4–5 times as long as wide, colourless. Secondary chemistry: no substances detected by TLC.

Distribution and habitat:—The new species is known from the Biosphere Reserve Los Tuxtlas in Veracruz, Mexico, a relict tropical lowland rainforest. It was found on bark of *Astrocaryum mexicanum* and *Pseudolmedia oxyphyllaria* in exposed understory at 200–345 m elevation.

Etymology:—This new species is dedicated to our mentor and colleague, María de los Angeles Herrera-Campos for her important contributions to lichenology in Mexico and especially the taxonomy of the genus *Usnea*.

Because of its completely carbonized excipulum, clear hymenium, and mid-sized, transversely septate ascospores, this new species would key out under *Graphis cognata* Müll.Arg. with entire labia and under *G. longula* Kremp., *G. asterizans* Nyl., and *G. glauconigra* Vain. with striate labia (Lücking *et al.* 2009). The latter species agrees in the mostly entire labia which eventually become striate, but differs in the shorter lirellae with distinct, conspicuous lateral thalline margin. *Graphis asterizans* likewise also has a distinct thalline margin and the lirellae are stellately branched. *Graphis longula* differs in the soon striate labia and the distinct lateral thalline margin which also forms white lines between the labial striae. The most closely related species seems to be *G. cognata*, but that species has a white-grey thallus and shorter lirellae with jet-black labia and a distinct basal thalline margin.

Gyalideopsis chicaque* Moncada & Lücking, *sp. nov. (Fig. 13E) Mycobank MB 517778

Sicut Gyalideopsis tuerkii sed apotheciis minoribus et ascosporis brevioribus differt.—http://www.eol.org/pages/Gyalideopsis chicaque

Type:—COLOMBIA. Cundinamarca: Sán Antonio del Tequendama, Chicaque Natural Park, 4°36'N, 74°18'W, 2300 m, montane rainforest, on compacted soil, August 2008, *Lücking s.n.* (UDBC, isotype F).

Thallus terricolous over strongly compacted soil, crustose, continuous, 10–30 mm across and 10–20 µm thick, with a cartilaginous, corticiform layer, uneven to irregularly verrucose with clusters of calcium oxalate crystals, pale greenish grey, nitidous. Photobiont trebouxioid, cells 5–8 µm diameter. Apothecia applanate to broadly sessile, 0.25–0.5 mm diameter and 80–100 µm high; disc plane, dark brown, non-pruinose; proper margin distinct, dark brown, non-pruinose. Excipulum composed of radiating and anastomosing hyphae embedded in a gelatinous matrix, 30–50 µm broad, colourless but externally covered by a dark brown, granular layer. Hypothecium 5–10 µm high, colourless; epithecium 5–10 µm high, dark brown granulose. Hymenium 70–90 µm high, colourless. Asci clavate, 60–80 × 12–15 µm. Ascospores 4–8/ascus, ellipsoid, submuriform with 3–5 transverse septa and 0–1 longitudinal septa per segment, with slight constrictions at the septa, 12–16 × 6–8 µm, 1.8–2.2 times as long as broad, colourless. Hyphophores not observed. Secondary chemistry: no substances detected with TLC.

Distribution and habitat:—*Gyalideopsis chicaque* is known from a single but well-developed collection found in a montane rainforest over compacted soil.

Etymology:—The epithet is a noun referring to the type locality.

Gyalideopsis chicaque is characterized by its small, broadly sessile, dark-brown apothecia lacking pruina and very small, submuriform ascospores. There is no similar species growing on rock or soil. *Gyalideopsis nepalensis* Vězda & Poelt has pruinose apothecia and larger ascospores, *G. modesta* Vězda & Poelt has pale-brown apothecia, and *G. lecideina* Kalb & Vězda has black apothecia and larger ascospores (Lücking *et al.* 2006). *Gyalideopsis mexicana* Tretiach, Giralt & Vězda, growing over bryophytes, has much larger, red-brown apothecia. The alpine, muscicolous *G. tuerkii* Vězda is most similar to the new species but has consistently larger apothecia and longer ascospores (15–25 µm, about 3 times as long as broad; Vězda 2003).

Gyrotrema papillatum* Lücking, *sp. nov. (Fig. 13F) Mycobank MB 517779

Sicut Gyrotrema wirthii sed apotheciis majoribus et thallo papilloso differt.—http://www.eol.org/pages/Gyrotrema papillatum

Type:—COSTA RICA. Puntarenas: Corcovado National Park, Los Patos Section, Los Patos Station (Osa Conservation Area), Osa Pensinsula, 160 km SSE of Sán José and 40 km WSW of Golfito, access trail to station and first, hilly part (5 km) of trail to Sirena, 83°29'W, 8°34'N, 100–300 m, lowland rainforest zone, closed primary forest, on bark (lower trunk), partially shaded, April 2003, *Lücking 16301* (holotype F, isotype INB).

Thallus grey-green to olive-green, with numerous white papillae, with dense, prosoplectenchymatous cortex; photobiont layer and/or medulla with clusters of calcium oxalate crystals. Apothecia erumpent, rounded to lobate, 1–1.5 mm diameter; disc exposed, cinnabar-red; margin lobulate to recurved, fused, cinnabar-red inside. Columella absent but concentric rings of excipular tissue separating rings of old hymenia, with youngest hymenium ring next to margin. Excipulum prosoplectenchymatous, carbonized; periphysoids absent. Hymenium 80–100 µm high; paraphyses unbranched. Ascospores 8/ascus, 5–9-septate, 25–30 × 6–8 µm, ellipsoid, with thick septa and lens-shaped lumina, colourless, I+ violet-blue (amyloid). Secondary chemistry: apothecial disc with unidentified anthraquinone.

Distribution and habitat:—*Gyrotrema papillatum* is known from a single, well-developed collection found in the lowland rainforest of southern Costa Rica.

Etymology:—The epithet refers to the papillose thallus.

Gyrotrema papillatum closely resembles *G. wirthii* and has the same apothecial pigment. However, its apothecia are larger and more irregular and its thallus is densely white-papillose. Whereas *G. wirthii* has been found in the southern part of Osa Pensinsula, *G. papillatum* is known from a rich collection from the central part close to the Golfo Dulce. It thus seems that in this case, also a microgeographic differentiation supports the separation of these two species.

Harpidium gavilaniae **Amo, Pérez-Ortega & A. Crespo, *sp. nov.*** (Fig. 14A–B) Mycobank MB 517780

Sicut Harpidium rutilans sed thallus effiguratus et areolae majores..—http://www.eol.org/pages/Harpidium gavilaniae

Type:—SOUTH AFRICA. North Cape Province: Namaqualand, 57 km E of Springbok, Kangna's Farm, 29º34'S, 18º20'E, 1036 m, quartzite creek area, June 2005, *Crespo & Amo de Paz SA-80b* (holotype MAF-Lich 16488, isotype MAF-Lich 16489).

Thallus crustose, effigurate. Thallus rounded to ellipsoid, up to 2.5 cm in diameter. Areoles independent, flat to bullate or sub-stipitate, affixed to substrate over most of lower surface; marginal zone usually free, maroon-purplish to copper-red. Peripheral areoles enlongated, forming lobes, 0.4–0.9(–1.3) mm in diameter. Central areoles rounded, bearing immersed apothecia, 0.3–0.6(–0.8) mm in diameter (n = 35). Areoles stratified in section, 0.2–0.4(–0.7) mm high. Upper cortex paraplectenchymatous, to 25 µm high; Photobiont layer continuous, 90–200 µm high; Photobiont chlorococcoid, *Trebouxia*-like, 6–15 µm in diameter. Apothecia irregularly rounded, usually one per areole, immersed as in typical *Aspicilia* species, disc blackish, 0.1–0.3(–0.4) mm in diameter. Thalline exciple up to 20 µm thick. Epihymenium reddish, K–, ca. 10 µm thick; hymenium 50–70 µm high; KI+ blue, paraphyses, moniliform, 4–6 µm wide, slightly wider at the apex. Asci unitunicate-rostrate, clavate, 8-spored, 24–27 × 11–14 µm (n = 30), ascus wall thick. Ascospores hyaline, simple, crescent form with the two apices rotated 90º, 9–13 × 6–7 µm (n = 35), with thick wall (ca. 0.8 µm). Pycnidia frequent, laminal, immersed; 70–120 µm in diameter. Conidia cylindrical to ellipsoidal, 3 x 1 µm. Secondary chemistry: no secondary metabolites detected by TLC.

Distribution and habitat:—*Harpidium gavilaniae* is so far only known from the type locality, growing on quartzites in vertical furrows (dihedral) with seasonal water flows. The area belongs to Namaqualand Hardevel biome (Mucina & Rutherford 2006) and it is very dry (below 100 mm per year).

Etymology:—This species is named for Rosario Gavilán, Botanist at the Universidad Complutense de Madrid (Spain) who took part in our lichenologial expedition to South Africa in 2005.

Harpidium is a small genus, with only two species described so far. *Harpidium rutilans* is known from few localities in the Eurasian mountains (Sancho & Crespo 1983) and *H. nashii* from four localities of SW North America (Schultz *et al.* 2000). *Harpidium* and *Euopsis* together comprise the family *Harpidiaceae* (Scheidegger & Schultz 2004). The new taxon represents the first record of the genus in the Southern Hemisphere. The new species differs from the other two known species of *Harpidium* in its thallus shape. It forms effigurate thalli, up to 2.5 cm in diameter. *Harpidium rutilans* is the most similar species but we have seen elongated areoles only in young thalli; subsequently the thallus becomes irregular with areoles dispersed over the surface. On the contrary, *H. gavilaniae* remains ellipsoid in shape and has elongated peripheral lobes. *Harpidium nashii* differs in having umbilicate areoles and a more dispersed thallus. These differences, together with the allopatric distribution and the genetic distance between populations (unpubl. data), in our opinion justify description of the South African population of *Harpidium* as a new species.

Hypogymnia amplexa **Goward, Björk & Wheeler, *sp. nov.*** (Fig. 14C) Mycobank MB 517781

Sicut Hypogymnia imshaugii sed lobis peripheralibus adnatis, thallo centrali cerebriformi et acido physodalico decipienti differt. Corticola.—http://www.eol.org./pages/Hypogymnia amplexa

Type:—U.SA. Washington: Spokane County, Riverside State Park, 6.5 km NW of downtown Spokane, 47˚42'N, 117˚30'W, 525 m, on branches of *Pinus ponderosa,* July 2009, *Björk 19340* (holotype UBC, isotypes B, CANL, GZU).

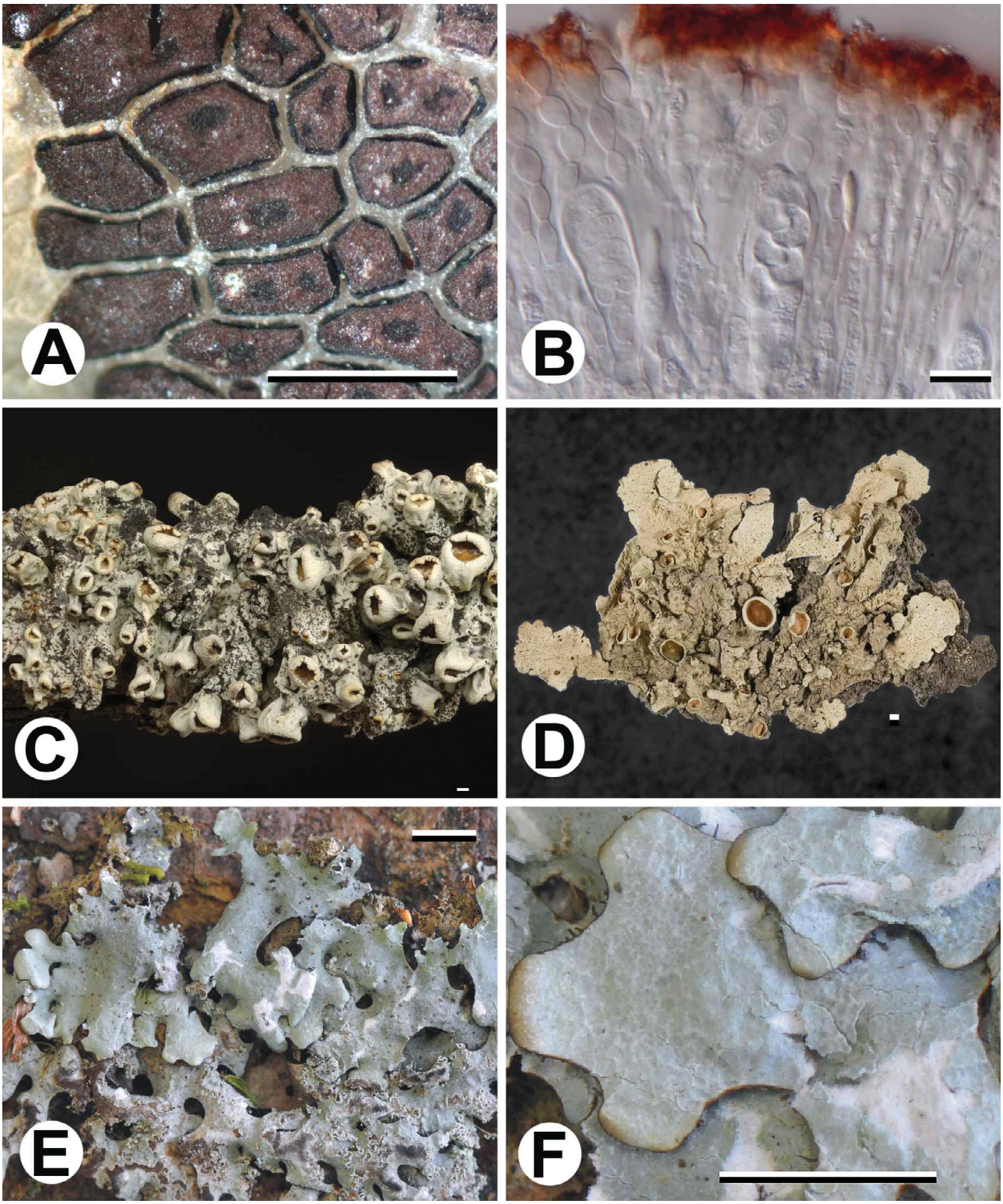

FIGURE 14. A–B. *Harpidium gavilaniae* (holotype). A. Habit. B. Hymenium detail. C. *Hypogymnia amplexa* (holotype), thallus with apothecia. D. *Hypotrachyna guatemalensis* (holotype), thallus with apothecia. E–F. *Hypotrachyna indica* (holotype). E. Habit and showing fragile and flaking upper cortex. F. Detail showing white-maculate upper surface. Scale in A, C, D = 1 mm, in B = 10 µm, in E, F = 2 mm.

Thallus foliose, up to 6–8(–10) cm across, corticate above and below; lobes hollow, usually readily divisible into two morphologically distinct lobe types: peripheral and central. Peripheral lobes short, usually about as broad as long, nearly or quite contiguous, usually flaring outward to the (rounded) tips, tending to wrap around the supporting branch, broadest ones 2–3(–4) mm wide, sometimes with small subapical perforations, these usually over the upper surface, but sometimes also at the lobe tip. Central lobes sparse to numerous, separate, more or less elongate, at least partly ascending, branching at first isotomic dichotomous, but later predominantly anisotomic, terminating at least in part in rather pointed tips, broadest ones 1.5–2.5 mm wide, occasionally with small lateral or axillary perforations (check near margin of lower surface). Upper surface whitish to pale pastel green, rather dull, becoming brownish where exposed, without black mottling, more or less rugose throughout, often becoming cerebriform toward thallus centre. Medullary ceiling white (except weakly brown near ruptures in lower surface). Lower surface black; thin, easily torn, sharply wrinkled or folded, without rhizines. Soredia and isidia absent. Photobiont trebouxioid. Apothecia laminal, sparse to more often numerous, stalked, the stalks pale, often scabrid, the excipulum not much expanded (except sometimes expanded in age), often incurled at the rim; disk brown, the largest ones (2–)3–6(–8) mm across, deeply cup-shaped, the outer portions usually vertically oriented; ascospores ellipsoid, averaging (6.8–)8.0(–9.0) × (4.8–)5.7(–7.0) µm, L/W ratio (1.11–)1.41(–1.67); pycnidia copious over the upper surface forming tiny black dots; conidia (6.5–)6.9(–8.0) × 1 µm. Secondary chemistry (TLC): atranorin, physodic acid (major, constant), unknown 7 (present, occasional); cortex K+ yellow, medulla KC+ abruptly pink.

Distribution and habitat:—Currently known only from western intermontane North America, especially eastern Washington, north and central Idaho, western Montana, rarely north to southern intermontane British Columbia. Most specimens seen were collected from the branches of *Pinus ponderosa*, with occasional material also from *Abies lasiocarpa, Artemisia tridentata*, *Pinus albicaulis* and *Pseudotsuga menziesii*. Usually restricted in well-illuminated sites. This is the most frequently encountered *Hypogymnia* in some portions of eastern Washington and adjacent Idaho, sometimes a dominant macrolichen of conifer branches in open, dry forests.

Etymology:—*Amplexa* is from Latin, meaning "embracing" or "clasping": a reference to the peripheral lobes, which tend to wrap around the supporting twig or branch.

Additional specimens examined (paratypes):—CANADA. British Columbia: Okanagan River Drainage, Three Lakes area, 8 km N of Oliver, *Björk 15123* (UBC). U.S.A. Idaho: Shoshone County, Coeur d'Alene Mountains, Bloom Peak, *Björk 16742a* (UBC). Montana: Lake Co., Jocko Canyon Road, *Wheeler 1834* (UBC). St. Marys Peak, *Wheeler 836* (UBC). Missoula County, N fork of Finley Creek, *Wheeler 2379* (UBC). Whelp Lake, Mission Mtns., *Wheeler 1418* (UBC). Washington: Grant Co., Northup Canyon, Grand Coulee, *Björk 17713* (UBC). Lincoln County, Telford Road, 16 km SE of Creston, *Björk 19095* (UBC). Spokane Co., Kentuck Trails Road, 9.5 km W of Fairfield, *Björk 19182* (UBC). Spokane Co., Turnbull National Wildlife Refuge, 11 km S of Cheney, *Björk 8946* (UBC). Spokane County, Riverside State Park, 7 km NW of downtown Spokane, *Björk 19334* (UBC). Spokane County, Peone Prairie, near Moffat Road, 17 km NE of downtown Spokane, *Björk 19196* (UBC). Spokane County, Dishman Hills County Park, 1 km SW Dishman, *Björk 10129* (UBC).

Hypogymnia is a well known genus of about 90 foliose lichens found primarily at temperate to boreal latitudes, mostly on trees. Most species are whitish above, hollow within, black below, and lack rhizines. Within the genus, *H. amplexa* is characterized by its combination of ascending, irregularly branched central lobes that taper to a blunt point, and appressed, flattened, apically rounded peripheral lobes that tend to wrap around the supporting branch, its strongly rugose (cerebriform) central portions, its deeply cup-shaped apothecia, and by its white medullary ceiling and P– medulla. *Hypogymnia amplexa* appears to be most closely allied with *H. imshaugii* Krog, with which it sometimes co-occurs. *Hypogymnia imshaugii is* a morphologically variable species described from British Columbia (Krog 1968), and endemic to western North America (Brodo *et al.* 2001). Both it and *H. amplexa* lack soredia, bear copious apothecia, and have long, narrow, divergently branched, ascending lobes, at least in central portions of the thallus. In *H imshaugii* Krog, however, the lobes are evenly branched, the apothecia tend to be shallowly saucer-shaped, and the

medulla is P+ orange. Additionally the central lobes of *H. imshaugii* are smooth to at most weakly rugose above and scarcely differ in habit from the (typically ascending) peripheral lobes. Subalpine populations of *H. amplexa* might be confused with the "swollen form" of *H. wilfiana* Goward, T.Sprib. & Ahti (Goward *et al.* 2010) which likewise has appressed lobes and a white medullary ceiling. Such material, however, lacks subapical perforations and ascending central lobes, has shallowly saucer-shaped apothecia, and contains apinnatic acid. An unusual feature of *H. amplexa* is the occasional presence of perforations in the upper cortex, especially in the vicinity of the lobe tips. Laminal perforations in *Hypogymnia* have hitherto been reported only in *H. magnifica* X.L.Wei & McCune, a southwest Asian endemic lichen clearly unrelated to our new species (Wei *et al.* 2010).

Hypotrachyna guatemalensis* Elix & van den Boom, *sp. nov. (Fig. 14D) Mycobank MB 517782

Sicut Hypotrachyna bahiana sed diminuta, medulla albida, rhizinis densis et ramosissimis et acidum conhypoprotocetraricum et acidum hypoprotocetraricum continente differt.—http://www.eol.org/pages/Hypotrachyna guatemalensis

Type:—GUATEMALA. Quezaltenango: S of Llano del Pinal, N slope of volcano Santa María, 14°47'N, 91°33'E, 2700 m, on *Alnus arguta* along path among small agriculture fields with small forests, shrubs, trees and outcrops, July 2004, *van den Boom & van den Boom 32993* (holotype CANB, isotype hb. van den Boom).

Thallus foliose, 4–5 cm wide, adnate to loosely adnate, coriaceous, irregularly lobate. Lobes contiguous to sparingly imbricate, sublinear to subirregular, 1–4 mm wide, with entire to crenulate margins and subrotund apices, eciliate but with rhizines projecting beyond the margins in part. Upper surface grey-white to yellowish grey, emaculate, shiny and black-margined at the apices but dull and rugulose in the centre, lacking soredia, isidia, pustules, dactyls, and lobules. Medulla white. Lower surface black but brown at the apices, rhizines dense, richly dichotomously branched. Apothecia common, sessile to substipitate, 1–4 mm diameter, disc pale brown, exciple smooth, margins thick and persistent. Ascospores broadly ellipsoid, 7–9 × 5–6 µm. Pycnidia common, black, immersed. Conidia weakly bifusiform, 6–8 × 1 µm. Secondary chemistry: atranorin (minor), chloroatranorin (minor), conhypoprotocetraric acid (major), hypoprotocetraric acid (minor), 4-*O*-demethylnotatic acid (trace).

Distribution and habitat:—At present, *H. guatemalensis* is known only from the type collection.

Etymology:—The specific epithet derives from the Latin *-ensis* (place of origin) and the location of the type.

Morphologically this new species resembles *Hypotrachyna bahiana* (Nyl.) Hale (1975), but is distinguished in having a white medulla (partially pigmented orange or yellow-brown in *H. bahiana*), smaller thallus (4–5 cm wide versus 6–20 cm) with dense, richly dichotomously branched rhizines (branched 3–5 times), whereas the rhizines in *H. bahiana* are sparse to moderately dense and moderately dichotomously branched (branched 1–3 times). The two species also differ chemically, since *H. bahiana* contains atranorin (minor), chloroatranorin (minor), protocetraric acid (major), virensic acid (minor or trace), ±gyrophoric acid (trace), ±conprotocetraric acid (trace) and the pigments skyrin (minor) ±pigmentosin A (major or minor) (Sipman *et al.* 2009). In contrast, *H. guatemalensis* lacks pigments and contains atranorin (minor), chloroatranorin (minor), conhypoprotocetraric acid (major), hypoprotocetraric acid (minor), 4-*O*-demethylnotatic acid (trace). The rare depsidone, conhypoprotocetraric acid, was first isolated from a Panamanian collection of *Relicina* cf. *incongrua* Hale (Elix *et al.* 1995). Conhypoprotocetraric acid is not known to occur as a major component in any other taxon in Parmeliaceae.

Hypotrachyna indica* Divakar, Lumbsch, Upreti & A.Crespo, *sp. nov. (Fig. 14E–F) Mycobank MB 518238

Sicut Hypotrachyna exasplendens sed differt acidum barbaticum, 4-O-demethylbarbaticum, obtusaticum, et norobtusaticum continente, et pustulata, sorediis destituta..— http://www.eol.org/pages/Hypotrachyna indica

Type:—INDIA. Tamil Nadu: Western Ghat, Nilgiri Hills, Dodabetta, trail from Samer to Tiger Hills, 11º 24'N, 76º 44'E, 2607 m, on coniferous tree trunk, *Divakar et al. 19715K* (holotype MAF-Lich, isotypes F, LWG).

Thallus corticolous, adnate, small, to 5 cm across. Lobes short, sublinear, dichotomously branched with truncate apices, 0.5–2 mm wide. Upper surface greenish grey, dull, strongly white-maculate, sometimes reticulate near lobe apices, pustulate, without soredia and isidia; upper cortex fragile and flaking, with blackened, eroded areas. Pustules subterminal, erupting apically, not forming soredia but may shed corticated granules from open pustule margins. Medulla white. Lower surface black with narrow brown margins, rhizinate, rhizines richly dichotomously branched, to 1.5 mm long. Apothecia and pycnidia not seen. Secondary chemistry: Cortex K+ yellow; medulla K–, C–, KC+ orange, P–; containing atranorin, barbatic acid, 4-*O*-demethylbarbatic acid, obtusatic acid and norobtusatic acid (trace).

Distribution and habitat:—The species grows on tree trunk in open and humid coniferous forest at 2607 m elevation. At present the taxon is only known from type locality.

Etymology:—The specific epithet refers to the name of the locality.

Additional specimens examined (paratypes):—INDIA. Tamil Nadu: Western Ghat, Nilgiri Hills, Dodabetta, trail from Samer to Tiger Hills, *Divakar et al. 19715O*, *19718P* (MAF-Lich).

Hypotrachyna indica is characterized by a strongly white-maculate upper surface, flaking upper cortex, pustules that do not form soredia and the presence of the barbatic acid complex. This new species resembles *Hypotrachyna exasplendens* (Hale) Hale, reported from Central America and South Africa (Hale 1975), but differs in containing barbatic acid, 4-*O*-demethylbarbatic acid, obtusatic acid and norobtusatic acid instead of alectoronic acid; and in having pustulate upper surface, which break open apically but do not produce soredia rather than capitate soralia. It is also similar to *Hypotrachyna exsecta* (Taylor) Hale, known from Australasia and South East Asia (Elix 1994a, Divakar & Upreti 2003, 2005), but the latter has an emaculate, shiny, and sorediate upper surface, a continuous upper cortex (not flaking), and broad (2–5 mm wide) lobes.

Hypotrachyna lueckingii* Sipman, *sp. nov. (Fig. 15A) Mycobank MB 517783

Hypotrachyna corticola thallo flavo, sine propagulis vegetativis, acida protocetraricum et gyrophoricum in medulla continens.— http://www.eol.org/pages/Hypotrachyna lueckingii

Type:—COSTA RICA. Cartago: Cordillera de Talamanca, Cerro de la Muerte, Cerro de la Asunción, along Carretera Interamericana near sideway to the peak, 83°46'W, 9°34'N, 3350 m, subpáramo scrub, ca. 2 m tall, epiphyte on shrub branches, April 1998, *Sipman et al. 43698* (holotype B, isotype INB).

Thallus foliose, corticolous, 5–10 cm wide, loosely adnate, not coriaceous, dichotomously to subdichotomously lobate. Lobes sublinear to subirregular, mostly separate, (0.5–)1.5–3 mm wide, plane to slightly convex, with subtruncate apices. Upper surface greenish yellow, slightly shiny, epruinose, emaculate, lacking soredia, isidia, pustules, dactyls or lobules, and with intact upper cortex. Medulla white, with a continuous algal layer above. Lower surface black, peripherally dark brown. Rhizines black, rather dense, sometimes forming a marginal fringe, ca. 0.5 mm long, 1–4 times dichotomously branched. Apothecia frequent, 2–7 mm in diameter, with concave, finally flat, brown, glossy discs and crenulated, incurved margins. Ascospores ellipsoid, 10–13 × 6–7 µm. Pycnidia frequent, laminal, immersed. Conidia weakly bifusiform, ca. 6 × 0.5 µm. Chemistry: upper cortex K–, C–, KC+ yellow, P–, UV–, medulla K–, C–, KC–, P+ orange-red, UV–. Secondary metabolites: upper cortex with usnic acid (major), medulla with protocetraric acid (major) and gyrophoric acid (minor).

Distribution and habitat:—Known so far only from two specimens from the highest parts of the Cordillera de Talamanca in Costa Rica, on scattered trees in páramo scrub at 3300–3500 m.

Etymology:—The epithet honours Robert Lücking (Chicago, U.S.A.), who contributed greatly to the lichenological knowledge of Costa Rica by, e.g., his detailed studies of foliicolous lichens and the organisation of the TICOLICHEN project.

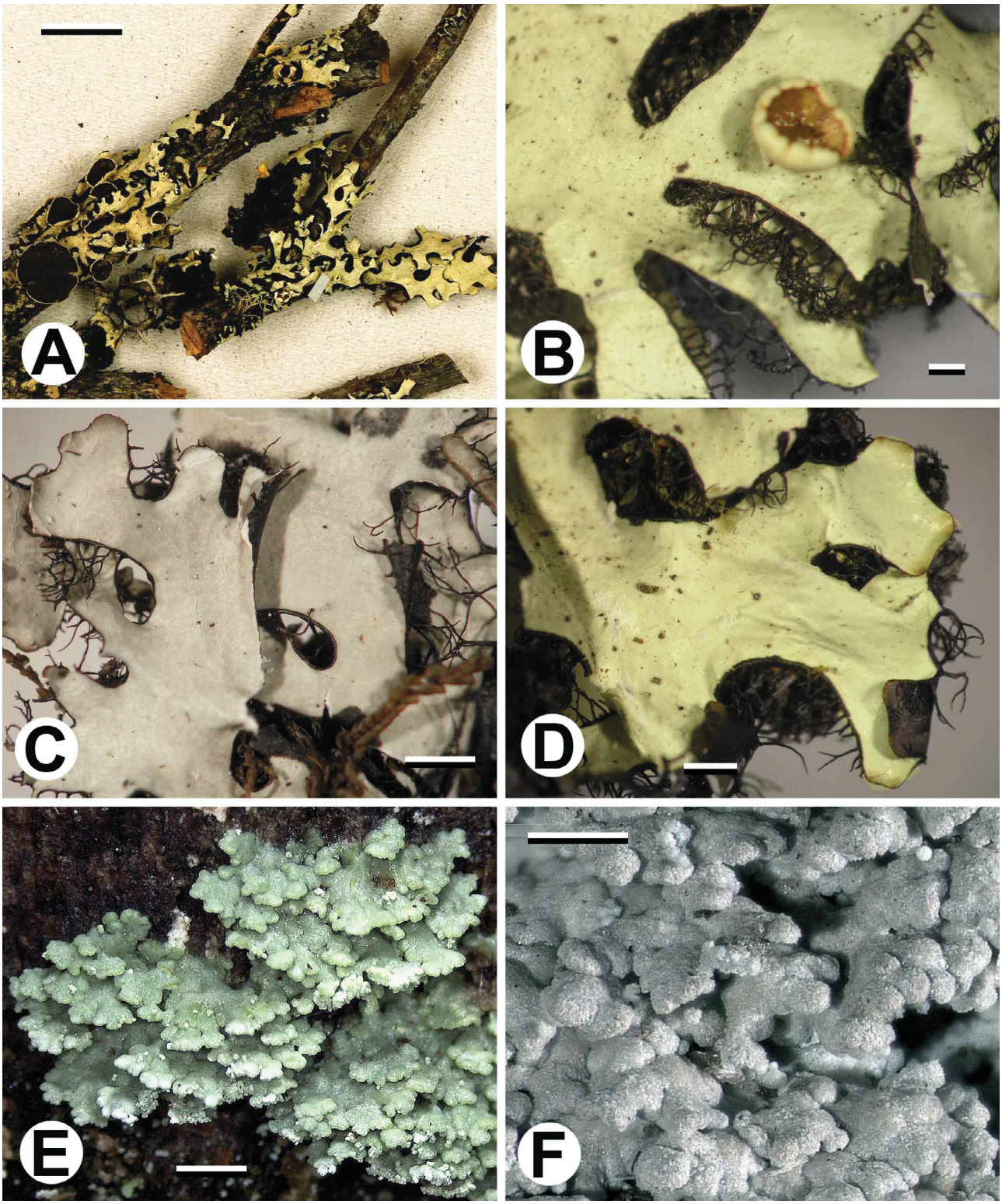

FIGURE 15. A. *Hypotrachyna lueckingii* (holotype), substrate with thalli. B. *Hypotrachyna paracitrella* (holotype), thallus lobes enlarged with apothecium. C. *Hypotrachyna paraphyscioides* (holotype), thallus lobes enlarged. D. *Hypotrachyna parasinuosa* (holotype), thallus lobes enlarged. E–F. *Icmadophila eucalypti* (E, holotype; F, *Kantvilas 21/04*). E. Habit (photograph J. Jarman). F. Detail of lobe apices; the swellings resemble apothecial initials of other members of the Icmadophilaceae (photograph J. Jarman). Scale in A = 10 mm, in B–D = 3 mm, in E = 1 mm, in F = 0.5 mm.

Additional specimens examined (paratypes):—COSTA RICA. Sán José: Cerro Buenavista, *Hafellner 7747* (GZU).

During the recent revision of *Hypotrachyna* (Sipman *et al.* 2009), the number of species was doubled in comparison with an earlier revision (Hale 1975). Nevertheless the diversity of this conspicuous genus in the Neotropics is still not completely understood and additional taxa continue to be described (Yánez-Ayabaca & Eliasaro 2009). *Hypotrachyna lueckingii* is very similar to *H. flavida* (Zahlbr.) Hale, with which it shares cortical usnic acid and medullary protocetraric acid as major substances, and the absence of vegetative reproduction (soredia, isidia, pustules, flaking cortex, deciduous rhizines). It is clearly distinguished by the presence of gyrophoric acid in the medulla, and its less linear thallus, which resembles more the isidiate *H. microblasta* (Vain.) Hale or the sorediate *H. sinuosa* (Smith) Hale. Different also is its corticolous habitat, while *H. flavida* is mostly found on rock or on moss covering rock. Of the latter only one corticolous specimen is known from Colombia (*Aguirre & Sipman* 5989 (B), which differs clearly from the new species in the absence of gyrophoric acid and the sublinear lobes. Further, *H. lueckingii* is allopatric with *H. flavida*, which is not known further north than Colombia. So far morphological analysis has not given clear indications for an infrageneric classification of *Hypotrachyna*, and Sipman *et al.* (2009) did not recognize any infrageneric categories. However, recent DNA analyses (Divakar *et al.* 2006) suggest that several distantly related groups are involved. In the absence of molecular data, the position of *H. lueckingii* within *Hypotrachyna s.lat.* remains uncertain. However, its morphological similarity with *H. sinuosa* would indicate an affinity with clade D of Divakar *et al.* (2006: fig. 1), while *H. flavida* might belong to clade B.

Hypotrachyna paracitrella* Sipman & Palice, *sp. nov. (Fig. 15B) Mycobank MB 517784

Hypotrachyna sine rhizinis, cum ciliis furcatis, corticola thallo flavo, sine propagulis vegetativis, acida barbaticum, obtusaticcum, 4-O-demethylbarbaticum et norobtusaticum in medulla continens.—http://www.eol.org/pages/Hypotrachyna paracitrella

Type:—ECUADOR. Tungurahua. Llanganates National Park, Cordillera Llanganates, ca. 5 km WSW of Cerro Hermoso, 01°15'S, 78°20'W, 3750–3800 m, well-lit dwarfy forest at steep, E-facing slope above unnamed lagoon, March 2003, *Palice 8487* (holotype PRA, isotype B, QCA).

Thallus foliose, corticolous, ca. 5 cm wide, loosely adnate, not coriaceous, dichotomously to subdichotomously lobate, ciliate. Lobes sublinear to subirregular, mostly separate, 2–3 mm wide, plane to slightly convex, with subtruncate apices. Upper surface greenish yellow with usually a black marginal rim, slightly shiny, epruinose, emaculate, lacking soredia, isidia, pustules, dactyls or lobules. Medulla white, with a continuous algal layer above. Lower surface black, paler and brown at the lobe tips. Rhizines absent. Marginal cilia present, black, somewhat dendroid, 1–2 mm long, near the base about 0.2 mm thick, 1–3 times furcately branched. Apothecia frequent, 2–5 mm in diameter, with strongly constricted base, with concave, finally flat, brown, glossy discs, and with crenulated, incurved margins. Ascospores ellipsoid, 12–13 × 6–7 µm. Pycnidia frequent, laminal, immersed. Conidia not seen. Secondary chemistry: upper cortex K–, C–, KC+ yellow, P–, UV–; medulla K+ yellow turning red, C–, KC–, P+ orange-red, UV–; upper cortex with usnic acid (minor), medulla with salazinic acid (major), consalazinic acid (minor), norstictic acid (trace) and protocetraric acid (trace) (HPLC kindly provided by J.A. Elix).

Distribution and habitat:—Known so far only from a single specimen in Tungurahua province, Ecuador, in humid dwarfed forest at 3750–3800 m.

Etymology:—The epithet reflects the similarity to *Hypotrachyna citrella* (Kurokawa) Hale (Sipman *et al.* 2009).

After revisions of neotropical representatives of the genera *Everniastrum* (Sipman 1986a) and *Hypotrachyna* (Sipman *et al.* 2009), these can now be identified routinely, which increases the chances for the discovery of rare species. *H. paracitrella* is apparently one such species. It is known only from a single collection, although the macrolichens of Ecuador have been sampled extensively by several trained lichenologists, in particular L. Arvidsson from Gothenburg, Sweden. As expressed by its name, *H.*

paracitrella is most similar to *H. citrella*. It agrees in lobe configuration, absence of vegetative reproduction, and chemistry, and differs in the absence of rhizines and the presence of furcately branched cilia. *Hypotrachyna* as currently circumscribed is polyphyletic as was shown/confirmed by recent molecular studies (Divakar *et al.* 2006, 2010). If the genus is to be divided, then the two newly described taxa would perhaps deserve affiliation to a separate genus because of the combination of unique features. *Hypotrachyna paracitrella* and two other species treated here, *H. paraphyscioides* and *H. parasinuosa*, are unusual because they lack rhizines and have furcately branched cilia instead. In this way they fall outside the traditional limit of the genus *Hypotrachyna* and fit rather the genus *Everniastrum*. Therefore they were left outside the recent revision of neotropical *Hypotrachyna* (Sipman *et al.* 2009). However, by their lobe configuration and their chemistry they deviate greatly from other representatives of *Everniastrum* and resemble more closely particular species of *Hypotrachyna*, as expressed by their names. As a consequence more characters suggest their affinity with species of *Hypotrachyna* rather than with species of *Everniastrum* species and they are therefore consigned here to *Hypotrachyna* rather than to *Everniastrum*. A tendency to develop a naked lower surface occurs also in *H. everniastroides* Sipman (Sipman *et al.* 1986b), where rhizines are restricted to a marginal zone. *Hypotrachyna* as currently circumscribed is polyphyletic as was shown/confirmed by recent molecular studies (Divakar *et al.* 2006, 2010). It is noteworthy that all species of *Hypotrachyna* with cilia instead of rhizines known so far are very rare, and that two are known only from a single localityt. This is somewhat reminiscent of hybrids in phanerogams, which show an unusual mix of characters from two parents, and are usually much rarer than either. It may also indicate relict endemism. It is also noteworthy that the specimens of *H. paracitrella* and *H. parasinuosa* grow mixed on the same tree.

Hypotrachyna paraphyscioides* Sipman, *sp. nov. (Fig. 15C) Mycobank MB 517785

Hypotrachyna corticola, sine rhizinis, cum ciliis furcatis, thallo cinereo, sine propagulis vegetativis, acida barbatica, obtusatica, 4-O-demethylbarbatica et norobtusatica in medulla continens.—http://www.eol.org/pages/Hypotrachyna paraphyscioides

Type:—COLOMBIA. Magdalena: Sierra Nevada de Santa Marta, transecto del Alto Buritaca, 2880 m, on branch, August 1977, *Rangel et al. 1083b* (holotype L).

Thallus foliose, corticolous, 5–10 cm wide, loosely adnate, not coriaceous, dichotomously to subdichotomously lobate, ciliate. Lobes sublinear to subirregular, mostly separate, (0.5–)1.5–3 mm wide, plane or slightly convex, with subtruncate apices. Upper surface pale grey with black marginal rims, slightly shiny, epruinose, maculate, lacking soredia, isidia, pustules, dactyls or lobules, and with intact upper cortex. Medulla white. Lower surface black, pale brown towards the lobe tips. Rhizines absent. Marginal cilia present, black, 1–3 mm long, somewhat flexuous and 1–2 times furcately branched at rather wide angles, occasionaly also present away from the margin on the lower side. Apothecia frequent, 2–7 mm in diameter, with concave, finally flat, brown, glossy discs and crenulated, incurved margins. Ascospores ellipsoid, 10–13 × 6–7 µm. Pycnidia frequent, laminal, immersed. Conidia weakly bifusiform, ca. 6 × 0.5 µm. Secondary chemistry: upper cortex K+ yellow, C–, KC–, P–, UV–; medulla K–, C+ yellow-orange, KC+ orange, P–, UV–; upper cortex with atranorin, medulla with barbatic acid (major), obtusatic acid (trace), 4-O-demethylbarbatic acid (major) and norobtusatic acid (trace) (TLC).

Distribution and habitat:—Known so far only from one specimen from the N-slope of the Sierra Nevada de Santa Marta in Colombia, on a branch in montane forest at 2880 m.

Etymology:—The epithet reflects the similarity to *Hypotrachyna physcioides* (Nyl.) Hale (Sipman *et al.* 2009).

Hypotrachyna paraphyscioides resembles *H. physcioides* closely in lobe configuration, presence of soralia, and chemistry (Sipman *et al.* 2009), and differs in the presence of furcately branched cilia and the absence of rhizines.

Hypotrachyna parasinuosa* Sipman & Palice, *sp. nov. (Fig. 15D) Mycobank MB 517786

Hypotrachyna corticola sine rhizinis, cum ciliis furcatis, thallo flavo, soraliis capitatis, acidum salazinicum in medulla continens.— http://www.eol.org/pages/Hypotrachyna parasinuosa

Type:—ECUADOR. Tungurahua. Llanganates National Park, Cordillera Llanganates, ca. 5 km WSW of Cerro Hermoso, 01°15'S, 78°20'W, 3750–3800 m, well-lit dwarfy forest at steep, E-facing slope above unnamed lagoon, March 2003, *Palice 8487b* (holotype PRA).

Thallus foliose, corticolous, ca. 5 cm wide, loosely adnate, not coriaceous, dichotomously to subdichotomously lobate, ciliate. Lobes sublinear to subirregular, mostly separate, 2–3 mm wide, plane to slightly convex, with subtruncate apices. Upper surface greenish yellow with usually a black marginal rim, slightly shiny, epruinose, emaculate, sorediate, lacking isidia, pustules, dactyls or lobules. Soralia apical or subapical, more or less capitate or spreading over the surface, pale yellow but becoming blackened with age, with granular soredia ca. 60 µm in diameter. Medulla white. Lower surface black, paler and brown at the lobe tips. Rhizines absent. Marginal cilia present, black, somewhat dendroid, 1–2 mm long, near the base about 0.2 mm thick, 1–3 times furcately branched. Apothecia and pycnidia not seen. Secondary chemistry: upper cortex K–, C–, KC+ yellow, P–, UV–; medulla K+ yellow turning red, C–, KC–, P+ orange-red, UV–; upper cortex with usnic acid (minor), medulla with salazinic acid (major), consalazinic acid (minor), norstictic acid (trace) and protocetraric acid (trace) (HPLC by J. A. Elix).

Distribution and habitat:—Known so far only from a single specimen in prov. Tungurahua, Ecuador, on humid, dwarfed forest at 3750–3800 m.

Etymology:—The epithet reflects the similarity to *Hypotrachyna sinuosa* (Taylor) Hale (Sipman *et al.* 2009).

Hypotrachyna parasinuosa resembles *H. sinuosa* closely in lobe configuration, presence of soralia, and chemistry (Sipman *et al.* 2009), and differs in the presence of furcately branched cilia and the absence of rhizines. For further comments see under *H. paracitrella*.

Icmadophila eucalypti* Kantvilas, *sp. nov. (Fig. 15E–F) Mycobank MB 517787

Species corticola, squamulosa vel subfruticulosa, albida, acidum thamnolicum continens, sorediata, squamis 1–3.5(–5) µm latis, flabellatis, a thallo primario effuso, ephemero, albido enatis, ascomata conidiomataque ignota sed huic generi ob materiam chemicam, anatomiam morphologiamque adsignata.—http://www.eol.org/pages/Icmadophila eucalypti

Type:—AUSTRALIA. Tasmania: Hartz Road near entrance to the National Park, 43°12'S, 146°47'E, 570 m, on moist trunks of old *Eucalyptus obliqua* in mixed forest, July 2007, *Kantvilas 285/07* (holotype HO, isotype BM).

Thallus squamulose, whitish to pale grey, sometimes with a pale bluish, creamish or beige tinge, forming extensive, irregular colonies to 50 cm wide. Individual squamules 1–3.5(–5) µm wide, unevenly 130–350 µm thick and densely inspersed with crystals that fluoresce in polarised light and dissolve in KOH, arising from an effuse, very thin and transient, white primary thallus, scattered and discrete, or imbricate, rarely fusing together, stellate, rosette-like or, more typically, flabellate and with one side tightly adnate to the substratum and the other ascending, initially with crenulate, rather thickened margins, soon becoming nodulose, lobulate or palmately lobed and ± subfruticulose, sorediate; upper surface matt, smooth or minutely granular-scabrid (lens), in section with a pseudocortex 20–30 µm thick comprising randomly orientated, short-celled hyphae 3–5 µm wide, interspersed with occasional dead algal cells; lower surface white, ecorticate; soredia coarsely granular, 40–80 µm diameter, concolorous with the thallus, originating at the lower surface of the squamule margins, soon eroding the margin somewhat and spreading acrosss the upper surface. Photobiont a unicellular

green alga with globose cells 5–11 µm diameter. Ascomata not seen. Pycnidia not seen. Secondary chemistry: thamnolic acid; thallus K+ vivid yellow, P+ orange, KC–, C–, UV–.

Distribution and habitat: *Icmadophila eucalypti* is widespread in Tasmania where it occurs in wet eucalypt rainforest and cool temperate rainforest from lowland to subalpine elevations. It occurs on the lower, shaded parts of trunks of very large trees with a thick, fibrous bark. *Eucalyptus obliqua* L'Hérit., a common dominant in many Tasmanian wet eucalypt forest communities, is by far the preferred host species, although the fire-sensitive, rainforest conifer, *Athrotaxis selaginoides* Don, is also sometimes colonised. The new species forms extensive patches on the moist sides of such trees, where it associates with several other lichens with a similar squamulose growth form: *Cladonia rigida* (Hook.f. & Taylor) Hampe, *Neophyllis melacarpa* (F.Wilson) F.Wilson and *Cladia schizopora* (Nyl.) Nyl. Its predeliction for very old trees suggests that it may serve as an old forest indicator in ecological studies.

Etymology: The specific epithet refers to the preferred host of the new species.

Additional specimens examined (paratypes):—AUSTRALIA. Tasmania: Algonkian Mountain, *Kantvilas 145/90* (HO); West of Tahune Bridge, *Kantvilas 21/98* (BM, HO); Weindorfers Forest, Mar1998, *Kantvilas s.n.* (HO); Mueller Road, *Kantvilas 11/98* (HO); track to Wylds Craig, *Kantvilas 616/03* (HO); Lake Helen, *Kantvilas 21/04* (HO, K); Florentine Road, *Kantvilas 306/05* (HO, K); W of Tahune Bridge, Coupe 8I, *Kantvilas 275/07* (BM, HO, MSC).

Icmadophila is a small, well-circumscribed genus of four species, characterised, *inter alia*, by: a crustose to squamulose thallus containing thamnolic acid, a *Coccomyxa*-type photobiont, sessile to stipitate ascomata and *Icmadophila*-type asci (Rambold *et al.* 1993). In the absence of fertile material, the inclusion of *I. eucalypti* in this genus was based on an evaluation of morphological, anatomical, ecological and chemical characters. Several attempts to extract DNA for molecular confirmation of this classification (by Dr H. Döring, Kew) were unsuccessful. Thus for the time being, this classification is provisional. However, the general morphology, anatomy and chemistry of the species are all consistent with what is found in *Icmadophila* as exemplified by the type species, *I. ericetorum* (L.) Zahlbr., *I. japonica* (Zahlbr.) Rambold & Hertel and the Australasian endemic, *I. splachnirima* (Hook.f. & Taylor) D.J.Galloway. The interpretation of the primary thallus of the new species is equivocal. Thin sections suggest that it is lichenised, albeit very weakly, although it does not seem to contain thamnolic acid. There is a possibility that this feature is better interpreted as a prothallus rather than a true *thallus horizontalis*, although the latter is found frequently in the family Icmadophilaceae. Occasional thalli of *I. eucalypti* also develop pinkish, gall-like thickenings on the surface and at the margins which are highly reminiscent of the ascomatal initials of other members of this family, including *Dibaeis* and *Siphulella*. However, sections did not reveal any early development of ascomatal tissues.

Krogia microphylla* Timdal, *sp. nov. (Fig. 16A–B) Mycobank MB 517788

Krogiae coralloidi et K. antillari affinis, sed squamis minoribus, hypothecio obscure olivaceo et thallo acidis lichenosis destituto.—http://www.eol.org/pages/Krogia microphylla

Type:—DOMINICAN REPUBLIC. El Ceibo: 25 km N of El Ceibo on road to Miches, 18 km S of Miches, 18°55'N, 69°09'W, January 1991, *Harris 26749* (holotype NY).

Thallus squamulose, effuse. Squamules to 0.3 mm wide when young but soon coalescing into a continuous, microphyllinous crust, deeply and irregularly divided into ca. 0.1 wide lobes, ascending, irregularly imbricate, pale brown (old herbarium material), with scattered patches of orange (K+ purple) spots, epruinose, dull; margin concolorous with upper side, not fibrillose; lower side pale brown; soredia and isidia absent. Upper cortex poorly defined, composed of a thin, rather loose layer of irregularly oriented hyphae. Algal layer filling the inner part of the squamule. Medulla and/or lower cortex poorly defined. No crystals in thallus section (polarized light), PD–, K–, K/I–. Prothallus lacking. Apothecia biatorine, to 0.7 mm

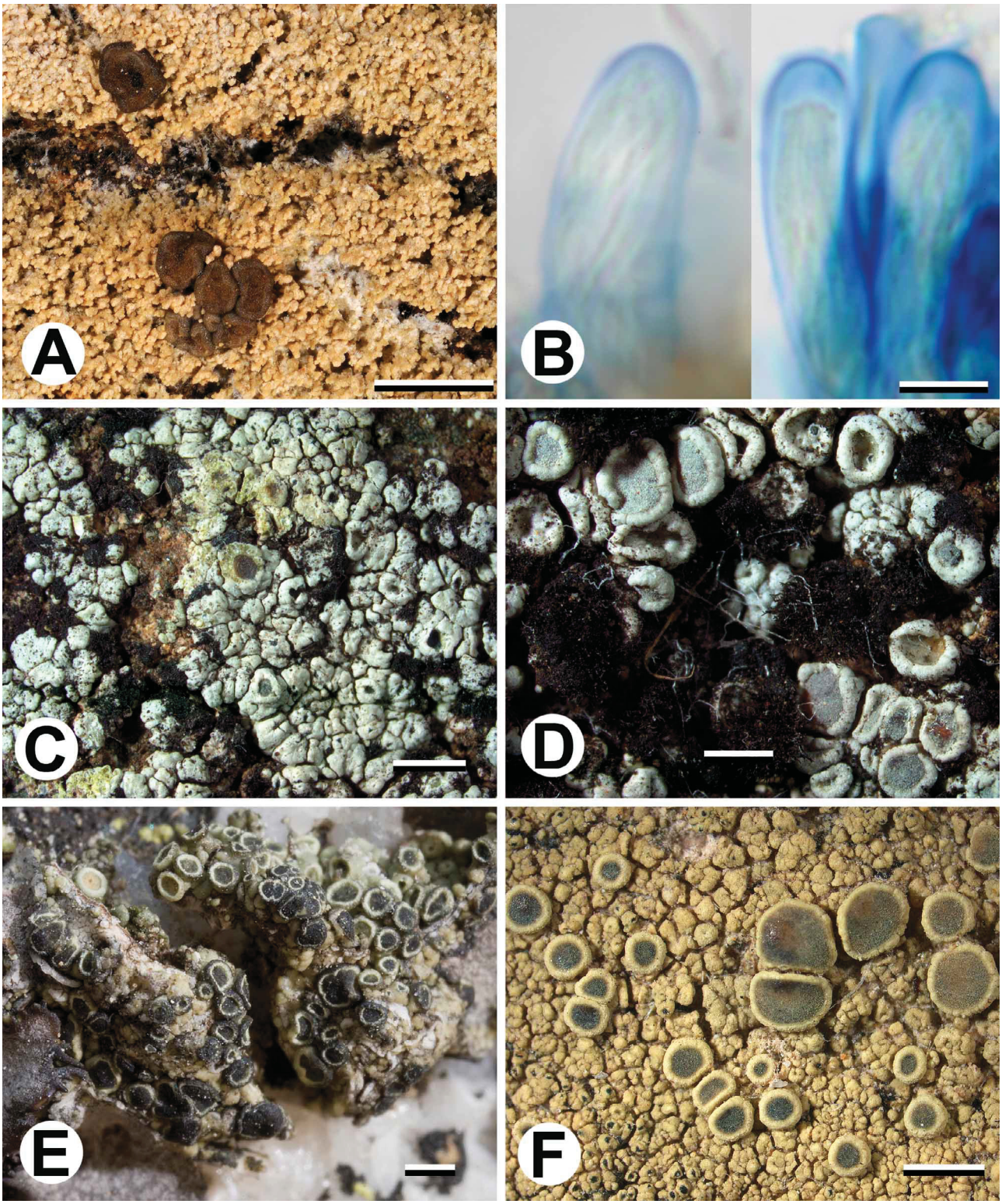

FIGURE 16. A–B. *Krogia microphylla* (holotype). A. Habit. B. Ascus in K/I. C–D. *Lecanora mugambii* (holotype). C. Thallus with apothecia. D. Apothecia. E. *Lecanora printzenii* (holotype), apothecia on thalli of *Umbilicaria*. F. *Lecanora xanthoplumosella* (holotype), thallus with apothecia. Scale in A, C–F = 1 mm, in B = 10 µm.

diameter when simple, but often forming up to 1 mm diameter aggregates, with a rusty brown, more or less plane disc and a grayish brown, slightly shiny, not fibrillose, often flexuous margin. Proper exciple dark olivaceous brown, K+ green in the inner part, pale brown to colourless in the rim, composed of radiating, closely conglutinated, thick-walled hyphae with cylindrical lumina, not containing crystals. Hypothecium

continuous with proper exciple, dark olivaceous brown, K+ green, composed of closely conglutinated, thick-walled hyphae with angular to cylindrical lumina, not containing crystals. Hymenium and epithecium colourless, not containing crystals. Paraphyses simple or sparingly branched, moderately conglutinated, rather thin-walled; apical cell slightly swollen, colourless. Ascus clavate, surrounded by a thin amyloid sheet; tholus well-developed, not amyloid or with a wide, faintly amyloid tube, with a well-developed ocular chamber when young. Ascospores eight in the ascus, colourless, thin-walled, filiform, curved, spirally arranged, simple or with 1–3 pseudosepta, 25–35 × ca. 1.0 µm (n = 20). Secondary chemistry: no lichen substances (by TLC).

Distribution and habitat:—*Krogia microphylla* is known only from the holotype. The collecting site was, according to the label, "cloud forest in ravine and scattered trees in pasture" at ca. 450 m elevation. Two species of *Phyllopsora* were collected at the same site: *P. chodatinica* Elix (*Harris 26683*, NY) and *P. furfuracea* (Pers.) Zahlbr. (*Harris 26725*, NY).

Etymology:—The species is named after the tiny squamules.

The genus *Krogia* and its originally sole species, *K. coralloides* Timdal, was described from one locality in Mauritius (Timdal 2002). A second species, *K. antillarum* Timdal, was described from six localities in the West Indies (Timdal 2008), and a third species is described here. *Krogia* is a corticolous genus occurring in subtropical rainforests and closely resembling *Phyllopsora.* It differs from *Phyllopsora* in having a weak or absent amyloid reaction in the tholus and filiform, curved ascospores which are spirally arranged in the ascus. The new species differs from *Krogia coralloides* and *K. antillarum* in forming smaller squamules which do not contain secondary substances, in having rusty brown apothecia with a grayish brown margin, and in having a dark olivaceous brown, K+ green hypothecium and inner part of the proper exciple. *Krogia coralloides* forms up to 1 mm wide squamules and contains boninic acid (Timdal 2002), and *K. antillarum* forms up to 1.5 mm wide squamules and contains 4-*O*-methylcryptochlorophaeic acid (Timdal 2008); both species have medium brown apothecia with a margin concolorous with or slightly paler than the disc, and a pale-brown, K– hypothecium and inner part of the proper exciple. The ascus and ascospores of *K. microphylla* are indistinguishable from those of the two other species.

Lecanora mugambii* Kirika, I.Schmitt, Fankhauser & Lumbsch, *sp. nov. (Fig. 16C–D) Mycobank MB 517789

A Lecanora glaucodea thallis crassis, ascosporis latis et acidum alectoronicum continente differt.—http://www.eol.org/pages/Lecanora mugambii

Type:—KENYA. Western Province: Bukusu District, Mt. Elgon Forest, Kimilili Rd., 0°55'N, 34°38'E, large boulders in remnant cloud forest, on siliceous rocks, January 2007, *Lumbsch et al. 19559a* (holotype EA, isotypes F, MIN).

Thallus thin to thick, verrucose to verruculose-bullate, whitish grey. Thallus surface smooth, epruinose, isidia and soredia absent. Prothallus not visible. Apothecia sessile, abundant, dispersed, plane or slightly convex, roundish, 0.6–1.5 mm diameter. Apothecial margin lecanorine, concolourous with the thallus, persistent, thick, entire when young, becoming slightly verruculose or remaining entire, disc grey to grey-brown with a thick, granulose, whitish grey to bluish grey pruina. Amphithecial cortex distinct, gelatinous, hyaline, inspersed with small crystals, uniform, 15–20 µm thick. Amphithecium with large crystals. Parathecium hyaline, 10–15 µm thick, with small crystals. Epihymenium red-brown to brown, 15–20 µm thick, granulose with coarse crystals soluble in KOH. Hymenium, subhymenium and hypothecium hyaline. Paraphyses sparingly branched and not thickened apically. Asci of *Lecanora*-type, 8-spored. Ascospores non-septate, hyaline, broadly ellipsoid to subglobose, 11–15 × 7–10.5 µm. Pycnidia immersed in verrucae, blackish with filiform conidia. Spot tests: K+ yellow, C–; KC–, P+ yellow, UV+ blue. Secondary chemistry: alectoronic acid [major], atranorin [submajor], chloroatranorin [minor], physodic acid [minor], usnic acid [submajor], and unidentified alectoronic acid derivatives [minors].

Distribution and habitat:—This species occurs on siliceous rocks in exposed habitats at the edge of a remnant cloud forest. It is only known from the type locality at 2500 m elevation, where it is very common. Associated species included *Diploschistes scruposus, Heterodermia* spp., *Ingvariella bispora, Pertusaria subventosa, Punctelia* spp., *Tephromela* sp., and *Xanthoparmelia* spp.

Etymology:—The species is named after our colleague and friend George Mugambi (Nairobi), who has made significant contributions to our knowledge of East African ascomycetes.

Lecanora mugambii is characterized by bluish grey pruinose apothecial discs, broadly ellipsoid to subglobose ascospores, and the presence of alectoronic and usnic acids in addition to the atranorin chemosyndrome. Alectoronic acid was not previously been reported from the *Lecanora subfusca* group (Guderley 1999, Lumbsch 1994). The species may be confused with the neotropical *Lecanora glaucodea* Nyl. The latter species is distinguished by a thin, never bullate thallus, smaller apothecia, an epihymenium with small crystals, narrower ascospores, a basally thickened amphithecial cortex, and a different chemistry (Feige *et al.* 2000, Guderley 1999). Another similar species is *Lecanora formosula* Lumbsch, which, however is readily distinguished by having a thin thallus, only slightly pruinose apothecial discs, smaller ascospores, and a different chemistry (Lumbsch *et al.* 1995).

Lecanora printzenii* Pérez-Ortega, Vivas & Hafellner, *sp. nov. (Fig. 16E) Mycobank MB 517790

Species habitu Lecanorae variae similis, sed in thallis Umbilicariarum lichenicola et in sequentia regionis ITS differt.—http://www.eol.org/pages/Lecanora printzenii

Type:—SPAIN. Castilla y León: Burgos, Neila, Parque Natural de las Lagunas de Neila, 42º 03'N, 03º 03'W, 1868 m, on *Umbilicaria cylindrica*, August 2007, *Pérez-Ortega 1204* (holotype MAF-Lich).

Thallus composed of areoles, ± dispersed or aggregated, esorediate; areoles irregularly rounded, up to 0.3 mm in diameter and height, convex, surface yellowish green, dull. Photobiont *Trebouxia*-like, cells up to 20 µm in diameter. Apothecia rounded, flexuose when mature, rarely single, often crowded; sessile, constricted at the base, especially when mature, (0.3–)0.5–1(–1.3) mm in diameter; disc greenish when young but soon becoming blackish, often pruinose when mature; margin prominent, persistent, matt and greenish when young but soon at least partly becoming melanized, black and shiny, with the exception of a narrow band, the closest part to the disc that remains greenish. Amphithecium corticated, up to 200 µm in the middle part, composed of a medulla of irregularly entangled hyphae and crowded algae; cortex composed of hyphae with thick walls, strongly gelatinized, with narrow lumina 0.5–1 µm; cortex 5–40 µm in the upper part, 20–70 µm in the middle part, 25–50 µm in the lower part, colourless within, outer part melanized. Hypothecium 20–40 µm high, hyaline; subhymenium 5–15 µm high; hymenium 50–65 µm; colourless; epihymenium ca. 10 µm, dark blackish green, K–; paraphyses weakly branched, anastomosed, 1–2 µm wide, expanded at the apex up to 5 µm, with a blackish green pigment surrounding the apices. Asci clavate, of *Lecanora*–type and with rostrate dehiscence, 35–40 × 9–14 µm (n = 10). Ascospores hyaline, simple, 7–11 × 4–6 µm (n = 40). Pycnidia not seen. Secondary chemistry: K–, C–, P+ yellow (amphithecium) or P–.

Distribution and habitat:—The new species is so far known from two localities in Spain and one in Austria. *Lecanora printzenii* lives lichenicolous on different species of *Umbilicaria*, causing serious damages in the areas of the lichen where it grows.

Etymology:—The new taxon is named after Christian Printzen (Frankfurt, Germany) for his contribution to the taxonomy of yellow Lecanoras in particular and to lichenology in general.

Additional specimens examined (paratypes):—SPAIN. Castilla y León: Salamanca, Sierra de Francia, June 2009, *Lumbreras & Roca s.n*. (MAF). AUSTRIA. Steiermark: Niedere Tauern, Seckauer Tauern, Groβer Ringkogel NW von Knittelfeld, NE-Abhänge ober dem Sundlsee, *Hafellner 75167* (GZU, MAF; to be distributed in Hafellner, Lichenicolous Biota).

The taxonomy of the *Lecanora varia* group was recently revised in several papers (Printzen 2001, Śliwa & Wetmore 2000, Laundon 2003, Martínez & Aragón 2004) and a phylogeny of the group was established (Pérez-Ortega *et al.* 2010). The new species is closely related to other species of the group, such as *L. varia*, *L. burgaziae*, and *L. densa*, but differs in its lichenicolous habitus, the at least partly melanized excipulum, the finally blackish disc, and the ITS sequence. A Blast search (Altschul *et al.* 1997) with the ITS sequence of *L. printzenii* as template returned *L. densa*, *L. burgaziae* and *L. varia* as the closest results, with a 93%, 92% and 92% of similarity respectively. A NJ tree made with species of the *L. varia* group (data not shown) returned *L. printzenii* as basal regarding the other three taxa. Other lichenicolous species of *Lecanora* from species of *Umbilicariaceae* are *L. lasalliae* on *Lasallia pustulata* (Pérez-Ortega & Etayo 2008) and *L. gyrophorina* on *U. hyperborea* (Poelt *et al.* 1996) but these do not belong to the *Lecanora varia* group and differ in their habitus, anatomical characters and chemistry.

Lecanora xanthoplumosella* Lumbsch & Elix, *sp. nov. (Fig. 16F) Mycobank MB 517791

Sicut Lecanora margarodes sed thallis cremeis, ascosporis minoribus et pannarinam destituto differt.—http://www.eol.org/pages/Lecanora xanthoplumosella

Type:— AUSTRALIA. Queensland: Razorback Range, 3 km NW of Mount Morgan, 23°28'S, 150°22'E, dry sclerophyll forest on steep slope with *Cycas* and *Macrozamia*, on metamorphic rocks, August 1993, *Elix 34643* (holotype CANB).

Thallus thin to thick, verrucose-areolate to verruculose, cream coloured or creamish yellow. Thallus surface smooth, epruinose, isidia and soredia absent. Prothallus well-developed, blackish brown. Apothecia sessile, abundant, dispersed, plane or slightly convex to convex, roundish, 0.5–1.2 mm diameter. Apothecial margin lecanorine, concolourous with the thallus, persistent, thick, entire when young, becoming strongly verruculose, disc bluish grey to grey with a thick, granulose, yellowish to yellowish grey pruina. Amphithecial cortex distinct, gelatinous, hyaline, inspersed with small crystals, 10–15 µm thick. Amphithecium with large and small crystals. Parathecium hyaline, 10–15 µm thick, lacking crystals. Epihymenium orange-brown to reddish brown, 15–20 µm thick, granulose with coarse crystals soluble in KOH. Hymenium, subhymenium and hypothecium hyaline. Paraphyses sparingly branched and slightly thickened apically. Asci of *Lecanora*-type, 8-spored. Ascospores non-septate, hyaline, broadly ellipsoid to ellipsoid, 9.5–13.5 × 6.0–7.5 µm. Pycnidia immersed in verrucae, bluish grey with filiform conidia. Spot tests: K+ yellow, C+ orange; KC+ orange, P+ yellow, UV+ dark orange. Secondary chemistry: thiophanic acid [major], arthothelin [minor], 2'-*O*-methylperlatolic acid [minor], atranorin [trace], chloroatranorin [trace], 5-chloro-2'-*O*-methylanziaic acid [minor].

Distribution and habitat:—This new species occurs on siliceous rocks in semi-exposed to exposed habitats in dry sclerophyll forests in Queensland. It is only known from two localities between 300 and 860 m elevation.

Etymology:—The name refers to the superficially similar neotropical species *Lecanora xanthoplumosa* Guderley.

Additional specimens examined (paratypes):—AUSTRALIA. Queensland: Razorback Range, 3 km NW of Mount Morgan, *Streimann 52399* (CANB, F), *Elix 34639* (CANB). Watsonville on the Herbeton-Petford Road, 10 km W of Herberton, *Mayrhofer 11899* (GZU).

Lecanora xanthoplumosella is characterized by a cream-coloured to creamish yellow thallus, the pruinose apothecial discs with the thalline margins that become strongly verruculose, broadly ellipsoid to ellipsoid ascospores and the presence of the thiophanic acid chemosyndrome, atranorin, 2'-*O*-methylperlatolic acid and 5-chloro-2'-*O*-methylanziaic acid. The latter substance is present as a minor constituent in *L. lividocinerea* Bagl. (Elix *et al.* 1997), a corticolous species occurring in Western Australia that lacks xanthones (Lumbsch 1994, Lumbsch & Elix 2004). The species may be confused with *Lecanora margarodes* (Körber) Nyl. and *L.*

pseudogangaleoides ssp. *verdonii* Lumbsch. The latter species is distinguished by having black apothecial discs, an egranulose epihymenium, and the presence of usnic acid in addition to the presence of the arthothelin chemosyndrome (Lumbsch 1995, Lumbsch & Elix 2004). *Lecanora margarodes* is readily distinguished in having epruinose apothecial discs, longer ascospores, and the presence of pannarin in addition to chlorinated xanthones (Lumbsch 1994, Lumbsch & Elix 2004). The neotropical *L. xanthoplumosa* Guderley is only superficially similar and differs in having smaller apothecia with epruinose or slightly pruinose apothcial discs, longer ascospores, and the presence of the chodation chemosyndrome (Guderley 1999, Guderley *et al.* 2000).

Lecidea lygommella* Elix, *sp. nov. (Fig. 17A) Mycobank MB 517792

Sicut Lecidea lygomma sed acida lichenum deficiente differt.—http://www.eol.org/pages/Lecidea lygommella

Type:—AUSTRALIA. Victoria: Alpine National Park, Bogong High Plains, Basalt Hill, 20 km SE of Mt. Beauty, 36°53'S, 147°18'E, 1650 m, on basalt rocks in exposed alpine grassland with basalt outcrops, February 1994, *Elix & Streimann 40407* (holotype CANB, isotypes Elix, Lichenes Australasici Exsiccati 284, as *Lecidea lygomma*).

Thallus saxicolous, verrucose to evanescent, up to 7 cm wide, 0.2–0.7 mm thick. Upper surface whitish to pale grey or rusty red-brown, areolate, areoles irregular to angular, 0.5–1.0 mm wide, flat, surface roughened or ±smooth; cortex 20–50 µm thick, upper cell layer unpigmented to grey-brown. Photobiont layer 70–100 µm thick, algal cells 9–16 µm wide. Medulla I−. Hypothallus dark grey, sometimes obvious at the thallus margin but often not developed. Apothecia scattered or crowded, rounded to angular, subimmersed to adnate, rarely basally constricted, 0.5–2.3 mm wide; disc black, flat to slightly convex, matt, epruinose or with rusty, red-brown pruina, margin concolorus with disc, distinct at first, persistent or excluded with age, rarely shiny. Hypothecium dark brown to black-brown in basal part, K+ violet-brown, 120–250 µm thick. Hymenium colourless, 60–85 µm high, I+ blue. Epihymenium brownish green, 10–15 µm high, N+ red-violet (*cinereorufa*-green); paraphyses occasionally branched and anastomosing, ca. 2 µm wide, apices thickened to 3–4 µm wide. Asci 8-spored, 50–65 × 11–13 µm. Ascospores simple, ellipsoidal, colourless, 10–17 × 5–8 µm. Pycnidia immersed, ostiole black, punctiform; conidia bacilliform, 9–12 × 1 µm. Secondary chemistry: nil.

Distribution and habitat:—At present this distinctive new species is known from rocks in alpine areas of New South Wales and Victoria.

Etymology:—The specific epithet refers to the similarity of this species to *Lecidea lygomma* Nyl.

Additional specimens examined (paratypes):—AUSTRALIA. New South Wales: Bulee Gap, 8 km NE of Nerriga, just S of Morton National Park, *Elix 39721* (CANB). Kosciuszko National Park, Blue Lake, 7 km NE of Mt Kosciuszko, *Streimann 9591* (CANB). Victoria: Alpine National Park, Bogong High Plains, Basalt Hill, 20 km SE of Mt. Beauty, *Elix & Streimann 40443* (CANB), *Elix & Streimann 40447* (B, CANB). Alpine National Park, Bogong High Plains, 20 km SSE of Mt. Beauty, *Elix & Streimann 40477* (CANB). 'Ruined Castle', Bogong High Plains, 16.5 km SSE of Mt. Beauty, *Elix & Streimann 40616* (CANB).

This species is characterized by the areolate, whitish to grey or rusty red-brown thallus, the I− medulla, the black, subimmersed to adnate apothecia, the dark brown to black-brown hypothecium and brownish green epihymenium; the relatively large ascospores and by the absence of lichen substances. *Lecidea lygommella* is morphologically very similar to *L. lygomma*, but the latter differs chemically in containing norstictic acid (major) and connorstictic acid (minor) (Rambold 1989, Hertel 1997). In the latter paper, Hertel commented that "*Lecidea lygomma* with no TLC-detectable substance … presently must be treated as *L. lygomma* sensu lato".

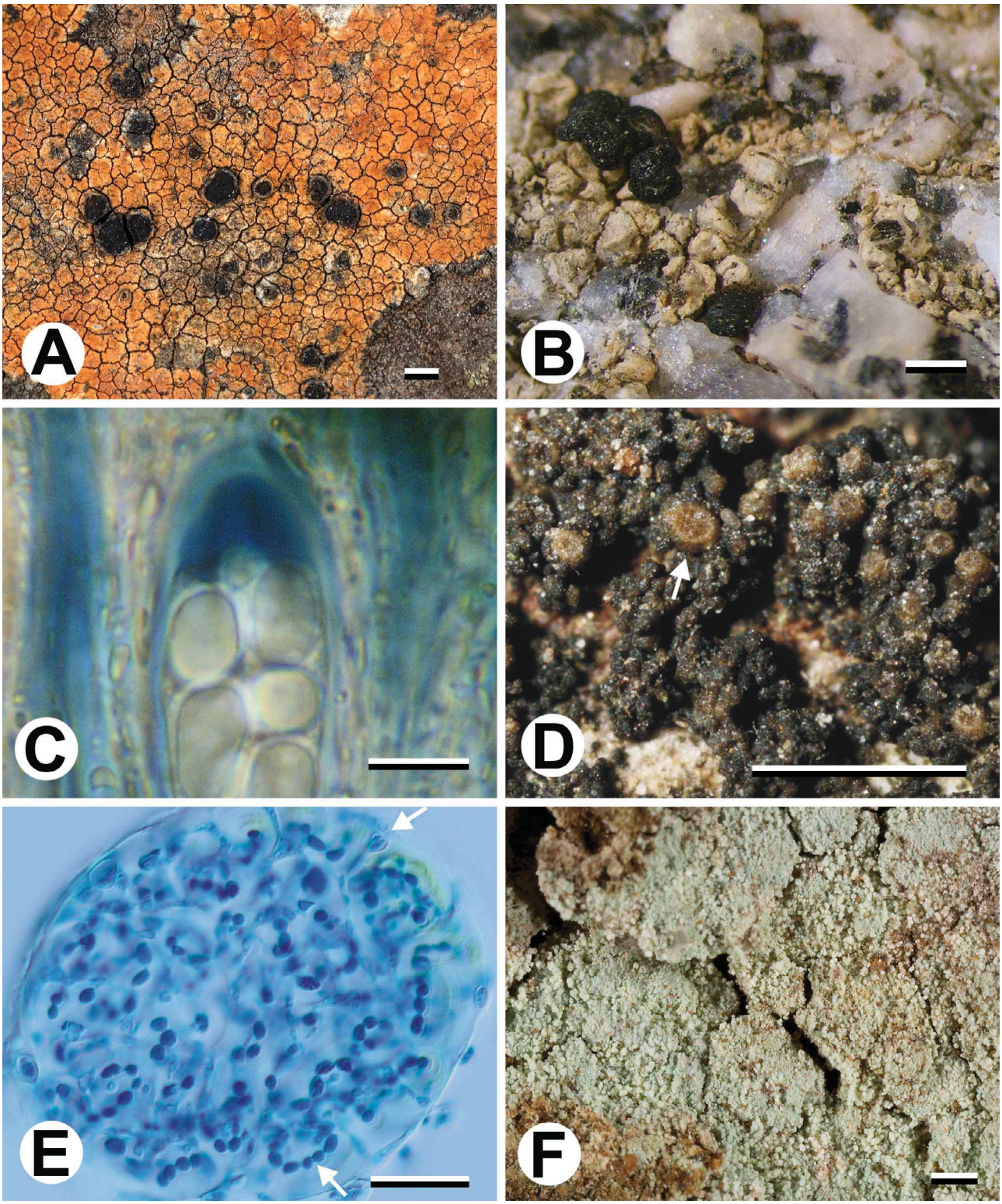

FIGURE 17. A. *Lecidea lygomella* (holotype), thallus with apothecia. B–C. *Lecidella greenii* (holotype). B. Thallus with apothecia. C. Ascus with ascospores. D–E. *Lempholemma corticola* (holotype). D. Central part of thallus with irregularly shaped areoles composed of densely aggregated thallus granules and numerous apothecia with thin, receding thalline margin (arrow). E. Section of thallus granule showing *Nostoc* photobiont (arrow bottom) and enlarged hyphal cell at thallus surface (arrow top). F. *Lepraria sekikaica* (holotype), thallus. Scale in A = 2 mm, in B, D, F = 1 mm, in C = 10 µm, in E = 25 µm.

Lecidella greenii **U.Ruprecht & Türk, *sp. nov.*** (Fig. 17B–C) Mycobank MB 517793

Thallus crustosus, areolatus, albidus. Apothecia lecideina, Asci ad typum Lecidella pertinens, Ascosporae hyalinae, non-septatae, ellipsoidae, 10–11(–12) × 6–7(–8) µm.—http://www.eol.org/pages/Lecidella greenii

Type:—ANTARCTICA. Ross Dependency: Transantarctic Range, Granite Harbour, 77°00'S, 162°31'E, January 2008, *Türk 43015* (holotype SZU, isotype A).

Thallus crustose, whitish, grey, beige, well-developed, rimose to areolate and sometimes granulose; chasmolithic and epilithic, up to 1 mm high and 5 cm in diameter. Pycnidia infrequent, up to 0.2 mm; photobiont *Trebouxia* sp. Apothecia in dense groups; visible margin when young, inconspicuous when old and large; black, matt disk, flat to convex, up to 1.2 mm in diameter, sessile, constricted at the base. Epihymenium up to 10 µm, olive to dark green; hymenium 80–90 µm, hyaline to light brownish when mature, inspersed; Paraphyses simple, 1–2 µm in diameter, rarely anastomosing, flexuous, slightly adglutinated, end cell dark green to olive and slightly thickened to 4 × 4 µm; subhymenium up to 40 µm, hyaline to light green; hypothecium hyaline, inspersed with brown crystals; excipulum to 200 µm broad, I–, hyaline, dark green margin, of radiate hyphae; asci of the *Lecidella*-type, 40–50 µm long; ascospores 8/ascus, non-septate, hyaline, 10–11(–12) × 6–7(–8) µm, broadly ellipsoid, length-width index 1.5–1.6. Secondary chemistry: chemotype I: nil, chemotype II: stictic acid chemosyndrome; spot tests: K– or K+ yellow, I–, C–.

Distribution and habitat:—So far endemic to continental Antarctica, on granite rock and sandy soil.

Etymology:—Dedicated to T. G. Allan Green, University of Waikato, New Zealand.

Additional specimens examined (paratypes):—ANTARCTICA: Ross Dependency: Transantarctic Range, Granite Harbour, *Türk 43007*, *43013*, *43014*, *43015*, *43017*, *43029* (SZU); Taylor Valley, *Türk 33611*, *33612*, *33620*, *33628*, *33586*, *33630*, *33649*, *33659*, *33700*, *33706* (SZU); Mt Suess, *Türk 42999* (SZU) .

The widespread genus *Lecidella* comprises c. 50 species worldwide. These crustose lichens occur on tree bark as well as on mosses, sand and rocks. The genus is characterized by small black lecideoid ascomata and *Lecidella*-type asci (Knoph & Leuckert 2004). The new species is one of two species of *Lecidella* occurring in continental Antarctica. It is identified by the shape and size of its ascospores, its exclusively saxicolous habit and its secondary chemistry that clearly sets this lichen apart from all other species of *Lecidella* so far described.

Lempholemma corticola **M.Schultz & T.Sprib., *sp. nov.*** (Fig. 17D–E) Mycobank MB 517794

Thallus corticola, nigrescente-olivaceus, ecorticatus, madefacte gelatinosus, granulosus vel irregulariter areolatus, granulis effusis, deinde aggregatis areolae irregulares formantes. Hyphae reticulum formantes. Apothecia thallo concolore, parva, 0.25–0.37 mm lata, adnata vel stipitata, margine thallino tenui, excipulo proprio pallido, disco pallide rufescenti, plano. Hymenium iodo caerulescens. Ascosporae octonae, simplices, ellipsoideae, (10.5–)13–19(–20.5) × (6–)6.5–8(–9) µm. Cyanobacterium symbioticum Nostoc. Pycnidia et pycnoconidia non visa.—http://www.eol.org/pages/Lempholemma corticola

Type:—GREECE. Crete: Fassas Valley, between Langos and Nea Roumata, 35°24'N, 23°53'E, 350 m, corticolous on *Platanus orientalis,* May 2004, *Spribille 13286* (holotype GZU, isotype HBG).

Thallus corticolous, blackish olivaceous, ecorticate or thallus granules and apothecia pseudocorticate, gelatinous when wet, granulose to irregularly areolate, granules ca. 65–165 µm wide, effuse to later aggregated forming irregularly shaped areoles, 0.6–2.5 mm wide giving the thallus a very uneven appearance, fixed to the substrate by pale rhizohyphae. Isidia and soralia lacking. Apothecia small, 0.25–0.37 mm, subglobose, adnate with slightly constricted base to stipitate, disc at first punctiform, eventually opened, pale brownish, plane, thalline margin thin, 25–30 µm thick, soon receding. Excipulum proprium thin but distinct, composed of few interwoven hyphae, pale, basally 5 µm thick, laterally ca. 10 µm thick, apically widened and seen from above as pale ring. Hymenium clear, 110–120 µm high, KOH/IKI+ blue, paraphyses distinct,

sparsely branched, apically widened. Asci broad cylindrical to obclavate, 75–80 × 12–15 µm, wall thin, not amyloid, tip not thickened. Ascospores 8/ascus, simple, ellipsoid to broad ellipsoid, hyaline, (10.5–)13–19(–20.5) × (6–)6.5–8(–9) µm. Pycnidia and pycnoconidia not seen. Ascomata developing from tangle of generative hyphae. Photobiont *Nostoc* in bead-like chains. Secondary chemistry: nil.

Distribution and habitat:—So far known only from the bark of old *Platanus orientalis* trees in the Fassas Valley in western Crete, in the vicinity of a stream. The riverine *Platanus* forests are in severe decline and threatened by encroachment of developments and orange plantations.

Etymology:—Referring to the substrate, which is most unusual in the genus.

Additional specimen examined (paratype):—GREECE. Crete: Langos, "Straßenrand, i.d.N. des Baches", May 2004, *Wagner s.n.* (UPS).

The new species is characterized by its corticolous habit and granulose to irregularly areolate growth form. The thallus is essentially ecorticate as in all species of *Lempholemma* but especially at the base of the thallus granules as well as towards the base of the apothecia a "primitive pseudocortex" (Degelius 1954: 46, 47) may be observed. The hyphae forming this pseudocortex are quite robust whereas those attacking the photobiont are more delicate. Hitherto, no species of *Lempholemma* was knownto grow directly on bark. Dry or moist rock, mosses and soil being preferred substrata. Growth form varies considerably among species of *Lempholemma*. Whereas membanaceous to subfoliose-plicate and umbilicate, squamulose-lobate thalli are common, granulose thalli are rare . *L. minutulum* (Born.) Zahlbr. and "*Psorotichia*" *lutophila* Arnold, both pioneer species on soil, are examples of the latter. *Lempholemma* is a mid-sized genus of c. 40 species occurring worldwide. The genus is in the family *Lichinaceae* and is distinguished from all other members of the family by the presence of *Nostoc* photobionts. The genus *Collema* also contains *Nostoc* photobionts but differs in the presence of septate ascospores, a thickened, amyloid ascus apex, a different type of pycnidia and conidiophores and the lack of finger-like fungal haustoria invaginating the cells of the photobiont.

Lepraria sekikaica* Elix, *sp. nov. (Fig. 17F) Mycobank MB 517795

*Sicut Lepraria lobificans sed acidum sekikaicum continente differt.—*http://www.eol.org/pages/Lepraria sekikaica

Type:—AUSTRALIA. Western Australia: Near summit of Mt. Brown, 3 km SE of York, 31°53'S, 116°47'E, 295 m, on soil below granite overhang in remnant *Acacia* woodland with scattered *Eucalyptus* and granite outcrops, April 2006, *Elix 38221* (holotype PERTH, isotypes CANB, HO).

Thallus leprose-sorediate, powdery, creamy white, grey-white, pale yellow-grey or brownish grey, forming extensive, irregularly spreading patches to 10 cm wide, or in small, irregularly roundish, colonies 0.5–2 cm wide that eventually coalesce; not delimited, well-defined lobes absent but sublobes often present, 0.4–1.0 mm wide, compacted at the margins; thin or thick (up to 250 µm thick), medulla absent; hyphae 1.0–2.5 µm thick; granules (soredia) farinose, dispersed or forming a thick, continuous layer, ± roundish, 15–40 µm wide, commonly aggregated in roundish to irregular clumps (consoredia) 100–200 µm wide; rarely with short projecting hyphae (10–20 µm long) but usually not apparent; photobiont chlorococcoid, more or less spherical, with individual cell 6–13 µm diameter. Hypothallus thin, dispersed, pale brown to white or orange-brown in part, sometimes not apparent. Secondary chemistry: atranorin (minor), sekikaic acid (major), homosekikaic acid (minor), 4'-*O*-demethylsekikaic acid (minor), fragilin (minor), ± di-*O*-methylstrepsilin (trace); thallus K+ yellow, C–, KC–, P+ pale yellow.

Distribution and habitat:—At present this new species is known from several localities in south-western Western Australia where it occurs on soil in sheltered rock ledges.

Etymology:—The epithet derives from the unique chemistry of this species.

Additional specimen examined (paratype):—AUSTRALIA. Western Australia: Boyagin Rock, Boyagin Nature Reserve, 20 km NW of Pingelly, *Elix 38939* (CANB, PERTH).

This is the first reported occurrence of sekikaic acid as a major secondary substance in the genus *Lepraria*. Morphologically this new species resembles the very common *L. lobificans* Nyl., with similar soredia, consoredia and occasional sublobes at the margins. However, *L. lobificans* differs in chemistry (atranorin, zeorin and the stictic acid complex), in having a distinct medulla and consoredia with long projecting hyphae up to 100 µm long.

Lobariella sipmanii* Moncada, Betancourt & Lücking, *sp. nov. (Fig. 18A–B) Mycobank MB 519082

Sicut Lobariella botryoides sed apotheciis instructis differt.—http://www.eol.org/pages/Lobariella sipmanii

Type:—COLOMBIA. Cundinamarca: Bogotá D.C., Páramo de Sumapaz, Laguna de Chisacá, 4°18'N, 74°13'W, 3725 m, paramo vegetation with with *Diplostephium revolutum* S.F.Blake, *Espeletia* spp. and *Pentacalia* spp., August 2010, *Lücking et al. s.n.* (holotype UDBC, isotype F).

Thallus growing on trunks and stems of small trees, up to 8 cm diameter, very loosely attached; individual lobes up to 3 cm long, irregular to rounded, 5–15 mm wide, irregularly branched. Photobiont cyanobacterial (*Nostoc*). Upper surface pale blue-grey, glabrous, densely white-reticulate through the formation of elongate-linear maculae; lower surface white to yellowish white, white-tomentose; tomentum up to 1.5 mm thick, formed by branched hairs with globose cells. Lobe margins entire to coarsely crenulate; isidia and soralia absent. Upper cortex paraplectenchymatous, consisting of 4–6 cell layers, 30–45 µm thick, hyaline; cyanobacterial layer 80–130 µm thick; medulla composed of longitudinally oriented hyphae, up to 180 µm thick; lower cortex paraplectenchymatous, consisting of 2–6 cell layers from which the tomentum emerges, 12–25 µm thick, hyaline. Apothecia abundant, cup-shaped, up to 8 mm diameter, with thick, strongly prominent, more or less entire to irregular but not distinctly lobulate, white margins; disc concave, vividly orange-brown. Ascospores fusiform to acicular, 55–115 × 4–5 µm, 5–9-septate, hyaline. Pycnidia not observed. Secondary chemistry: gyrophoric acid (major) and satellite substances; medulla C+ rose to red, K–, P–.

Distribution and habitat:—The species is known from several collections at the type locality, growing in partial shade on the lower to mid-trunks and stems of small trees of *Diplostephium revolutum* S. F. Blake, associated with *Lobariella pallida* and mosses of the family Dicranaceae.

Etymology:—We dedicate this species to our colleague, mentor, and friend Harrie Sipman for his invaluable contributions to lichenology in the Neotropics.

Additional specimens examined (paratypes):—COLOMBIA. Cundinamarca: Bogotá D.C., Páramo de Sumapaz, Laguna de Chisacá, *Mondada et al. 4084*, *4098* (UDBC).

Lobariella is a small genus in *Lobariaceae*, currently comprising five species that are characterized by forming pseudocyphellae on the upper surface and a more or less continuous, white tomentum on the lower surface (Yoshimura 1984, 1998, 2002, Yoshimura & Arvidsson 1994). The species of this group, first designated as *L. crenulata* group, were subsequently separated in the genus *Durietzia* Yoshim., which turned out to be an illegitimate later homonym of *Durietzia* Gyeln. Yoshimura (2002) therefore introduced the replacement name *Lobariella* for this group. Only three species were formally recombined in *Lobariella* (Yoshimura 2002) and the following two species are recombined here: ***Lobariella botryoides* (Yoshim. & Arv.) Moncada & Lücking, *comb. nov.*** [*Lobaria botryoides* Yoshim. & Arv., *Acta Bot. Fenn.* 150: 226 (1994); *Durietzia botryoides* (Yoshim. & Arv.) Yoshim., *Recollecting Edvard August Vainio (São Paulo)*: 91 (1998)] and ***Lobariella pallida* (Hook.f.) Moncada & Lücking, *comb. nov.*** [*Sticta pallida* Hook.f. in Kunth, *Syn. Plant. Aequinoct. Orb. Novi* 1: 28 (1822); *Lobaria pallida* (Hook.f.) Trevis., *Lichenotheca Veneta*: no. 75 (1869); *Durietzia pallida* (Hook.f.) Yoshim., *Recollecting Edvard August Vainio (São Paulo)*: 91 (1998)]. The new species is only the second one in the genus having a cyanobacterial photobiont after *L. botryoides*; all other species have green photobionts. *Lobariella sipmanii* differs from *L. botryoides* in the more or less smooth surface which lacks reticulate ridges; instead, the surface is very strongly reticulate-maculate. In

addition, isidia and soralia are absent and apothecia are abundantly formed. Because of the different lobe morphology, *L. sipmanii* cannot be considered the fertile counterpart of *L. botryoides*. Except for the photobiont, the new species resembles *L. crenulata* (Hook.f.) Yoshim. and *L. pallida* in the richly apotheciate thallus with the white, reticulate pattern of the lobe surface, but differs from both latter species in several details: *L. crenulata* has a more strongly attached thallus with conspicuous pseudocyphellae that only partly form a reticulate pattern; in addition, the apothecial margins are strongly lobulate. *Lobaria pallida* shares with *L. sipmanii* the loosely attached thallus and the formation of reticulate maculae, but the maculae are usually less distinct and also in that species, the apothecial margin is strongly lobulate. Therefore, *L. sipmanii* cannot be considered a photomorph of either *L. crenulata* or *L. pallida*.

Megalospora austropacifica **Lumbsch, Naikatini & Lücking, *sp. nov.*** (Fig. 18C) Mycobank MB 517796

Similis Megalosporae javanicae sed ascosporis majoribus et angustatis differt.—http://www.eol.org/pages/Megalospora austropacifica

Type:—FIJI. Taveuni: Access road to summit of Devo Peak, montane relict forest at roadside, 16°51'S, 179°58'W, April 2008, *Lumbsch 19805h* (holotype SUVA, isotype F).

Thallus yellowish grey to whitish grey, glossy, thick, slightly rugulose to continuous, often irregularly cracked, sometimes with small papillae containing conidiomata. Isidia and soredia absent. Apothecia common, orbicular, up to 4.5 mm in diameter, up to 1 mm high, disc concave when young, becoming flat to slightly convex, orange-brown to red-brown, blackish towards the margins, glossy, epruinose. Margin prominent, thick, inner part (proper exciple) yellowish brown to pale brown, matt, epruinose, outer part (thalline margin) concolorous with thallus, glossy, epruinose. Exciple with an orange-brown inner part and a hyaline ectal part, K–. Epihymenium orange-brown, 20–35 µm thick. Hypothecium hyaline to orange. Hymenium 200–250 µm high, hyaline, inspersed, amyloid. Asci 8-spored. Ascospores hyaline, 2-celled, slightly curved (*sulphurata*-type, fide Sipman 1983: 44), 60–85 × 22–26 µm, spore walls 2–3 µm thick with thin, smooth epispore. Secondary chemistry: usnic acid and zeorin.

Distribution and habitat:—So far only known from the islands of Taveuni and Viti Levu in Fiji, where the species occurs in relict or secondary montane forests on bark.

Etymology:—Named after the occurrence of the new species in the South Pacific.

Additional specimens examined (paratypes):—FIJI. Taveuni, Access road to summit of Devo Peak, montane relict forest at roadside, *Lumbsch 19804t* (F, SUVA). Viti Levu: Nadarivatu Nature Reserve, Secondary montane forest at road to Koro'o, *Lumbsch 19850 g* (F, SUVA).

This is an additional species in the *Megalospora sulphurata* complex (Sipman 1983), which is characterized by asci with more than one, 2-celled, and usually curved ascospores. *Megalospora sulphurata* Meyen was recognized in a wide sense by Sipman (1983), but recently Untari (2006) separated additional species in the complex. The new species is distinguished from *M. flavoexcipulata* Untari and *M. sulphurata* in having a hyaline to orange hypothecium and from *M. javanica* Untari in having paler margins, regularly zeorine apothecia, a paler hypothecium, a hyaline ectal exciple, and longer and narrower ascospores.

Megalospora galapagoensis **Bungartz, Ziemmeck & Lücking, *sp. nov.*** (Fig. 18D–E) Mycobank MB 517797

Sicut Megalospora porphyritis sed acidum usnicum continente differt.—http://www.eol.org/pages/Megalospora galapagoensis

Type:—ECUADOR. Galápagos: Isla Sán Cristóbal, trail from Cerro Pelado to El Ripioso, 0°52'S, 89°28'W, 392 m, transition zone, *Psidium guajava* forest with some old *Hippomane mancinella* trees and dense

understory of *Rubus niveus*, *Tournefortia rufosericea* and *Zanthoxylum fagara*, on bark, S-exposed side of inclined *Hippomane mancinella* trunk (ca. 20 cm in diameter), semi-shaded, wind- and rain-sheltered, August 2008, *Bungartz 8516* (holotype CDS-41162, isotype F).

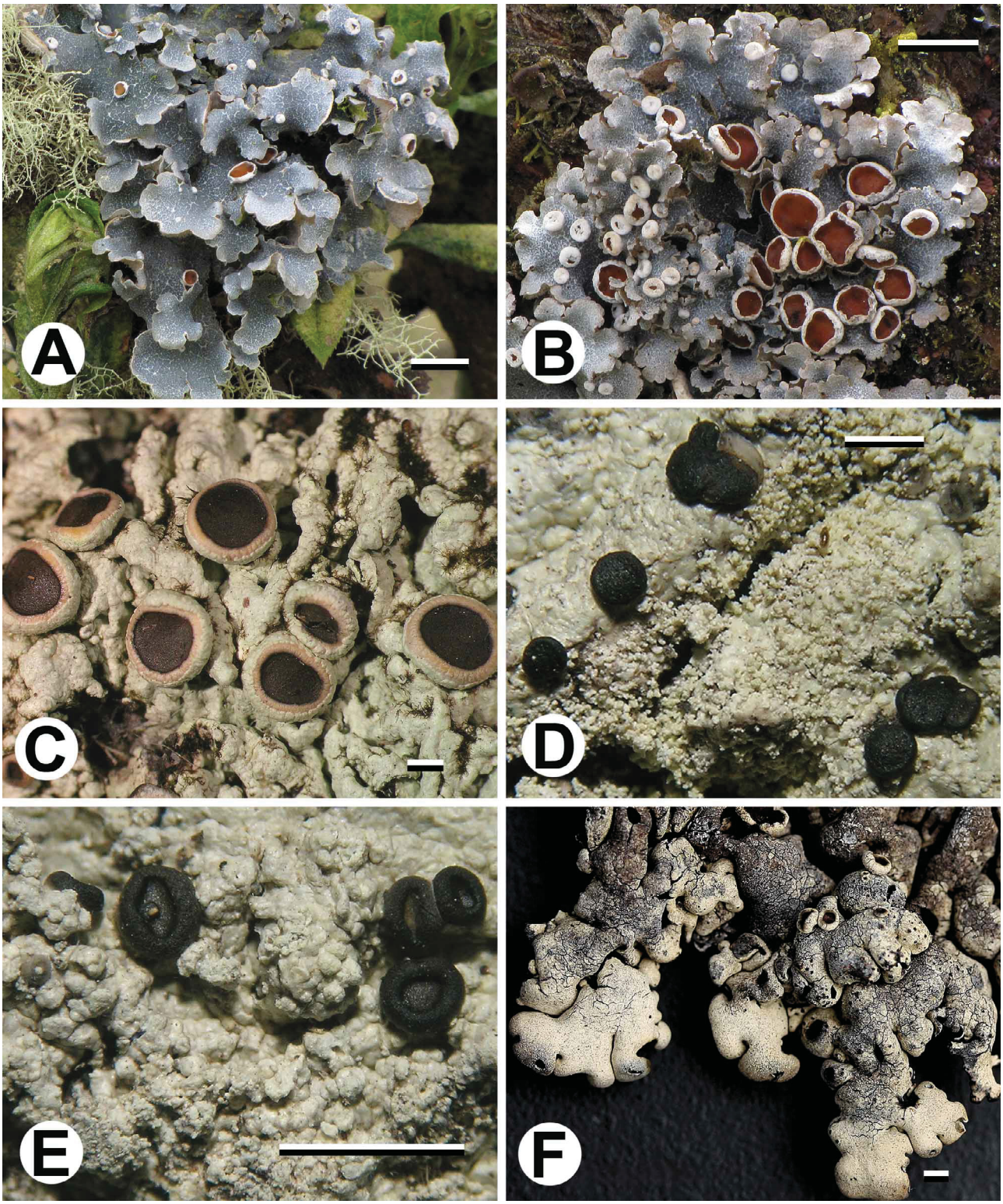

FIGURE 18. A–B. *Lobariella sipmanii* (A, holotype; *Moncada 4084*), thallus with apothecia. C. *Megalospora austropacifica* (holotype), thallus with apothecia. D–E. *Megalospora galapagoensis* (D, holotype; E, *Bungartz 3987*), thallus with apothecia and soredia. F. *Menegazzia endocrocea* (holotype), thallus with apothecia (photograph J. Jarman). Scale in A, B = 10 mm, in C–E = 1 mm, in F = 5 mm.

Thallus yellowish grey to whitish grey, glossy, thick, uneven to slightly rugulose, up to 20 cm diameter. Soredia present, diffuse, starting out as coarse, corticated granules but soon becoming confluent and maculate. Apothecia round, 0.5–1.5 mm in diameter, up to 0.6 mm high, disc concave when young, becoming flat to slightly convex when mature, grey-black to black, glossy, epruinose. Margin prominent, thick, black. Excipulum brownish, K–. Epihymenium reddish brown, 10–20 µm thick. Hypothecium brown, 100–130 µm high. Hymenium 200–250 µm high, hyaline, strongly inspersed, amyloid. Ascospores single, hyaline, (3–)5-septate, 45–75 × 15–25 µm. Secondary chemistry: usnic acid and zeorin.

Distribution and habitat:—So far only known from the Galápagos Islands, found on both Santa Cruz and Sán Cristóbal Island in the transition and the humid zone.

Etymology:—The epithet refers to the known geographical range of the new species.

Additional specimen examined (paratype):—ECUADOR. Galápagos: Isla Santa Cruz, along the dirt road from Bellavista to Media Luna, *Bungartz 3987* (CDS).

This species belongs in the *Megalospora tuberculosa* aggregate and could be included in that species in a wide sense (Sipman 1983). However, Harris (1984, 1986) reported that populations with pannarin instead of usnic acid, a sorediate thallus, and smaller ascospores represent an autonomous taxon which he recognized as *M. porphyritis* (Tuck.) R.C.Harris, a position adopted by other authors (Lücking 2007). The new species is intermediate between *M. tuberculosa s. str.* and *M. porphyritis* and represents a third species in this group. Thallus chemistry and the non-pruinose apothecia are as in *M. tuberculosa s. str.*, but the (granular) soralia and the comparatively small ascospores with few septa recall *M. porphyritis*. The new species is potentially endemic to the Galápagos Islands, as no such material has yet been found among neotropical mainland populations of *Megalospora*.

Menegazzia endocrocea **Kantvilas, *sp. nov.*** (Fig. 18F) Mycobank MB 517798

Ad saxa granitica incolens, Menegazziae elongatae M. corrugataeque aliquantum similis et item acidum sticticum continens sed hoc habitu singulari et pigmento pallide croceo medulloso differens.—http://www.eol.org/pages/Menegazzia endocrocea

Type:—AUSTRALIA. Tasmania: Mt Cameron, 40°59'S, 147°56'E, 550 m, on granite outcrops in heathland, July 1995, *Kantvilas & Crittenden 42/95* (holotype HO, isotype BM).

Thallus rather loosely adnate, forming irregular rosettes to 100 mm wide, or occurring as scattered, smaller clumps of lobes, lacking soredia and isidia. Lobes hollow, inflated, cylindrical, (1–)1.5–3(–4) mm wide, ± dichotomously branched, slightly constricted at the axils; central lobes densely imbricate, generally lacking secondary lobules; marginal lobes radiating, contiguous, with apices somewhat decumbent. Upper surface perforate, pale grey to cream-grey, pale brownish grey at the lobe apices, smooth, matt, often patchily discoloured blackish in older or abraded portions, lightly whitish-pruinose, especially in younger parts of the thallus. Perforations numerous, scattered, roundish to broadly ellipsoid, 0.5–1.7 mm wide, with margins usually flush to the the surface or, occasionally, raised and the perforations appearing volcano-like. Lower surface wrinkled, dull to glossy black, becoming brownish near the lobe tips. Medullary cavity black and often with a loose cobweb of whitish hyphae in older lobes, faintly pale orange in younger lobes and towards the lobe apices. Apothecia scattered, 1–4 mm wide, roundish, subpedicillate; thalline margin initially thick and inrolled, later to 0.1–0.3 mm wide, mostly smooth and entire or with occasional radial cracks and crenulations; disc reddish brown, undulate, often eroded. Hymenium 90–140 µm thick, colourless in the lower part, overlain by a reddish brown, non-granular epithecial layer 5–10 µm thick, becoming fuscous brown in KOH. Asci 2-spored, broadly ellipsoid, 80–110 × 30–55 µm, rather rarely encountered, mostly nestled deeply within a reticulum of anastomosing paraphyses 2–3 µm thick, with capitate, brown apices 3–8 µm thick. Ascospores simple, hyaline although sometimes brownish when over-mature, subglobose to broadly ellipsoid, (38–)40–*51.5*–66(–72) × (24–)28–*34.8*–44(–56) µm; wall 4–8 µm thick. Pycnidia abundant, scattered,

immersed in the upper surface and evident as black specks; ostiole 0.08 mm wide; conidia fusiform, 6–8 × 1–1.2 µm. Secondary chemistry: atranorin (trace), chloroatranorin (trace), stictic acid, constictic acid, cryptostictic acid (trace), peristictic acid (trace), plus the pigment isopigmentosin A and traces of isopigmentosin B and isopigmentosin C (pigments determined by J. Elix using HPLC); cortex K+ yellow; medulla K+ yellow, KC–, C–, P+ orange, UV+ orange.

Distribution and habitat:—*Menegazzia endocrocea* is restricted to the east coast of Tasmania and the islands of Bass Strait. The species occurs exclusively on Devonian granite, typically in sheltered, fire-protected crevices on rocky, heathy summits overlooking the sea. It is rarely abundant and most colonies are very fragmented, suggesting a relict distribution and a species in decline. Fire in this heathy, sclerophyllous vegetation represents a very significant threatening factor to many lichens. The granite of Tasmania's eastern coastal areas supports a diverse flora rich in highly restricted and/or endemic taxa, not only of lichens but also of vascular plants (Kantvilas & Elix, 2008). This new species adds to the already high conservation value of this region.

Etymology:—The specific epithet refers to the orange pigmentation of the medullary cavity of young lobes.

Additional specimens examined (paratypes):—AUSTRALIA. Tasmania: Mt. Amos, *Kantvilas 289/91* (HO). Mt. Freycinet, *Kantvilas 151/95* (HO). Mt. Dove, *Kantvilas 135/95* (HO). Mt. Mayson, *Kantvilas 3328/97* (HO). Summit of Mt. Freycinet, *Kantvilas 359/99* (HO). Flinders Island, Mt. Leventhorpe summit, *Kantvilas 48/07* (HO).

With at least 25 species including four endemics (McCarthy 2009), *Menegazzia* is well represented in Tasmania. Most species are epiphytic and occur in high rainfall or highland areas, especially in *Nothofagus*- or conifer-dominated cool temperate rainforest, scrub or heathland in western parts of the island. In that regard alone, this species is rather unusual because, in lower rainfall areas, the only taxa likely to be encountered are the sorediate *M. subpertusa* P.James & D.J.Galloway, *M. nothofagi* (Zahlbr.) P.James & D.J.Galloway or *M. caesiopruinosa* P.James, or the brown-lobed *M. aeneofusca* (Müll.Arg.) R.Sant. Morphologically and chemically, the new species is very well-characterised. There are numerous esorediate, two-spored species, just as there are species containing stictic acid, but few combine these features with relatively broad lobes and the presence of an orange pigment. In the Tasmanian flora, somewhat similar species, both restricted to corticolous habitats in high rainfall areas, include *M. corrugata* P.James, which has a wrinkled thallus and a very thick, inflated, corrugated apothecial margin, and *M. elongata* P.James, which is chemically identical but and has markedly constricted, sausage-like lobes. Orange or yellow pigments occur in numerous species of *Menegazzia*. Secalonic acid-type compounds give a suffused yellow colour and are K–; they occur in *M. pertransita* (Stirt.) R.Sant. Intensely orange-yellow skyrin, co-occurring with pigmentosin, reacts K+ purple, UV+ orange and is found in *M. jamesii* Kantvilas & Louwhoff. Then there are K+ purple, UV+ orange emodin-type pigments that occur in *M. caliginosa* P.James & D.J.Galloway and *M. foraminulosa* (Kremp.) Bitter (Kantvilas & Louwhoff 2004). The pigment combination found in *M. endocrocea* is also known in *M. elongata* (endemic to Tasmania), *M. lordhowensis* Elix (endemic to Lord Howe Island) and *M. grandis* P.James (endemic to New South Wales).

Myriotrema endoflavescens* Hale *ex* Lücking, *sp. nov. (Fig. 19A–B) Mycobank MB 517799

Sicut Myriotrema album sed medulla flava et apotheciis ecolumellatis differt.—http://www.eol.org/pages/Myriotrema endoflavescens

Type:—PANAMA. Veraguas: 4–8 km from Alto Piedra along road to Río Calovebora, 800 m, primary rain forest, February 1975, *Hale 44859* (holotype US).

Thallus light yellow-olive, smooth to uneven, in parts bullate to almost gall-forming, with dense, prosoplectenchymatous cortex with internal splitting; medulla pale yellow; photobiont layer and/or medulla

with clusters of calcium oxalate crystals. Apothecia immersed, rounded, 0.2–0.4 mm diameter; disc covered by narrow, 0.1–0.2 mm wide pore, flesh-coloured, white-pruinose; margin entire, fused, light yellow. Columella absent. Excipulum prosoplectenchymatous, yellow-brown; periphysoids absent. Hymenium 60–80 µm high; paraphyses unbranched. Ascospores 8/ascus, 3–5-septate, 15–20 × 5–7 µm, ellipsoid, with thick septa and lens-shaped lumina, colourless, I+ violet-blue (amyloid). Secondary chemistry: no substances (all spot tests negative); medulla with pale yellow pigment (K+ yellow).

Distribution and habitat:—Known from a single collection in a lower montane rainforest in Panama.

Etymology:—The specific epithet refers to the pale yellow medullary pigmentation.

Mason Hale intended to describe this very characteristic species as new but never published it formally. It displays a very typical *Myriotrema* morphology and appears to be most closely related to *M. album* Fée, *M. myrioporum* (Tuck.) Hale, and *M. subconforme* (Nyl.) Hale, all lacking secondary substances. No species of *Myriotrema* having a pigmented medulla is known to date. Most species with pigmented medulla belong in *Ocellularia* s.str. (Rivas Plata *et al.* unpubl. data). Except for the pigmented medulla, *M. endoflavescens* resembles *M. album*, which also differs by its often present irregular pseudocolumella, and *M. myrioporum* and *M. subconforme*, respectively, which differ in their either 1-septate or submuriform ascospores.

Ocellularia albobullata **Lücking, Sipman & Grube, *sp. nov.*** (Fig. 19C) Mycobank MB 517800

Ocellularia thallo albo-cinereo, acido psoromico; apothecia non carbonisata, verrucis bullatis immersa, pseudocolumella instructa; ascosporae hyalinae, transverse 3–5-septatae, ad 20 × 9 µm, I+ violaceae.—http://www.eol.org/pages/Ocellularia albobullata

Type:—COSTA RICA. Puntarenas: Corcovado National Park, Sirena Section, Sirena Biological Station (Osa Conservation Area), Osa Pensinsula, 160 km SSE of Sán José and 50 km WSW of Golfito, round trail NW of station (Sendero Sirena and Sendero Guanacaste), 83°35'W, 8°29'N, sea level, lowland and coastal rain forest zone, oldgrowth coastal secondary forest and primary forest remnants on sandy soil, on bark (lower trunk), exposed, April 2003, *Grube 11580* (holotype INB-4066756, isotype GZU).

Thallus white-grey, bullate, with dense, prosoplectenchymatous cortex; photobiont layer and/or medulla with clusters of calcium oxalate crystals. Apothecia prominent, angular-rounded to irregular, 0.7–1.2 mm diameter; disc covered by narrow, 0.2–0.3 mm wide pore, filled by brown, white-pruinose pseudocolumella; margin annulate, white, laterally covered by thick thalline layer. Pseudocolumella present, irregular, brown, white-pruinose. Excipulum prosoplectenchymatous, orange-brown; periphysoids absent. Hymenium 60–80 µm high; paraphyses unbranched. Ascospores 8/ascus, 3–5-septate, 10–20 × 6–9 µm, ellipsoid, with thick septa and lens-shaped lumina, colourless, I+ violet-blue. Secondary chemistry: psoromic, subpsoromic and 2'-O-demethylpsoromic acids (C–, K–, P+ yellow).

Distribution and habitat:—Known from several collections from the coastal rainforest in southern Costa Rica.

Etymology:—The specific epithet refers to the white-bullate thallus.

Additional specimens examined (paratypes):—COSTA RICA. Puntarenas: Corcovado National Park, Sirena Section, Sirena Biological Station (Osa Conservation Area), Osa Pensinsula, 160 km SSE of Sán José and 50 km WSW of Golfito, beach south of station, *Sipman 51123* (B, INB).

This new species is easily recognized by its irregularly bullate thallus with white-grey colour. It belongs to a small number of species of *Ocellularia* with psoromic acid and where the thallus does not have the characteristic olive-green colour but is more or less white. Other such species include *O. antillensis* Hale and the Australian *O. wirthii* Mangold, Elix & Lumbsch (Mangold *et al.* 2008, 2009), which, among other characters, are separated from *O. albobullata* by their non-bullate thallus and carbonized excipulum. *Ocellularia calvescens* (Fée) Müll.Arg. is similar to *O. albobullata* in chemistry and ascospores but has a non-bullate thallus, lacks a columella, and has a carbonized excipulum.

Ocellularia vizcayensis* Rivas Plata, Duya & Lücking, *sp. nov. (Fig. 19D) Mycobank MB 517801

A Ocellularia mordenii medulla alba differt.—http://www.eol.org/pages/Ocellularia vizcayensis

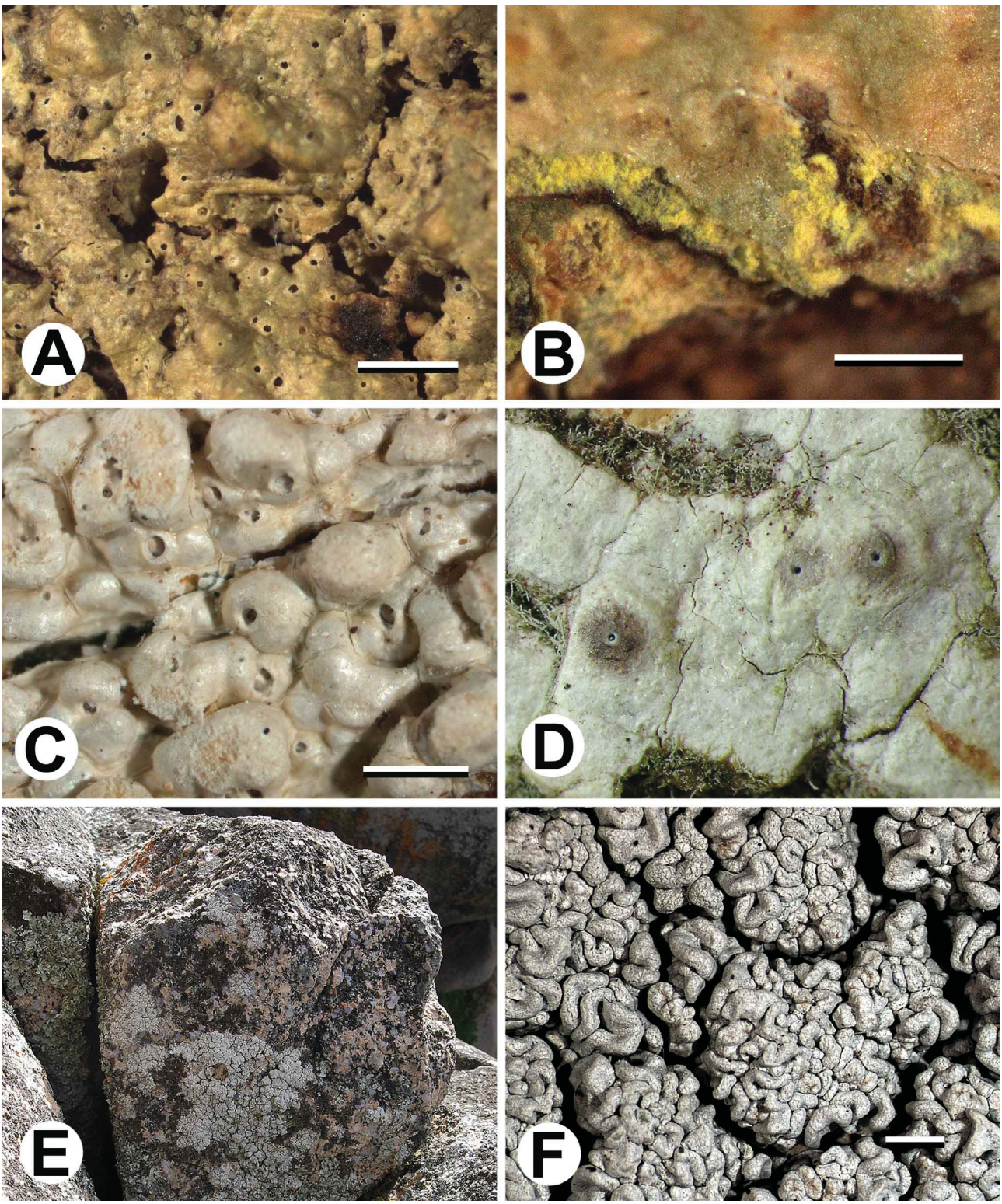

FIGURE 19. A–B. *Myriotrema endoflavescens* (holotype). A. Thallus with apothecia. B. Thallus showing yellow medulla. C. *Ocellularia albobullata* (holotype), thallus with apothecia. D. *Ocellularia vizcayensis* (holotype), thallus with apothecia. E–F. *Ochrolechia insularis* (F, holotype). E. Habit on coastal granite boulders (photograph G. Kantvilas). F. Thallus (photograph J. Jarman). Scale in A–D = 1 mm, in F = 2 mm.

Type:—PHILIPPINES. Luzon Island, Nueva Vizcaya: Mount Palali, 1400 m, March 2007, *Rivas Plata 1170* (holotype F, isotype CAHUP).

Thallus white, distinctly areolate, with loose, irregular cortex; photobiont layer and/or medulla with large clusters of calcium oxalate crystals. Apothecia immersed to erumpent in thalline warts, round, 0.8–1.5 mm diameter; disc covered by very narrow, 0.05–0.1 mm wide pore; margin with a broad, red-brown to purplish brown zone around the ostiole. Columella absent. Excipulum strongly carbonized laterally, jet-black, 100–200 µm wide; periphysoids absent. Hymenium 250–400 µm high, clear; paraphyses unbranched. Ascospores 1–2 per ascus, 15–29-septate, 100–300 × 15–30 µm, oblong-fusiform, with thick septa and lens-shaped lumina, colourless, I+ violet-blue. Secondary chemistry: no substances detected by TLC.

Distribution and habitat:—Known from a single, well-developed collection in pristine lower montane rainforest in northern Luzon.

Etymology:—The epithet refers to the province of the type locality.

Ocellularia contains a number of species with very large, transversely septate ascospores. Among these, only two lack secondary substances including pigments. *Ocellularia dolichotata* (Nyl.) Zahlbr. has a pale yellowish-brown, minutely verrucose thallus with columnar clusters of calcium oxalate crystals in the photobiont layer and medulla and a paraplectenchymatous cortex; in addition, the apothecia are columellate. *Ocellularia jamesii* (Patw. & C.R.Kulk.) D.D.Awasthi differs in the smaller, pale brown ascospores, among other features. Most closely related to the new species appears to be *O. mordenii* Hale, which agrees in the whitish, more or less areolate thallus; however, that species produces a vivid, cinnabar-red pigment in the medulla and the apothecial margin is very irregularly and coarsely verrucose and lacks the brown zone around the ostiole. *Ocellularia vizcayensis* superficially resembles *Thelotrema monosporum* Nyl. and allies, which also has a whitish thallus and brown-rimmed apothecia, but the internal anatomy of the apothecia is very different, being uncarbonized and featuring periphysoids and brown ascospores in the *Thelotrema* species.

Ochrolechia insularis* Kantvilas & Elix, *sp. nov. (Fig. 19E–F) Mycobank MB 517802

Species littoralis, saxicola, thallo albido, crustaceo, usque ad 4.5 mm crasso, papillato vel nodulato vel plicato, acidum gyrophoricum continenti recognita; apothecia ignota, igitur eam huic generi cautione aliqua adsignamus.—http://www.eol.org/pages/Ochrolechia insularis

Type:—AUSTRALIA. South Australia: Kangaroo Island, Cape Willoughby, 35°50'S, 138°08'E, 50 m, on sunny, exposed faces of granite outcrops overlooking the sea, September 2009, *Kantvilas 367/09* (holotype HO, isotypes AD, CANB).

Thallus crustose, intensely papillate, nodular or plicate, 0.3–4.5 mm thick, with upper surface white, smooth, matt to rather glossy, in places minutely speckled with white maculae, not pruinose or crystalline, forming irregular, undelimited patches to 10 cm across, not lobate or placodioid at the margins; prothallus absent; individual nodules 0.5–1 mm wide, very densely crowded together in clumps to 5 mm wide, rather loosely attached, in section with a poorly developed cortex 15–30 µm thick composed of irregularly orientated, branched and anastomosing, short-celled hyphae 2–4 µm thick, overlain by a hyaline, epinecral layer; photobiont cells generally concentrated in a subcortical layer 40–100 µm thick, with individual cells globose, 6–15 µm diameter; medullary hyphae loosely interwoven, 3–5 µm thick. Pycnidia immersed, visible as minute, pale brownish dimples or short cracks; conidia bacilliform, 4–6.5 × 1 µm. Secondary chemistry: gyrophoric acid [major], lecanoric acid [minor or trace], 2'-*O*-methyllecanoric acid [± trace]; cortex K–, KC+ red, C+ red, P–, UV–; medulla K–, KC+ red, C+ red, P–, UV–.

Distribution and habitat:—*Ochrolechia insularis* is a seemingly rare species, known only from the type locality where it occurs on large, sunny, windswept, granite boulders overlooking the sea but well above the normal extent of sea spray. It is associated with the typical community that dominates coastal granite rocks in southern Australia and Tasmania: *Rinodina blastidiata* Matzer & H.Mayrhofer, *Tylothallia pahiensis* (Zahlbr.)

Hertel & Kilias, *Xanthoria ligulata* (Körber) P.James and species of *Buellia*, *Caloplaca* and *Xanthoparmelia*, especially *X. conranensis* (Elix) Elix and *X. subprolixa* (Nyl. *ex* Kremp.) Blanco *et al.* The species is extremely localised, and has been found on only a few large boulders; searches in similar habitats in the general vicinity, as well as further afield such as on Flinders Island in Bass Strait, have failed to reveal any further localities. Thus it represents an extremely uncommon taxon of high conservation value, especially as much of the site where it grows is heavily degraded by the impact of sheep grazing and other disturbance.

Etymology:—The specific epithet refers to the habitat of the new species on Kangaroo Island off the southern coast of mainland Australia.

Additional specimens examined (paratypes):—AUSTRALIA. South Australia: Kangaroo Island, Cape Willoughby, 35°50'S, 138°08'E, 50 m, on sunny, exposed faces of granite outcrops overlooking the sea, September 2008, *Kantvilas 332/08* (AD, HO).

In the absence of apothecia, the generic assignment of this species is tentative; however, its highly localised distribution warrants its description, and *Ochrolechia* is considered the most appropriate genus. Its position there is supported by its general appearance, in combination with its habitat ecology, chlorococcoid photobiont, secondary chemistry and bacilliform conidia. However, it is conceded that these characters may all be found in several other genera. From the thallus chemistry (cortex C+ red, medulla C+ red) this species appears to belong to *O. africana* Vain. group (Brodo, 1991), but morphologically it closely resembles *O. tartarea* (L.) A. Massal. Both *O. tartarea* and *O. insularis* are saxicolous and may develop an irregularly warty to nodulate-papillate upper surface. However, *O. insularis* differs in having a smooth and glossy upper surface (granular to powdery-tartareous in *O. tartarea*) and in lacking a prothallus (*O. tartarea* is surrounded by a paler prothallus) (Fletcher *et al.*, 2009). In addition, the colour of the upper surface of *O. tartarea* varies from pale to dark grey (white in *O. insularis*) and the medulla of *O. insularis* reacts C+ red (C– in *O. tartarea*). At first glance, the new species is most reminiscent of members of the *Pertusaria dactylina* complex, which, in the southern Australian region, is well-represented on granite in such habitats (Kantvilas & Elix, 2008). However, these lichens are all isidiate rather then papillate, and contain salazinic, norstictic or hypothamnolic acids. One fragment of the new species (*Kantvilas 332/08A*, HO) supports a small cluster of stalked mazaedia of *Sphinctrina leucopoda* Nyl., a lichenicolous fungus previously unrecorded for South Australia. This widespread species is commonly known to parasitise the genera *Pertusaria*, as well as *Diploschistes* and *Rinodina* (Tibell, 1987). It has not been reported previously from *Ochrolechia*.

Opegrapha viridipruinosa* B.J.Coppins & R.Yahr, *sp. nov. (Fig. 20A–B) Mycobank MB 517715

Sicut Opegrapha varia sed thallo tenui, griseoviridi, pulverulento, saepe sulphureo suffuso, ascosporis brevioribus, 4-5 septatis, pycnidiis et conidiis parvioribis differt.— http://www.eol.org/pages/Opegrapha viridipruinosa

Type:—ENGLAND. East Suffolk, Needham Market, 52°9'N, 1°4'E, on *Sambucus* bark in sheltered, disused chalk pit, June 2004, *Earland-Bennett & Hitch s.n.* (holotype E).

Thallus thin, grey-green powdery, effuse, turning lemon-yellow in herbarium or almost absent except as thin veil at margins of excipulum. Pigments in thallus dissolving K+ yellow in section (best observed adjacent to or below lirellae). Photobiont trentepohlioid. Lirellae erumpent-sessile, mostly simple, few- or stellate-branched, scattered evenly over the thallus, with thin powdery lateral thalline cover, 0.3–0.6(–1) mm long, 0.1–0.3(–0.4) mm broad. Exciple margins completely carbonized and raised above disc, generally slit-like at first and mostly gaping to broadly exposed later, brownish-yellow at inside margins, K– in section. N+ red. Disc mostly exposed, dark brown and often with green (yellow in herbarium) pruina, dissolving in K to give bright yellow. Hymenium 40–60 µm, I+ red. Ascospores 8/ascus, (3–)4–5 septate, (14)–15–19(–22) × (3–)4–5(–6) µm, hyaline, excluding perispore (1 µm), with medial cells somewhat enlarged, and infrequent slight constriction below these. Perispore of old ascospores turning brown and roughly wrinkled. Pycnidia frequent, pale-green pruinose, sessile 0.07–0.12 mm diameter, with short bacilliform conidia 2.5–3 × 1–1.3 µm.

Distribution and habitat:—Britain and Ireland, on bark and lignum of hardwood trees (*Acer platanoides*, *A. pseudoplatanus*, *Betula*, *Fraxinus*, *Quercus*, *Sambucus* and *Ulmus*).

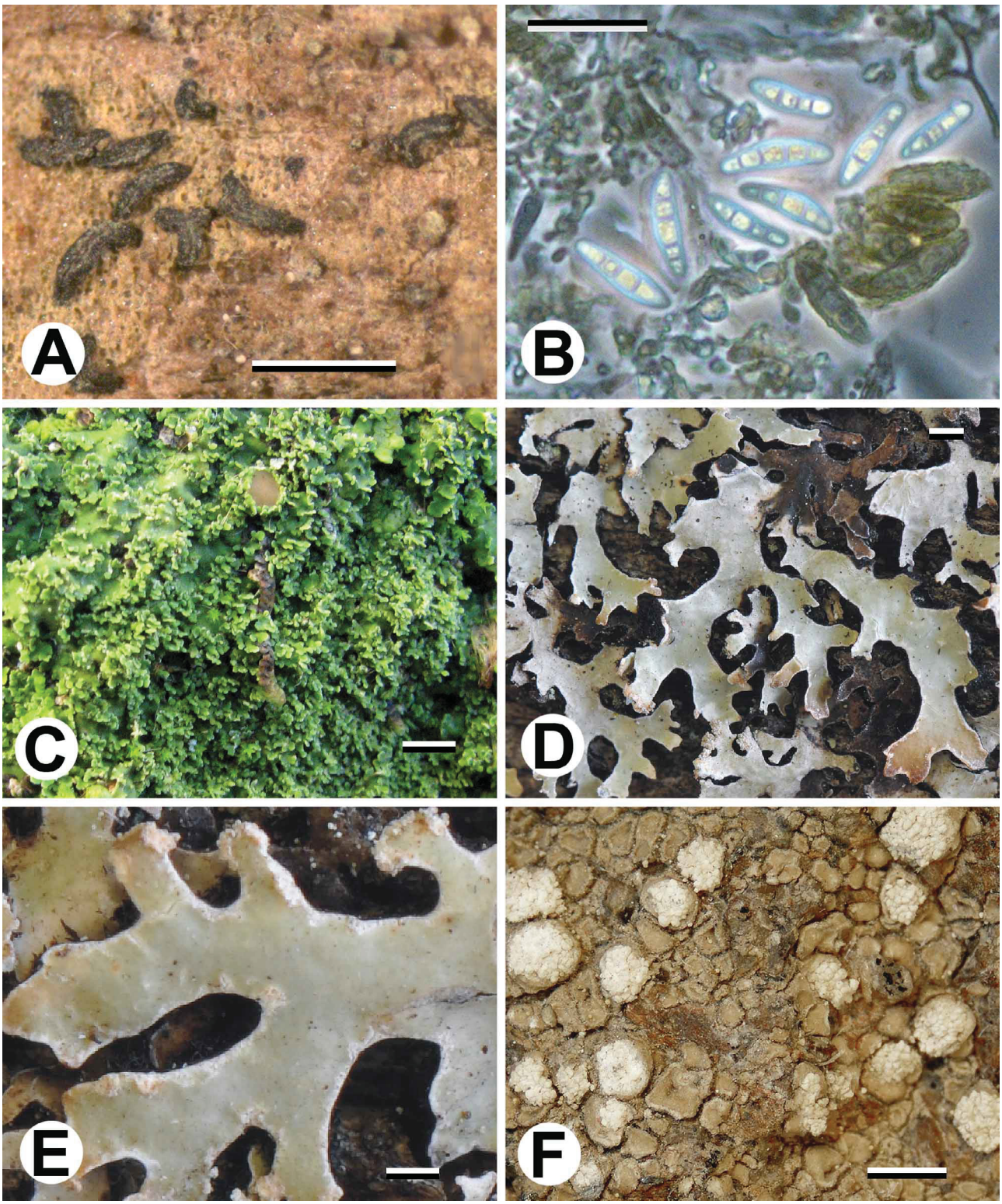

FIGURE 20. A–B. *Opegrapha viridipruinosa* (holotype). A. Habit showing ascomata and soredia-covered pycnidia (top right and lower right). B. Mature ascospores (centre of image) and overmature ascospores (below and to the right). C. *Pannaria phyllidiata* (holotype), photographed in the field. D–E. *Parmelia asiatica* (holotype). D. Habit. E. Detail showing terminal soralia and marginal linear pseudocyphellae. F. *Pertusaria conspersa* (holotype), thallus with soralia. Scale in A, F = 1 mm, in B = 20 µm, in C–E = 2 mm.

Etymology:—From the yellowish-green powdery pruina, conspicuous on the discs and pycnidia.

Additional specimens examined (paratypes):—ENGLAND. East Suffolk: Sudbourne, January 2002, *Earland-Bennett & Hitch s.n.* (E); Pettistree, Byng Hill Lane, March 1997, *Earland-Bennett* (E). NORTHERN IRELAND. Londonderry, SSW of Dungiven, Banagher Woods, *Coppins et al. 14438* (E). SCOTLAND. East Lothian: Oak Wood, *Coppins 22638* (E); Binning Wood (NW), *Coppins 22505* (E); Peebles: West Linton, Coaly Burn, *Coppins 22819* (E).

Opegrapha is a large genus of ca. 300 species, with both lichenized and lichenicolous species (Kirk *et al.* 2008). The genus is generally characterized by having crustose, non-corticate thalli and carbonized, elongate to rounded lirellae, transversely-septate and I– ascospores, but the large size of the genus results in few reliable morphological features common across the genus (Ertz 2009). The new species is most likely to be confused with *O. varia* Pers., but is distinguished by smaller and fewer septate ascospores (mostly 5–6-septate in *O. varia*), generally smaller lirellae and pycnidia, and smaller conidia. In *O. varia* the pycnidia are mostly (0.1–)1.2–2(–2.5) mm diameter, with conidia that are either ellipsoid to pyriform, 3.5–4.5 × 1.5–2 µm, or bacilliform, 3.8–5.5(–6.5) × 1–1.5 µm. *Opegrapha varia* generally has a whiter thallus, lacking the yellowish colouration present in many collections of the new species, even when the apothecia or pycnidia are greenish pruinose. The same is true for *O. herbarum* Mont, and is very evident in collections on lignum where it grows side-by-side with *O. viridipruinosa*. *Opegrapha herbarum* differs further in having 3-septate ascospores, and apparently never producing pycnidia. *Opegrapha xerica* Torrente & Egea differs in having a K+ green epithecium and exciple, and longer conidia. The new species is most frequently found in the eastern, drier parts of Britain and Northern Ireland, and is found in both pycnidiate and sexual forms. It is so far known from SE England, E Scotland, W Scotland (rare), and Northern Ireland. The earliest collection dates only from 1991, and it is tempting to suggest that it has only recently entered the British Isles or, at least, expanded greatly in E Scotland and E England following the amelioration of high SO_2 levels since the 1980s. It grows on a range of hardwood trees, mainly in woodland or woodland edge situations, and associated species include *Anisomeridium biforme*, *A. polypori*, *Bacidia delicata*, *Chaenotheca brachypoda*, *Chrysothrix candelaris*, *Cliostomum griffithii* and, on lignum, *Opegrapha herbarum* and *O. ochrocheila*. It occurs on dry bark and does not seem to enter the *Xanthorion* communities, as can the similar *O. herbarum* and *O. varia*. It is frequent in secondary woodland and is not strongly linked to old-growth woodland or veteran trees, as is *O. xerica*.

Pannaria phyllidiata* Elvebakk, *sp. nov. (Fig. 20C) Mycobank MB 517803

Pannariae sphinctrinae similis, sed praesentia circiter 0.5 mm longorum, ramosorum, ascendentium phyllidiorum et perisporarum nodulosis apicalibus extensionibus instructarum differt.—http://www.eol.org/pages/Pannaria phyllidiata

Type:—AUSTRALIA. New South Wales: Brown Mountain, 40 km NNE of Bombala, Rutherford's Creek (S of Piper's Lookout), 36°35'S, 149°27'E, 90 m, on Southern Sassafras (*Atherosperma moschatum*), April 2008, *Elvebakk 08:160* (holotype NSW, isotypes CANB, UPS, TROM).

Thallus foliose, corticolous, forming rosettes 3–15 cm in diameter, closely attached to the substrate, unless growing over bryophytes or other uneven substrates. Lobes irregularly to subdichotomously branched, discrete in peripheral parts, imbricate to centrally coalescent, 0.7–1.2 mm wide and up to 10 mm long, flattened to weakly concave, margins entire, narrowly swollen, 120–200 µm thick. Upper surface pale greyish green when fresh and dry, salad green when fresh and moist, turning gradually chestnut brown after storage in herbaria, glabrous and glossy. Epicortex 30–50 µm thick, upper third developing brown pigmentation after storage and almost sclerenchymatic near the surface, below paraplectenchymatic with luminae globose to irregularly ellipsoid, 8–15 µm long, walls 1.5–3 µm thick. Photobiont layer 20–25 µm thick, of globose to subglobose cf. *Myrmecia* cells, 5–15 µm in diameter. Medulla 50–100 µm thick, white, dark brown in lower part. Lower cortex lacking; rhizines common, brown and simple to sparingly branched; hypothallus felted,

brown, and sometimes forming a blackish prothallus, particularly when growing on smooth bark. Cephalodia common, laminal on the upper surface, globose to subglobose when young, later becoming irregularly pulvinate, and finally placodioid-nodulose and up to 2 mm in size, occasionally also developed on the hypothallus and the lower side; epicortex as in the chlorobiont, but luminae 5–10 µm in size; cyanobiont *Nostoc*, cells greyish green, subglobose to irregularly ellipsoid, 3–4.5 × 4–7 µm in size, organized within indistinct spherical glomeruli, ca. 20 µm in size, and without visible chain structures. Apothecia scattered, laminal, substipitate, 0.7–2.5 mm broad, discs rufous brown, flat,; thalline excipulum crenate-striate, with phyllidia; epithecium light brown, 15–25 µm thick, hymenium colourless, but strongly IKI+ blue, ca. 100 µm thick; hypothecium light brown, ca. 80 µm thick, IKI negative; paraphyses simple to weakly branched, septate, with slightly swollen apices; asci clavate, 15 × 70–90 µm in size, no internal IKI+ amyloid structures observed, with eight ascospores. Proper ascospores hyaline, non-septate, ellipsoid to weakly citriform, 7.5–10 × 12–16 µm in size; perispores ellipsoid to weakly citriform, 8–11 × 14–19 µm in size, distinctly verrucose when mature. Secondary chemistry: vicanicin (major) and unidentified terpenoids (trace).

Distribution and habitat:—Australia, New South Wales, with single occurrences in Victoria and Queensland. The species is common on tree or tree fern trunks in rainforests from elevations between 200 and 1500 m, occasionally on rocks near streams. Other specified phorophytes include *Nothofagus, Eucalyptus, Olearia, Pomaderis, Trochocarpa laurina, Lomatia ilicifolia,* and *Bedfordia salicina*.

Etymology:—Named after its numerous large phyllidia.

Additional specimens examined (paratypes):—AUSTRALIA. New South Wales: Clyde Mountain, *Elix 1305*, *1306, 1767*, *1770*, *1785*, *1796*, *1809*, *1810* (CANB); Brown Mountain, below lookout, *Elix 2025*, *2028, 9647* (CANB); Brown Mountain, Rutherford's Creek, *Streimann 16714* (CANB); ibid., *Elix 40822*, *Elix & Kalb 40859* (CANB); ibid., *Elvebakk 08:166*, *08:167*, *08:168* (CANB, TROM). 15 km W of Dorrigo along the Armidale Road, *Elix 2331* (CANB). Mount Warning State Park, *Elix 4044* (CANB). New England National Park, Point Lookout, 34 km SW of Dorrigo, *McVean 67189* (CANB). New England National Park, E of Armidale Knights Lookout road, *Weber & McVean s.n.* (CANB-L49343). New England National Park, Weeping Rocks Track, *Elix 33918* (CANB). New England National Park, track to Wright's Lookout, 72 km E of Armidale, *Streimann 47880* (CANB). South Coast, Maxwell's Road, Nadgee State Forest, 41 km SSW of Eden, *Elix 21521*, *21526*, *Elix & Streimann 21528* (CANB). Big Badja Hill, 44 km SW of Araluen, *Streimann 39881A* (CANB). Gibraltar Range National Park, 56 km SE of Tenterfield, *Streimann 43568* (CANB). Moppy Lookout, Barrington Tops State Forest, 40 km WNW of Gloucester, *Streimann 44421*, *44475*, *44480* (CANB). Dilgry River, Dilgry Circle Road, Barrington Tops State Forest, 40 km WNW of Gloucester, *Streimann 44619* (CANB). Pinkwood Creek, Hanging Mountain Forest Reserve, 25 km SW of Moruya, *Streimann 44925* (CANB). 3 km SW of Monga, along the Milo Forest road, *Elix 6491* (CANB). Queensland: Bunya Mountains, between Westcott Picnic Area and Long Plain Bald, *Kantvilas 167/95* (HO). Victoria: Along the Bonang River, 7 km S of Bonang township, *Elix 5186* (CANB).

This species belongs to the *Pannaria sphinctrina* (Mont.) Tuck. complex, as circumscribed by Elvebakk (2007). Among the foliose tripartite species of *Pannaria* previously accommodated in *Psoroma*, this group is characterized by having thin lobes and by vicanicin as its major secondary compound. *Pannaria sphinctrina* is a panaustral primarily fertile species. Similar specimens with vegetative propagules are very common both in southern South America, southeastern Australia and New Zealand, and have generally been interpreted as *P. microphyllizans* (Nyl.) P.M.Jørg., in Australian herbaria also filed under *P. sphinctrina sensu lato*. *Pannaria microphyllizans* is probably not a part of this complex, and that material instead represents several undescribed species. *Pannaria phyllidiata* is characterized by its numerous ascendent, branched phyllidia. These are c. 0.5 mm in size and much larger than the propagules of the other still undescribed species, but shorter than the simple ascendent lobules of *Pannaria lobulifera* Elvebakk, another new species in the complex recently described from New Caledonia (Elvebakk 2007). *Pannaria phyllidiata* has a remarkably restricted distribution. It is very common in the eastern moist forests of New South Wales, and almost restricted to this area. So far just a single occurrence has been confirmed about 20–25 km into neighbouring Victoria, and one locality is known from Queensland.

Parmelia asiatica* A.Crespo & Divakar, *sp. nov. (Fig. 20D–E) Mycobank MB 518288

Similis Parmeliae protosulcatae sed differt acidum salazinicum continente et distributione in Asia austro-orientali..—http://www.eol.org/pages/Parmelia asiatica

Type:—CHINA. Yunnan: Jianchuan County, Shi Bao Shan Park, 75 km S of Lijiang, 26º 22'N, 99º 50'E, 2490 m, on *Rhododendron* tree trunk, *Crespo et al. s.n.* (holotype MAF-Lich 16478).

Thallus corticolous, adnate, small, to 3 cm across. Lobes sublinear, separate, 1–2 mm wide. Upper surface pale greenish to whitish grey, brownish towards lobe apices, smooth, pseudocyphellate, sorediate, without isidia. Pseudocyphellae marginal, linear, appearing as continuous white rim (to 2 mm long) (Fig. 20 E). Soralia terminal, developing on lobe apices (Fig. 20 D), usually orbicular; soredia granular. Medulla white. Lower surface black, densely rhizinate, rhizines densely squarrosely branched, to 1 mm long. Apothecia and pycnidia not seen. Secondary chemistry (TLC): atranorin and salazinic acid; cortex K+ yellow; medulla K+ yellow turning red, C–, KC–, P+ orange-red.

Distribution and habitat:—The species grows on *Rhododendron* tree trunk in humid *Rhododendron* forest at 2490 m elevation. *Parmelia asiatica* occurs in temperate regions of China and at present is known from type locality.

Etymology:—The specific epithet refers to its Asian distribution.

Parmelia asiatica is distinguished by: terminal soralia, marginal, linear pseudocyphellae and atranorin and salazinic acid. This species recalls *Parmelia protosulcata*, reported from Australia, New Zealand, South America and the Falkland Islands (Hale 1987, Elix 1994b), but differs in having salazinic acid, and a temperate Southeast Asian distribution. In containing salazinic acid, and having a sorediate upper surface and squarrose rhizines it resembles other related species with wide distributions such as *Parmelia sulcata* (Hale 1987, Divakar *et al.* 2005) and *Parmelia hygrophiloides* known from the Indian subcontinent (Divakar *et al.* 2003). However *Parmelia asiatica* is easily distinguished in having terminal soralia and marginal, linear pseudocyphellae. Molecular studies based on nuITS rDNA show that *Parmelia asiatica* and *Parmelia sulcata* are not closely related (Crespo *et al.* unpubl. data).

Pertusaria conspersa* Messuti, *sp. nov. (Fig. 20F) Mycobank MB 517804

Thallus crustaceus, avellaneus, saxicola, areolatus usque ad rugoso-areolatus, tenuis vel crassus, sorediatus. Apothecia ignota. Acidum haemathamnolicum in magna summa continens.—http://www.eol.org/pages/Pertusaria conspersa

Type:—CHILE. V. Región (Valparaíso): Provincia Sán Felipe de Aconcagua, Cuesta La Dormida, north of Santiago, October 1960, *Mattick 232d* (holotype B).

Thallus crustose, light to moderate yellowish brown (hazel), areolate to rugose-areolate, thin to thick, surface smooth and dull, epruinose or with ~~a~~ white pruina, saxicolous, areolae flattened to slightly bullate, orbicular to angular or irregular, margins of the areoles thick and slighty effuse, contiguous or separated by thick, deep cracks, lacking isidia, sorediate. Soralia cream coloured, orbicular, flattened to convex, numerous, conspicuous, solitary or crowded, sometimes confluent (2–4), sessile, somewhat resembling apothecia, erumpent, with a smooth or irregular margin, concolorous with the thallus, light to moderate yellowish brown, 0.2–1.5 mm wide; soredia granular, 0.10–0.15 mm diameter. Apothecia not seen. Pycnidia not seen. Secondary chemistry (determined by HPLC): haemathamnolic acid (major), thamnolic acid (major, minor or trace).

Distribution and habitat:—The species was found only in the central region of Chile (Chile Central), in the V Región de Valparaíso (Valparaíso and Sán Felipe de Aconcagua Provinces). It is an uncommon saxicolous species known only from three localities in Chile. Reported substrates include rocks with quartz and also sandstone. The species grows at an elevation of 1000 to 1200 m in open and exposed areas.

Etymology:—The specific epithet *conspersa* is derived from the Latin *conspersus,* sprinkled, a reference to the appearance of the cream coloured soralia on the brownish thallus.

Additional specimens examined (paratypes):—CHILE. V. Región (Valparaíso): Provincia Sán Felipe de Aconcagua, Cuesta de Chacabuco, N to Santiago, *Mattick 266* (B). Cuesta La Dormida, N of Santiago, *Mattick 232b* (B).

Pertusaria is a large, cosmopolitan genus of ca. 700 species (Archer 1997) found in subarctic to tropical regions colonising bark, dead wood, non-calcareous rocks, and rarely soil. The genus is characterized by a crustose thallus, hemiangiocarpous apothecia, a cupulate true exciple, paraphysoids, thick-walled asci, and one celled, often thick-walled, hyaline to brownish ascospores, and includes numerous substance classes (Lumbsch *et al.* 1999). This species is readily identified by its moderately yellowish brown thallus, the numerous, erumpent soralia, the absence of apothecia and the presence of haemathamnolic acid. This species may be confused with other sterile, saxicolous *Pertusaria* species, but is readily distinguished by its chemistry. Morphologically the new species resembles the saxicolous *P. subventosa* Malme var. *subventosa* but the latter is distinguished chemically by the presence of lichexanthone, thamnolic acid and picrolichenic acid as major substances (Archer 1997). The presence of haemathamnolic acid, with varying concentrations of thamnolic acid, in this new species also distinguishes it from the similar saxicolous *P. kinigiensis* A.W.Archer *et al.* from Central Africa (Archer *et al.* 2009). *Pertusaria kinigiensis* has a pale-grey to pale yellowish grey thallus and white soralia. Other saxicolous species with soralia, are *P. coccopoda* Vain. (TUR-Vain 06667, lectotype, selected here, TUR-Vain 06668, duplicate) (= *P. xantholeucoides* Müll.Arg,) from Brazil, which also contains haemathamnolic acid but differs in having slightly stipitate soralia and in containing lichexanthone, and *P. sordida* A.W.Archer from Australia, but this species contains atranorin and fumarprotocetraric (Archer 1991).

Phlyctis psoromica* Elix & Kantvilas, *sp. nov. (Fig. 21A) Mycobank MB 517805

Phlyctidi subuncinatae, P. sordidae P. uncinataeque similis sed acidum psoromicum continens et ascosporis minoribus, 30–52 µm longis, 4–6 µm latis.—http://www.eol.org/pages/Phlyctis psoromica

Type:—AUSTRALIA. New South Wales: Cottan-Bimbang National Park, Stockyard Creek Rest Area, *c.* 83 km E of Walcha, 31°24'S, 152°07'E, 685 m, on *Acacia* in wet *Eucalyptus* forest, August 2008, *Elix 43095* (holotype CANB, isotypes HO, NSW).

Thallus crustose, 40–80 µm thick, whitish to very pale blue-grey to greenish grey, rimose, scurfy or furfuraceous, lacking isidia and soredia but often becoming ulcerous, eroded and rather granular in the vicinity of the apothecia, forming extensive, irregularly spreading patches 3–10 cm wide; prothallus white, arachnoid, sometimes forming a narrow, ± byssoid margin; photobiont chlorococcoid, with cells globose to subglobose, 6–12(–15) µm wide. Apothecia 0.1–0.4 mm wide, usually aggregated in clusters of 2–6(–10), rarely solitary, immersed to adnate; thalline margin slightly raised, at first entire, soon becoming abraded and at length reduced to white, granular blotches on the surface of the thallus; disc irregularly roundish, plane to concave, pale grey to grey-brown, densely covered with a fine, white pruina; proper exciple grey to grey-black, in section cupular, 10–40 µm, brownish, composed of interwoven, short-celled, branched and anastomosing hyphae 2–4 µm thick. Hypothecium brownish, ca. 25–40 µm thick, poorly differentiated from the excipulum. Hymenium colourless, separating readily in K, 75–120 µm thick, overlain by a brownish, K± olive-brown, granular epihymenial layer that partially dissolves in K; paraphyses simple in the lower part, sparsely branched towards the apices, septate, 1.5–2.5 µm wide, with apices slightly thickened to 2–4 µm wide; asci (4–)8–spored, cylindrical-clavate, 70–100 × 10–12 µm, with wall 1.5–2 µm thick, weakly amyloid but with a thin, more intensely amyloid outer coat, especially near the ascus apex. Ascospores hyaline, fusiform, transversely (3–)7-septate, coiled in the ascus, straight or sigmoid-curved, 30–*39.3*–50(–52) × 4–*5.2*–6 µm. Pycnidia not seen. Spot tests: cortex K–, KC–, C– P+ intense yellow. Secondary chemistry: psoromic acid.

Distribution and habitat:—This new species is known at present only from several localities in New South Wales. It occurs on smooth bark in shaded habitats on the trunks of understory trees in wet upland forests from 680 to 1500 m elevation. Frequent hosts include *Doryphora sassafras*, *Atherosperma moschatum* and species of *Elaeocarpus* and *Pomaderris*.

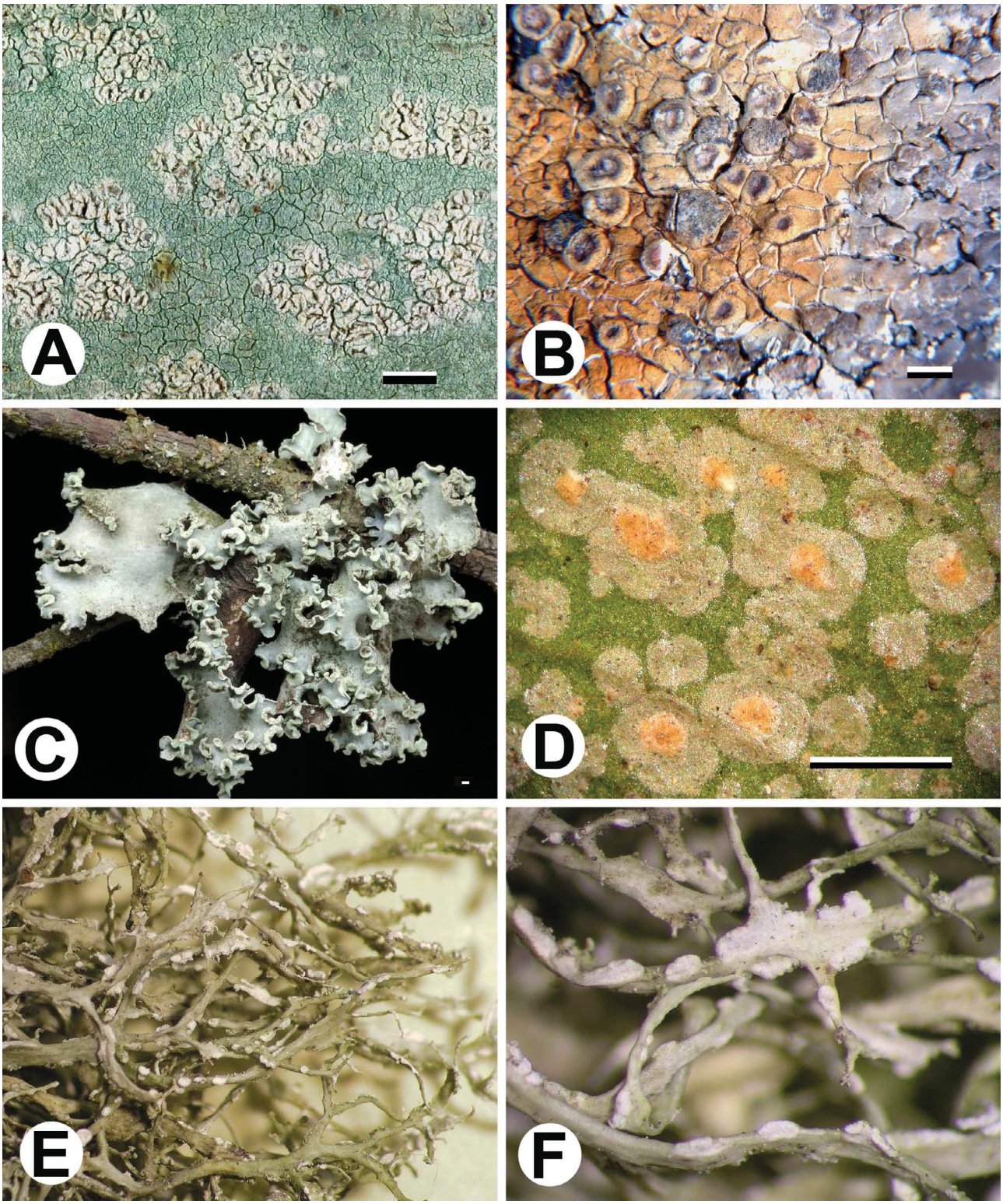

FIGURE 21. A. *Phlyctis psoromica* (holotype), thallus with apothecia. B. *Placopsis imshaugii* (holotype), thallus with apothecia and cephalodia. C. *Platismatia wheeleri* (holotype), thallus with soralia. D. *Porina huinamdungensis* (holotype), thallus with perithecia. E–F. *Ramalina hyrcana* (*Maassoumi 2105*). E. Apical branches. F. Detail with marginal soralia, mainly on the lower side. Scale in A, C–F = 1 mm, in B = 3 mm.

Additional specimens examined (paratypes):—AUSTRALIA. New South Wales: Mt William, *Kantvilas 328/88* (HO, NSW); New England National Park, *c.* 3 km W of Point Lookout, *Kantvilas 661/88* (HO, NSW); Mount Hyland Nature Reserve, 20 km N of Hernani, *Elix 36611, 36652, 36658* (CANB, HO).

Morphologically, *Phlyctis psoromica* closely resembles several other species of *Phlyctis* that share a whitish, often scurfy thallus, ± immersed, often clustered apothecia, 8-spored asci, and fusiform, transversely septate ascospores. It differs from these taxa mainly by its chemical composition. *Phlyctis subuncinata* Stirt., which is widespread in Australasia, differs in containing stictic, constictic and cryptostictic acids, as well as having somewhat larger ascospores, 40–72 × 5–7 µm (Galloway 2007). Other related species, also with larger ascospores, include: *P. uncinata* Stirt., containing norstictic acid but currently unrecorded for Australia; and *P. sordida* C.Knight, which contains hypostictic acid and is here recorded from Australia for the first time (New South Wales: Gloucester Tops, 32°04'S, 151°34'E, *Kantvilas 406/88A*, HO). Psoromic acid is known from at least two other species of the genus. *Phlyctis megalospora* (P.James) D.J.Galloway & G.Guzmán occurs in New Zealand, also contains conpsoromic acid and has ascospores 285–390 × 75–95 µm occurring singly in the ascus. There is also a closely related, similarly large-spored and as yet unidentified species in alpine areas of Tasmania.

Placopsis imshaugii* D.J.Galloway, *sp. nov. (Fig. 21B) Mycobank MB 516034

Sicut Placopsis baculigera sed differt in characteribus sequentibus: lobi marginales pallide cinerei sine maculis albidis, effiguratis; hymenium alterum (250–300 µm) et sporae parum latiores et conidia filiformia (27–45 × 1 µm); acida gyrophoricum (major) lecanoricumque (minor) et atranorinam (minor) continens.—http://www.eol.org/pages/Placopsis imshaugii

Type:—CHILE. XII Región: Isla Desolación, treeless ridge in cirque on W side of Fondeadero Nassau, Puerto Churruca, 53º 04'S, 73º 56'W, October 1969, *Imshaug & Ohlsson 44877* (holotype MSC).

Thallus rosette-forming, to subirregular, sometimes forming coalescing patches, ±lobate or effigurate at margins, rarely lobate from margins to centre, more commonly areolate centrally, closely attached to substratum from margins to centre, (15–)20–55(–75) mm diameter, prothallus absent. Lobes not swollen, rather flattened to subconvex, 0.5–2 (rarely to 4) mm wide, parallel, radiating, contiguous from margins to centre, or only in a broad marginal zone and areolate-cracked centrally, separated by narrow to deep and sometimes gaping cracks; margins entire, flabellate, shallowly rounded or scalloped to occasionally minutely lobulate. Upper surface pale grey brown to pinkish brown at margins, orange-brown to rust-coloured centrally, smooth, subnitid and somewhat coriaceous at or near margins, uneven to minutely papillate to ±cerebriform (×10 lens) in central areolae, without isidia, maculae, pruina, pseudocyphellae or soredia. Cephalodia widely scattered centrally, to occasionally developing in groups or clustered in bands towards thallus margins, rounded, 1–5(–9) mm diameter, purplish blue when wet, rusty brown to brown-black when dry, shallowly hemispherical to somewhat flattened, margins plicate-crenulate, surface very shallowly ridged at first becoming deeply ridged and/or with gaping, radiating fissures at maturity; cyanobiont in chains, cells rounded to laterally compressed, 5–8.5 µm diameter. Apothecia subimmersed to ±aspicilioid at first, becoming sessile and appearing subthelotremoid at maturity, 0.8–1.5(–2.5) mm diameter, scattered to crowded centrally, solitary to 2–4-together, rounded to slightly constricted through mutual pressure. Thalline margin prominent, obscuring disc at first, swollen, 0.3–0.6 mm thick, concolorous with thallus or paler, entire to striate-cracked, roughened or wrinkled, without pruina or soredia. Proper margin very thin to scarcely apparent, concolorous with disc or slightly darker; disc deeply urceolate, sometimes reduced to a slit or a pore by the swollen thalline margin, especially when young, yellow-brown to dark-brown, waxy, glossy, epruinose. Epithecium pale pinkish brown, granular, 25–30 µm thick. Hymenium colourless, (200–)250–300 µm tall. Hypothecium pale yellow-brown or pinkish, opaque, 150–200 µm thick. Asci cylindrical, 200–250 × 8–10 µm. Ascospores uniseriate in ascus, broadly ellipsoidal, colourless, 25–30 × 15–18(–20) µm. Pycnidia

common, scattered on thallus from near margins to central areolae, immersed, ostiole minute, punctiform, pale whitish to red-brown to black. Conidia filiform, 27–32.5(–35) × 1 µm. Chemistry (J. A. Elix, pers. comm. 2010): medulla K–, C+ red, KC+ red, P–; containing gyrophoric acid (major), lecanoric acid (trace) and atranorin (trace).

Distribution and habitat:—*Placopsis imshaugii* appears to be a rare Chilean endemic and is presently known only from several remote coastal sites in Region XII, in the canals region of western Patagonia. It colonises hard siliceous rocks on scattered outcrops on ridges and open hillsides and associates occasionally with *Aspicilia* sp., *Placopsis gelida* (L.) Linds., and with rust-coloured species of *Porpidia*. The rather few collections seen give only a sketchy idea of its ecology, and since it is a distinctive rust-coloured species, it is easily seen and should be more carefully looked for, so that its ecological requirements can be more clearly ascertained.

Etymology:—The specific epithet honours the major contribution to temperate South American lichenology made by its collector, the late Prof. Henry A. Imshaug, 1925–2010 (Fryday & Prather 2001).

Additional specimens examined (paratypes):—Chile. XII Región: Isla Wellington, Puerto Charrúa, *Imshaug & Ohlsson 43586, 44635* (MSC, CANB). Isla Grant, Puerto del Morro, Canal Trinidad, *Imshaug & Ohlsson 44707, 44709* (MSC, CANB). Isla Pilot, Puerto del Morro, Canal Trinidad, *Imshaug & Ohlsson 44713* (MSC, CANB). Isla Desolación, moorland on ridge and summit of hill at head of Brazo Lobo, *Imshaug & Ohlsson 44842* (MSC).

Placopsis imshaugii is characterized by: the closely attached, rosette-forming thallus without a marginal prothallus, with a grey-brown to pinkish brown marginal zone and an orange-brown or rust-brown upper surface centrally, without isidia, maculae, pruina, pseudocyphellae or soredia; apothecia that are aspicilioid at first then becoming subthelotremoid, with a prominent thalline margin often obscuring the disc; a colourless hymenium 200–300 µm tall; cylindrical asci, 200–250 × 8–10 µm; broadly ellipsoidal ascospores, 25–30 × 15–18(–20) µm; filiform conidia, 27–32.5(–35) × 1 µm; and gyrophoric acid as principal secondary metabolite (together with traces of lecanoric acid and atranorin). A rust-coloured thallus is characteristic of several Southern Hemisphere species of *Placopsis* with the ability to accumulate iron from the substratum, a situation found also, though more widespread, in the genus *Porpidia* (Schwab 1986, Gowan 1989a, 1989b, Gowan & Ahti 1993, Fryday 2005), with taxa of the two genera often forming sympatric communities. *Placopsis imshaugii* is distinct from the following rust-coloured species: *Placopsis baculigera* I.M.Lamb is a Chilean endemic having distinctly swollen, convex lobes that are pale to dark cinnamon-buff to orange-brown, minutely papillate and with white, effigurate maculae; sessile apothecia with a thick, entire to striate-cracked or wrinkled thalline margin, a waxy, glossy, yellow-brown to dark-brown disc; and characteristic rod-shaped conidia 5–7.5(–10) × 0.5–1 µm. *Placopsis bicolor* (Tuck.) B.de Lesd. is an austral species known from southern Chile, Îles Kerguelen, Îles Crozet, Heard Island, Prince Edward Islands, North and South Islands of New Zealand and from South Georgia (Lamb 1947, Dodge 1948, Galloway 2001, 2002, 2007, Galloway *et al.* 2005, Øvstedal & Gremmen 2006, 2007). It is separated from *P. imshaugii* by differences in thallus morphology: *P. bicolor* has rather more convex lobes that are conspicuously rusty, orange-yellow to red-brown and lack a pale, grey-brown or pinkish brown marginal zone; the hymenium is shorter (160–240 µm); ascospores are smaller [(18–)20–24 × 10–15 µm]; and the chemistry is different, with minor amounts of gyrophoric acid and the major metabolites being either porphyrilic acid or cryptostictic acid, with differing trace amounts of pannaric acid, pannaric acid 2-methyl ester, stictic acid and alternariol methyl ether (J.A. Elix pers. comm. 2010). *Placopsis elixii* D.J.Galloway (Galloway 2001) is a New Zealand endemic that is often markedly rusty, orange-brown, especially when growing in exposed habitats. It is distinguished from *P. imshaugii* by the white, laminal pseudocyphellae, the distinctive surface maculation, the patches of glistening, white pruina on the lobe apices and on the surface of the cephalodia, and by differences in apothecial anatomy and ascospore size, those of *P. elixii* being (30–)31.5–36.5(–40) × (8.5–)10–12(–13.5) µm. *Placopsis lateritioides* I.M.Lamb is an austral species (Galloway 2007) that differs from *P. imshaugii* in having characteristic, grey-blue, scattered, laminal soralia, and it is very rarely fertile. It also has a differing chemistry of gyrophoric (major), stictic (minor) and norstictic (trace) acids.

Platismatia wheeleri* Goward, Altermann & Björk, *sp. nov. (Fig. 21C) Mycobank MB 517806

Platismatiae glaucae similis sed thallii linearibus et soraliis marginalibus latis densisque differt. Isidia absunt. Apothecia et conidiomata ignotae. Corticola.—http://www.eol.org./pages/Platismatia wheeleri

Type:—U.S.A. Montana: Missoula County, Mount Sentinel, 1 km E of the University of Montana, 45°51'N, 113°57'W, 1050 m, on branches of *Pseudotsuga menziesii*, March 2008, *Wheeler 2985* (holotype UBC).

Thallus foliose, up to 5–10 cm across, corticate above and below; lobes ascending, loosely attached from the base, proportionately rather broad, rounded to irregular in outline, mostly 6–20 mm wide, thin. Upper surface whitish, smooth to weakly pitted, without pseudocyphellae, matt or at any rate not distinctly shiny, I–. Soredia present, fine, powdery, uniform in size, borne in continuous long marginal soralia, also sometimes present over upper or lower surface in more or less circular soralia; marginal soralia strongly sinuous even when young. Lower surface varying from brown to more often black, usually with a reticulum of narrow raised ridges, dull to occasionally shiny toward the tips, lacking rhizines or with sparse unbranched rhizines. Upper cortex 16–26 µm thick, prosoplectenchymatous; medulla white, 100–170(–200) µm thick, lower cortex 100–150 µm thick, prosoplectenchymatous, I+ purplish; photobiont cells *Trebouxioid*. Apothecia and pycnidia unknown. Secondary chemistry: atranorin (cortex K+ yellow) and caperatic acid (by TLC).

Distribution and habitat:—Currently known only from western intermontane North America, north into southern British Columbia, and south to Washington, Idaho and Oregon. All specimens seen by us were collected from the branches of *Pinus ponderosa* and *Pseudotsuga menziesii*.

Etymology:—*Platismatia wheeleri* is named in honour of lichen photographer and taxonomist Timothy B. Wheeler, who first brought this species to our attention, and who contributed both the holotype and the accompanying photograph.

Additional specimens examined (paratypes):—CANADA. British Columbia: Fraser River Drainage, Siska Valley, 10 km S of Lytton, *Goward 09-88* (UBC). Idaho: Kootenay County, Q'emlin Park, 1 km W of downtown Post Falls, *Björk 14186* (UBC). Bonner County, University of Idaho Field Campus, trail to Antelope Lake, 1.5 km SE of town of Clark Fork, *Björk 14255* (UBC). Washington: Spokane Co., Riverside State Park, 6.5 km NW of downtown Spokane, *Björk 14132* (UBC). Shortly east of Highway 195, 43 km S of Spokane, *Björk* 19109 (UBC). Near intersection of Cahill and Kentuck Trails Roads, 31 km SSW of Spokane, *Björk 19187* (UBC). Riverside State Park, slopes above Deep Creek, 13 km NW of downtown Spokane, *Björk 19198* (UBC). Peone Prairie, near Moffat Road, 17 km NE of downtown Spokane, *Björk 20081* (UBC).

Platismatia is a well-known genus of 11 foliose lichens found primarily at temperate latitudes, mostly on trees (Culberson & Culberson 1968). It is characterized by the presence of large, whitish, more or less basally attached lobes and a white to black lower surface usually without rhizines. *Platismatia wheeleri* was formerly included in *P. glauca* (L.) W.L.Culb. & C.F.Culb., a highly variable lichen recognized by its broad lobes usually with at least some marginal isidia. In some specimens the isidia grade into soralia, leading to confusion with *P. wheeleri*. In *P. glauca*, however, the soredia vary in size and at least when young bear tiny dark apical initials ("eye spots"), giving the supporting soralia a minutely "speckled" appearance at ×40. The soredia of *P. wheeleri* are more uniform and lack "eye spots"; when exposed to light, they darken uniformly across the upper surface. Additionally, soredia of *P. wheeleri* are borne in more or less continuous marginal soralia that are strongly sinuous from the first, while in *P. glauca* soralia tend to be more discontinuous and become strongly sinuous, if at all, only later during their development. Both species also bear laminal soralia, though only *P. glauca* produces, in addition, "isidioid fruticose branches" as described by Culberson & Culberson (1968) and illustrated in Brodo *et al.* (2001: fig. 693). The holotype specimen of *P. wheeleri* was sequenced in connection with a separate study on *P. glauca s. lat.* (Goward & Altermann unpubl. data). The resulting sequence (ITS only) differed by eleven or more base pairs (10 sites) from 15 sequenced specimens of *P. glauca* available on GenBank. *Platismatia wheeleri* is also superficially similar to *Parmotrema praesorediosum* (Nyl.) Hale which differs, however, in the presence of smaller, more appressed lobes up to 10 mm across, a smooth lower surface, and production of medullary praesorediosic acid.

Porina huainamdungensis* Papong, Thammathaworn & Lücking, *sp. nov. (Fig. 21D) Mycobank MB 517807

Sicut Porina cupreola sed peritheciis pallide aurantiacis differt.—http://www.eol.org/pages/Porina huainamdungensis

Type:—THAILAND. Chiang Mai Province: Huai Nam Dung National Park, 19°14'N, 98°41'E, 1474 m, lower montane rainforest, February 2006, *Papong 2697* (holotype KKU).

Thallus epiphyllous, crustose, glabrous, dispersed into rounded, confluent patches, shiny, greenish grey, without visible prothallus, 15–20 µm thick. Photobiont *Phycopeltis*, with rectangular cells in radiating rows. Perithecia applanately lens-shaped, basal part spreading, pale yellow-orange, 0.2–0.3 mm diameter. Involucrellum light yellow, K+ orange; excipulum colourless, K+ yellowish; no algal layer between excipulum and involucrellum. Paraphyses unbranched. Asci fusiform, 65–75 × 8–10 µm, colourless, tholus I–. Ascospores 8 per ascus, colourless, fusiform, 7–septate, 24–28 × 3–4 µm.

Distribution and habitat:—Known from several collections in the lower montane rainforest of Thailand; typical of the forest understory.

Etymology:—Referring to the type locality in Huai Nam Dung National Park.

Additional specimen examined (paratypes):—THAILAND. Chiang Mai Province: Huai Nam Dung National Park, *Papong 2707* (KKU), *2714* (KKU), *2719* (KKU). Loei Province: Phu Kradueng National Park, *Papong 2061* (KKU).

Porina huinamdungensis is similar to *P. cupreola* (Müll.Arg.) F.Schill. in its small, lens-shaped perithecia and 7-septate ascospores, but the latter has dark red-brown perithecia and slightly longer ascospores. The Valdivian *P. fulvelloides* Lücking agrees with the new species in general appearance but has 3-septate ascospores. *Porina subapplanata* Malcolm, Vězda, P.M.McCarthy & Kantvilas is very similar but has larger perithecia and ascospores and appears to be a cool-temperate rainforest species of southeastern Australia, Tasmania, and New Zealand.

Ramalina hyrcana* Sipman, *sp. nov. (Fig. 21E–F) Mycobank MB 517808

A Ramalina farinacea simili differt soraliis lateralibus deorsum versis, acidum sekikaicum continens.—http://www.eol.org/pages/Ramalina hyrcana

Type:—IRAN. Golestan: Gonbad-e-Kavus district, along road from Khan Bebin to Shirabad waterfall, 120 m, deciduous forest with *Parrotia persica* and *Carpinus*, on *Pterocarya* trunk, October 2007, *Sipman et al. 55201* (holotype IRAN, isotypes B, hb. Sohrabi 9432).

Thallus forming bushy cushions 1–4 cm thick, densely and often dichotomously branched from a simple base into strap-shaped, 0.2–1 mm wide lobes; lobes flat with rounded margin, surface sometimes slightly striate; pseudocyphellae absent; often with tiny, 0.5–1 mm long and ca. 0.1 mm wide, fragile branchlets with hooked tip, mainly towards the lobe tips, sometimes also on the soralia; soralia present, mainly marginal, round to elongate with somewhat raised thalline rim, to ca. 0.5 × 0.2 mm in size, the larger ones turned downward so that the soredia are mainly produced on the underside of ± horizontal lobes. Apothecia and pycnidia unknown. Secondary chemistry: usnic acid (trace, cortical), sekikaic acid with traces of related substances (medullary).

Distribution and habitat:—So far *Ramalina hyrcana* is known only from the Hyrcanian forest area along the Caspian coast in Iran, between 10 m (sea level) and ca. 400 m, where it grows on tree trunks and can stand considerable shade.

Etymology:—The epithet refers to the forest type where this species is found.

Additional specimens examined (paratypes):—IRAN. Gilan: Prope Enseli ad mare Hyrcanum, April 1902, *Bornmüller (Iter Persicum alterum) s.n.* (B). Mazandaran: Zirab, between Khalil Kola and Zebh Valley,

Valadbeigi 19 (B). Tonekabon, She-hezar towards Lireh-sar, *Maassoumi 2105* (B, TARI). Zirab, Amlak Valley, *Valadbeigi 11, 17* (B). Northern Khorasan: Darkesh, Nargesli, *Hadjmoniry 1905* (B, FUMH).

Ramalina hyrcana is sympatric with *R. farinacea* and *R. pollinaria* and strongly reminds one of these species by its deeply divided thallus with strap-like lobes and marginal soralia. It is distinguished from both by the presence of sekikaic acid and down-turned soralia. The soredia-producing surface of the soralia is directed downward, at least in the larger soralia, giving the branches a dorsiventral aspect uncommon in *Ramalina*. In *R. farinacea*, soralia are lateral and remain so, not becoming turned downward; in Iran strains with protocetraric, salazinic and norstictic acid are known. *R. pollinaria*, also known from Iran, contains evernic acid and has less regularly divided thalli with often wider lobes, to 3 mm; its soralia, which may sometimes be turned downward, become often granular. The new species agrees with *R. nervulosa* (Müll.Arg.) Des Abb. and *R. peruviana* Ach. in its chemistry, thallus shape and presence of soralia (Krog & Swinscow 1976, Swinscow & Krog 1988; own TLC observations). It differs from both in its down-turned soralia. *R. nervulosa* is mainly confined to tropical regions, although it is reported from Yemen (Sipman 2002). *R. peruviana* has mostly cylindrical lobes (Stevens 1987, Swinscow & Krog 1988).

Ramalina stoffersii* Sipman, *sp. nov. (Fig. 22A) Mycobank MB 517809

*A Ramalina dendroide persimili differt soraliis farinosis, acido salacinico absente et acido divaricatico presente.—*http://www.eol.org/pages/Ramalina stoffersii

Type:—NETHERLANDS ANTILLES. Saba: Lower Hell's Gate, trail head of trail to Sulphur Mine, 17°39'N, 63°14'W, 300 m, steep slope with scrub and rock outcrops, on andesite rock, March 2007, *Buck 54767* (holotype NY, isotype B).

Thallus pale yellowish green, 3–10 cm high, forming ca. 3–20 cm wide, rather intricate, subpendulous cushions; prothallus spreading and giving rise to swarms of thallus lobes, but often decayed and the thallus attached by secondary attachment spots on the thallus lobes; thallus lobes linear, rather regularly dichotomously branched up to over 10 times over their whole length, applanate, ca. 1–2 mm wide and ca. 0.3 mm thick, with flat to slightly convex sides, rarely in part canaliculate or subcylindrical; pseudocyphellae present, linear, mainly on the lobe margins and there to over 1 cm long and causing the lobes to become rectangular in section, also frequent on the sides but there shorter and rarely over 2 mm long; lobe upper parts and tips sometimes with minute lobules, often densely branched, about 0.1 mm wide, to over 1 mm long, with hooked tips; soralia present, marginal, farinose, rounded to elongate, ca. 0.2–0.5 mm in diameter, sometimes warty, with ca. 50 µm wide soredia. Apothecia and pycnidia unknown. Secondary chemistry: usnic and divaricatic acids.

Distribution and habitat:—Known from the Lesser Antillean islands of Saba and St. Maarten/St. Martin and from Puerto Rico (Landron 1972). The species occurs in maritime environment below ca. 500 m, mainly on andesite boulders and stone walls among cultivated fields, once one a trunk of a *Mammea americana* tree. Perhaps it is more commonly epiphytic in more natural vegetation.

Etymology:—The new species is named after the late A. L. Stoffers (Utrecht, The Netherlands), who raised my interest in Antillean lichens.

Additional specimens examined (paratypes):—NETHERLANDS ANTILLES. Saba: Windwardside, 17°38'N, 63°14'W, 400 m, *Sipman 15176* (B). Along path Windwardside-Rendez Vous, *Sipman 15185* (B), *15238* (B). Hell's Gate, on steep N-facing slope above the sulphur mine, *Sipman 15384* (B). North Coast trail from parking area in Lower Hell's Gate to Crab Rock, mostly within Saba National Park, *Buck 50882* (NY), *50884* (NY). Village of Windwardside, *Buck 50942* (NY). St. Maarten: Dutch Cul de Sac, Emilio Wilson estate, Sentry Hill, *Buck 50963* (NY).

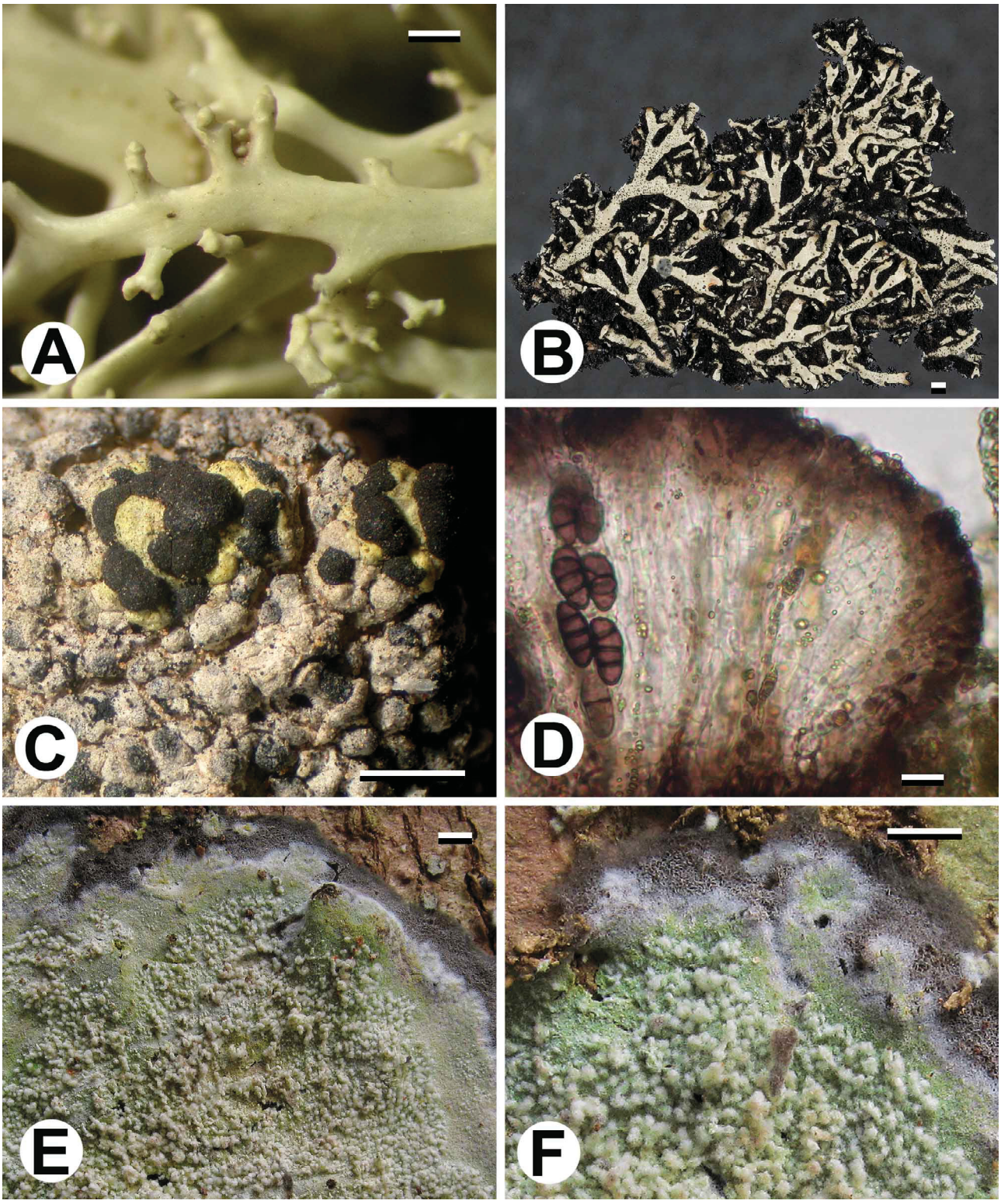

FIGURE 22. A. *Ramalina stoffersii* (holotype), lobe fragment with soralia. B. *Relicina colombiana* (holotype), thallus. C–D. *Rhizocarpon diploschistidina* (*McCune 29900*). C. Habit. D. Hymenium in water. E–F. *Sagenidiopsis isidiata* (holotype), thallus with pseudoisidia. Scale in A–C, E, F = 1 mm, in D = 10 µm.

Ramalina is among the largest genera of macrolichens but nevertheless new species are still being discovered regularly. The Antilles, where *R. stoffersii* was discovered, are promising for diversity in the genus *Ramalina*, because the genus as a whole shows considerable insular endemism, e.g., on the Canary Islands (Krog & Osthagen 1980), the Galápagos Islands (Aptroot & Bungartz 2007), and St. Helena (Aptroot 2008).

Moreover, the Neotropics in general, in spite of some regional treatments (Kashiwadani 1987, Kashiwadani & Kalb 1993) appear to be very incompletely explored, as suggested by, e.g., the published results from unfinished studies in Venezuela by Morales Méndez and collaborators (Marcano & Morales Méndez 1994). The representation of the genus on the Antillean Island of Puerto Rico has received considerable attention (Landron 1972, Harris 1989), and most of the specimens collected by the author on the islands of Saba and St. Eustatius fit the indicated species well. Only one group of specimens lacked description because it was misunderstood, and it is described here. *Ramalina stoffersii* is morphologically very similar to *R. dendroides* Nyl., which grows in the same localities. In fact, Landron (1972) was already aware of its existence but treated it as a chemically deviant population. The specimens collected on the Antillean islands Saba and St. Eustatius made clear that it involves two distinct species with a different mode of vegetative reproduction. *R. stoffersii* is a truly sorediate species producing soredia in rounded, marginal, sometimes slightly tuberculate soralia. *R. dendroides* produces larger, corticate granules on top of short, ca. 1–2 mm long, cylindrical, lateral branchlets. These morphological differences may be obscured in poorly developed specimens and much abraded herbarium material. The combination of linear thallus lobes with marginal soralia and divaricatic acid seems to occur otherwise only in *R. nervulosa* (Müll.Arg.) Des Abb. (Stevens 1987), but that species lacks the prominent marginal peudocyphellae and has larger, more elongate and excavate soralia. The primary species related to both *R. dendroides* and *R. stoffersii* is probably *R. peranceps* Nyl., or if one prefers to consider this a chemical strain, *R. anceps* Nyl. The presence of divaricatic acid was tested in all listed specimens and confirmed by cochromatography with *Evernia divaricata* (L.) Ach. using standard TLC procedure (Orange *et al.* 2001; solvents A, B' and C).

Relicina colombiana **Elix & Sipman, *sp. nov.*** (Fig. 22B) Mycobank MB 517810

Sicut Relicina subabstrusa sed diminuta, lobis angustioribus et lobulatis et acidum sticticum et acidum constictícum continente differt.—http://www.eol.org/pages/Relicina colombiana

Type:—COLOMBIA. Bogotá D.C.: Páramo de Chisacá, along the road Usmé-Nazareth, highest point of road at Laguna Grande, 3700 m, on rock outcrops on hill slope with *Espeletia* vegetation, September 1984, *Aguirre & Sipman 5032* (holotype B, isotypes CANB, COL).

Thallus small foliose, adnate to tightly adnate, 1–3.5 cm wide. Lobes separate or rarely sparingly imbricate, dichotomously branched, linear-elongate, 0.2–1.0 mm wide, lobulate; lobules marginal, sublinear, simple or rarely dichotomously branched, 0.05–1.0 mm wide; apices pointed to subtruncate; bulbate cilia conspicuous, forming a dense marginal fringe, simple or often furcate, black. Upper surface pale yellow-green, ±flat, shiny at the apices, smooth to rugulose, emaculate, without isidia. Medulla white. Lower surface black; rhizines sparse, black, simple then becoming densely entangled. Apothecia not seen. Pycnidia common, black, immersed; ostiole punctiform, to 0.1 mm wide. Conidia bacilliform, ca. 3 × 1 µm. Secondary chemistry: usnic acid (major), norstictic acid (major), stictic acid (submajor), constictic acid (minor), salazinic acid (trace), cryptostictic acid (trace), peristictic acid (trace), connorstictic acid (trace).

Distribution and habitat:—Restricted to saxicolous substrata in the paramos of the Eastern Cordillera of Colombia (3700–4315 m elevation).

Etymology:—The epithet refers to the geographic distribution of this species.

Additional specimen examined (paratype):—COLOMBIA. Boyaca: Sierra Nevada del Cocuy, Boqueron de Cusirí, *Cleef 8816b* (B, COL).

In overall morphology and chemistry this new species resembles *Relicina subabstrusa* (Gyeln.) Hale, but it is distinguished in having a smaller thallus (1–3.5 cm wide versus 4–8 cm) with narrower lobes (0.2–1.0 mm wide versus 0.5–2.0 mm) which bear dense marginal lobules (*R. subabstrusa* is elobulate), and in containing medullary stictic and constictic acids in substantial amounts. By contrast, *R. subabstrusa* contains only norstictic acid and connorstictic acids in the medulla (Elix 1995). *Relicina subabstrusa* is common and

widely distributed in north-eastern Australia, Southeast Asia, South America (Brazil, Guyana and Paraguay) and the Indian Ocean (Comoro Is.) where it occurs on the trunks and branches of trees in a broad range of habitats, from mangroves at sea level to forests at mid elevation (850 m). By contrast, *R. colombiana* is restricted to quartzitic rock in the páramo zone of the Eastern Cordillera of Colombia (3700–4315 m elevation). Yellow and white species of *Hypotrachyna*, such as *H. flavida* (Zahlbr.) Hale and *H. physcioides* (Nyl.) Hale, are very common on the mossy quartzite rocks in the páramo belt of the Colombian Andes, and *R. colombiana* was at first confused with this genus. It differs in having stout, bulbate cilia which form a marginal fringe. Ciliate margins may occur on lobules of some *Hypotrachyna* species, but the the cilia are never bulbate. Further, the new species differs chemically from known species of *Hypotrachyna* (Sipman *et al.* 2009).

Rhizocarpon diploschistidina* McCune, *sp. nov. (Fig. 22C–D) Mycobank MB 516796

Species lichenicola, hospes Diploschistes muscorum; sicut Rhizocarpon malenconianum sed thallo crasso flavo et acidum rhizocarpicum continente differt.—http://www.eol.org/pages/Rhizocarpon diploschistidina

Type:—U.S.A. Oregon: Gilliam County, Fourmile Allotment of Bureau of Land Management, SW of Fourmile Road, 45°37'N, 120°03'W, 258 m, with *Pseudoroegneria spicata, Poa secunda*, and *Festuca octoflora*, on *Diploschistes muscorum* on silty soil, summit of low ridge, May 2009, *McCune et al. 29990* (holotype OSC, isotypes UPS, US).

Thallus areolate, very pale yellowish tan to an intense fluorescent yellow, forming small yellow mounds of areoles on *Diploschistes*; areoles first appearing as a yellowing surface of the *Diploschistes*, later protruding as a convex mound with a diffuse margin, ultimately forming discrete but contiguous areoles; apothecia black, lacking a thalline margin; to about 1 mm diameter, developing centrally or marginally on the areoles, circular to irregular in outline, becoming compound or confluent; spores dark brown, 16–18 × 7–8 µm , mostly 4-celled (occasionally more or less), the septation and outline often slightly asymmetrical or irregular; epihymenium dark brown; hymenium with POL+ granules; hypothecium dark brown. Secondary chemistry: rhizocarpic acid (lecanoric and diploschistesic acids also detected by TLC in two of three specimens, but these are presumably from the host); cortex P–, K–, C–, KC–, UV+ orange; medulla P-, K-, C- , KC- or KC+ pink (from underlying *Diploschistes*?), IKI– or partly IKI+ bluish (from underlying *Diploschistes*?), UV–.

Distribution and habitat:—So far known only from shrub steppe and grasslands in central Washington and north-central Oregon, overgrowing *Diploschistes muscorum* on soil and grass stubble in little-grazed areas with well-developed biotic crusts.

Etymology:—The epithet refers to the apparently obligate host, *Diploschistes*.

Additional specimens examined (paratypes):—U.S.A. Oregon: Deschutes Co., from Highway 97 in Terrebonne, *Root 1820* (OSC). Gilliam Co., above Eightmile Canyon, low ridge, *McCune 29999* (OSC). Wheeler Co., 6 km E of the John Day River, off Highway 218, near John Day Fossil Beds State Park, *Rosentreter 6518* (herb. Rosentreter). Washington: Yakima Co., Bureau of Land Management, *Ponzetti 1582* (OSC). Benton Co., Horse Heaven Hills, *Ponzetti 955a, 1149a, 1189, 1245, 1285a, 1291b, 1308b, McCune 24291* (all OSC).

Spores and apothecia of *R. diploschistidina* are very similar to those of *R. malenconianum* (Llimona & Werner) Hafellner & Mayrh. In fact, *R. diploschistidina* was first reported from North America as *R. malenconianum* (McCune & Ponzetti 2005, McCune & Rosentreter 2007), but that species apparently should be removed from the North American checklist. The author thanks Josef Hafellner for pointing out the consistent absence of a distinct thallus in *R. malenconianum*. Furthermore, *R. malenconianum* occurs on *Diploschistes diacapsis* on gypsiferous soils in Spain and North Africa (Llimona & Werner 1975, Casares-Porcel *et al.* 1994), while *R. diploschistidina* occurs on *D. muscorum* on noncalcareous silt loams and loams

in North America. It is similar in appearance to *Epilichen scabrosus* (Ach.) Clem. *ex* Hafellner, but that species occurs on *Baeomyces* rather than *Diploschistes*. These differ in that spores of *Epilichen* are 2-celled, while *R. diploschistidina* is usually 4-celled and thickly halonate.

Sagenidiopsis isidiata* G.Thor, Elix, Lücking & Sipman, *sp. nov. (Fig. 22E–F) Mycobank MB 517811

*Differt a Sagenidiopse undulata pseudoisidis numerosis, simplicibus, usque ad 0.8 × 0.5 mm.—*http://www.eol.org/pages/Sagenidiopsis isidiata

Type:—GUATEMALA. Baja Verapaz: Biotopo del Quetzal, road CA-14, 3 km SE of Purulha, Sendero Corto (Los Helechos) trail, 15°13'N, 90°13'W, 1600–1800 m, montane rain forest with *Podocarpus oleifolius*, *Hieronia guatemalensis*, *Oreomunnia guatemalensis*, *Ocotea* spp., May 2008, *Lücking & Rivas Plata 25511* (holotype F, isotypes BIGU, UPS).

Thallus up to 10 cm diameter, usually several thalli of different size growing intermixed, rather loosely appressed to the substrate, byssoid, not flaking off, cream-coloured to greyish; in section up to 0.4 mm thick, hyphae 3–5 µm wide, without calcium oxalate crystals. Hypothallus below the entire thallus, byssoid, dark brown to blackish brown, composed of 3–4 µm wide hyphae. Prothallus prominent, up to 5 mm wide, byssoid, composed of interwoven and radiating hyphae, dark chocolate brown. Pseudoisidia numerous, cylindrical, unbranched or sparsely branched, fluffy-felty with projecting hyphae, of same colour as thallus or slightly paler, up to 0.8 × 0.5 mm. Photobiont cells single or in short, irregular threads, 23–31 × 17–25 µm. Ascomata and pycnidia not seen. Secondary chemistry: C+ red, K–, PD–, UV+ white, I–, K/I–; diploschistesic acid [major] and lecanoric acid [minor] (*P. & B. v.d. Boom & V. Freire 33413*, HPLC by J. Elix).

Distribution and habitat:—*Sagenidiopsis isidiata* is known from a few but widely distributed localities in Central and South America. The species is corticolous in tropical montane rainforests.

Etymology:—The new species is named after the pseudoisidia frequently occurring on the thallus surface. Note that *Sagenidiopsis undulata* incorrectly is referred to as *undulatum*, e.g. in Egea *et al.* (1995), Cáceres (2007) and *Index Fungorum* (http://www.indexfungorum.org/Names/Names.asp).

Additional specimens examined (paratypes):—GUATEMALA. Baja Verapaz: SSE of Coban, SE of Purulhá, Biotopo Mario Dary Rivera (Biotopo del Quetzal), Fern trail, including the area of the biological station, 1700 m, August 2004, *P. & B. v.d. Boom & V. Freire 33413* (herb. P. v.d. Boom, UPS). HAITI. Dept. De l'Ouest: ridge north of Foret des Pins (Shada station), near border of Dominican Republic, 1770 m, July 1958, *Imshaug & Wetmore 2900* (H). VENEZUELA. Mérida: Finca San Eusebio, La Carbonera, cercanías de Mérida, 2200 m, March 1978, *Lopez-Figueiras & M. Keogh 15530* (S). ECUADOR. Zamora-Chinchipe: Nature Reserve of Estacion Cientifico San Francisco, S of road Loja-Zamora, ca. 40 km from Loja, 2025 m, June 2004, *Sipman 52623* (B-600148395, LOJA). Cordillera Numbala, Reserva Biologica San Francisco, S of road Loja-Zamora, June 2004, *Sipman 52600* (B-600148375, LOJA); ibid., July 2004, *Sipman 53148* (B-600148848, LOJA).

This puzzling species has been known to the first author for at least 20 years. As the generic position has been unclear, it has until now remained undescribed. It is superficially similar to other byssoid genera in the Arthoniales like *Crypthonia*, *Dichosporidium*, and *Herpothallon sensu lato*. *Crypthonia* and *Herpothallon* both have thalli reacting K/I+ patchily blue in 0.2% and 1% aqueous iodine solution (Frisch & Thor 2010, Frisch *et al.* 2010) and *Dichosporidium* has thalli that at least sometimes are sparsely squamulose, a chemistry with depsidones of the β-orcinol series and when pseudoisidia are present, these are more compact (Thor 1990). Otherwise, *Dichosporidium nigrocinctum* (Ehrenb.Fr.) G.Thor resembles the new species in thallus morphology and coloration. The genus *Sagenidiopsis* in South America until now only includes *S. undulata* (Fée) Egea, Tehler, Torrente & Sipman (Egea *et al.* 1995, Cáceres 2007), a species previously included in *Byssophoropsis* (Tehler 1993). *Sagenidiopsis undulata* has apothecia, lacks pseudoisidia and has a similar secondary chemistry including lecanoric acid and an unidentified pinkish spot (Tehler 1993). The presence of

diploschistesic acid in *S. isidiata* is surprising as this substance previously has only been found in *Diploschistes* species.

Sticta venosa* Lücking, Moncada & Robayo, *sp. nov. (Fig. 23A–C) Mycobank MB 517812

Sicut Sticta filicinella sed thallo foveolato isidiate et tomento venoso differt.—http://www.eol.org/pages/Sticta venosa

Type:—ECUADOR. Pichincha: Río Guajalito Protected Forest, 0°09'S, 78°39'W, 1800 m, montane rainforest, on ground between mosses, September 2008, *Lücking 26252* (holotype QCNE, isotype F).

Thallus growing on the ground between mosses and hepatics, up to 15 cm diameter, individual lobes up to 10 cm long, linear to slightly flabellate, 3–5 mm wide, much branched especially towards the tip; upper and lower surface strongly and reticulately ridged, appearing faveolate. Photobiont cyanobacterial (*Nostoc*). Upper surface blue-grey with brownish tinge when fresh, pale brownish grey when dry, glabrous; lower surface white to yellowish white, glabrous except for thin lines of dark brown tomentum growing on top of the ridges and forming distinct, thin, radiating veins; tomentum up to 2 mm thick, formed by strongly branched and partly conglutinated hairs with cylindrical cells; cyphellae scattered, minute, up to 0.15 mm diameter, with pore-like opening (thelotremoid), white, K–. Lobe margins much incised and crenulate, with tufts of up to 0.5 mm long, dark brown hairs growing from the incisions especially at the lobe tips; lobe margins otherwise and towards the thallus center forming numerous marginal isidia, isidia terete to flattenend, unbranched to branched and partly resembling phyllidia, 0.05 mm wide and up to 0.5 mm long, of the same colour as the upper lobe surface. Upper cortex paraplectenchymatous, consisting of 1–2 cell layers, 15–25 µm thick, hyaline; cyanobacterial layer 25–50 µm thick; medulla composed of longitudinally oriented, more or less compacted hyphae, up to 100 µm thick; lower cortex paraplectenchymatous, consisting of a single cell layer from which the tomentum emerges, 15–25 µm thick, brown, cells with rounded outer surface. Apothecia not observed. Secondary chemistry: no substances detected by TLC; thallus and medulla C–, K–, P–.

Distribution and habitat:—The species is known from a rich collection from the type locality, growing in the shaded understory of a montane rainforest.

Etymology:—The epithet refers to the distinct veins formed by the ridges and the tomentum following the ridges on the lower side.

This new species is similar and closely related to *Sticta filicinella* Nyl., which agrees in the substrate and general lobe morphology including the cyanobacterial photobiont. We examined an isotype of the collection cited in the protologue of *Sticta filicinella* and the specimen also exhibits the thin white veins on the lower surface partially covered with lines of brown tomentum; that material lacks isidia but bears apothecia instead. *Sticta venosa* can therefore be considered the isidiate counterpart of *S. filicinella*. The distinctly ridged and foveolate lobe surface forming veins on both sides and the tomentum on the lower side following these veins give the appearance of a *Peltigera* or a *Lobaria* of the *L. peltigera* group. The new species somewhat resembles the enigmatic submersed lichen formerly known as *Hydrothyria venosa* J.L.Russell (*Peltigera hydrothyria* Miadl. & Lutzoni), but can immediately be separated by its terrestrial ecology and the presence of cyphellae on the lobe underside.

Tapellaria albomarginata* Lücking, *sp. nov. (Fig. 23D–E) Mycobank MB 517813

Sicut Tapellaria leonorae sed ascosporis minoribus 3-septatis differt.—http://www.eol.org/pages/Tapellaria albomarginata

Type:—COSTA RICA. Puntarenas: Isla del Caño Biological Reserve, 8°42'N, 83°52'W, sea level, lowland rainforest, foliicolous, July 1992, *Lücking 92-3797* (F).

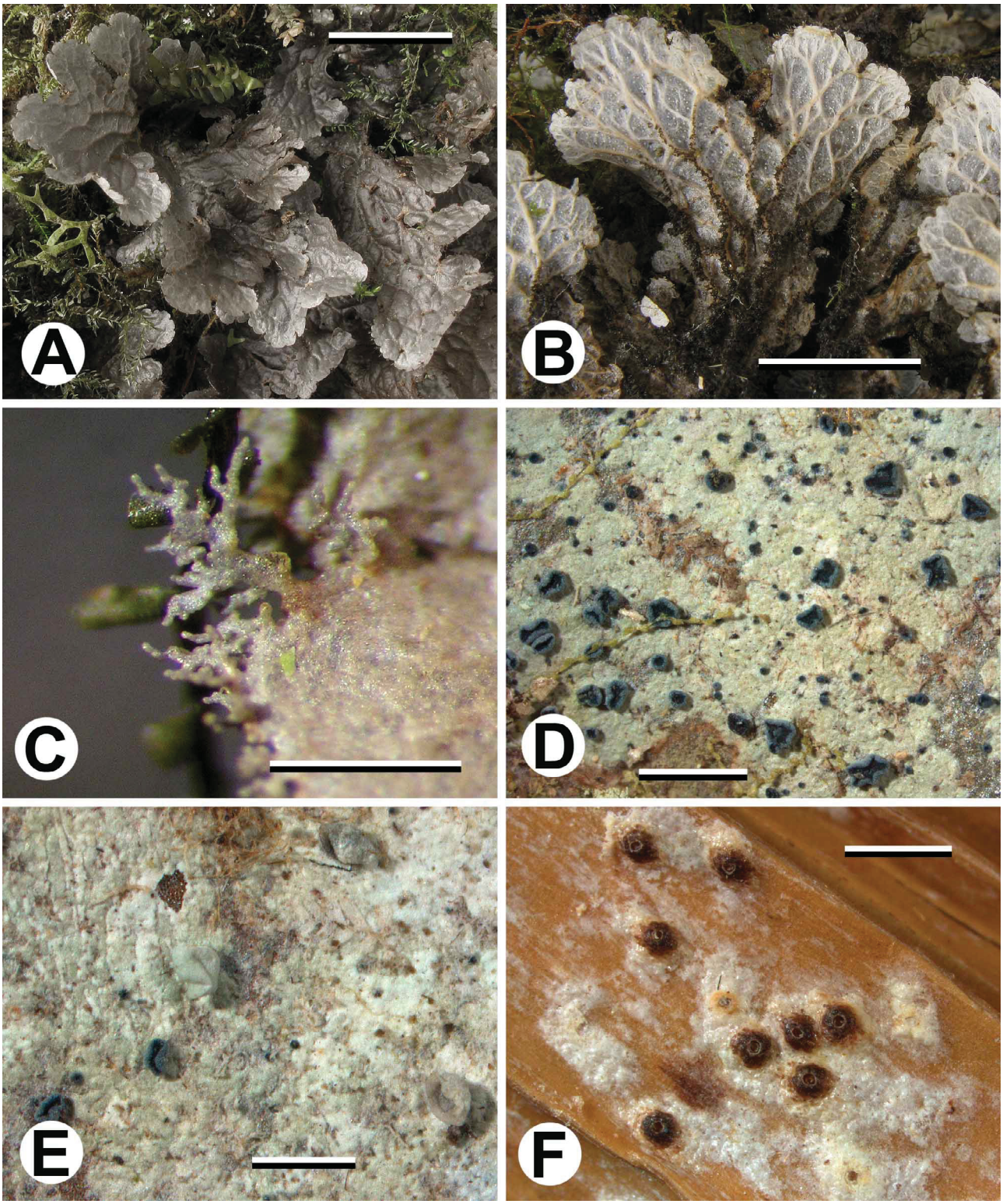

FIGURE 23. A–C. *Sticta venosa* (holotype). A. Thallus in situ. B. Thallus underside. C. Marginal isidia. D–E. *Tapellaria albomarginata* (holotype). D. Thallus with apothecia. E. Thallus with campylidia. F. *Thelotrema fijiense* (holotype), thallus with apothecia. Scale in A, B = 5 mm, in C = 0.5 mm, in D–F = 1 mm.

Thallus dispersed into rounded, partly confluent patches, 10–25 mm across and 10–15 µm thick, ecorticate, smooth, pale grey to white. Apothecia rounded to strongly irregular in outline, 0.3–0.5 mm diameter and 100–150 µm high; disc plane to slightly concave, black; margin thin, pale grey pruinose (in

necrotic specimens pure black). Excipulum 20–30 µm broad, pale brown. Hypothecium 20–50 µm high, dark brown, K+ purplish. Apothecial base dark purplish brown. Epithecium distinct, 5–10 µm high, dark aeruginous brown. Hymenium 50–60 µm high, colourless. Asci 40–50 × 10–15 µm. Ascospores (6–)8 per ascus, ellipsoid, 3(–4)-septate, 14–20 × 3–6 µm, 3–5 times as long as broad, colourless. Campylidia sessile, 0.3–0.5 mm broad; lobe well-developed, hood-shaped, pale grey to white pruinose; socle not apparent. Conidia filiform with slightly clavate apex, usually enrolled, 3–7-septate, 20–40 × 2–2.5 µm, associated with scattered algal cells. Chemistry: no substances detected by TLC.

Distribution and habitat:—Neotropics, apparently confined to coastal lowland areas.

Etymology:—The epithet refers to the white-pruinose apothecial margin.

This species was considered conspecific with the paleotropical *Tapellaria bilimbioides* R.Sant. (Lücking 2008). However, after further revision of the available material, it appears that the neotropical populations consistently have a slightly prominent and irregular, white-pruinose apothecial margin, whereas the few available paleotropical collections have apothecia with a non-pruinose, black, flush margin. *Tapellaria albomarginata* thus differs from *T. bilimbioides* in the same way as *T. nana* (Fée) R.Sant. differs from *T. epiphylla* (Müll.Arg.) R.Sant. or *T. leonorae* M.Cáceres & Lücking from *T. nigrata* (Müll.Arg.) R.Sant. (Lücking 2008). The new species is externally most similar to *T. leonorae*, which has much larger, 7-septate ascospores.

Thelotrema fijiense **Lumbsch, Lücking & Naikatini, *sp. nov.*** (Fig. 23F) Mycobank MB 517814

Sicut Thelotrema subtile sed ascomatis brunneis et ascosporis minutis differt. http://www.eol.org/pages/Thelotrema fijiense

Type:— FIJI. Taveuni Island, access road to summit of Devo Peak, 16°51'S, 179°58'E, April 2008, *Lumbsch 19813c* (holotype SUVA, isotype F).

Thallus epi- to hypophloedal, thin, whitish grey, pale olive to brown around ascomata. Thallus dull to shiny, smooth, continuous. Protocortex discontinuous, up to 20 µm thick. Algal layer continuous, crystals sparse, small. Vegetative propagules not seen. Ascomata 0.2–0.4 mm in diameter, roundish, apothecioid, solitary to rarely marginally fused, semi-emergent to emergent, flattened-hemispherical. Disc often becoming partly visible, greyish to pale flesh-coloured, slightly pruinose. Pores small, up to 0.25 µm in diameter, roundish to slightly irregular, entire to slightly split, proper exciple apically visible from surface, whitish to off-white, incurved. Thalline rim margin thin, becoming wide to rarely gaping with age, roundish to irregular-roundish, entire, olive-brown to brown. Proper exciple becoming free, at least partly, hyaline to pale yellowish internally, yellowish brown marginally, amyloid at the base. Hymenium up to 140 µm high, clear, conglutinated, paraphyses moderately interwoven, unbranched to slightly branched, tips slightly thickened, lateral paraphyses present, inconspicuous, up to 30 µm long, columellar structures absent. Epihymenium hyaline to brown, granulose. Asci 8-spored, tholus thick narrowing at maturity. Ascospores transversely septate, cell walls thick, smooth, non-halonate, hyaline when young, becoming brown at maturity, faintly amyloid, fusiform, ends roundish to acute, loci angular to roundish, 19–27 × 5–7 µm with (7–)9(–11) septa. Pycnidia not seen. Secondary chemistry (HPTLC): no substances (all spot tests negative).

Distribution and habitat:—This new species is only known from the type locality in Taveuni Island (Fiji), where it grows on twigs in a cloud forest at 800 m elevation.

Etymology:—The name refers to the archipelago of Fiji, where the type was collected.

Thelotrema is a large genus of crustose, mostly tropical-montane lichens in *Graphidaceae*, characterized by apothecia with a double margin and periphysoids projecting from the excipulum (Frisch 2006, Rivas Plata *et al.* 2010). *Thelotrema fijiense* is characterized by its whitish thallus with brown ascomata, and small, transversely septate ascospores that turn brown when mature. The species lacks secondary metabolites and is similar to *T. subtile* and *T. suecicum* (Lumbsch *et al.* 2008, Mangold *et al.* 2009). The latter differs in having

larger ascospores that remain hyaline and less emergent ascomata that are concolorous with the thallus. *Thelotrema subtile* agrees with the new species in having ascospores that turn brown, but is readily distinguished by having ascomata that are concolorous with the thallus and larger, halonate ascospores with more or less crenate cell walls. A further species of the *T. subtile*-group that may be confused with *T. fijiense* is *T. defossum* (Lumbsch *et al.* 2008). This species, however, differs in having halonate, hyaline ascospores that never turn brown, and in having inconspicuous, immersed ascomata.

Tricharia nigriuncinata **Yeshitela, Eb.Fischer, Killmann & Sérus.,** ***sp. nov.*** (Fig. 24A–B) Mycobank MB 517815

Ab omnibus speciebus generis Trichariae differt nigris setis in medio uncinatis.—http://www.eol.org/pages/Tricharia nigriuncinata

Type:—UGANDA. Budongo forest, 01°43'N, 31°32'E, ca. 1000 m, on living leaves on *Argomuellera macrophylla*, October 2005, *Yeshitela 16* (holotype LG).

Thallus epiphyllous, continuous, smooth, lacking crystals, thin, greyish green, up to 5 mm wide, furnished with abundant sterile setae. Photobiont chlorococcoid with cells green and globose, 5–8 µm diameter. Setae setiform, black, simple or usually furnished with 1–2(–6) horizontal or usually downwards bending hooks near their middle, slightly bending, up to 1.5 mm long and 0.04 mm thick at their base, black. Hyphophores not found. Apothecia usually absent, sometimes abundant, sessile, round, 0.1–0.2 mm diameter, ca. 75 µm high; disc light orange to almost translucid, opaque, plane without pruina; margin thin, non or slightly prominent, smooth, pale brown, usually darker than the disc. Excipulum gelatinized, prosoplectenchymatous, 20–30 µm thick, light brown. Hypothecium ca. 10 µm thick, hyaline. Epithecium 5–8 µm high, pale brown. Hymenium hyaline, 40–50 µm thick. Paraphyses branched and anastomosing, 1 µm thick. Asci broadly clavate, 1(–2)-spored, 50–65 × 35–50 µm. Ascospores muriform with numerous cells, ellipsoid, 40–55 × 15–25 µm, hyaline.

Distribution and habitat:—*Tricharia nigriuncinata* is typically a foliicolous species in the understory of dense rainforests; it is confined to undisturbed forests along the Albertine Rift, a major biodiversity hotspot in East Africa (Plumptre *et al.* 2007). It seems to be most common on the Western side of the Rift in Congo RDC.

Etymology:—The epithet refers to the characteristic hooks on the setae.

Additional specimens examined (paratypes): CONGO RDC. South Kivu: Irangi, rainforest by river Luhoho, *Lambinon 78/263, 269, 272, 273* (all LG). Kahuzi-Biega National Park, km 58 of Bukavu-Walikale road, *Lambinon 78/320* (LG). RWANDA. Nyungwe Forest National Park, near Kamiranzovu swamp, *Lambinon s.n.* (LG). Gisakura waterfall, December 2009, *Fischer s.n.* (KOBL). UGANDA. Budongo forest, *Yeshitela 65, 66, 71 & 75* (KOBL), *Sérusiaux s.n.* (LG).

Within the very diverse lichen family *Gomphillaceae*, the genus *Tricharia* is a well-delimited and coherent taxon (Lücking *et al.* 2005), with black setae as a distinct character. Indeed, black setae are otherwise known only in *Gyalectidium nashii, Paratricharia paradoxa* and in rare forms of *Arthotheliopsis floridensis* (Lücking *et al.* 2007, Lücking 2008). *Tricharia nigriuncinata* is easily recognized by its long and rather stiff setae usually furnished with 1–2(–6) hooks near their middle. *Tricharia demoulinii* Sérus. (known from Papua New Guinea and Thailand), *T. elegans* Sérus. (known from Papua New Guinea), and *T. substipitata* Vězda (known from Congo RDC) are the only other three species in the genus with hooked setae (Sérusiaux 1984, Vězda 1979, Papong *et al.* 2007). However, the hooks of these species are at the tip of the setae; in *T. substipitata*, the hooked setae may represent immature hyphophores as the thallus is otherwise furnished with very long, black hairs. The setae of *T. nigriuncinata* are similar to the white setae of *Aderkomyces armatus* (Vězda) Lücking, Sérus. & Vězda (Vězda 1975). *Tricharia nigriuncinata* is very similar with the widespread and pantropical *T. vainioi* R.Sant. and differs only in the hooks on the setae. We first considered it might be an

aberrant form of the latter, but we finally came to the conclusion that it represents a different species as both are sympatric in a restricted area in the Tropics (e. g. pristine forests in the Albertine Rift in Africa) and as *T. nigriuncinata* has never been observed in the large collections examined either from the Neotropics (Lücking 2008) or from Papua New Guinea (E. Sérusiaux unpubl. data).

Usnea galapagona **Truong & P.Clerc, *sp. nov.*** (Fig. 24C–F) Mycobank MB 518904

*Thallus erectus; basi leviter rubescens; ramuli irregulares; soralia punctiformia, interdum agregata vel conjuncta; cortex nitidus et valde crassus (proportione 16–18%); medulla valde tenuis (3–4.5%) et K– (substantiam incognitam et UV+ viridis continente).—*http://www.eol.org/pages/Usnea galapagona

Type:—ECUADOR. Galápagos Islands: Isla Sán Cristóbal, Cerro Mundo, at the top of the rock cliffs on the S side close to the summit, 00°53'S, 89°34'W, 282 m, transition zone with *Bursera graveolens*, *Croton scouleri* and *Jasminocereus thouarsii*, on *Jasminocereus thouarsii* on the ridge, August 2008, *Clerc & Truong 08-405* (holotype CDS, isotypes G, CMA: 16/3/61.5; chemistry: usnic acid, unknown medullary metabolite reacting UV+ green after charring).

Thallus fruticose, up to 8 cm long, erect and strongly shrubby, often with several attachment points. Base concolorous with thallus, usually with a reddish tinge. Branching distinctly anisotomic-dichotomous. Branches irregular to tapering, not constricted at their attachment point. Section of branches terete to slightly flattened or ridged. Terminal branches with few divisions and thickened at the tips. Fibrils few or absent. Papillae hemispherical, often numerous. Soralia minute, often aggregating in small packs or fusing and thus looking like a large single soralium, developing on top of papillae or directly on the cortex *ad initio*, remaining plane with a distinct cortical margin, rarely becoming slightly stipitate or efflorescent, but never excavating. Isidiomorphs present, very small. Apothecia not seen. Cortex thick (15.5–19.5% of branch width, n = 10), very hard and vitreous in longitudinal section of branch. Medulla compact, usually very thin and almost indistinct (3–4.5%), rarely thicker (up to 10%) close to the base. Axis very thick (54.5–62%). Medulla K–, C–, P–. Secondary metabolites detected by thin layer chromatography (n = 9): usnic acid and an unknown compound reacting UV+ green after charring (RF classes: solvent A = 6; B = 3; C = 5).

Distribution and habitat:—Endemic to the Galápagos Islands, so far known from Isabela, Sán Cristóbal and Santa Cruz Islands. This species usually grows on exposed habitats, for instance along ridges or on the slopes of the volcan's crater. It was found in the transition vegetation zone, seldom in the arid and humid zones. Substrate: on rocks, on cactus and more rarely on bark (for exemple trunks of *Bursera graveolens*).

Etymology:—The epithet refers to the location where this species was discovered.

Additional specimens examined (paratypes):— ECUADOR. Galápagos Islands: Isabela, Volcán Alcedo, *Aptroot 64769A* (CDS). Isabela, Volcán Darwin, SW slope, *Bungartz 7862B* (CDS). Sán Cristóbal, sector of the "gotera de agua", *Clerc & Truong 08-330* (CDS, G). Santa Cruz, N side of the island, *Aptroot 64568* (CDS

Usnea is a large genus of c. 350 mainly corticolous species Swinscow & Krog 1979, Clerc 1987, 2006, 2008, Halonen *et al*. 1998, Herrera-Campos *et al*. 1998, Ohmura 2001, Stevens 2004). The genus is characterized by the fruticose thallus, branches holding a central axis and the presence of usnic acid in the cortex (Clerc 1998). This new species, so far endemic to the Galápagos, is characterized by anisotomic-dichotomous branching, terminal branches with few divisions, the absence of fibrils and the minute soralia developing from low papillae or on the cortex of branches, often aggregating in packs or fusing. Anatomy in longitudinal section of branch is very characteristic, with a thick, very hard and vitreous cortex, a thick axis and a very thin, almost indistinct medulla. TLC analysis revealed the presence of a new unknown substance in the medulla, reacting UV+ green after charring. The cortex of *U. subscabrosa* Motyka (Herrera-Campos *et al.* 1998) is similar to *U. galapagona*, but the former species is pendulous, with a very different morphology, chemistry and ecology.

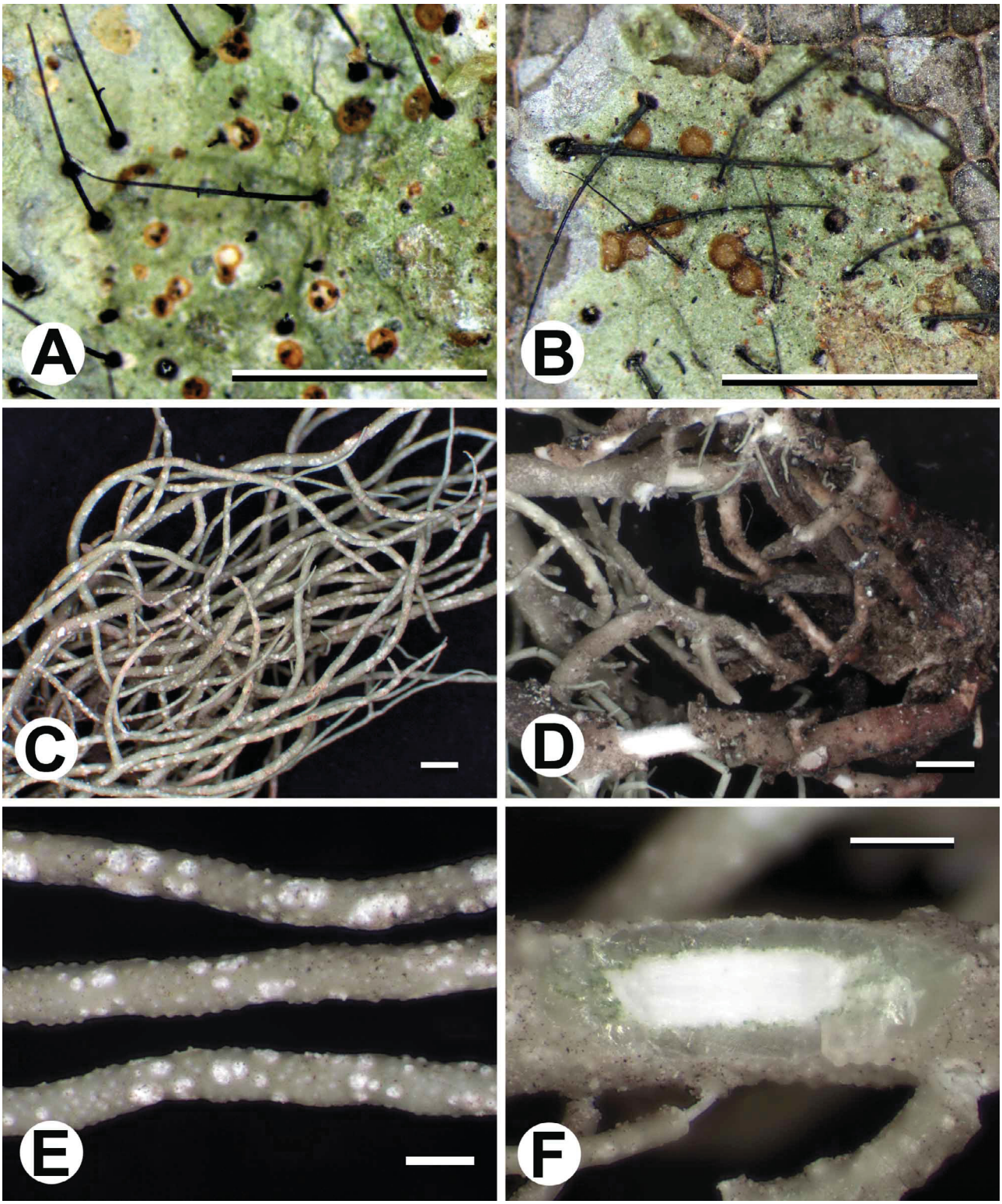

FIGURE 24. A–B. *Tricharia nigriuncinata* (A, holotype; B, *Yeshitela 71*), thalli with apothecia and setae. C–F. *Usnea galapagona* (holotype). C. Thallus showing irregular branches with few ramifications. D. Concolorous basis with a reddish tinge. E. Detail showing minute soralia, aggregating in small packs and developing on top of papillae. F. Detail showing thick and vitreous cortex, compact and almost indistinct medulla, and very large axis. Scale in A–D = 1 mm, in E, F = 500 μm.

Usnea pallidocarpa* Wirtz & Lumbsch, *sp. nov. (Fig. 25A–B) Mycobank MB 517816

A Usnea perpusilla ascomatis croceo-brunneis vel brunneis differt. http://www.eol.org/pages/Usnea pallidocarpa

Type:—ARGENTINA. Río Negro: Sán Carlos de Bariloche, Cerro Catedral, 41°16'S, 71°20'W, 1900 m, December 2003, *Wirtz & Messuti PA-25b* (holotype F).

Thallus approx. 5–7 cm, arising from a proliferating, unpigmented or brownish holdfast with main branches tapered towards the holdfast; erect, shrubby, subdichotomous to richly branched with terete branches; thallus surface yellow-green, conspicuously smooth and glossy, sparsely faveolated; main branches unpigmented, side branches ± variegated with bands of black pigment. "Compressed" morphotypes with thick, clawed, dark pigmented side branches occurring (as in *U. perpusilla*). Cortex annulations occurring. No papillae. Fibrils very rare. Medulla dense. Axis thick, occupying (34)–53–(71)% of branch diameter Soredia and isidiomorphs unknown. Apothecia frequent, subterminal, rarely terminal, occasionally in series; cupular, becoming mostly flat or undulate with maturity. Disc light yellow to brownish sometimes with black blotches or shaded; excipulum smooth, margin thin, often excluded, with few rays. Usneoid ascospores 8/ascus, simple, ellipsoid, hyaline, with no taxonomic value. Photobiont trebouxioid. Secondary chemistry (TLC): inconsistent hypostrepsilic acid chemosyndrome (Elix *et al.* 2007).

Distribution and habitat:—Known from just a single locality in the Andean Cordillera in southern South America (Argentina). It is an alpine species found at high elevations, about 1800 m, on rocks, in communities with *U. perpusilla*, *U. sphacelata* and *U. lambii*.

Etymology:—The epithet refers to the pale apothecial discs.

Additional specimens examined (paratypes):—ARGENTINA. Río Negro: Sán Carlos de Bariloche, Cerro Catedral, 41°16'S, 71°20'W, 1850 m, December 2003, *Wirtz & Messuti PA-24* (F).

Usnea pallidocarpa belongs to a small group of polar-alpine species formerly summarized in the subgenus *Neuropogon* (Walker 1985, Wirtz *et al.* 2008). This group is characterized by its fruticose growth form, a yellow-green thallus with varying black pigmentation, a black or rarely brown apothecial disc and saxicolous habitat (Walker 1985). The new species (referred to as *U.* aff. *perpusilla* in Wirtz *et al.* 2006 and as *Usnea* sp. 1 in Wirtz *et al.* 2008) is closely related to *U. perpusilla*, but is distinguished by its smooth almost glossy thallus surface, a thick central cord, a dense medulla and a yellow apothecial disc with a smooth excipulum. Given just the single collection of the species and having not collected at sites with similar habitats in the near surroundings, especially north of Sán Carlos de Bariloche, it is very likely that the species occurs more frequently in the Andean Cordillera. However, we were unable to find *U. pallidocarpa* and *U. perpusilla* about 1000 km further south in the El Chalten region in Santa Cruz.

Verrucaria rhizicola* Aptroot & Thüs, *sp. nov. (Fig. 25C–D) Mycobank MB 517817

Verrucaria corticola ad radicem Alnis saepe in aqua submergenti, thallo viridi, ascomatis superficialibus nigris, involucrellum dimidiatum, ascosporis reniformibus (10-) 12-15 µm longis. http://www.eol.org/pages/Verrucaria rhizicola

Type:—France. Pas de Calais, Forêt de Boulogne, plot 99, 1 May 2009, *Aptroot 68737* (holotype ABL).

Thallus corticolous, crustose, continuous with finely uneven surface appearing smooth from a distance, green, dull, remaining opaque when wet (not subgelatinous), 25–50 µm thick, covering areas of up to 2 cm diameter at the upper surface of roots, margins not delimited by a hypothallus, without blackened basal layer and without back dots. Cortex absent. Algae chlorococcoid, cells round or more often ellipsoid to angular, irregularly arranged in the thallus, ca. 5–10 × 7–15 µm. Ascomata superficial, black, shiny, 0.1–0.2 mm diameter, with black clypeus above that extends sideways as a saucer-like flat disc with a smooth surface, covering the upper 1/3 to 2/3 of the exciple in some perithecia or reaching the exciple base; exciple hyaline to

pale brown below. Ostiole 10–25 µm wide. Hamathecium consisting of unbranched periphyses of 7–10 × 2–3 µm in gel near the ostiole. Asci clavate, 25–40 × 9–15 µm. Ascospores 8/ascus, hyaline, long ellipsoid, asymmetrical with one side flattened, in some views kidney- or D-shaped, (10–)12–15 × 4.5–6 µm, on average 12 × 5 µm (25 measured). Pycnidia unknown.

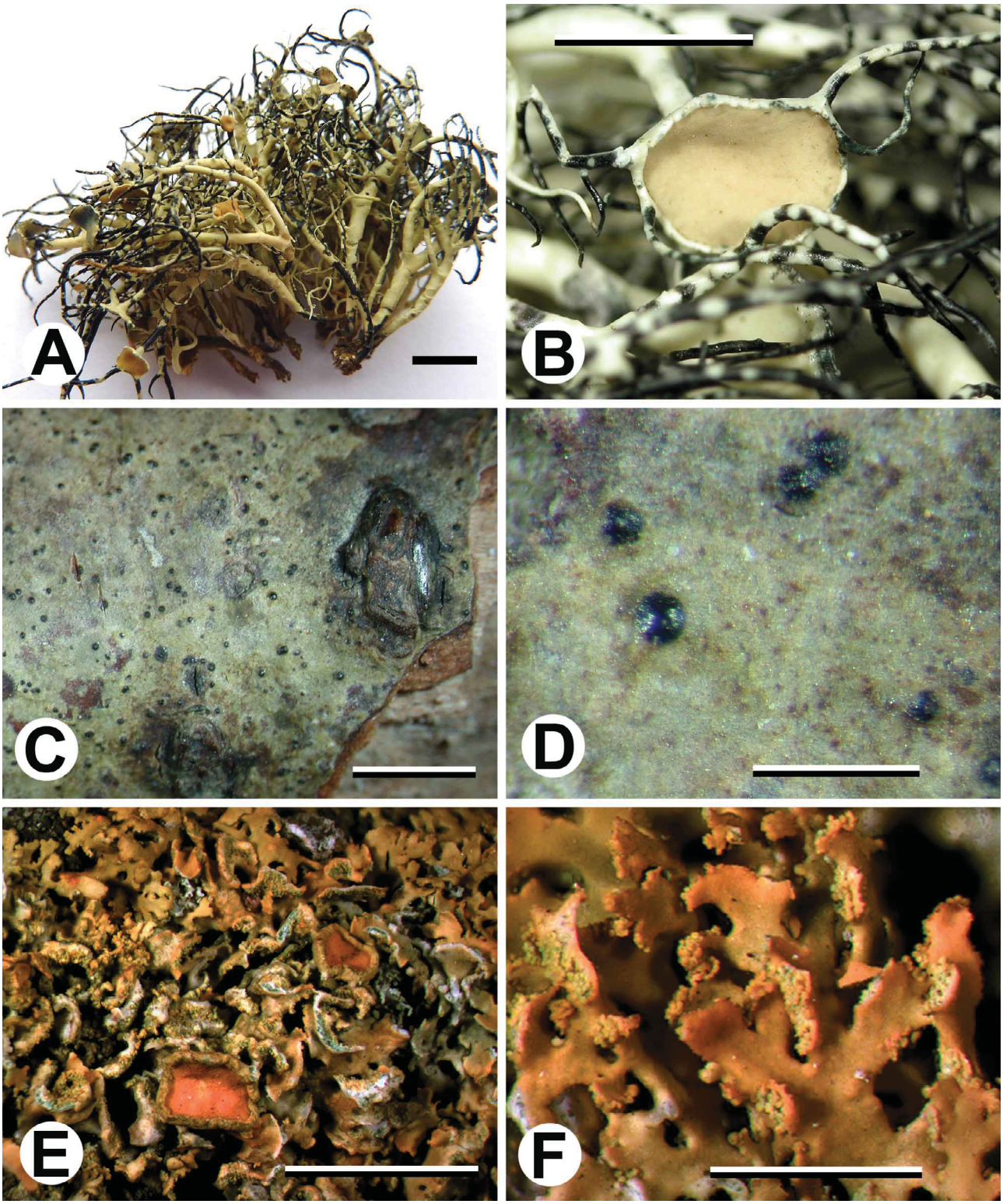

FIGURE 25. A–B. *Usnea pallidocarpa* (holotype). A. Thallus with apothecia. B. Apothecium enlarged. C–D. *Verrucaria rhizicola* (holotype). C. Thallus with perithecia. D. Perithecia enlarged. E–F. *Xanthomendoza rosmarieae* (isotype). E. General habit. F. Enlarged fragments with soredia. Scale in A = 10 mm, in B = 5 mm, in C, F = 1 mm, in D = 0.5 mm, in E = 3 mm.

Distribution and habitat:—Only known from the type from roots of *Alnus glutinosa* along small rivulet in temperate forest. Irregularly submersed in fresh water.

Etymology:—After the substrate.

Numerous aquatic species have been described in *Verrucaria*, but only 20 corticolous species are known (Lendemer & Breuss 2009). The special habitat is not a character *per se*, as for instance of the 22 lichen species found on submerged alder roots in Lithuania (Motiejunaite 2003) nine are known to be more widespread on rocks (Smith *et al.* 2009), amongst them distinctive species such as *Bacidia arnoldiana* Körb. and *B. inundata* (Fr.) Körb. Furthermore, some terrestrial saxicolous *Verrucaria* species, e.g. *V. muralis* Ach., are occasionally found on bark It remains to be seen whether not some of the *Verrucaria* which are described as strictly corticolous, like *V. viridigrana* Breuss, are not in fact occurrences of species usually growing on other substrates (in this case probably *V. bryoctona* (Th.Fr.) A.Orange, a species known from soil, moss, lignum, leather and other waste materials). However, the species described here is unique among all known species of *Verrucaria*, whether aquatic, terrestrial, corticolous or saxicolous, because of the prominent, tiny, shiny ascomata with a distinctive dimidiate involucrellum and the asymmetrically kidney-shaped ascospores with a size which is larger than e.g. in *V. aquatilis* and some of the corticolous species but smaller than other *Verrucaria* species which generally occur on bark or rocks. In freshwater habitats *Hydropunctaria rheithrophila* (Zschacke) Keller, Gueidan & Thüs can have similar sized ascospores, but this species has immersed perithecia with a usually rough surface and a subgelatinous thallus, which often contains black dots (Thüs & Schultz 2008). *Verrucaria cinereolutescens* Zschacke is a poorly known taxon with only slightly shorter ascospores but a yellowish, thick thallus and immersed perithecia with a dark brown exciple (Zschacke 1927). *Verrucaria madida* Orange has a subgelatinous thallus, perithecia covered by a thallus mantle and an olive-grey pigment in the cortex (Orange 2004). Among the corticolus species treated by Lendemer & Breuss (2009) *Verrucaria lignicola* Zschacke comes closest but has larger ascospores (15–19 × 7–9 µm). *Verrucaria lignicola* is regarded as a synonym of the mostly saxicolus *Verrucaria sublobulata* in Thüs & Schultz (2008). Re-examination of the type material (Bouly de Lesdain: Spa, racines d'Alnus dans un ruisseau. 10.08.1904. W: Aqcu-No. 1921-718) has comfirmed the range of ascospore size quoted by Zschacke which extends the documented minimual range for *V. sublobulata* marginally from 16 to 15 µm. The thallus of the type material of *V. lignicola* is sharply delimited, in parts with a distinctly cracked surface and half immersed perithecia. A section reveiled a thin involucrellum that is thin and fading downwards, making the type material indistinguishable from *V. sublobulata* Eitner ex Servit. The new species grows together on the roots with *Porina aenea* (Wallr.) Zahlbr. Further accompanying species in this lichen-rich forest are mentioned in Van den Broeck *et al.* (2009).

Xanthomendoza rosmarieae* S.Y.Kondr. & Kärnefelt, *sp. nov. (Fig. 25E–F) Mycobank MB 517818

Xanthomendozae gallowayi similis, sed sorediis isidiosis, rhizinis latioribus brevioribusque (0.06–0.12 × 0.3–0.4 mm), ascosporis angustioribus (6–8(–11) µm latis), et excipulo vero , e typo 'textura intricata', minus evoluto differt.— http://www.eol.org/pages/Xanthomendoza rosmarieae

Type: U.S.A. Delaware: Sussex Co., Georgetown, northern entrance drive of Stockley Centre (on bark of aspen growing together with *Parmelia sulcata*), April 2000, *Crichton 57* (holotype ZH, isotype K).

Thallus of numerous semierect, very narrow, richly branched and anastomosing, yellowish to whitish orange, sorediate lobes; soralia becoming isidiose, either marginal, of *fallax*-type, (0.2–)0.3–1(–1.2) mm long, or on the underside, of *ulophyllodes*-type, as a greenish spherical mass, (28–)35–50(–60) µm diameter. Sometimes 2–3 soredia aggregated in irregular groups, to 90(–100) µm across, where true conblastidia are absent. Lobes mainly horizontally orientated and somewhat raised above the substrate; main lobes 2–2.5(–4) mm long and 0.1–0.2 mm wide, becoming narrower towards the tips, 0.4–0.5(–0.6) mm wide at the base, usually only 1 mm long fragments seen; secondary lobules ca. 0.1 mm wide throughout and 1–1.5 mm long; the total width of a lobe including secondary lobules are 2–2.5 mm. Rhizines variable in size but generally

rather short, 0.05–)0.06–0.12 mm diameter and (0.2–)0.3–0.4(–0.5) mm long. Thallus in section (90–)110–120(–150) µm thick, upper cortical layer to 25(–30) µm thick, more or less mesodermatous paraplectenchymatous, lower cortical layer to 12(–30) µm thick, leptodermatous to mesodermatous paraplectenchymatous with vertically elongated cell lumina; algal layer 30–40 µm thick; medulla to 40–50(–70) µm thick, usually with a few scattered hyphae, sometimes with paraplectenchymatous parts, sometimes completely filled with algal clusters. Apothecia to 1.5(–2.2) mm diameter, 0.35–0.4 mm high, lecanorine, thalline margin to 0.1–0.15(–0.2) mm wide; cortical layer on the underside 25–30(–40) µm thick, mesodermatous paraplectenchymatous; true exciple often indistinct or poorly developed, 'textura intricata'; hymenium 70–90 µm high; subhymenium 20–30 µm thick; paraphyses ca. 2 µm diameter in lower portion, and to 4–5 µm diameter towards the tips, very often with oil droplets (better seen in K); asci 8-spored but often with 2–4–6 mature bipolar ascospores together with aborted two-celled spores; ascospores from elongated ellipsoid to broadly ellipsoid or ovoid with a wide septum; (8–)10–16 × 6–8(–11) µm in water and (10–)11–14(–16) × 7–10 µm in K, septum rather wide, (3–)5–8 µm wide in water and (4–)7–8 µm wide in K; spermogonia to 360 µm diameter, punctiform, reddish; spermatia very narrow, bacilliform, 3.1–4.0 × 0.6–0.8 µm.

Distribution and habitat:—This new species is only known from the type locality where it grows on bark of trees.

Etymology:—*Xanthomendoza rosmarieae* is named for the distinguished Swiss lichenologist, Rosmarie Honegger, in recognition of her unique contributions to xanthorioid lichens.

Xanthomendoza S.Y.Kondr. & Kärnefelt is a genus of 20 species found mainly on tree trunks in the Northern Hemisphere and on rocks in both North and South America. The genus is characterized by mainly foliose thalli with well-developed rhizines (Kondratyuk & Kärnefelt 1997, 2003a, Søchting *et al*. 2002, Fedorenko *et al.* 2009, Kondratyuk *et al.* 2011). This new species is distinguished by the presence of isidiate soredia, rather wide and short rhizines, narrow ascospores, and a poorly developed true exciple of *textura intricata* type. The rhizines of *X. rosmarieae* are broader (90–100 µm wide) in comparison most similar species of the *X. gallowayi* group (50–60 µm wide) and the genus *Oxneria* (Kondratyuk & Poelt 1997) Furthermore, *X. rosmarieae* differs in lacking a strongly gelatinized pseudoprosoplectenchymatous true exciple. In addition to the wider rhizines, *X. rosmarieae* differs from *X. gallowayi* (syn. *X. weberi*) and *X. sogdiana* in having a higher hymenium and narrower ascospores (Kondratyuk & Kärnefelt 2003b, Kondratyuk *et al*. 2011). The apothecial anatomy of *X. rosmarieae* is similar to that of the Southern Hemisphere genus *Jackelixia* S.Y.Kondr. *et al.,* belonging to the same phylogenetic branch as *Xanthodactylon* (Fedorenko *et al.* 2009), in having the *Jackelixia*-type of true exciple, i.e. poorly developed in the basal portion and its *textura intricata* nature.

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