

UREDINALES OF GUATEMALA BASED ON COLLECTIONS BY E. W. D. HOLWAY

III. PUCCINIA, EXCLUSIVE OF SPECIES ON CARDUACEAE

J. C. ARTHUR

The two previous instalments of the present account of the rusts of Guatemala were published in this Journal (June and October, 1918, pp. 325-336, 420-446), and one more part is to follow concluding with an index. The present part lists 76 species, of which twelve are described as new, six are placed under new combinations due to discovery of additional spore forms, and a number heretofore known from South America are now added to the North American flora.

Probably the most interesting group of rusts included in this part is that found on grasses. Grass rusts seem to be less common in the tropics than in the colder regions of the north, possibly because grasses are less abundant, at least where collectors go, or because these rusts are less conspicuous and so escape detection. The fine showing of fifteen species secured by Professor Holway, three being undescribed, is greatly to his credit as a close and discerning collector. Rather strangely, the two cosmopolitan rusts on corn and sorghum are not found in his material.

Even more satisfying than securing hitherto unknown species is the discovery made by Professor Holway of the probable connection of an aecial form on *Eupatorium* to go with one of the grass rusts on *Aegopogon*. It will be a slow process to connect the alternate forms of heteroecious species in the tropics, as the chances for making successive observations at the same locality and the opportunity to make cultures can come only at rare intervals. Professor Holway is to be congratulated on his fortunate find and clever observations in this direction.

Less interesting, but equally difficult for the taxonomist, are the *Salvia* rusts. Although autoecious, they are given to forming only uredinia, and run into endless modifications. Pycnia and aecia are especially rare. Not until numerous collections on every species of

host possible, taken at different periods and under diversified conditions of growth, are made available, can the taxonomic status of the various forms be reasonably well worked out. Dr. E. B. Mains has recently studied all the material in the writer's herbarium, and the seven species included in this article are in accordance with the results of this study.

The writer is deeply indebted to Professor Luigi Buscalioni, Director of the Royal Botanic Garden of Catania, Sicily, who is monographing the genus *Saurauja*, for his painstaking examination of the hosts for the two species of rusts on this genus. No fruit or flowers were present, making the task a difficult one. Thanks are also due to a number of American botanists who have given critical judgment upon the hosts of quite a number of collections. In general the hosts have been named for Professor Holway from phanerogamic specimens gathered at the same time as the rust specimens and submitted to various phanerogamic authorities.

102. PUCCINIA SORGHII Schw. (on Poaceae).

Euchlaena mexicana Schrad.

Zea Mays L.

A specimen of this rust, common wherever Indian corn is grown, was collected by Kellerman on *Zea Mays* at Guatemala City, Feb. 3, 1905, II, 5474, and reported by Kern in Journ. Mycol. *l. c.* A specimen was also taken by him on *Euchlaena mexicana* at Guatemala City, Feb. 23, 1906, II, 5077.

103. PUCCINIA PURPUREA Cooke (on Poaceae).

Sorghum vulgare Pers.

This common tropical rust was collected by Kellerman, at Antigua, Dept. Sacatépequez, Feb. 8, 1907, and issued in Kellerm. Fungi Sel. Guat. 16.

104. PUCCINIA ANDROPOGONIS Schwein. (on Poaceae).

Andropogon condensatus H.B.K., San Lucas Toliman, 5100 feet alt., Dept. Solola, Feb. 2, 1915, II, III, 178.

A common rust of the whole United States, having aecia on *Castilleja* and *Pentstemon*, but not before taken south of the border.

105. *Puccinia infuscans* Arthur & Holway sp. nov. (on Poaceae).

Imperata braziliensis Trin., Guatemala City, Jan. 3, 1915, 15.

Uredinia hypophyllous, scattered, oblong or linear, 0.5-1 mm. long, soon naked, chestnut-brown, pulverulent, ruptured epidermis

evident; paraphyses none; urediniospores broadly ellipsoid or obovoid, 20–26 by 26–32 μ ; wall dark cinnamon-brown, moderately thick, 2–3 μ , finely and closely verrucose, the pores 4, equatorial, distinct.

Telia hypophyllous, scattered, oblong or linear, 0.4–1 mm. long, early naked, chocolate-brown, ruptured epidermis evident; teliospores ellipsoid, 17–23 by 28–35 μ , wall chestnut-brown, 1.5–2 μ , lighter and thicker above, 5–7 μ , smooth; pedicel slightly tinted or colorless, once to twice length of spore, uniform diameter.

The host belongs to the tribe Andropogoneae. The urediniospores are similar to those of *Puccinia Ellisiana*, but very much larger. The species is readily distinguished from *P. rufipes* Diet. on *I. arundinacea*, which has paraphyses and echinulate urediniospores, and from *Uredo Imperatae* Magn. on *I. cylindrica* from Palestine, which has echinulate urediniospores, considerably thickened above.

106. *PUCCINIA CHASEANA* Arth. (on Poaceae).

Anthephora hermaphrodita (L.) Kuntze, Quirigua, Dept. Zacapa, March 22, 1916, II, III, 600.

Heretofore this heteroecious rust has been known only from the West Indies. Aecia have not yet been detected.

107. *PUCCINIA LEVIS* (Sacc. & Bizz.) Magn. (on Poaceae).

Paspalum Humboldtianum Flügge, Solola, 7000 feet alt., Jan. 27, 1915, II, III, 129; Guatemala City, Feb. 14, 1917, II, 864.

A heteroecious rust for which no aecia have yet been found. It is found on a number of species of hosts from Texas and Louisiana through Mexico and the West Indies to Brazil and Argentina.

108. *Puccinia tubulosa* (Pat. & Gaill.) Arth. nov. comb. (on Poaceae).

Paspalum conjugatum Bergins, Quirigua, Dept. Zacapa, March 22, 1916, II, 594.

Paspalum Humboldtianum Flügge, San Rafael, 7000 feet alt., Dept. Guatemala, Jan. 11, 1915, II, 64.

Paspalum paniculatum L., Quirigua, Dept. Zacapa, March 22, 1916, II, III, 595.

Solanum torvum Swartz, Montufar, on the railway between Barrios and Guatemala City, Dec. 28, 1914, I, 0.

A widespread tropical rust on many species of hosts. It is reported from Jamaica, Porto Rico, Cuba, and Bermuda of the West Indian Islands, and on the continent from Panama, Costa Rica, Mexico, and Texas.

Although often taken in the uredinial stage, when it has generally passed under the name of *Uredo paspalicola* P. Henn. (*U. Stevensiana* Arth.), yet the telia are not uncommon. Observations by Whetzel and Olive in Porto Rico and by Bethel in Panama, made it highly probable that the alternate form is *Aecidium tubulosum* on *Solanum torvum*. Cultures confirming this suggestion were made by Thomas in Porto Rico (Phytopathology 8: 163, 1918).

The species was also collected by Kellerman on *Paspalum Humboldtianum*, El Rancho, Dept. Baja Vera Paz, Jan. 1, 1908, II, 8034, and on *Axonopus compressus* (Swartz) Beauv., at Los Amates, Dept. Izabal, Feb. 22, 1908, II, 7540.

109. **Puccinia macra** Arthur & Holway sp. nov. (on Poaceae).

Paspalum candidum (Humb. & Bonpl.) Kunth, Solola, 7000 feet alt., Jan. 31, 1915, II, III, 168.

Uredinia chiefly hypophyllous, scattered or in small linear groups, round or elliptic, small, 0.5–1 mm. long, early naked, orange or yellowish, pulverulent; urediniospores ellipsoid, 23–29 by 28–35 μ ; wall thin, 1–1.5 μ , pale yellow, finely and moderately or sparsely echinulate, the pores about 8, scattered.

Telia hypophyllous, scattered or sometimes crowded and confluent, elliptic or oblong, 0.5–1.5 mm. long, early naked, dark chestnut-brown, ruptured epidermis evident; teliospores ellipsoid or obovoid-ellipsoid, 23–28 by 35–48 μ , rounded at both ends or slightly narrowed below, slightly constricted at septum; wall chestnut-brown, 1.5–2 μ thick, slightly thicker at apex, 5–7 μ , smooth; pedicel tinted or nearly colorless, as long as the spore.

110. **PUCCINIA ESLAVENSIS** Diet. & Holw. (on Poaceae).

Valota insularis (L.) Chase (*Panicum insulare* Mey.), Laguna, Lake Amatitlan, Dept. Amatitlan, Feb. 8, 1915, II, 205; Agua Caliente, Dept. Guatemala, Feb. 10, 1917, II, 857.

A rust ranging from the southern border of the United States to Guatemala, the aecia for which are not known. It was collected by Kellerman on the same host in the same locality, Jan. 31, 1906, II, III, 5469, and reported by Kern in Journ. Mycol. l. c.

111. **PUCCINIA CYNODONTIS** DeLac (on Poaceae).

Capriola dactylon (L.) Kuntze (*Cynodon dactylon* Pers.), Guatemala City, March 17, 1916, II, III, 592; same, Feb. 14, 1917, II, 865; Quirigua, Dept. Zacapa, March 22, 1916, II, 599.

A common rust wherever the host grows, but the aecia, which occur on *Plantago*, have not been found in America.

1112. PUCCINIA CENCHRI Diet. & Holw. (on Poaceae).

Cenchrus echinatus L., Guatemala City, March 17, 1916, II, iii, 591.

Cenchrus viridis Spreng., Quirigua, Dept. Zacapa, March 22, 1917, II, 597.

A common southern rust, for which the aecia are not known. It extends from the southern United States through Mexico and the West Indies.

1113. PUCCINIA TRISETI Erikss. (on Poaceae).

Trisetum deyeuxioides (H.K.B.) Kunth, San Rafael, 7000 feet alt., Dept. Guatemala, Jan. 7, 1915, II, III, 35; same, Jan. 10, 1915, II, III, 58.

A somewhat common rust from Colorado to Guatemala, for which the aecia are not known. It was collected by Kellerman on the same host, at Antigua, Feb. 13, 1905, II, III, 5322.

1114. PUCCINIA DOCHMIA Berk. & Curt. (on Poaceae).

Muhlenbergia ciliata (H.B.K.) Kunth, San Rafael, 6800 feet alt., Dept. Guatemala, Jan. 9, 1915, III, 53.

The species ranges from central Mexico to Costa Rica. Its aecia are not yet known. It was collected by Kellerman near Antigua, on *M. quitensis* (H.B.K.) Hitchc., Feb. 3, 1908, 7196, 7199.

1115. PUCCINIA JAMESIANA (Peck) Arth. (on Poaceae).

Bouteloua filiformis (Fourn.) Griffiths, Chile, on railway between Guatemala City and Barrios, Feb. 12, 1915, III, 206.

A heteroecious rust with aecia on various asclepiadaceous genera, common in the United States, but much less so southward.

1116. PUCCINIA EPIPHYLLA (L.) Węttst. (on Poaceae).

Poa annua L., San Rafael, 7000 feet alt., Dept. Guatemala, Jan. 8, 1915, II, III, 36.

It is noteworthy that this heteroecious rust, often listed as *P. Poarum* Niels., here shows telia as well as uredinia, although nowhere east of the Rocky Mountains in the United States, where it is common, are telia known. Furthermore, on this host no telia have previously been taken, although known from various collections ranging through Mexico, California, and northward to Oregon. Other hosts in the mountains show telia. The aecial hosts are Tussilago and Petasites, all the aecial species being natives of northern regions.

117. *Puccinia Aegopogonis* Arthur & Holway sp. nov. (on Poaceae and Carduaceae).

Eupatorium Mairetianum DC., Solola, Jan. 25, 1915, O, I, 113.

Eupatorium sp., Guatemala City, Dec. 23, 1916, O, I, 631; same, Feb. 14, 1917, O, I, 868; Huehuetenango, Jan. 21, 1917, O, I, 754.

Aegopogon cenchroides Humb. & Bonpl., San Rafael, 7000 feet alt., Dept. Guatemala, Jan 9, 1915, II, III, 54 (type); Solola, 7000 feet alt., Jan. 31, 1915, ii, III, 164; Antigua, Dept. Sacatépequez, Dec. 28, 1916, II, III, 650; Huehuetenango, Jan. 21, 1917, III, 760; Guatemala City, Feb. 14, 1917, II, 869.

Aegopogon tenellus (Cav.) Trin., San Rafael, 7000 feet alt., Dept. Guatemala, Jan. 8, 1915, ii, III, 37.

Uredinia hypophyllous, scattered, oblong-linear, 0.2–0.5 mm. long, cinnamon-brown, pulverulent, early naked, ruptured epidermis noticeable; urediniospores globoid or broadly ellipsoid, 21–25 by 23–29 μ ; wall golden- or light cinnamon-brown, thin, 1–1.5 μ , finely and closely echinulate, the pores 6–8, scattered.

Telia hypophyllous, like the uredinia in size and distribution, chocolate-brown, early naked; teliospores broadly ellipsoid, 19–24 by 25–30 μ , rounded above and below, slightly or not constricted at the septum, which is often oblique; wall chestnut-brown, moderately thin, about 1.5 μ , darker and slightly thicker at apex, 3–5 μ , smooth; pedicel yellowish or colorless, once to twice length of spore.

The species differs from *Uromyces Aegopogonis* Diet. & Holw. (*Nigredo Aegopogonis* Arth.) by having in general somewhat larger urediniospores, and in having two-celled instead of one-celled teliospores. The two forms, or so-called species, are undoubtedly to be considered races of one and the same species.

The same kind of aecia have been found associated with both forms in such intimate and unmistakable relation that no hesitation is longer felt in connecting them with this species, although no opportunity has yet presented itself to confirm the observations by cultures. The aeciospores have the somewhat uncommon character of thickened wall above, which readily separates them from the aecia of *Puccinia Eleocharidis* Arth. on the same genus of hosts, which have a uniformly thickened wall.

The aecia were described as *Aecidium roseum* Diet. & Holw., from a collection made at Eslava, near the City of Mexico, Oct. 3 or 4, 1896. The type collection of *Uromyces Aegopogonis* Diet. & Holw.

was also taken near the City of Mexico, Oct. 1, 1896. A collection of aecia was made at Amecameca, near the City of Mexico, on Oct. 20, 1903, and of telia Oct. 22, 1903. Collections of both aecia and telia were made at Patzcuaro, Oct. 19, 1898. Many other collections were made of both stages in these and nearby localities as well as elsewhere in central Mexico.

It was not, however, until Prof. Holway was collecting in Guatemala in January, 1917, that the genetic connection of the two stages was clearly suspected. On Jan. 21, of this year, at Hehuatenango, a clump of some shrubby *Eupatorium* was found completely covered with *Aecidium roseum* (no. 754). It was at the bottom of a high bank, with *Aegopogon cenchroides* on the bank above, well rusted with *Puccinia Aegopogonis* (no. 760), and no other sedge or grass rust in the vicinity. The same close and well isolated association was again found on Feb. 14, 1917, near Guatemala City (nos. 868 and 869).

The circumstantial evidence is both direct and abundant, indicating that the apically thickened aeciospores on *Eupatorium* go genetically to the *Aegopogon* rust, and that they are not part of the rust on *Eupatorium*, which since 1906 has often been called *Puccinia rosea*, but should go under the name *P. Conoclinii* Seym. The name *Aecidium roseum* Diet. & Holw., should technically be entered as a synonym under *Uromyces Aegopogonis*.

The rust was collected by Kellerman, on phanerogamic specimens now in the National Herbarium, of *A. cenchroides*, Santa Maria, Dept. Quezaltenango, Feb. 5, 1905, II, 5572, and Cerro Quemada, Dept. Quezaltenango, Feb. 8, 1906, III, 5932, 5948.

118. ***Puccinia subdigitata*** Arthur & Holway sp. nov. (on Poaceae).

Brachypodium mexicanum (Roem. & Schult.) Link, San Rafael, 7000 feet alt., Dept. Guatemala, Jan. 7, 1915, II, III, 23.

Uredinia amphigenous, scattered, elliptic, small, about 0.5 mm. long, early naked, yellowish, pulverulent, ruptured epidermis inconspicuous; paraphyses few, oblong or clavate, 10–15 by 26–35 μ , the wall pale cinnamon-brown, 1–2 μ thick; urediniospores globoid or broadly ellipsoid, 12–15 by 14–19 μ ; wall thin, 1 μ or less, pale yellow or colorless, finely and closely echinulate, the pores obscure, probably scattered.

Telia chiefly hypophyllous, crowded but seldom confluent, elliptic or oblong, 0.5–1 mm. in length, dark gray, long covered by the epidermis bordered by a thin layer of dark brown stromal hyphae; teliospores oblong or clavate-oblong, 10–16 by 27–45 μ , the apex truncate,

smooth or with a few, 1-5, short digitate projections, usually somewhat narrowed below, slightly or not constricted at septum; wall dark chestnut-brown above, paler below, thin, about $1\ \mu$, slightly thickened at apex, $3-7\ \mu$ including projections; pedicel very short, tinted.

On *Brachypodium* there also occur *Puccinia Baryi*, which has teliospores with smooth apices, and *P. himalensis*, which has coronate teliospores, but the coronations are more prominent and the urediniospores much larger than in the present form.

119. PUCCINIA CYPERI Arth. (on Cyperaceae).

Cyperus hermaphroditus (Jacq.) Standley, San Rafael, 7000 feet alt., Dept. Guatemala, Jan. 8, 1915, II, III, 136 A.

Cyperus sp., Quirigua, Dept. Zacapa, March 22, 1916, II, III, 598.

Kyllinga odorata Vahl, Panajachel, Dept. Solola, Jan. 3, 1917, II, 663.

A common heteroecious rust of North America. It is here considered distinct from the somewhat more common *P. canaliculi*, having aecia on *Ambrosia* and *Xanthium*.

120. PUCCINIA ELEOCHARIDIS Arth. (on Cyperaceae).

Eleocharis geniculata (L.) R. Br.

Eleocharis sp.

A collection was made by Kellerman on *E. geniculata*, at Palmar, Dept. Quezaltenango, Feb. 11, 1916, II, 5419, and reported by Kern in *Mycologia l. c.*; and on an undetermined *Eleocharis*, at Laguna, Lake Amatitlan, Feb. 5, 1905, II, 5365, and also at the same place, Feb. 17, 1906, II, 5399.

The species is abundant in north temperate America, where the aecia occur on species of *Eupatorium*, but in tropical America only uredinia are known.

121. PUCCINIA CARICIS-POLYSTACHYAE Diet. (on Cyperaceae).

Carex polystachya Wahl. (*C. cladostachya* Wahl.), San Rafael, Dept. Guatemala, Jan. 10, 1915, ii, III, 55; Solola, Dept. Guatemala, Jan. 27, 1915, ii, III, 124; Guatemala City, Dec. 20, 1916, II, III, 611.

A long-cycle, heteroecious rust, whose aecia and alternate host are unknown. The species was originally collected in southern Mexico by Professor Holway (no. 3727). The Guatemalan material here

listed was recently described as a new species by Kern, *P. Kellermanii* (Mycologia 9: 210. 1917), but a careful comparison seems to indicate that only one species is involved. The pores of the urediniospores are often indistinct, and appear to vary from 2 to 4, always equatorial.

122. PUCCINIA PALLOR Arth. & Holw. (on Amaryllidaceae).

Bomaria acutifolia Herb., Volcan de Agua, Dept. Sacatépequez, Jan. 13, 1915, II, III, 84; same, March 7, 1916, O, I, II, III, 562.

An Eriosporangium-like species with all spore forms. It occurs also in Costa Rica.

123. PUCCINIA CANNAE (Wint.) P. Henn. (on Cannaceae).

Canna sp., Mazatenango, Dept. Suchitepequez, Feb. 22, 1916, II, 516.

A common long-cycle rust of the tropics, whose pycnia have not been seen. Whether pycnia are associated with aecia or with primary uredinia can not be predicted. It was collected by Kellerman at Mazatenango, Feb. 28, 1905 (Kellerm. Fungi Sel. Guat. 3).

124. PUCCINIA POLYGONI-AMPHIBII Pers. (on Polygonaceae).

Persicaria (*Polygonum*) sp.

A collection was made by Kellerman at Laguna, Lake Amatitlan, Jan. 25, 1906, II, 5392, and reported by Kern in Mycologia l. c. This long-cycle species is not uncommon in the tropics, where only uredinia are generally found.

125. PUCCINIA PUNCTIFORMIS Diet. & Holw. (on Polygonaceae).

Rumex crispus L., Solola, 6500 feet alt., Jan. 25, 1915, II, 116; Panajachel, Dept. Solola, Jan. 3, 1917, II, III, 676.

A long-cycle species, whose aecia are not known. It ranges from Berkeley, Calif., southward through Mexico, into Central America.

126. PUCCINIA DETONSA Arth. & Holw. (on Caryophyllaceae).

Stellaria ovata Willd., Colomba, Dept. Quezaltenango, Feb. 3, 1917, 824.

A short-cycle species, occurring on the same host in Costa Rica. The spores have thinner walls than in *P. Arenariae*.

127. PUCCINIA MODICA Holw. (on Caryophyllaceae).

Arenaria alsinioides Willd., Volcan de Agua, Dept. Sacatépequez, March 4, 1916, II, iii, 561.

Arenaria lanuginosa Rohrb., Solola, 7000 feet alt., Jan. 25, 1915, II, III, 111.

This long-cycle rust has heretofore been known only from Mexico. Most of the teliospores in the collection number 561 are mesosporic. Re-examination of the type collection shows the presence of a few mesospores, but they are not mentioned in the published description. The other collection here listed also has only a few mesospores. Apparently such one-celled teliospores are most abundantly produced in sori first arising when telial production begins. The first stage of this rust is yet unknown.

128. *PUCCINIA FOVEOLATA* (Berk. & Curt.) P. Henn. (on Anonaceae).

Xylopia sp.

This peculiar short-cycle rust, first found in Surinam and named *Dasyspora foveolata*, and later found in other parts of South America, was collected by Kellerman, at Los Amates, Dept. Izabal, March 15, 1905, 5330, and reported by Kern in *Mycologia l. c.* under the often used name *Puccinia gregaria* Kunze.

129. *Puccinia circinata* (Schwein.) comb. nov. (on Malpighiaceae).

Genus and species undetermined.

Through the kindness of the Director of the Royal Botanic Gardens, Kew, the writer has recently been able to examine a part of the type collection of *Uredo circinata* Schwein., published by Berkeley and Curtis in their account of "Exotic fungi from the Schweinitzian herbarium, principally from Surinam," *Journ. Acad. Phila.* 2: 282. 1853. It was stated to be "on the leaves of some unknown plant."

A collection made by Kellerman, at Gualan, Dept. Zacapa, Guatemala, Dec. 28, 1905, 5457, on the leaves of some plant, whose identity was not ascertained, shows uredinia and telia, and the uredinia exactly correspond to those of the rust from Surinam. The urediniospores are very distinctive on account of the conspicuously long echinulations. In the comments attached to the original description it is noted that "the globose spinulose spores are the distinctive mark of this fine species; the processes are nearly as strong as in [the teliospores of] *Puccinia aculeata* Schweinitz." It required, however, another spore form to make evident the systematic position of the rust, and to rescue the name from the limbo of *species dubiae*.

The species has the same general characteristic as *Puccinia inflata* Arth., on species of *Stigmaphyllon* in the West Indies. In both species the bulbous inflation of the pedicel next to the spore is a curious and marked feature. From *P. inflata*, however, it is abundantly distinct,

but we may fairly infer that the hosts of both the Guatemalan and Surinam collections are species of *Stigmaphyllon*, or at least that they belong to the *Malpighiaceae*. The rust may be characterized as follows:

Uredinia amphigenous, scattered or in groups 2–3 mm. across, round or oval, 0.3–1 mm. across, rather tardily naked, pulverulent, cinnamon-brown, ruptured epidermis conspicuous; urediniospores when dry or in alcohol broadly ellipsoid or globoid, 22–26 by 26–32 μ ; wall golden or dark cinnamon-brown, 2.5–3 μ thick, very sparsely and prominently echinulate, the echinulations 2.5 μ long, 1 μ wide at base, 7–10 μ apart, and colorless, the pores 2–4, equatorial; urediniospores when in water swelling to 27–32 by 32–40 μ ; wall 5–7 μ thick, with a cinnamon-brown inner layer 3–4 μ thick and a colorless outer layer 1.5–4 μ thick.

Telia amphigenous, scattered, blackish-brown; teliospores broadly ellipsoid, 26–35 by 35–50 μ , rounded at both ends, slightly or not constricted at septum; wall dark chestnut-brown, uniformly 3–4 μ thick, rather obscurely reticulate, the areolae about 2–3 μ across; pedicel usually attached obliquely, once to once and a half length of spore, in water forming a globoid swelling next the spore up to 26 μ in diameter.

130. *PUCCINIA EUPHORBIAE* P. Henn. (on *Euphorbiaceae*).

Aklema caracasana (Klotzsch & Garcke) Millsp. (*Euphorbia caracasana* Boiss.), Guatemala City, Dec. 31, 1914, II, III, 3; Antigua, Dept. Sacatépequez, Jan 11, 1915, ii, III, 66; same, Dec. 27, 1916, II, III, 641; Quezaltenango, Jan. 18, 1917, III, 740.

A long-cycle rust, having pycnia, uredinia, and telia, with large and highly characteristic teliospores. It is the form designated by the Sydows as variety *longipes*, but agrees with the type material from Abyssinia. It was also collected by Kellerman, on *Aklema cotinifolia* (L.) Millsp. (*Euphorbia cotinifolia* L.), at San Lucas, Dept. Solola, Feb. 16, 1906, II, III, 5433. It occurs in Mexico and the West Indies.

131. *Puccinia velata* (Ellis & Everh.) comb. nov. (on *Euphorbiaceae*).

Aklema Scotana (Schlecht.) Millsp. (*Euphorbia Scotana* Boiss.)

A phanerogamic specimen of this host in the Field Museum at Chicago, Ill., sheet number 195471, shows the rust named. It was collected at San Lucas, Dept. Solola, Feb. 16, 1906, by Kellerman, 5433, and there are both uredinia and telia present.

The species is listed in Sydow's Monog. Ured. 1: 457, as *P. Euphorbiae minor* Diet. & Holw., described in 1897, and credited to Mexico, but it is also identical with *Uredo velata* Ellis & Everh. (Bull. Torrey Bot. Club 22: 435. 1895), on *Chamaesyce cordata* (Meyer) Millsp. (*Euphorbia cordata* Meyer), from Hawaii. The type specimen of *Uredo velata* has been examined and shows telia as well as uredinia. The species is closely related to the preceding one, but is readily distinguished by the broader and shorter teliospores, and the shorter pedicels.

132. PUCCINIA ARECHAVELATAE Speg. (on Sapindaceae).

Cardiospermum coluteoides H.B.K., Progreso, between Guatemala City and Barrios, Feb. 12, 1915, 208.

A short-cycle rust, very common in the tropics. The host of this collection has not before been reported. The species was collected by Kellerman, on *C. grandifolium* Swartz, at El Rancho, Dept. Jalapa, Jan. 6, 1906, 5461, and reported by Kern in Journ. Mycol. 1. c.

133. PUCCINIA GOUANIAE Holw. (on Frangulaceae).

Gouania lupuloides (L.) Urban (*G. domingensis* L.), Escuintla, Feb. 17, 1916, II, 500.

A long-cycle species, having pycnia, uredinia, and telia, known from Cuba, Porto Rico, and Panama.

134. PUCCINIA INVAGINATA Arth. (on Frangulaceae).

Gouania lupuloides (L.) Urban (*G. domingensis* L.), Escuintla, Feb. 17, 1916, ii, III, 497.

Gouania sp., Mazatenango, Feb. 21, 1916, II, 518; Guatemala City, Dec. 21, 1916, ii, III, 614; Moran, Dept. Amatitlan, Dec. 22, 1916, ii, III, 618.

The rust is a long-cycle form, for which the primary stage is unknown, but it doubtless has pycnia and no aecia. It was first collected on the island of St. Croix in 1896, and named *Uredo Gouaniae* Ellis & Kelsey. Since then it has been taken a number of times in Porto Rico, always in the uredinial stage. The telia have heretofore been known only from Cuba. The teliospores are very similar to those of *P. Gouaniae* Holw., only slightly larger, but the one-pored, peculiarly shaped urediniospores are quite unlike those of that species.

135. PUCCINIA HETEROSPORA Berk. & Curt. (on Malvaceae).

Abutilon discissum Schlecht., Zunil, Dept. Quezaltenango, Jan. 28, 1917, 782.

Abutilon sp., Aguas Amargas, Dept. Quezaltenango, Jan. 30, 1917, 797, 798.

Malvaviscus arboreus Cav., Mazatenango, Feb. 25, 1916, 529; San Felipe, Dept. Retalhuleu, Jan. 12, 1917, 694.

Malvaviscus sp., Chinautla, Dept. Guatemala, Feb. 12, 1916, 485.

Sida cordifolia L., Sanarate, Dept. Guatemala, Feb. 10, 1916, 474.

A very common short-cycle rust of tropical regions, notable for its abundant production of mesospores, and its numerous hosts. It was also collected by Kellerman on *Sida cordifolia*, at Gualan, Dept. Zacapa, Jan. 23, 1905, 4323, and again at the same place, March 12, 1905, 4323bis (Kellerm. Fungi Sel. Guat. 6).

136. PUCCINIA SHERARDIANA Körn. (on Malvaceae).

Sida spinosa L., Chinautla, Dept. Guatemala, Feb. 12, 1916, 488.

A short-cycle species with large golden-brown sori and terete teliospores, somewhat resembling *P. Malvacearum*. It occurs abundantly in western North America, and ranges southward along the mountains to Peru.

137. PUCCINIA EXILIS Syd. (on Malvaceae).

Pavonia rosea Schlecht., Quirigua, Dept. Zacapa, March 22, 1916, 593.

A short-cycle rust, resembling *P. heterospora* but with much smaller teliospores and seemingly without mesospores. This is the first record for North America. It has heretofore been known only from Brazil.

138. PUCCINIA FILOPES Arth. & Holw. (on Sterculiaceae).

Buettneria lateralis Presl, Escuintla, Feb. 17, 1916, 501.

A short-cycle species for which this number is the type, occurring also in Costa Rica.

139. **Puccinia vergrandis** Arthur & Holway sp. nov. (on Dilleniaceae).

Saurauja pauciserrata Hemsl., Colomba, Dept. Quezaltenango, Feb. 2, 1917, ii, III, 820.

Uredinia not seen; urediniospores in the telia, obovoid, 26–32 by 32–40 μ ; wall golden-brown, thick, 3 μ , somewhat thicker above up to 5 μ , coarsely and moderately echinulate, the pores 2–4, approximately equatorial or slightly superequatorial.

Telia chiefly hypophyllous, confluent in annular groups 2–4 mm. across, round, 0.3–1 mm. in diameter, early naked, chestnut-brown becoming cinereous from germination, ruptured epidermis evident;

teliospores ellipsoid or oblong, 29–31 by 37–45 μ , rounded above, blunt below, slightly constricted at septum; wall golden- or cinnamon-brown, rather thick, 1.5–2.5 μ , thicker above, 4–7 μ , rugosely verrucose; pedicel colorless, fragile.

The species appears like a short-cycle form, and the presence of urediniospores does not necessarily exclude that possibility. Sectioning for pycnia failed to disclose the presence of such a stage.

140. **Puccinia aucta** Arthur & Holway sp. nov. (on Dilleniaceae).

Saurauja Conzatti Busc. (?), Chinautla, Dept. Guatemala, Jan. 17, 1915, 90; Guatemala City, Dec. 20, 1916, 608.

Saurauja Smithiana Busc. (?), Huehuetenango, Jan. 23, 1917, 775; Colomba, Dept. Quezaltenango, Feb. 2, 1917, 819; road between Colomba and Quezaltenango, Feb. 4, 1917, 830 (type).

Saurauja sp., Guatemala City, Feb. 8, 1917, 844.

Telia hypophyllous, crowded in small mostly confluent groups 0.5–2 mm. across on somewhat larger purple spots, round, 0.1–0.5 mm. in diameter, early naked, pulvinate, chocolate-brown, ruptured epidermis inconspicuous; teliospores oblong, 10–15 by 32–42 μ , rounded or obtuse at both ends, often narrowed below, somewhat constricted at septum; wall light chestnut-brown, or lighter after germination, 1.5–2 μ thick, much thicker above, 3–10 μ , smooth; pedicel light brown to colorless, once to twice length of spore or shorter, persistent.

A short-cycle rust, causing abundant spotting on both sides of the leaves. Probably no pycnia are formed. Germination takes place readily *in situ* at maturity. The several collections appear to belong possibly to two or more species of host, as the leaves vary from smooth to strongly pubescent.

141. **Puccinia violae** (Schum.) DC. (on Violaceae).

Viola nannei Polak., Volcan de Agua, Dept. Sacatépequez, March 7, 1916, II, III, 566; same, Dec. 29, 1916, II, III, 656.

A long-cycle rust, common on violets in both America and Europe, having somewhat variable characters.

142. **Puccinia cupheae** Holw. (on Lythraceae).

Cuphea Hookeriana Walp., Solola, 5500 feet alt., Jan. 27, 1915, 133.

A short-cycle species, rather common in Mexico and Central America.

143. PUCCINIA FUCHSIAE Syd. & Holw. (on Onagraceae).

Fuchsia microphylla H.B.K., Quezaltenango, Jan. 19, 1917, 753.

Lopezia hirsuta Jacq., San Rafael, Dept. Guatemala, Jan. 9, 1915, 34; Antigua, Dept. Sacatépequez, Dec. 28, 1916, 647 (with some *Uredo Fuchsiae*).

A short-cycle rust, heretofore known only from the type collection by Professor Holway, made in central Mexico.

144. PUCCINIA HYDROCOTYLES (Link) Cooke (on Ammiaceae).

Hydrocotyle Bonariensis Lam., San Lucas Toliman, 5100 feet alt., Dept. Solola, Feb. 3, 1915, II, 190.

Hydrocotyle mexicana Schlecht. & Cham., San Lucas Toliman, 6500 feet alt., Dept. Solola, Feb. 3, 1915, II, 189.

A common long-cycle rust of both North and South America. Pycnia have not yet been found, and aecia probably do not occur in the life cycle. The aecia on *Hydrocotyle* that have been referred here are doubtless heteroecious.

145. **Puccinia Arracacharum** (Lindr.) Arth. comb. nov. (on Ammiaceae).

Arracacia bracteata Coult. & Rose, Volcan de Agua, Dept. Sacatépequez, Jan. 13, 1915, O, I, II, III, 86; same, March 7, 1916, O, I, II, iii, 558.

This distinctive species is Eriosporangium-like in its general combination of characters, and especially in having aecia without peridia, and pale teliospores germinating at maturity in the sorus. It is quite unlike *P. imperspicua* Syd. on another species of *Arracacia* from Mexico, a species without uredinia, with a peridium in the aecium, and with thicker-walled teliospores.

The species was described by Lindroth in 1891 (Medd. Stockholms Högsk. Bot. Inst. 4: 1, 5) from collections made by Lagerheim in Ecuador, S. A. During two years' observation Lagerheim did not find the aecia, which were very common, to be followed by uredinia and telia (cf. Lindroth, Die Umbelliferen-Uredineen, Act. Soc. Faun. Fl. Fenn. 22¹: 142. 1902), and their genetic association was considered doubtful. The aecia were therefore described as *Caeoma Arracacharum* (l. c., p. 1), and the uredinia and telia as *Puccinia Arracachae* (l. c., p. 5), in which disposition the Sydows concurred (Monogr. Ured. 1: 360. 1902). In the Guatemalan collections by Professor Holway, cited above, all spore forms occur on the same leaves. More-

over, there is a remarkable and significant similarity in the size and sculpturing of the aeciospores and urediniospores, not taken into account in the published comments on the South American material, although to be seen in the type material as well as in that from Guatemala. For convenience a full technical description is appended. The generic name of the host was written Arracacha at one time, but is now accepted in the form Arracacia.

Pycnia chiefly epiphyllous, few, subepidermal, chestnut-brown, globoid, 150–220 μ in diameter.

Aecia amphigenous, in groups of 2–6 with the pycnia, 0.1 μ or less in diameter; peridium wanting, the sorus bounded by a thin layer of mycelium; aeciospores angularly ellipsoid or oblong, 18–23 by 24–35 μ ; wall colorless, 2–2.5 μ thick, variably verrucose, sometimes appearing echinulate.

Uredinia hypophyllous, scattered, round, 0.2–0.5 mm. across, early naked, pulverulent, yellow or pale cinnamon-brown, ruptured epidermis evident; urediniospores ellipsoid or obovoid, 18–24 by 29–37 μ ; wall colorless or yellowish, moderately thick, 1.5–2.5 μ , closely echinulate, the pores obscure.

Telia hypophyllous, scattered, round, 0.4–0.6 mm. across, early naked, pulvinate, chestnut-brown, ruptured epidermis inconspicuous, germinating readily in the sorus; teliospores ellipsoid or oblong, 21–29 by 34–51 μ , round at both ends, or slightly narrowed below, little constricted at septum; wall cinnamon-brown, thin, 1–2 μ , much thicker above, 5–10 μ , smooth; pedicel colorless, once and a half length of spore or less, tapering downward.

146. ***Puccinia obscurata*** Arthur & Holway sp. nov. (on Ammiaceae).

Neonelsonia ovata Coult. & Rose, Volcan de Agua, Dept. Sacatépquez, March 4, 1916, II, III, 555.

Uredinia chiefly hypophyllous, scattered, round or oval, 0.1–0.8 mm. across, early naked, pulverulent, pale cinnamon-brown, ruptured epidermis evident; urediniospores globoid or obovoid, 18–26 by 24–29 μ ; wall colorless or light-yellow, moderately thick, 1.5–2.5 μ , closely echinulate, the pores rather indistinct, 2–3, usually 2, equatorial.

Telia hypophyllous, scattered, round, 0.1–0.3 mm. across, early naked, somewhat pulverulent, chestnut-brown, ruptured epidermis evident; teliospores broadly ellipsoid or oblong, 23–31 by 30–40 μ , rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, thin, 1–1.5 μ , thicker above, 3–7 μ , smooth; pedicel colorless, longer than the spore, fragile, and usually broken away.

The microscopic appearance of this rust gives much the same impression as that of *P. Arracacharum*, on Arracacia, but the detailed

characters are quite dissimilar. Coulter and Rose (Contr. U. S. Nat. Herb. 3: 306) consider the host of this rust to be somewhat like *Arracacia* and *Smyrnum*, but not closely allied to any genus of the family. The life cycle could not be completed from the material in hand. The germination of the teliospores does not seem to take place in the sorus at maturity.

147. *PUCCINIA OBLIQUA* Berk. & Curt. (on Asclepiadaceae).

Philibertia crassifolia Hemsl., Laguna, Lake Amatitlan, Feb. 8, 1915, 197, 198.

Asclepiad vine, San Rafael, 7000 feet alt., Dept. Guatemala, Jan. 9, 1915, 45; same, between San Lucas Toliman and Patalul, Feb. 4, 1915, 192; Mazatenango, Feb. 21, 1915, 519.

An exceedingly variable short-cycle species in both gross and microscopic characters. The two collections from Lake Amatitlan are quite unlike in gross appearance. Number 198 has large, compact sori, each often with a ring of smaller sori about it, in contrast to the groups of numerous, small, pulvinate sori generally seen. This form with large sori corresponds to a similar form of *Puccinia Asteris*, which was once given the name of *P. monoecia*. The same species was collected by Kellerman on *P. crassifolia* at Laguna, Lake Amatitlan, Feb. 11, 1905, 4348 (Kellerm. Fungi Sel. Guat. 5), and again at the same place Jan. 20, 1906, 5437, and reported by Kern in Journ. Mycol. l. c. under the name of *P. Cynanchi* Lagerh., a name now treated as a synonym.

148. *PUCCINIA MARSDENIAE* Diet. & Holw. (on Asclepiadaceae).

Marsdenia mexicana Decaisne, San Lucas Toliman, 5100 feet alt., Dept. Solola, Feb. 2, 1915, II, iii, 171; same, Jan. 4, 1917, II, III, 677.

This striking rust was previously known only from the type locality at Cuernavaca, Mexico. Its initial stage has not yet been seen.

149. *PUCCINIA NOCTICOLOR* Holw. (on Convolvulaceae).

Ipomoea fistulosa Mart., Mixco, Dept. Guatemala, Jan. 9, 1915, I, III, 40.

This long-cycle rust has heretofore been known only from a number of collections on *I. intrapilosa*, all made by Professor Holway in Mexico. No pycnia are yet known, and uredinia do not occur. The aeciospores are sometimes thickened up to 12 μ above. The species has been published as *Allodus nocticolor* (Holw.) Orton.

150. PUCCINIA CRASSIPES Berk. & Curt. (on Convolvulaceae).

Ipomoea glabriuscula House, Sanarate, Dept. Guatemala, Feb. 10, 1916, i, III, 472; Agua Caliente, Dept. Guatemala, Feb. 10, 1917, I, III, 856.

Ipomoea tiliacea (Willd.) Choisy (*I. fastigiata* Sweet), Guatemala City, Jan. 3, 1915, I, 11; Laguna, Lake Amatitlan, Feb. 8, 1915, I, III, 201.

151. PUCCINIA DICHONDRAE Mont. (on Dichondraceae).

Dichondra sericea Swartz, San Rafael, Dept. Guatemala, Jan. 9, 1915, 50.

A short-cycle rust occurring from the southern United States, southward into South America, and also in Australia.

152. PUCCINIA FUMOSA Holw. (on Polemoniaceae).

Loeselia ciliata L., Palin, Dept. Amatitlan, Dec. 24, 1916, II, 636.

Loeselia glandulosa G. Don., San Lucas Toliman, 6500 feet alt., Dept. Solola, Feb. 3, 1915, ii, III, 184.

A long-cycle rust with all spore stages, heretofore reported only from Mexico.

153. PUCCINIA HELIOTROPII Kern & Kellerm. (on Heliotropiaceae).

Heliotropium indicum L., Sanarate, Dept. Guatemala, Feb. 10, 1916, 468.

A short-cycle rust, heretofore known only from Kellerman's two collections on the same host from Gualan, Dept. Zacapa, March 12, 1905, 4326, and Dec. 30, 1905, 5422, reported by Kern in Journ. Myc. l. c. where the species is described, and also issued in Kellerm. Fungi Sel. Guat. 15.

154. *Puccinia gilva* Arthur & Holway sp. nov. (on Heliotropiaceae).

Heliotropium physocalycinum Donn. Smith, Moran, Dept. Amatitlan, Dec. 22, 1916, II, III, 626; Antigua, Dept. Sacatépequez, Dec. 30, 1916, II, III, 658 (type).

Uredinia hypophyllous, scattered, round, 0.2–0.6 mm. across, early naked, pulverulent, dirty white, ruptured epidermis noticeable; urediniospores obovoid, 16–19 by 19–23 μ ; wall light yellow or colorless, thin, 1–2 μ , closely echinulate, with the pores obscure.

Telia hypophyllous, aggregated or scattered, often crowded and circinating about a uredinium, round, pulvinate, early naked, 0.1–0.3 mm. across, pale brown, often cinereous from germination, ruptured epidermis inconspicuous; teliospores oblong, 16–22 by 40–47 μ , obtuse above, obtuse or somewhat narrowed below, slightly constricted at

septum; wall yellowish to pale golden-brown, 1–1.5 μ thick, much thicker at apex, 4–7 μ , smooth; pedicel colorless, short, fragile.

A species having the appearance of a leptiform, but with uredinia unmistakably associated with the telia. No trace of pycnia or aecia could be found. It has paler and thinner-walled spores than the short-cycled *P. Heliotropii* K. & K., and larger teliospores than *P. heliotropicola* Speg.

155. PUCCINIA CORDIAE (P. Henn.) Arth. (on Ehretiaceae).

Cordia gerascanthus L. (*C. alliodora* Cham.), Escuintla, Feb. 18, 1916, O, II₁, ii₂, III, 503; same, Feb. 19, 1916, ii₂, III, 508.

At the time this species was described by the writer (*Mycologia* 8: 17. 1916), no collection answering to Hennings' description of *Uredo Cordiae* (Hedwigia 43: 163. 1904) had been seen. Number 503 of Professor Holway's material bears all spore forms from pycnia to telia belonging to the species, thus completing our knowledge of the life cycle. The primary uredinia correspond exactly to Hennings' description, which brings his name into synonymy. Primary uredinia are also shown in Sydow's *Uredineen* 2098. They differ from secondary uredinia in having slightly larger urediniospores, in absence of paraphyses, and in causing marked hypertrophy, as well as in the presence of pycnia. The pycnia are amphigenous or caulicolous, in groups or scattered over more or less deformed terminal leaves, conspicuous, and subepidermal. The secondary uredinia are scattered over the under side of the leaf, without causing hypertrophy. They have hyphoid, peripheral paraphyses, and, of course, are not accompanied by pycnia.

156. PUCCINIA URBANIANA P. Henn. (on Verbenaceae).

Cornutia grandifolia Schauer, Colomba, Dept. Quezaltenango, Feb. 2, 1917, 822.

A new host for this short-cycle and very common tropical rust.

157. PUCCINIA ELATIPES Arth. & Holw. (on Verbenaceae).

Lippia myriocephala Schlecht. & Cham., San Lucas Toliman, Dept. Solola, Jan. 4, 1917, O, ii, III, 678; road between Quezaltenango and Colomba, Feb. 4, 1917, O, ii, III, 831.

A long-cycle species having pycnia, uredinia, and telia, also found in Costa Rica, for which the Guatemalan collection 831 is the type.

158. PUCCINIA FARINACEA Long (on Lamiaceae).

Salvia amarissima Orteg., Antigua, Dept. Sacatépequez, March 1-2, 1916, O, I, II, III, 547.

Salvia elegans Vahl, Solola, Jan. 28, 1915, III (with *P. delicatula*), 140a; Sija, Dept. Quezaltenango, Jan. 26, 1917, ii, III, 780.

Salvia Holwayi Standley, Quezaltenango, Jan. 18, 1917, II, III, 741.

Salvia lavanduloides H.B.K., Solola, Jan. 30, 1915, II, 165; Antigua, Dept. Sacatépequez, Dec. 28, 1916, II, 654.

Salvia Lindenii Benth., Volcan de Agua, Dept. Sacatépequez, Jan. 13, 1915, II, iii, 88; same, March 7, 1916, II, III, 580; road between Quezaltenango and Colomba, Feb. 4, 1917, II, 833.

Salvia nepetoides H.B.K., Quezaltenango, Jan. 20, 1915, ii, III, 94.

Salvia sp., Huehuetenango, Jan. 23, 1917, O, I, ii, III, 773; same, Jan. 24, 1917, O, I, II, III, 777.

The most common *Salvia* rust of Mexico and Central America, extending northward into the United States.

Until now the life cycle has been incompletely known. However, all the spore forms occur upon numbers 547, 773, and 777, and from them the following characters have been obtained to complete the stages.

Pycnia epiphyllous, crowded in small groups, noticeable, subepidermal, globoid, 100-135 μ in diameter.

Aecia chiefly hypophyllous, crowded in small groups of 2 to 8, cylindric, 0.2-0.5 mm. in diameter and about twice as high; peridium with margin somewhat erose, the peridial cells rectangular or rhomboidal, 13-15 by 35-45 μ , abutted, the outer wall 3-4 μ thick, smooth, the inner wall 2-3 μ , verrucose; aeciospores angularly globoid, ellipsoid or oblong, 15-19 by 19-32 μ ; wall colorless or pale yellow, 1-2 μ thick, very closely verrucose.

159. PUCCINIA MITRATA Syd. (on Lamiaceae).

Salvia polystachya Orteg., Quezaltenango, Jan. 20, 1915, ii, III, 95; Solola, 7000 feet alt., Jan. 25, 1915, ii, III, 120.

Salvia purpurea Cav., San Lucas Toliman, Dept. Solola, Feb. 3, 1915, ii, III, 186.

Salvia sp., Santa Maria, Dept. Quezaltenango, Jan. 15, 1917, II, III, 724; Colomba, Dept. Quezaltenango, Feb. 3, 1917, II, 825.

The species occurs also in southern Mexico and Costa Rica. The initial stages in the life cycle are unknown. In the collections on *S. polystachya* and *S. purpurea* here listed, the pore in the lower cell of the

teliospore is in the lower half of the cell, instead of in the usual position close to the septum.

160. *PUCCINIA INFREQUENS* Holw. (on Lamiaceae).

Salvia cinnabarina Mart. & Gal., San Rafael, Dept. Guatemala, Jan. 7, 1915, ii, III, 19B; Volcan de Agua, Dept. Sacatépequez, Jan. 13, 1915, II, III, 78; same, March 4, 1916, II, III, 552; Quezaltenango, Jan. 21, 1915, II, III, 99; same, Jan. 16, 1917, II, III, 727; same, Jan. 18, 1917, II, iii (with *P. delicatula*), 751a; Antigua, Dept. Sacatépequez, March 2, 1916, II, III, 546; Huehuetenango, Jan. 23, 1917, II, III, 768.

The species occurs also in southern Mexico, and has not so far been found on more than the one species of host. The initial stages of the life cycle are unknown.

The species was collected by Kellerman at Volcan de Atitlan, Dept. Solola, Feb. 16, 1906, 5438, and reported by Kern in Journ. Mycol. l. c.

161. *Puccinia* (?) **degener** Mains & Holway sp. nov. (on Lamiaceae).

Salvia albiflora Mart. & Gal. (?), road between Quezaltenango and Colomba, Feb. 4, 1917, II, 838.

Uredinia hypophyllous, scattered or crowded in small groups, round, 0.1–0.3 mm. in diameter, early naked, pulverulent, cinnamon-brown, ruptured epidermis evident; urediniospores broadly obovoid-globoid, or somewhat flattened from above, 19–23 by 19–25 μ ; wall light cinnamon-brown, thin, 1–1.5 μ , moderately and rather prominently echinulate, with one subequatorial pore, usually 5–7 μ from the hilum.

Apparently distinct from all other known *Salvia* rusts in its single basal pore. Its general resemblance to the preceding group of species makes it seem safe to place the form under the genus *Puccinia* with no present knowledge of the teliospores.

162. *Puccinia filiola* Mains & Holway sp. nov. (on Lamiaceae).

Salvia involucrata Cav., Solola, Jan. 30, 1915, ii, III, 156 (type).

Salvia pulchella DC., San Rafael, Dept. Guatemala, Jan. 7, 1915, ii, III, 19A; same, Jan. 9, 1915, II (with *P. delicatula*), 41a; Totonicapam, Jan. 24, 1915, ii, III, 107.

Salvia sp., Volcan de Agua, Dept. Sacatépequez, March 7, 1916, II, III, 579.

Uredinia hypophyllous, scattered, round, minute, 0.1–0.2 mm. in diameter, early naked, pulverulent, cinnamon-brown, ruptured epi-

dermis inconspicuous; urediniospores oblate-spheroid, $23-27\ \mu$ broad by $19-23\ \mu$ long, or triangular obovoid, $21-23\ \mu$ broad by $23-26\ \mu$ long; wall dark cinnamon-brown, $1.5-2\ \mu$ thick, moderately and strongly echinulate, the pores 2-3, subequatorial.

Telia among and similar to the uredinia, but somewhat darker; teliospores oblong or ellipsoid, $23-29$ by $35-50\ \mu$, rounded at both ends, not constricted at septum; wall chestnut-brown, $2-3.5\ \mu$ thick, thickened over the germ pores into a low yellowish umbo, $5-7\ \mu$ thick, moderately verrucose with the markings uniting into short irregular lines, giving the appearance of being coarsely verrucose, the pore of lower cell variable; pedicel colorless, two to three times length of spore, with thin wall, $1\ \mu$ or less.

The species is closely related to *P. mitrata* Syd., from which it differs in the thinner-walled and more oblong teliospores and in larger and characteristically shaped urediniospores.

A collection made by Lagerheim on *Salvia macrostachya* at Pangor, Ecuador, September, 1891, appears to be the same species, although possessing only uredinia.

This species, taken with the preceding four species, makes up a group of tropical salvia rusts with many intergrading forms. They are to some extent limited by hosts, but morphological characters are at present the chief means of separation. Much of the study of the *Salvia* rusts has been done by Dr. E. B. Mains, and his discriminating judgment has been followed in assorting the collections. More varied material on well identified hosts is needed to get a clear understanding of this difficult group.

163. PUCCINIA IMPEDITA Mains & Holw. (on Lamiaceae).

Salvia occidentalis Swartz, Antigua, Dept. Sacatépequez, Dec. 27, 1916, II, 642; San Felipe, Dept. Retalhuleu, Jan. 13, 1916, II, 712.

The full life cycle for this species is not yet known. The rust is not uncommon in southern Mexico and the West Indies on the same host as well as on others.

164. PUCCINIA DELICATULA (Arth.) Sacc. & Trott. (on Lamiaceae).

Salvia cinnabarina Mart. & Gal., Quezaltenango, Jan. 18, 1917 (with *P. farinacea*), 751; same, Jan. 23, 1917 (with *P. farinacea*), 769; same, Jan. 31, 1917, 811.

Salvia elegans Vahl, Solola, Jan. 28, 1915 (with *P. farinacea*), 140.

Salvia Holwayi Standley, Quezaltenango, Jan. 18, 1917 (with *P. farinacea*), 743; Zunil, Dept. Quezaltenango, Jan. 28, 1917, 789.

Salvia pulchella DC., San Rafael, Dept. Guatemala, Jan. 9, 1915
(with *P. farinacea*), 41.

Heretofore, this short-cycle, leptiform rust has been known only by a single collection, made by Professor Holway in the Federal District of Mexico. It was published under the name *Polioma delicatula* (Journ. Mycol. 13: 29. 1907), a genus founded to embrace the short-cycle species of *Puccinia* having colorless teliospores that germinate in the sorus at maturity. The spores range somewhat shorter in many cases than indicated in the original description and in the North American Flora (7: 219).

165. *PUCCINIA FIDELIS* Arth. (on Lamiaceae).

Hyptis lilacina Schiede & Deppe, San Rafael, 7000 feet alt., Dept. Guatemala, Jan. 7, 1915, II, iii, 27a.

Hyptis pectinata (L.) Poir. (*Mesosphaerum pectinatum* Kuntze), Solola, Jan. 27, 1915, II, III, 136.

This long-cycle species with all spore forms has been previously known from Mexico and Guatemala on other species of hosts. It is given in the North American Flora (7: 212) under the name *Eriosporangium fidelis* Arth. The Guatemalan collections previously known were made by Kellerman, on *H. urticoides* H.B.K., Laguna, Lake Amatitlan, Jan. 17, 1906, II, iii, 5401, as well as on *H. lilacina*, Guatemala City, Feb. 1, 1905, II, 5334, and mentioned by Kern in Journ. Mycol. (13: 23. 1907), but not given a name. The urediniospores of this species have basal pores.

166. *PUCCINIA MEDELLINENSIS* Mayor (on Lamiaceae).

Hyptis pectinata (L.) Poir. (*Mesosphaerum pectinatum* Kuntze), Antigua, 5300 feet alt., Dept. Sacatépequez, Jan. 11, 1915, II, 68; Guatemala City, Feb. 8, 1916, II, 465; Aguas Amargas, Dept. Quezaltenango, Jan. 30, 1917, II, 795.

A long-cycle rust, very common throughout tropical America, especially in the uredinial stage. The species was given in the North American Flora (7: 212) under the name *Eriosporangium tucumanense* (*Aecidium tucumanense* Speg.), a name which properly belongs to a South American rust, not yet reported for North America. The description there given applies to *Puccinia medellinensis* Mayor, a species based on a collection from Colombia, S. A., but very common in Central America and the West Indies. The species has urediniospores with two equatorial pores and very similar to those of *P. Hypti-*

dis (Curt.) Trel. & Earle, but with teliospores much shorter. The range is more southernly than that of *P. Hyptidis*.

The entry in the North American Flora (7: 212) of *Hyptis spicata* as a host under *Eriosporangium Hyptidis* was founded on four collections made by Kellerman in Guatemala, and reported by Kern (Journ. Myc. 13: 22) under *Puccinia Hyptidis*. A recent study of these specimens indicates that they should be transferred to *P. medellinensis*, and that the hosts are not *H. spicata*, as reported, but as follows: *H. pectinata* (L.) Poir., Moran, Dept. Amatitlan, Feb. 11, 1905, II, 5310; *H. polystachya* H.B.K., Moran, Feb. 11, 1905, II, 4327, 5311, and Fiscal, Dept. Guatemala, Jan. 11, 1906, II, 5443.

167. ***Puccinia parilis*** (Arth.) Arthur comb. nov. (on Lamiaceae).

Hyptis stellulata Benth. (*Mesosphaerum stellulatum* Kuntze), Agua Caliente, Dept. Guatemala, Feb. 10, 1917, O, II, iii, 848.

This species has heretofore been known only from Mexico and only on *Hyptis pectinata*, a host very similar in its appearance to *H. stellulata*. There are plenty of pycnia scattered over this collection, but rarely associated intimately with the uredinia. The main features of the collection, however, indicate that it should be referred to *P. parilis*, a species without aecidioid aecia, and which has heretofore been called *Argomyces parilis* Arth. (N. Amer. Fl. 7: 217. 1912).

There is also present on some of the leaves a scanty amount of teliospores that are small, broadly ellipsoid, with a verrucose, dark brown wall and short colorless pedicel. They are much like those of the short-cycle *Hyptis* rust, *P. distorta* Holw.

168. ***Puccinia pallidissima*** Speg. (on Lamiaceae).

Stachys Lindenii Benth., Agua Amargas, Dept. Quezaltenango, Jan. 30, 1917, 805.

The species is a short-cycle form. The Sydows (Monog. Ured. 1: 299. 1902) maintain *Puccinia albida* Diet. & Neg. (Engl. Bot. Jahrb. 24: 160. 1897), as distinct from *P. pallidissima* on the ground that the latter has the wall of the spore of uniform thickness. Type material has not been seen by the author for either form, but a collection in the Arthur herbarium labeled *P. pallidissima*, made by Lorentz at the type locality of that species in Argentina, and on *Stachys arvensis*, the type host, shows the spores to be thickened above. Believing that the two forms are essentially alike, they are here united. This is the first record of a rust on *Stachys* for North America.

169. *Puccinia fuscata* Arthur & Holway sp. nov. (on Lamiaceae).

Cunila leucantha Benth., Quezaltenango, Jan. 18, 1917, O, I, II, III, 742; same, Jan. 28, 1917, O, I, II, III, 785 (type).

Cunila polyantha Benth., Solola, 7000 feet alt., Jan. 31, 1915, O, I, II, iii, 166.

Pycnia epiphyllous, crowded in small groups, subepidermal, inconspicuous, globoid, 128–150 μ in diameter.

Aecia hypophyllous, in small groups of two to five opposite the pycnia, round, 0.1–0.4 mm. across; peridium wanting and replaced by a more or less definite layer of mycelium; aeciospores ellipsoid or globoid, 23–29 by 26–33 μ ; wall colorless, 1.5 μ thick, closely and coarsely verrucose.

Uredinia hypophyllous, scattered, roundish, 0.1–0.6 mm. across, early naked, pulverulent, golden-brown, ruptured epidermis rather inconspicuous; urediniospores broadly ellipsoid or obovoid, 23–26 by 26–32 μ ; wall cinnamon-brown, 1.5 μ thick, moderately echinulate, the pores 2, equatorial.

Telia hypophyllous, scattered, round, 0.2–0.4 mm. across, early naked, pulvinate, light chestnut-brown, becoming cinereous by germination, ruptured epidermis inconspicuous; teliospores clavate or oblong, 20–27 by 38–56 μ , rounded above, more or less narrowed below, somewhat constricted at septum; wall dark cinnamon-brown, paler to colorless below, very thin, 1 μ or less, much thicker at apex, 5–10 μ , smooth; pedicel colorless, 35–60 μ long.

An Eriosporangium-like species, having no aecial peridium, and with readily collapsing teliospores that germinate in the sorus at maturity. It differs from *P. Cunilae* Diet. by the broader aeciospores, the presence of uredinia, and the shorter, apically thickened, and more colored teliospores.

170. *PUCCINIA NESODES* Arth. & Holw. (on Scrophulariaceae).

Castilleja communis Benth., Santa Maria de Jesus, Volcan de Agua, Dept. Sacatépequez, March 4, 1916, 551; Panajachel, Dept. Solola, Jan. 3, 1917, 673.

Castilleja tenuiflora Benth., Solola, 5300 feet alt., Jan. 27, 1915, 125 (with *Cronartium coleosporioides* (Diet. & Holw.) Arth.); Antigua, Dept. Sacatépequez, Dec. 28, 1916, 653.

Castilleja sp., Panajachel, Dept. Solola, Jan. 3, 1917, 669.

A short-cycle rust occurring also in Costa Rica on species of *Lamourouxia*.

171. **PUCCINIA DEPALLENS** Arth. & Holw. (on Bignoniaceae).

Pithecoctenium muricatum DC. (?), Guatemala City, Feb. 15, 1916, O, III, 492.

A short-cycle rust occurring on the same host in Costa Rica.

172. **PUCCINIA RUELLIAE** (B. & Br.) Lagerh. (on Acanthaceae).

Justicia sp., San Felipe, Dept. Retalhuleu, Jan. 12, 1917, II, 691.

The assignment of the collection on *Justicia* to this species is made without complete certainty, as no telia are present and no previous collection on this host is known. The species is a long-cycle one with all spore forms, and has usually been listed as *P. lateripes* Berk. & Rav.

The same species was collected on *Blechnum Brownei* (Swartz) Juss., by Kellerman, at Laguna, Lake Amatitlan, Jan. 17, 1906, II, 5400, and reported by Kern in Journ. Mycol. l. c. and issued in Kellerm. Fungi Sel. Guat. 17, in both places under the name *P. Tetramerii* Seym. The rust on this host is often called *P. Blechi* Lagerh.

173. **Puccinia varia** (Diet.) Arth. comb. nov. (on Acanthaceae).

Acanthaceae (*Ruellia* or *Jacobina*?), Panajachel, Dept. Solola, Jan. 30, 1915, II, iii, 160.

The uredinia of the collection agree well with those of the type collection for *Uredo varia* Diet. (Hedwigia 36: 35. 1897), obtained at Rio de Janeiro, Brazil, in December, 1891, E. Ule 1817. The urediniospores have two equatorial pores. In addition to the uredinia the Guatemalan collection shows a few telia, which are epiphyllous, chestnut-brown, round, 0.3 mm. across, with the ruptured epidermis noticeable. The teliospores are broadly ellipsoid, 24–29 by 39–45 μ , the wall chestnut-brown, 2–3 μ thick, slightly thicker above, 5–6 μ , smooth, with the pedicel tinted and up to 55 μ long. As in the type collection the host remains uncertain, except as to the family.

174. **PUCCINIA ELYTRARIAE** P. Henn. (on Acanthaceae).

Elytraria (Tubiflora) sp., Palin, Dept. Amatitlan, Dec. 24, 1916, 635.

A short-cycle rust, of which few collections have previously been known, and all from Mexico or Costa Rica.

175. **PUCCINIA LATERITIA** Berk. & Curt. (on Rubiaceae).

Crucea calocephala DC., Guatemala City, Jan. 8, 1917, 684.

Spermacoce podocephala DC., Solola, 5100 feet alt., Jan. 27, 1915, 139; Panajachel, Dept. Solola, Jan. 3, 1917, 662.

A common short-cycle rust of American tropical regions, extending well north and south into the temperate zones. The first host mentioned is a new one for the rust.

176. *Puccinia eximia* Arthur & Holway sp. nov. (on Rubiaceae).

Galium mexicanum H.B.K. (?), Antigua, Dept. Sacatépequez, March 1, 1916, i, III, 542.

Galium sp., Volcan de Agua, 7000 feet alt., Dept. Sacatépequez, Jan. 13, 1915, I, ii, III, 81; Antigua, Dept. Sacatépequez, Dec. 28, 1916, I, III, 645; Quezaltenango, Jan. 16, 1917, I, II, iii, 735 (type); same, Jan. 31, 1917, I, III, 809.

Aecia amphigenous, more or less scattered upon rather indefinite yellowish areas, short cylindric, 0.2–0.5 mm. high, 0.2–0.4 mm. in diameter; peridium white, the erose margin soon breaking away, the peridial cells rhombic or rhomboidal, 16–23 by 23–40 μ , slightly overlapping, the outer wall striate, 3–7 μ thick, the inner wall verrucose, 2.5–5 μ thick; aeciospores irregularly globoid or ellipsoid, 18–21 by 19–24 μ ; wall colorless, thin, 1–1.5 μ , finely and closely verrucose.

Uredinia hypophyllous, scattered, oval or oblong, 0.6–1 mm. long, somewhat tardily naked, pulverulent, dark cinnamon-brown, ruptured epidermis conspicuous; urediniospores ellipsoid or obovoid, 21–29 by 32–35 μ ; wall dark cinnamon-brown, moderately thick, 2–3 μ , coarsely echinulate, the pores 2–3, superequatorial.

Telia hypophyllous, scattered or in small groups, oval, 0.6–0.8 mm. long, early naked, compact, dark chestnut-brown, ruptured epidermis noticeable; teliospores oblong, clavate-oblong, or clavate-ellipsoid, 21–27 by 42–58 μ , round at both ends, or somewhat narrowed below, slightly constricted at septum; wall golden- or pale chestnut-brown, 1.5–2 μ thick, thicker above, 5–12 μ , smooth; pedicel colorless, about as long as the spore.

No pycnia were detected in the collection examined. The species differs from other *Galium* rusts having uredinia by the large urediniospores with their two or three superequatorial pores. The teliospores are also unusually large. In part of the collections uredinia were absent. When only aecia and telia are present there is a resemblance to *P. ambigua*, but this form differs by the naked telial sorus and lighter-colored teliospores, with their ends more rounded. The teliospores are also noticeably broader, and usually somewhat larger. A eugyrinous species in which the uredinia are slightly or not developed is not unknown, although somewhat rare. The malvaceous rust *Puccinia heterospora*, common in California, not infrequently shows this behavior.

177. PUCCINIA HIERACII (Schum.) Mart. (on Cichoriaceae).

Hieracium sp., Volcan de Agua, Dept. Sacatépequez, March 7, 1916, II, III, 577; Antigua, Dept. Sacatépequez, Dec. 28, 1916, II, III, 648.

A widespread long-cycle rust, having pycnia, uredinia, and telia, found in both temperate and tropical regions.

PURDUE UNIVERSITY,
LAFAYETTE, INDIANA



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