STUDIES ON THE LICHEN FAMILY THELOTREMATACEAE. 2.

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LEPTOTREMA HAWAIIENSE Hale, sp. nov.

Thallus corticola, epiphloeodes, tenuis albidus, 6 cm latus; apothecia emergentia, prominentia, 0.7-1.1 mm diametro, excipulo interiore distincto, disco albo-pruinoso; columella nulla; ostiolum latum, 0.4-0.6 mm diametro, ambitu pulverulentum; hymenium ca. 200μ altum; sporae 6-8:nae, obscurae, murales, transversim 18-22-loculatae, longitudinale 1-3-loculatae, 20-25 X 70-90μ.

Chemistry: Stictic and constictic acids.

Holotype: On Kukui tree, Kauai, Hawaii, A. A. Heller 2536, 9 July 1895 (US) (Fig. 1).

This species is very closely allied to L. lepadodes (Tuck.) Zahl. (syn. L. pinarocarpum Zahl.), which has smaller apothecia on the average and lacks any lichen substances. The inner lepadinoid exciple is conspicuous in earlier stages but at maturity the whole hymenium pulls away from the apothecial wall and the exciple disappears.

OCELLULARIA AURULENTA Hale, sp. nov.

Thallus corticola, epiphloeodes, valde irregulariter bullatus, fere crasse isidiatus, cinereo-albus, usque ad 15 cm latus; medulla flavo-aurea; apothecia inconspicue inter verrucas dispersa, semi-emergentia, ca. 0.5 mm diametro, apice fuliginea; columella nulla; ostiolum rotundatum, 0.1 mm diametro; hymenium 200-230μ altum; sporae 1-2:nae, incolores, transversim 15-20 septatae, 25-35 X 150-200μ, I+.

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Chemistry: Hypoprotocetraric acid and 4-O-demethylnotatic acid with unidentified yellow pigments.

Holotype: Rain forest, El Llano-Carti road, Prov. of Panama, Panama, elev. 300 m, M. E. Hale 38548, 6 April 1973 (US) (Fig. 2).

This species is conspicuous in the field because of the extensive, bullate thallus which, when abraded, reveals the yellow-orange medulla. It is obviously related to O. fecunda (Vain.) Hale, which has identical chemistry but much larger emergent apothecia and lacks bullate outgrowths. The typical habitat is mid-bole and canopy branches of mature rain forest trees.

Additional specimens examined. PANAMA. Same locality as type, Hale 38528, 38536, 38587 (US); Cerro Jefe, elev. 700 m, Prov. of Panama, Hale 38441, 38452, 38486, 38495 (US).

OCELLULARIA CONFIGURATA Hale, sp. nov.

Thallus corticola, epiphloeodes, tenuis, opacus, brunneo-viridis, ca. 6 cm latus; apothecia immersa, pro parte lineare aggregata, ca. 0.3 mm diametro, excipulo discreto, albo-granuloso; columella nulla; ostiolum rotundum, 0.1 mm diametro, conspicue albo-cinctum; hymenium 70μ altum; sporae 8:nae, incolores, transversim 4-loculate, 4 X 8μ, I+.

Chemistry: "Olivacea" unknown.

Holotype: Virgin peat forest, 20 mi. N of Sibu, Sarawak, elev. 1 m, M. E. Hale 31207, 12 March 1965 (US) (Fig. 3).

The immersed apothecia resemble those of O. bicinctula Nyl. in having a distinct free exciple, but they are arranged in irregular rows and have a conspicuous white rim around the pore. In chemistry it resembles O. olivacea (Fée) Müll. Arg., but that species lacks a free exciple and white pore.

OCELLULARIA FLAVIDA Hale, sp. nov.

Thallus corticola, epiphloeodes, valde bullato-verruculosus, fere isidiatus, pallide flavidus vel flavido-cinereus, usque ad 8 cm latus; medulla flavida; apothecia semi-emergentia vel emergentia; 0.8-1.1 mm diametro; columella nulla vel parce evoluta; ostiolum rotundatum, depressum, 0.05-0.15 mm diametro; hymenium ca. 200μ altum; sporae 1-2:nae, incolores, transversim 18-22-loculatae, 18-20 X 80-100μ, I+.

Chemistry: P+ materia ignota et materia flavida.

Holotype: 25 km SE Labason, Zamboanga del Norte, Philippines, elev. 300 m, M. E. Hale 25163, July 1964 (US) (Fig. 4).

The bright yellow medulla is unique among the pigmented Ocellularias. The bullate almost isidiate thallus is somewhat similar to that of O. aurulenta. O. flavida was collected on the upper bole of dipterocarps.

Additional specimens examined. PHILLIPINES. Irosin, Sorsogon, Elmer 16841 (US). SARAWAK. 20 mi. N Sibu, Hale 31197 (US).

OCELLULARIA FRAGILIS Hale, sp. nov.

Thallus corticola, epiphloeodes, nitidus, verruculosus subbullatusque, fragilis, cinereo-albus, 6 cm latus; apothecia semi-emergentia, bullata, 0.5-0.7 mm diametro; columella nulla; ostiolum rotundatum, 0.1-0.2 mm diametro; hymenium 130-140μ altum; sporae 8:nae, incolores, transversim 4-loculatae, 6 X 12μ, I+.

Chemistry: Psoromic and conpsoromic acids.

Holotype: 3 km S Campo Capote, Santander, Colombia, elev. 100-200 m, M. Nee and S. Mori 3727, 26 March 1971 (US) (Fig. 5).

The fragile bullate thallus breaks apart easily. The apothecia are small and inconspicuous. There are no close relatives in the genus.

OCELLULARIA GLOBOSA Hale, sp. nov.

Thallus corticola, epiphloeodes, tenuis, pallide brunneo-albus, 2-3 cm latus; apothecia emergentia, basin constricta, globosa, 0.6-1.0 mm diametro, apice fuliginea; columella nulla; ostiolum rotundatum, albo-cinctum, 0.1-0.3 mm diametro; hymenium 100μ altum; sporae 8:nae, incolores, transversim 9-11-loculatae, 8-10 X 40-50μ, I+.

Chemistry: Protocetraric acid± "amplior" unknown.

Holotype: Above Layang Layang, Kinabalu National Park, Sabah, elev. 2800 m, M. E. Hale 28657, August 1964 (US) (Fig. 6).

The conspicuous globose apothecia and presence of protocetraric acid characterize this species. It occurs on the lower trunks of trees at higher elevations.

Additional specimens examined. SARAWAK. Mt. Matang, Hale 30773 (US).

OCELLULARIA ISIDIIFERA Hale, sp. nov.

Thallus corticola, epiphloeodes, rimosus, cinereo-albus, usque ad 20 cm latus, isidiatus, isidiis simplicibus, ca. 1 mm altis, primo erectis sed aetate decumbentibus; apothecia semi-

emergentia, 0.5-1.0 mm diametro, margine erecto, albo; columella nulla vel parce evoluta, actinoidea; ostiolum latum, primo irregulariter fissum, aetate rotundum, 0.2-0.6 mm diametro, disco clare viso, albo-pruinoso; hymenium ca. 85μ altum; sporae 8:nae, incolores, transversim 5-6-loculatae, 6-8 X 18-22μ, I+.

Chemistry: Psoromic and conpsoromic acids.

Holotype: Cloud forest, trail from Cerro Punta to Boquete, Prov. of Chiriqui, Panama, elev. 2200 m, M. E. Hale 38709, 31 March 1973 (US) (Fig. 7).

Truly isidiate species are very rare in the Thelotremataceae. Thelotrema insigne Zahl., for example, has identical tall, thin, decumbent isidia and chemistry, but the spores and apothecia are quite different. T. isidiophorum Krmph. from Sarawak has much coarser, dense isidia. O. isidiifera was very common in the Chiriqui region at tree bases but did not occur in low elevation rain forest.

Additional specimens examined. PANAMA. Same locality as holotype, Hale 38742, 38776, 38778, 38896 (US).

OCELLULARIA RIPLEYI Hale, sp. nov.

Thallus corticola, epiphloeodes, opacus, minute verrucosus, albo-cinereus, 8-14 cm latus; apothecia emergentia, minute verrucosa, 1.0-1.5 mm diametro, apice fuliginea; columella centralis evoluta; ostiolum rotundatum, albocinctum, 0.2 mm diametro, centro album; sporae 1-2:nae, incolores, transversim 8-25-loculatae, 12-15 X 80-200μ, I+.

Chemistry: Psoromic and conpsoromic acids.

Holotype: Secondary rain forest, Barro Colorado Island, Canal Zone, Panama, elev. 100 m, M. E. Hale 38664, 4 April 1973 (US) (Fig. 8).

This is a large conspicuous species occurring at lower trunk levels in lowland rain forest. The minutely verrucose thallus and apothecia are very similar to T. interpositum Nyl. The species is named in honor of S. Dillon Ripley, secretary of the Smithsonian Institution, who provided travel funds for field work in Panama.

Additional specimens examined. PANAMA. Barro Colorado Island, Hale 38621, 38648, 38650, 38658, 38688, 38700 (US); Herre 14 (US). CUBA. Oriente, La Prenda, Hioram 6157, Sante Fé Spring, Hioram 6853 (US).

PHAEOTREMA CALEDONIENSE Hale, sp. nov.

Thallus corticola, epiphloeodes, opacus, albidus, 4-6 cm latus; apothecia immersa vel semi-emergentia, 0.8-1.4 mm diametro, apice fuliginea; columella nulla vel vix evoluta; ostiolum rotundum 0.1-0.3 mm diametro; hymenium ca. 150μ altum; sporae 8:nae, obscurae, transversim 3-5-loculatae, 8 X 10-12μ.

Chemistry: Psoromic and conpsoromic acids.

Holotype: On Podocarpus, Riviere Bleue, New Caledonia, elev. 100 m, G. Degelius s.n., 15 April 1970 (Degelius herbarium; isotype in US) (Fig. 9).

New Caledonia has an unusually rich thelotreme flora and some 18 species have already been described from the island. P. caledoniense is unlike any other species known in the genus; the large semi-emergent apothecia and weakly developed columella are distinctive.

PHAEOTREMA MAMMILARE Hale, sp. nov.

Thallus corticola, epiphloeodes, crassus, rimosus, cinereo-albus, ca. 10 cm latus; apothecia immersa vel semi-emergentia, ca. 0.5 mm diametro; columella nulla; ostiolum distinctum 0.05-0.1 mm diametro, albocinctum, margine annulato, prominente; hymenium 140μ altum; sporae 8:nae, obscurae, transversim 5-8-loculatae, 14-16 X 30-40μ.

Chemistry: Psoromic acid.

Holotype: Logging area S of Santa Ana, Cayagan Prov., Phillippines, elev. 100 m, M. E. Hale 25632, August 1964 (US) (Fig. 10).

The characteristic feature is the mammulate apothecia. No other presently known Phaeotremae with psoromic acid have this trait. It is found at canopy level in dipterocarp forests.

THELOTREMA DIMINITUM Hale, sp. nov.

Thallus corticola, epiphloeodes, pallide cinereo-viridis, usque ad 8 cm latus; apothecia emergentia, numerosa, basin constricta, globosa, 0.2-0.4 mm diametro, solitaria vel 2-3 aggregata, fragiles, apice erosa; columella nulla; ostiolum 0.05 mm diametro; hymenium 80-90μ altum; sporae 8:nae, incolores, murales, transversim 3-4-loculatae, longitudinale 0-1-loculatae, 6-8 X 12-15μ.

Chemistry: Materia indeterminata (P+ reddish?).

Holotype: Lowland rain forest, Bako National Park, Sarawak, elev. 100 m, M. E. Hale 30536, 10 March 1965 (US) (Fig. 11).

The tiny emergent apothecia often become pulverulent apically, but the pore remains distinct. There are no close relatives in the genus.

Additional specimen examined. AUSTRALIA. Mossman River Gorge, Queensland, W. A. Weber and D. McVean s.n. (COLO, US).

THELOTREMA FISSIPORUM Hale, sp. nov.

Thallus corticola, epiphloeodes, nitidus, continuus, brunneo-albidus, ca. 8 cm latus; apothecia semi-emergentia, 0.7-1.0 mm diametro, apice concentrice striata; columella nulla; ostiolum irregulariter fissuratum, 0.1-0.3 mm latum, aetate erosum, albidum; hymenium 130μ altum; sporae 6-8:nae, incolores, murales, transversim 5-7-loculatae, longitudinale 1-2-loculatae, 8-10 X 22-30μ, I+.

Chemistry: No lichen substances present.

Holotype: Dipterocarp forest, 40 km NW Lianga, Surigao del Sur, Philippines, elev. 350 m, M. E. Hale 24648a, August 1964 (US) (Fig. 12).

The apothecia with concentric apical striae are very close to those of T. guadeloupense Hale, which differs in having stictic acid, larger spores (to 85μ long), and less emergent apothecia.

THELOTREMA MEXICANUM Hale, sp. nov.

Thallus corticola vel pro parte muscicola, epiphloeodes, nitidus, verrucosus, pallide viridi-albicans, ca. 8 cm latus; apothecia numerosa, emergentia, 0.4-0.6 mm diametro, primo clausa sed aetate aperta, ± albo-pruinosa; columella nulla; hymenium 200μ altum; sporae 1-4:nae, incolores, murales, loculis numerosis, 35-40 X 120-200μ.

Chemistry: No lichen substances present.

Holotype: Gomes Farias, Tamaulipas, Mexico, elev. 1120 m, S. Nakanishi 82, 19 Dec. 1970 (US; isotype in Nakanishi herbarium) (Fig. 13).

This species bears a strong resemblance to Pertusaria. The spores, however, are muriform and the pore at maturity is clearly thelotremaceous. The emergent ascidioid noncarbonized apothecia are similar to those of T. muscigenum Stzb., T. papillosum Hale, and T. tuberculiferum Vain. but differ from these in being

much smaller.

THELOTREMA SCABROSUM Hale, sp. nov.

Thallus corticola, epiphloeodes, opacus, minute scabrosus, albidus, ca. 5 cm latus; apothecia emergentia, basin constricta, margine crasso, lobato-radiate diviso, pulverulento, 1.0-1.3 mm diametro; columella nulla; ostiolum rotundum, 0.2-0.5 mm diametro; hymenium ca. 200µ altum; sporae 1-2:nae, incolores, murales, loculis numerosis, 30-40 X 120-160µ, I+.

Chemistry: Fumarprotocetraric acid.

Holotype: Dipterocarp forest, 15 km E Pagbilao, Sierra Madre, Quezon Prov., Philippines, elev. 300 m, M. E. Hale 26898, August 1964 (US) (Fig. 14).

At first one might mistake this species for a degenerate Lecanora, but the apothecial pore and spores are obviously thelotremaceous. Only three other Thelotrema species produce fumarprotocetraric acid: T. cinerareum Müll. Arg. and T. microstomum Müll. Arg. from Japan and T. secernendum Harm. from New Caledonia

Additional specimen examined. PHILIPPINES. Same locality as holotype, Hale 26863 (US).

THELOTREMA STEYERMARKII Hale, sp. nov.

Thallus muscicola, verrucosus, fragilis, pallide flavido-albus, usque ad 6 cm latus; apothecia congesta, semi-emergentia, 0.5-0.7 mm diametro, margine lobato-radioso, excipulo pauce distincto; columella nulla; ostiolum irregulare, 0.1-0.3 mm latum; hymenium ca. 100µ altum; sporae 8:nae, incolores, murales, transversim 3-4-loculatae, longitudinale 0-1-loculatae, 5-6 X 10-12µ, I+.

Chemistry: Hypoprotocetraric acid, 4-O-demethylnotatic acid, and lichexanthone.

Holotype: Cerro Jaua, Bolivar, Venezuela, elev. ca. 2000 m, J. Steyermark 98008, 22-27 March 1967 (US) (Fig. 15).

While hypoprotocetraric acid is not rare in Thelotrema, this is the first joint occurrence with lichexanthone. The fragile crusty thallus and small apothecia with radiate-lobate divisions are also diagnostic characters. The species is named for Julian Steyermark, who has contributed much to our knowledge of Venezuelan lichens through his collections.

THELOTREMA SUBPRAESTANS Hale, sp. nov.

Thallus corticola, epiphloeodes, crassus, rimosus, albo-cinereus, 10-20 cm latus; apothecia numerosa, emergentia, ca. 2.5 mm diametro, apice fuliginea; columella centralis evoluta, crassa; ostiolum rotundatum, ca. 0.1 mm diametro, albo-cinctum; hymenium ca. 300μ altum; sporae 1:nae, incolores, murales, loculis numerosis, 30-50 X 150-300μ, I+.

Chemistry: Stictic and constictic acids and high "quintaria" spot above stictic acid.

Holotype: Rain forest, El Llano-Carti road, Prov. of Panama, Panama, elev. 300 m, M. E. Hale 38525, 6 April 1973 (US) (Fig. 16).

This species has some of the largest apothecia that I have seen in the family. It is typically collected on canopy branches in lowland rain forest. A very closely related species, T. praestans Müll. Arg., contains a P+ unknown ("praestans" unknown) and occurs in the West Indies and Brazil. It has fewer, less prominent apothecia.

Additional specimens examined. PANAMA. Same locality as holotype, Hale 38534, 38549; Cerro Jefe, Prov. of Panama, Hale 38432, 38515; Barro Colorado Island, Canal Zone, Hale 38637, 38655, 38660, 38682, 38696 (US).

THELOTREMA SUBSIMILE Hale, sp. nov.

Thallus corticola, epiphloeodes, continuus, nitidus, cinereo-albus, ca. 6 cm latus; apothecia immersa vel semi-emergentia, 0.3-0.5 mm diametro; columella centralis evoluta, tenuis; ostiolum rotundatum, 0.05-0.98 mm diametro; hymenium 110-120μ altum; sporae 8:nae, incolores, murales, transversim 6-7-loculatae, longitudinale 0-1-loculatae, 8-10 X 22-26μ, I+.

Chemistry: Protocetraric acid.

Holotype: Tree base, Las Lapas trace, Arima, Trinidad, elev. 750 m, M. E. Hale 37447, 17 April 1972 (US) (Fig. 17).

This is the only Thelotrema with protocetraric acid and a columella. It is externally indistinguishable from Ocellularia perforata (Lgt.) Müll. Arg.

THELOTREMA WEBERI Hale, sp. nov.

Thallus tenuis vel evanescens, corticola vel muscicola, albo-cinereus, 2-3 cm latus; apothecia emergentia, cupuliformia, basin constricta, ca. 1.0 mm alta, 1.0-1.5 mm diametro, excipulo interiore evoluto; columella nulla; ostiolum rotundatum, 0.2-

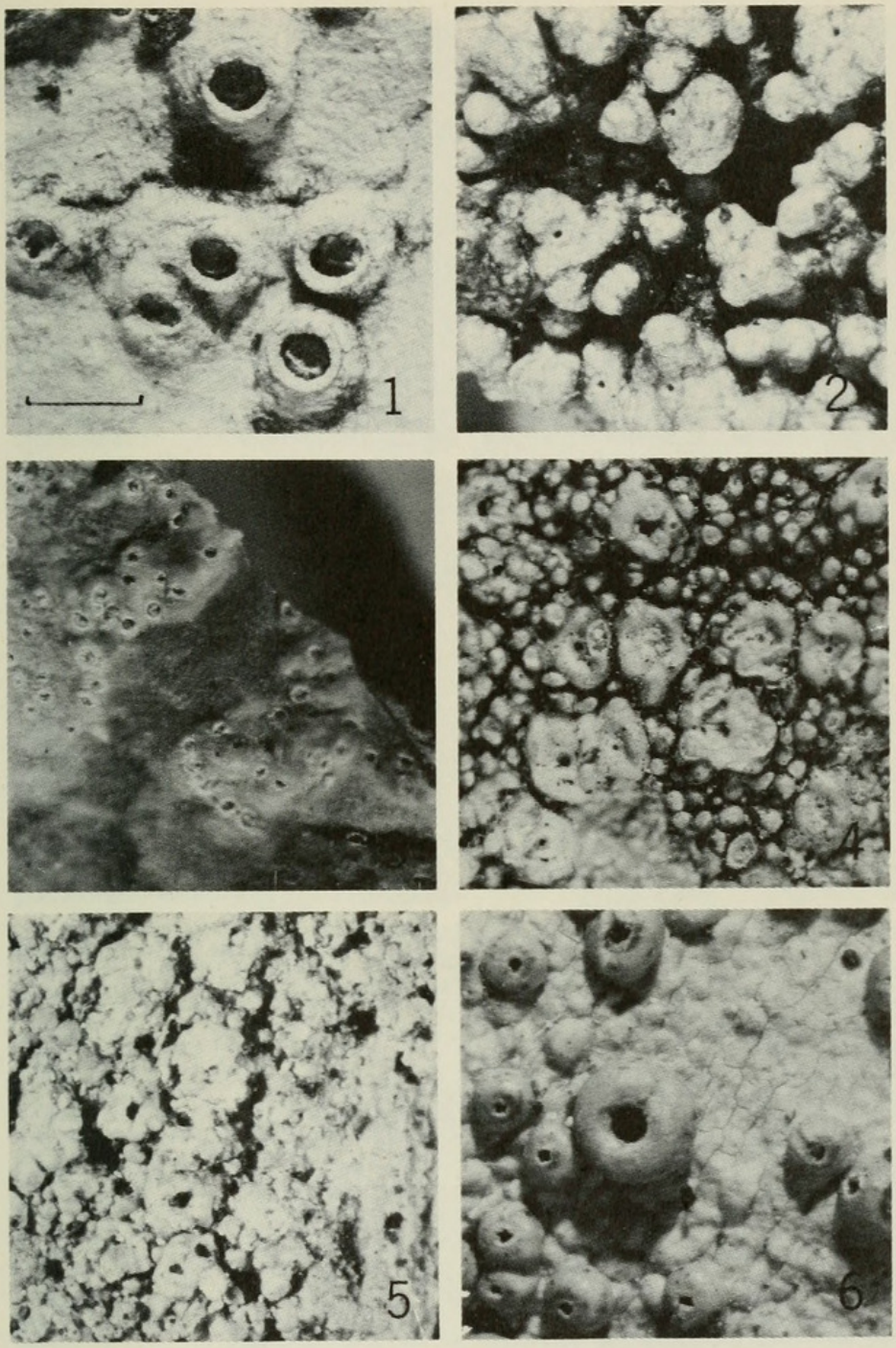
0.5 mm diametro, albo-pruinosum; hymenium ca. 140μ altum; sporae 1-2:nae, incolores, murales, loculis numerosis, 16-24 X 80-100μ, I+.

Chemistry: Norstictic acid.

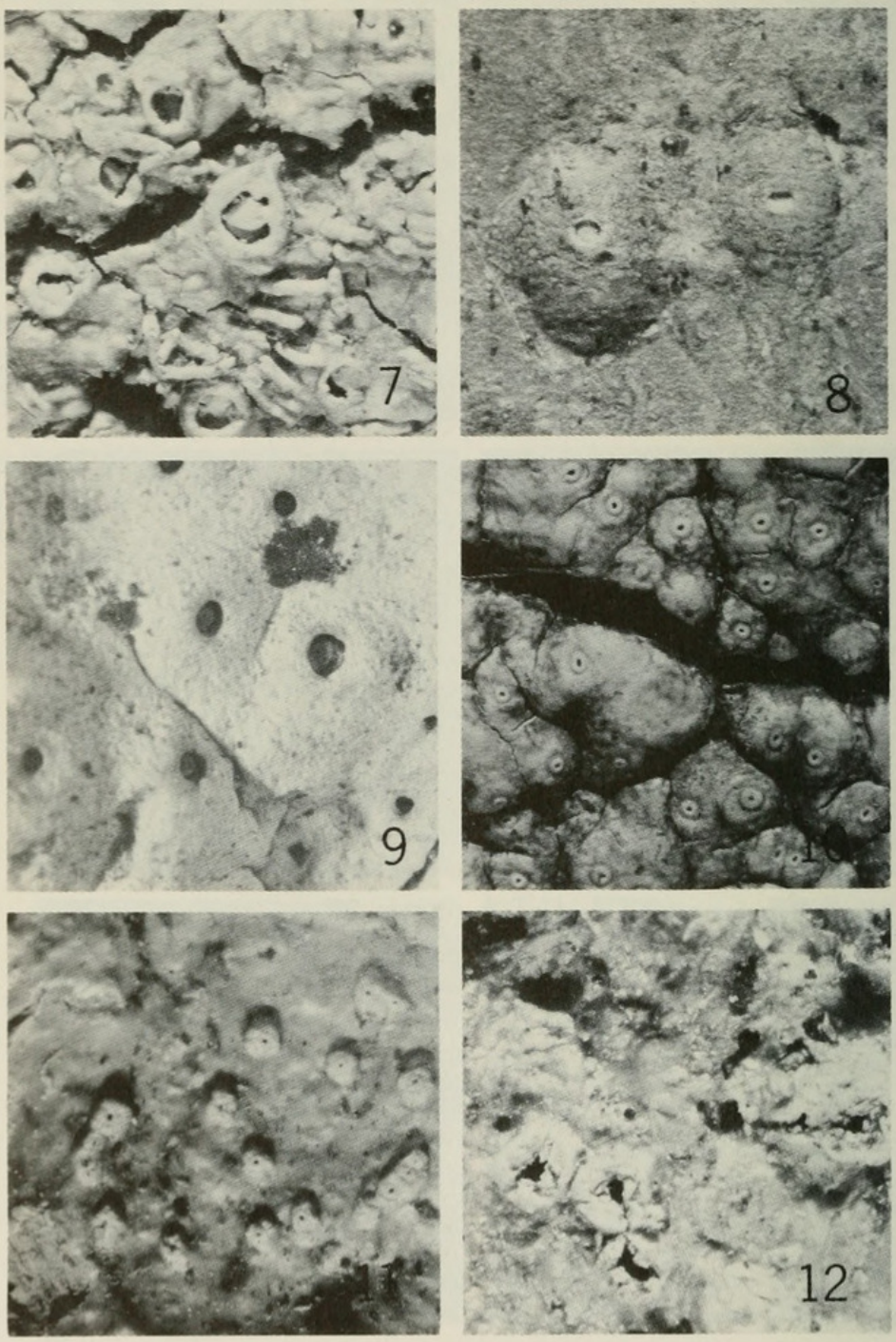
Holotype: Mount Wilhelm, Eastern Highlands, New Guinea, elev. 3490 m, W. A. Weber and D. McVean 48666, 1 July 1968 (COLO; isotype in US) (Fig. 18).

The large urceolate apothecia and chemistry distinguish this species. It occurs at high elevation on mosses and dead decorticate wood.

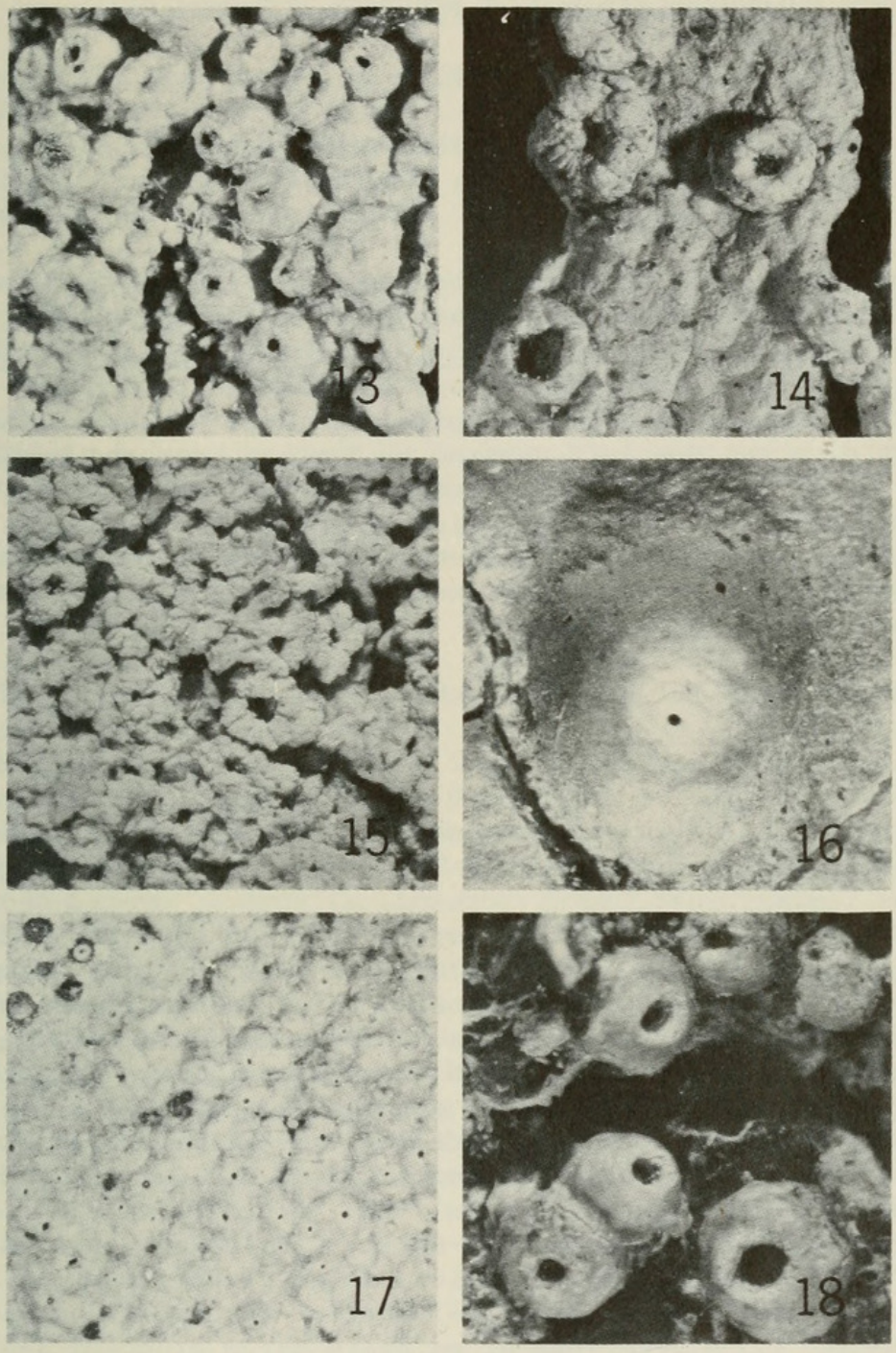
Additional specimens examined. NEW GUINEA. Same locality as holotype, elev. 4450 m, Weber and McVean s.n. (COLO). SABAH. Above Layang Layang, elev. 2800 m, Hale 28654 (US).



Figures 1-6. Holotypes of Leptotrema and Ocellularia species. 1. L. hawaiiense; 2. O. aurulenta; 3. O. configurata; 4. O. flavida; 5. O. fragilis; 6. O. globosa. Scale in Fig. 1 = 1 mm.



Figures 7-12. Holotypes of Ocellularia, Phaeotrema, and Thelotrema species. 7. O. isidiifera; 8. O. ripleyi; 9. P. caledoniense; 10. P. mammilare; 11. T. diminitum; 12. T. fissiporum. Scale as in Fig. 1.



Figures 13-18. Holotypes of Thelotrema species. 13. T. mexicanum; 14. T. scabrosum; 15. T. steyermarkii; 16. T. subpraestans; 17. T. subsimile; 18. T. weberi. Scale as in Fig. 1.